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1. Introduction

At the beginning of 2018 Italian banks were performing well. On the Italian stock market, values for Intesa San Paolo and UniCredit were stable. The 5-year CDS spreads for the two Italian banks were at the lowest level in years, with the price ranging between 48 and 55 basis points. The ability of the Italian government to attract investors was improving: the 10-year spread between the Italian BTP and the German Bund was at 150 basis points, far from the peaks touched years before.

On September 27, 2018, the new Italian government coalition released the DEF update note, the annual economic programmatic document. The government intended to pursue a basic income guarantee and a flat tax provision. Extensive debates follow on funding these new proposals. The government stated that the deficit on GDP ratio would be moved to 2.4% instead of the 2% agreed with the European Union. Basically, the idea was to fund the reforms with more government debt, a greater deficit that would increase the already giant amount of Italian public debt.

Markets were scared and reacted accordingly. The differential with the German Bund started to grow, and in the first ten days of October it reached 300 basis points. At the same time, Italian banks equity price dropped in the immediate after the announcement. Intesa San Paolo and UniCredit 5-year CDS spreads, quoted both 50 basis points few months before, reached both value 200 basis points in October.

This recent situation described is a practical example of a complex phenomenon observable in Europe in the last decade and still active nowadays, the doom loop. This loop is a self-reinforcing cycle between the sovereign and the banking sector credit risks. It consists in a continuous transferring of credit risk from one sector to the other, without regard to where the shock started.

Our aim is to examine from every angle this vicious cycle. The first claim is that there was no relationship between the two sectors credit risks prior to the 2007-2008 Financial crisis. The second claim is that the public intervention, made by European governments to save distressed financial institutions after the Lehman Brothers collapse in 2008, instituted a credit risk transfer from the financial sector to the sovereign one. The third claim is that this transfer established a self-reinforcing loop where the credit risk is shared between the sovereign and the banking sector. After the bailouts, the credit risk moved quickly between them. The fourth claim is that measures thought to reduce or eliminate this self-reinforcing spiral were not effective, as shown in the above example. The fifth claim is that there is no real proposal able to bring the situation back to an uncorrelated relationship between the two.

The second chapter of the thesis will introduce the claims, show them graphically and discuss theories behind them. The third chapter will confirm or reject the claims through empirical analysis. The fourth chapter focuses on the fifth claim: it is a discussion on new proposals, not yet implemented, and their effectiveness, to mitigate the presence of the vicious cycle.

1.1 Related literature

Several authors covered the themes dealt with in this study. We can divide their contributions into three main groups.

A first group analysed the initial risk transfer mechanism from the financial sector to the sovereign one and the role of bailouts. Acharya, Yorulmazer (2007) wrote a model which explain how ex post the regulator must always bailout banks in a systemic crisis, meaning when there are many banks failing simultaneously. The first empirical evidence of the public intervention as cause of the risk transfer in Europe was made by Attinasi, Checerita, Nickel (2009). They focused on the role of the fiscal fundamentals: higher expected budget deficits and/or higher government debt ratios relative to Germany contributed to higher government bond yield spreads. Ang, Longstaff (2011) studied empirically how the sovereign credit risk increase in the European debt crisis was due to distressed financial sector.

The main reference study for the topic is Acharya, Drechsler and Schnabl (2013). Their paper analysed the doom loop and the risk transfer mechanism from the banking sector to the sovereign via public intervention. They built a theoretical model according to which bailouts were financed in the short run through the issue of new debt. This new debt increased the sovereign credit risk. Practically, bailouts transferred the risk from the distressed financial sector to the sovereign. The increase in the sovereign credit risk weakened the financial sector again through guarantees and bond holdings. They introduced also an empirical study showing and quantifying how in the post bailout sovereign changes in CDS spread modify banks CDS spread, confirming the existence of the doom loop.

A second group focused only on the existence of the vicious cycle. Gennaioli, Martin, Rossi (2013) stated that the default rate and the home bias are positively related. Indeed, sovereign defaults hurt the financial sector via the sovereign exposure. Alter and Beyer (2014) and Alter and Schueler (2012) made empirical models with evidences on the doom loop phenomenon using CDS spread measures. Fratzscher and Rieth (2015) added empirical evidences on the doom loop increasing the timeframe used and starting the analysis in 2003. Angelini, Grande & Panetta (2014) clarified the channels of the risk transmission from the banking sector to the sovereign and vice versa. Mainly these authors focused on the channels for which the sovereign credit risk could be transmitted to the financial sector, with a complete description of the home bias phenomenon.

The third group started from the assumption of an existing vicious cycle and tested proposals to eliminate the phenomenon. Brunnermeier et al. (2011) and Brunnermeier et al. (2016) proposed to eliminate the doom loop by reducing the sensitivity of banks' sovereign debt portfolios to the domestic sovereign risk, so reducing the impact of the home bias phenomenon. The idea was that banks' sovereign bond holdings would consist mainly of the senior and junior tranche of European safe bond, a well-diversified portfolio built via securitization using sovereign bonds. Merler and Pisani-Ferry (2012) also studied the introduction of a Eurobond to weaken the risk exposure between sovereigns and banks, mainly affecting the home bias phenomenon. Covy, Eydman (2016) discussed the effect of the BRR Directive implementation, in particular of the bail-in tool, on the doom loop and the possible ending of the feedback loop. Empirically, they tested the relationship between the banking and the sovereign sector credit risk using CDS spreads for sovereigns and banks in two different time periods: before and after the BRR Directive introduction. Breton et al. (2012) suggested the introduction of a risk-weighted system for sovereign debt instruments, especially when used as collateral for operations with the European Central Bank. Indeed, the presence of a risk weight could induce banks to diversify their portfolio and eliminate the home bias.

2. Preliminary Evidence

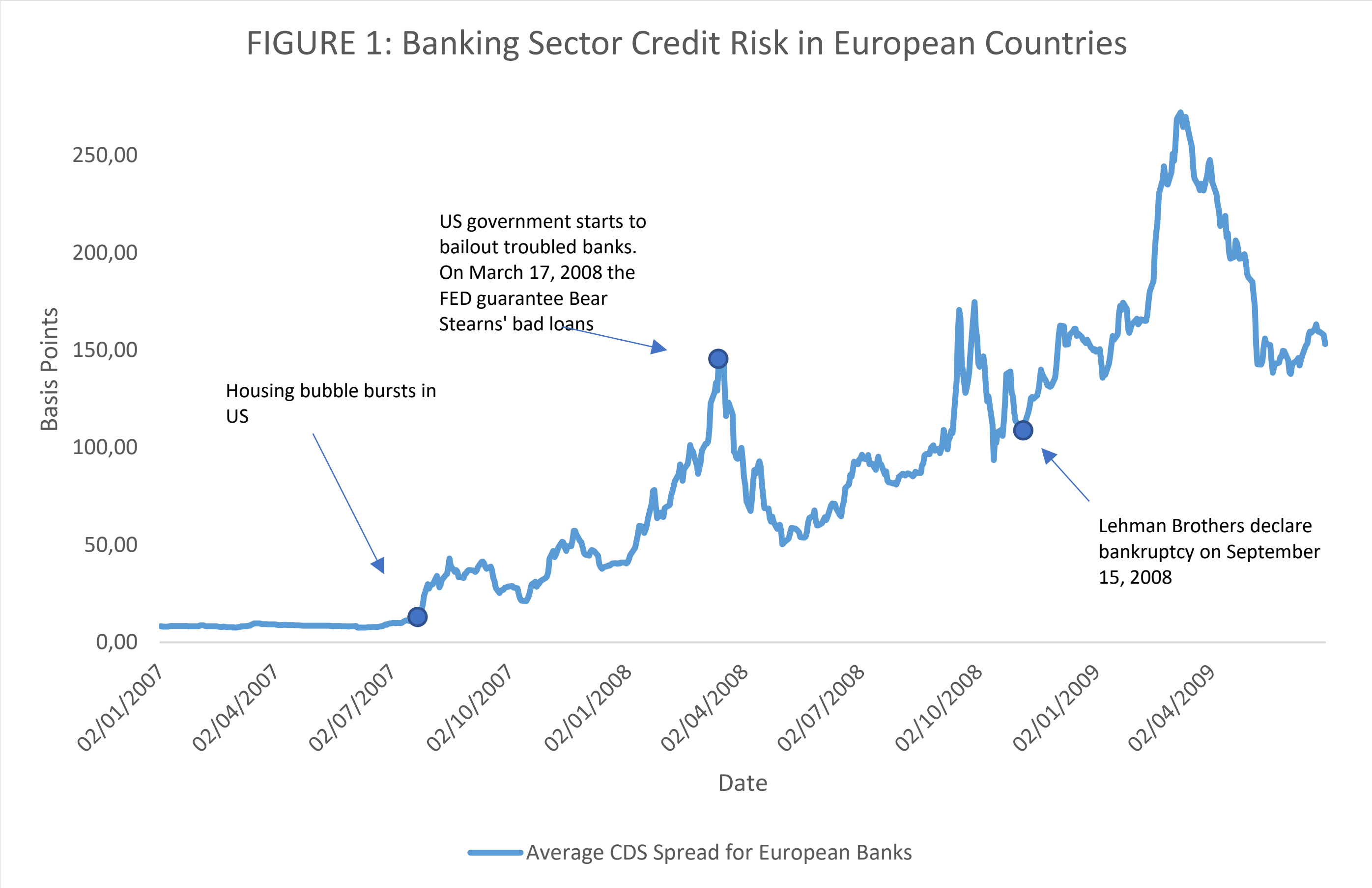
2.1 The banking and the sovereign credit risk relationship before the Financial crisis

This paragraph analyses the relationship between the banking sector and the sovereign sector in Europe prior to the 2007-2008 Financial crisis, with a particular focus on the possible connection between the two sectors credit risks. Our aim is to introduce the claim that the banking sector and the sovereign sector were decoupled.

Credit risk is the loss in which the buyer could fall into due to the borrower's failure to meet its contractual obligation, like the failure to repay a loan. Historically, debt instruments issued by a financial institution always bore a certain degree of credit risk. When dealing with the banking sector, default was always seen as a reasonable possibility.

We show graphically the credit risk inherent to the banking sector. Let's use as credit risk measure the CDS spread. We'll deepen widely in the next chapter why existing literature mainly use this value to indicate the credit risk. FIGURE 1 plots the CDS spread for European banks between January 2007 and June 2009. This measure was found as an equally weighted average between 29 European banks that compose the sample for this study[1].

[1] Which we will specify in the next chapter.

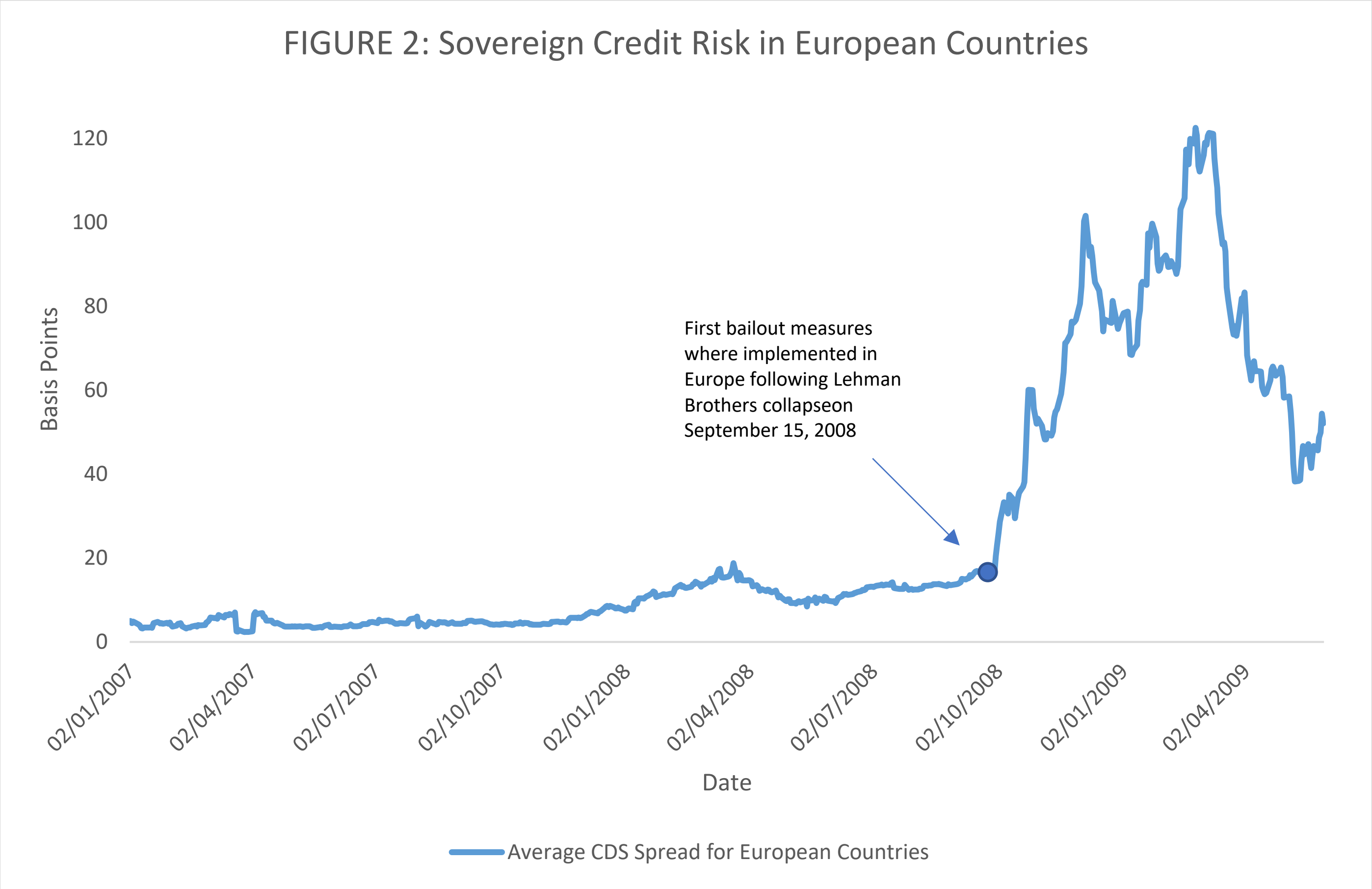


Source: Bloomberg and author's calculation

FIGURE 1 show us how the credit risk for the banking sector changes even before the Lehman Brothers collapse. Indeed, it shows how the banking sector reacted to the US house bubble burst and to the first bailout measures implemented by the US government. Even if historically it never reached the level shown in this graph due to the 2007-2008 Financial crisis, movements and changes in the measure were common depending on different events such as corporate news for banks, new rules for the sector or macroeconomic shocks.

Different was the situation for sovereign issuers, or at least for developed countries ones. Particularly in Europe, the evaluation of government debt instruments treated default as a very low probability event, meaning a very low credit risk. European government bonds were seen as safe heavens, meaning assets uncorrelated or even negatively correlated to other assets in time of economic distress. The absence of sovereign default risk was a hypothesis never argued and indeed, it was largely used the assumption of government bonds interest rates as a proxy for the long-term risk-free rate.

Let's show graphically this absence of sovereign credit risk in Europe prior to the 2007-2008 Financial crisis.

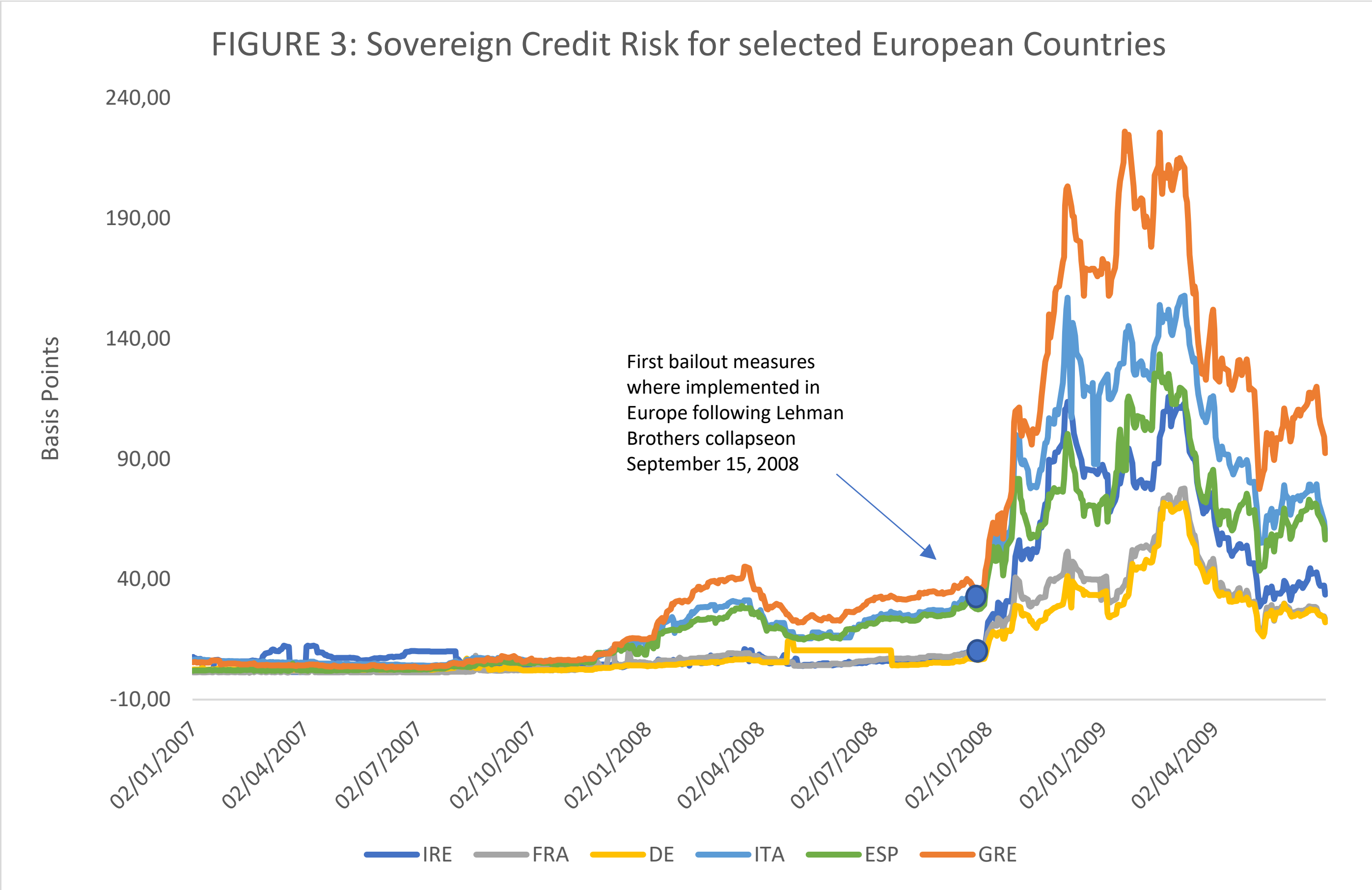


Source: Bloomberg and author's calculation

FIGURE 2 plots the CDS Spread for European countries between January 2007 and June of 2009. This measure was found as an equally weighted average between 14 European countries that compose our sample for this study[2]. FIGURE 3 plots the same measure in the same timeframe for 6 selected countries[3].

[2] Which we will specify in the next chapter.

[3] They are Ireland, France, Germany, Italy, Spain and Greece and were chosen or for they particular role in the first years of the crisis, like Ireland and Greece, or for their dimension in terms of population and GDP in the Eurozone.



Source: Bloomberg and author's calculation

As it is clearly shown in both FIGURE 2 and FIGURE 3, CDS spread for European countries was narrow previously to October 2008 and it had always been so historically. The CDS spread measure was few basis points greater than zero in 2007, with few exceptions. In 2008, when the US crisis effect started to spread in Europe, we detect a slightly credit risk' increase in Greece, Italy and Spain. Finally, with the Lehman Brothers collapse, the sovereign credit risk jumps up heavily for all countries.

The sovereign credit risk was not a concern for investors prior the financial crisis, and even more important, it was not expected to be in the future. The banking sector had its own credit risk pattern, depending on the financial situation of the single institution, or even of the entire sector in case of crisis. There was no documented relationship between the two sectors, meaning debt instruments issued by banks and governments were uncorrelated, and the prevailing view was that no relationship was expected to be in the future.

2.2 Bailouts and the risk transferring mechanism

The second claim of our study is that bailouts in Europe starting from the end of September 2008 transferred the credit risk from financial institutions to sovereign entities. European financial institutions, mainly banks and mortgage lenders, were suffering for the Financial crisis started in US the previous year. European governments, following the lead of the US government, heavily intervened to lighten financial distress and avoid bankruptcy, transferring the credit risk from one sector to the other.

A bailout is a public intervention, meaning an act of assistance, performed by a government or a public entity, to save from bankruptcy a failing business, in particular a financial institution. A bailout could be performed, basically, through: 1) direct equity capital injections; 2) different form of guarantees, ranging from a greater deposit insurance schemes to the obligation for the government to repay any amount not paid to any creditor; 3) purchases of assets with a problematic decreasing credit quality or “deteriorated assets”.

Let’s deepen the historical context in which these bailouts were required. The aforementioned Financial crisis started in US in 2007 and it rapidly expanded worldwide.

Reasons were multiple, but mainly we can list the following factors. 1) Borrowing was encouraged worldwide by extremely low interest rates. 2) Several countries were experiencing a house bubble. In US, Spain, Ireland and Germany the real estate market prices were growing exponentially. 3) Easy borrowing and house bubble together made easier and convenient the use of subprime mortgages, meaning to lend money to risky borrowers to acquire real estates: interest was higher than a regular mortgage and in case the risky subscribers fail to repay the loan, the value of the underlying assets was in an upward path and was expected to be so in the future. 4) Financial institutions exploited the cash collected from mortgages, pooling them in new financial instruments and selling their related cash flows to investors as securities. This practice is called securitization and before the crisis it was a relatively new practice, loosely regulated. The collateralized debt instruments[4] created were considered safer as they really were: the diversification created pooling together mortgages was supposed to create several tranches with different ratings, but the reality was that tranches with the higher rates contained risky subprime mortgages and their failure was much more likely than expected. 5) The new millennium brought a strong deregulation worldwide. Poorly regulated financial players started to make riskier investments and financial institutions became overleveraged.

The housing bubble burst at the beginning of 2007. Overleveraged banks had liquidity issues due to the high possession of collateralized debt instruments, no longer sellable on secondary markets. US Federal Reserve made its first intervention in March 2008 with an acquisition of deteriorated assets, in particular toxic banks

[4] A collateralized debt instrument is part of a broader family called ABS or Asset backed securities. They are securities whose income payments and hence value are derived from and collateralized by a specified pool of underlying assets. A CDO, or collateralized debt obligation, is backed by a pool of debt instruments; a CDO squared by other CDOs; a MBS, or Mortgage-Backed Security, by mortgages, and so on.

debt. Few months later, US Treasury nationalized Fannie Mae and Freddie Mac, two of the largest US mortgage lenders, while IndyMac Bank failed.

Banks faced the worst part of the crisis from September 15, 2008 onward, when the giant US investment bank Lehman Brothers declared bankruptcy. This event triggered global panic, and governments worldwide had to step in to provide support to banks and financial institutions.

Bailouts were used first in Europe following the panic generated by Lehman Brothers, and used widely for at least five years. From January 1, 2016, European regulation excludes bailouts, even if still nowadays bailouts are used in many cases, as we'll discuss in the next paragraphs.

In our analysis, we concentrate in the period from the end of September 2008 to the end of October 2008. In just few days, all major European economies announced the adoption of massive bailout programs for banks suffering from financial crisis. The most common rescue package announced was composed by explicit guarantees on deposits and other creditors and the creation of a fund performing equity capital injection and acquisition of toxic assets in case of the immediate need to save a single financial institution on the verge of collapse.

After rapidly recalling the bailout experiences happened in October 2008 in Europe, we focus on several case studies which better show the risk transfer mechanism claimed.

In Italy, Portugal and Spain, governments augmented the existing deposit guarantee scheme and created funds for recapitalisation or purchase of assets for individual troubled banks: in Italy and Portugal up to €20 billion while in Spain up to €50 billion. Austria created legal basis for state guarantee and capital injection for individual banks in case of need. It was the only European country which not introduced a clear bailout program. Danish government guaranteed all depositors and creditors of Danish banks. French government settled a lending guarantees of up to €320 billion and a fund for banks recapitalisation of up to €40 billion. The last announcement of a rescues package in the first intense month of public bailouts to limit financial distress to take over in Europe was made by Swedish government on October 27th, 2008: €160 billion in credit guarantees and a fund of €1.6 billion for capital injection.

2.2.1 Case study: Benelux Region

In September 2008, Fortis was the largest Belgian bank, operating mainly in the Benelux region. It was facing liquidity problems, the equity value was sloping down, and it had just acquired the Dutch bank ABN Amro, draining its resources. Belgium, Netherlands and Luxembourg partially nationalise Fortis on September 28th, 2008, investing €11.2 billion. On October 3rd, 2008, BNP Paribas acquired the majority stakes in the Belgian and Luxembourgian banking divisions, with the two governments remaining as minority stakeholders; the Dutch government acquired the Dutch division and renamed it ABN Amro, investing others €16.8 billion.

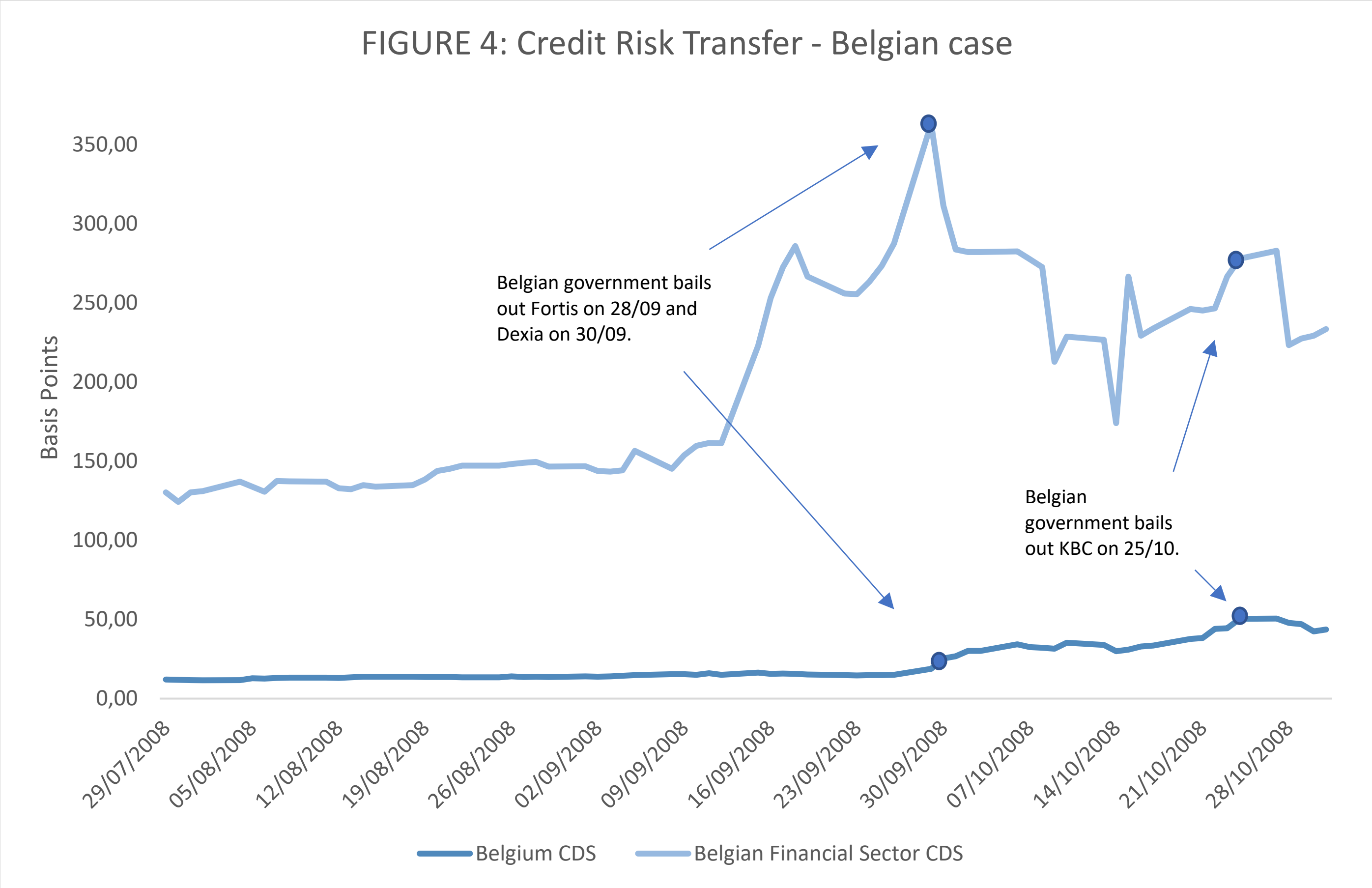
Dexia was a Belgian/French financial institution operating in the Benelux, heavily hit by the crisis due to losses at its US subsidiary and the exposure it had versus other troubled European institutions, like the German Hypo Real Estate. Belgium and Luxembourg injected €6.4 billion in Dexia on September 30th, 2008.

The Dutch government announced a bailout for ING Group, on October 19th, 2008: the operation consisted in a capital injection for €10 billion, taking an almost 9% stake in the financial institution.

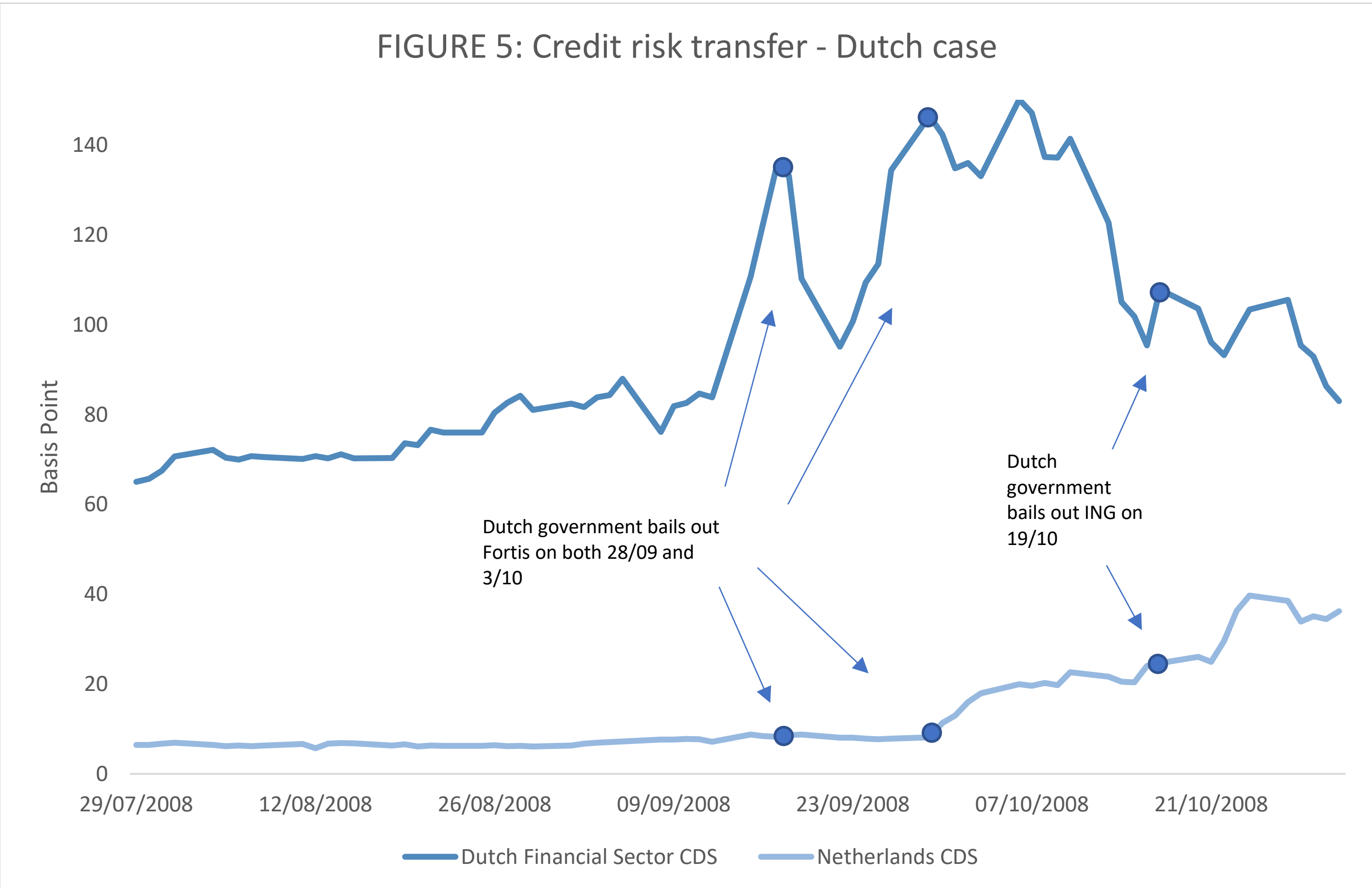
KBC, one of the biggest banks and insurance in Belgium at that time, was experiencing difficulties due to the bailouts of its two largest competitors. On October 25th, 2008, the Belgian government injected €3.5 billion in cash.

Let’s highlight the risk transfer from the banking to the sovereign sector that happened due to these bailout measures. As already stated, we’ll largely debate the choice of the risk measure in the next chapter, but most of modern literature use Credit Default Swaps. Here below, FIGURE 4 and FIGURE 5 plot the risk transfer mechanism for Netherlands and Belgium. FIGURE 4 plots an equally weighted CDS spread composed by largest Belgian banks, Dexia and KBC, and the sovereign CDS spread. FIGURE 5 plots the same for Netherlands, with the financial sector CDS built as the equally weighted average between ING and Rabobank. We cannot plot the risk transfer in the third Benelux country since Luxembourg has no public traded CDS.

Previously to the Lehman Brothers collapse, we expect the sovereign credit risk to be low, the banking credit risk to be already growing due to the first signal of the incoming global crisis, and the two to be uncorrelated or poorly correlated, since investors never suspected any connections between the two. We expect also a risk transfer immediately after the announce of a bailout: the public intervention to save banks from financial distress should increase the sovereign credit risk, reduce or at least keep stable the banking one, and increase the correlation between the two.



Source: Bloomberg and author's calculation



Source: Bloomberg and author's calculation

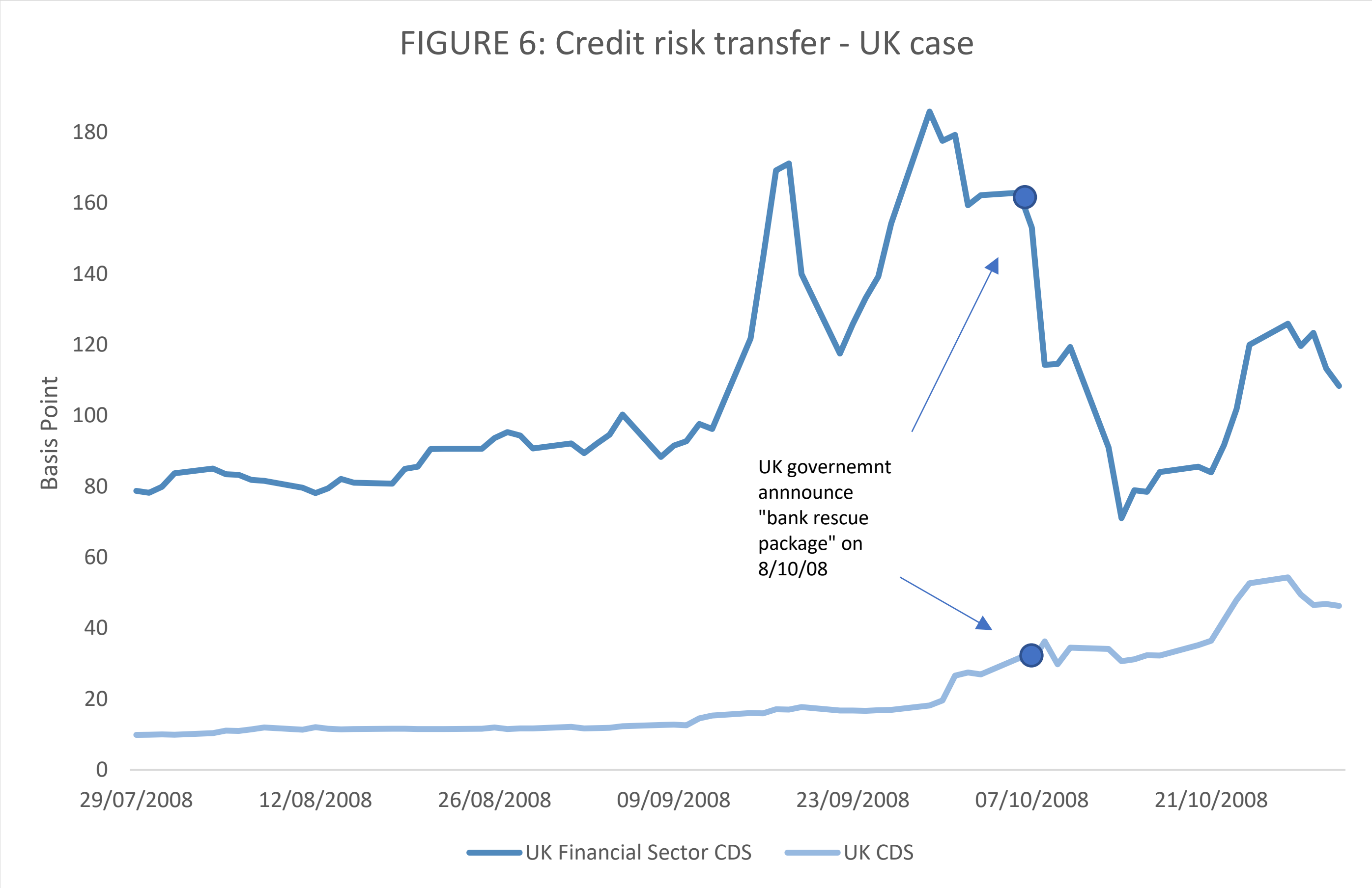
As we can clearly see, both FIGURE 4 and FIGURE 5 shows exactly what we expected: sovereign CDS were mildly traded before October 2008 and the price was low: government bondholders and speculators on markets found no interest in protecting themselves or betting against a decrease in credit rating for neither Netherlands nor Belgian governments. At the same time, the financial sector CDS spread was already higher and slightly increasing, due to the spreading of the Financial crisis worldwide. Immediately after the first announcement on September 28th of the Fortis bailout, the sovereign CDS spread jumped up, and the financial sector one slightly decreased, showing clearly the transfer of a portion of the credit risk due to bailout. Other bailouts announcement followed from Benelux governments to save Dexia, then again Fortis, and after that ING and KBC, and the transfer mechanism worked again.

2.2.2 Case study: UK

Great Britain firstly increased the amount guaranteed on deposits on October 7th, 2008 and afterwards announced a bank rescue package for €630 billion on October 8, 2008. Extra capital was made available to eight of UK's largest banks in exchange for preference shares. While was mandatory the use of these funds for the first eight, other financial institutions could apply. The scheme was made by a short-term liquidity loan of €250 billion available from the Bank of England, and €315 billion in loan guarantees available at commercial rates to encourage banks to lend to each other. Among the top eight banks, only Lloyds and Royal Bank of Scotland used this facility.

We plot in FIGURE 6 an average CDS spread for main English financial institutions[5] and the same measure for the English government. As expected, following the bank rescue package announcement, investors found more onerous to protect themselves against the deteriorating in credit conditions for the government debt, while the financial sector was found less risky and the average price of bank CDS dropped.

[5] They are Barcalys, HSBC, Lloyds and Standard Chartered.



Source: Bloomberg and author's calculation

2.2.3 Case study: Ireland

The Irish government agreed to issue a guarantee and cover existing liabilities for two years on September 29th, 2008. The guarantee regarded not only retail deposits, but also corporate ones, interbank deposits, senior unsecured debt, asset covered securities and subordinated debt.

We plot in FIGURE 7 an average CDS spread for the Irish government and Irish banks in our sample, Allied Irish Banks and Bank of Ireland.

For our third case study regarding the risk transfer from the banking sector to the sovereign sector, the results are confirmative as shown in FIGURE 7: once investors discovered that the government would guarantee all deposits, started to protect themselves against the credit risk associated with the government sector rather than the banking one. This is shown by an increase in the sovereign CDS spread and a reduction in the banking one, which highlights the risk transfer.

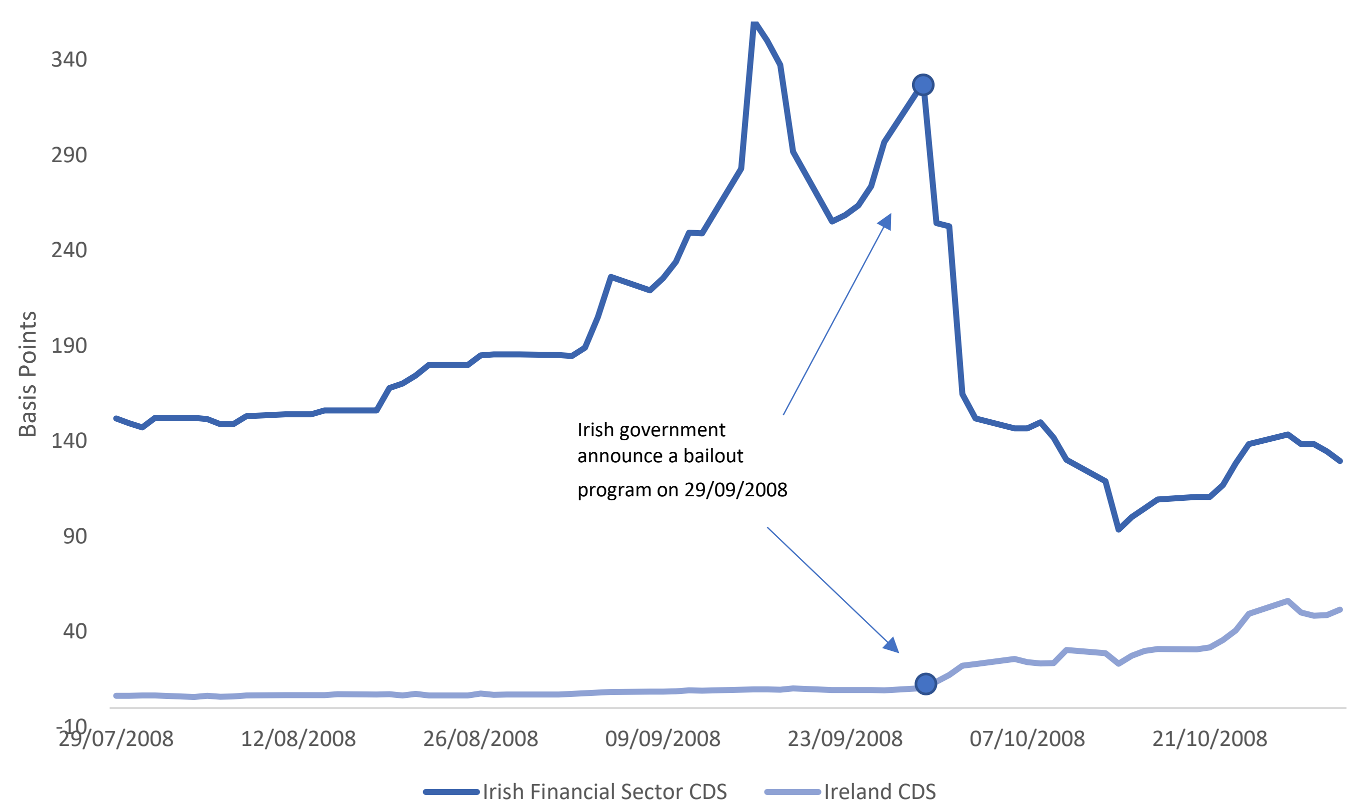


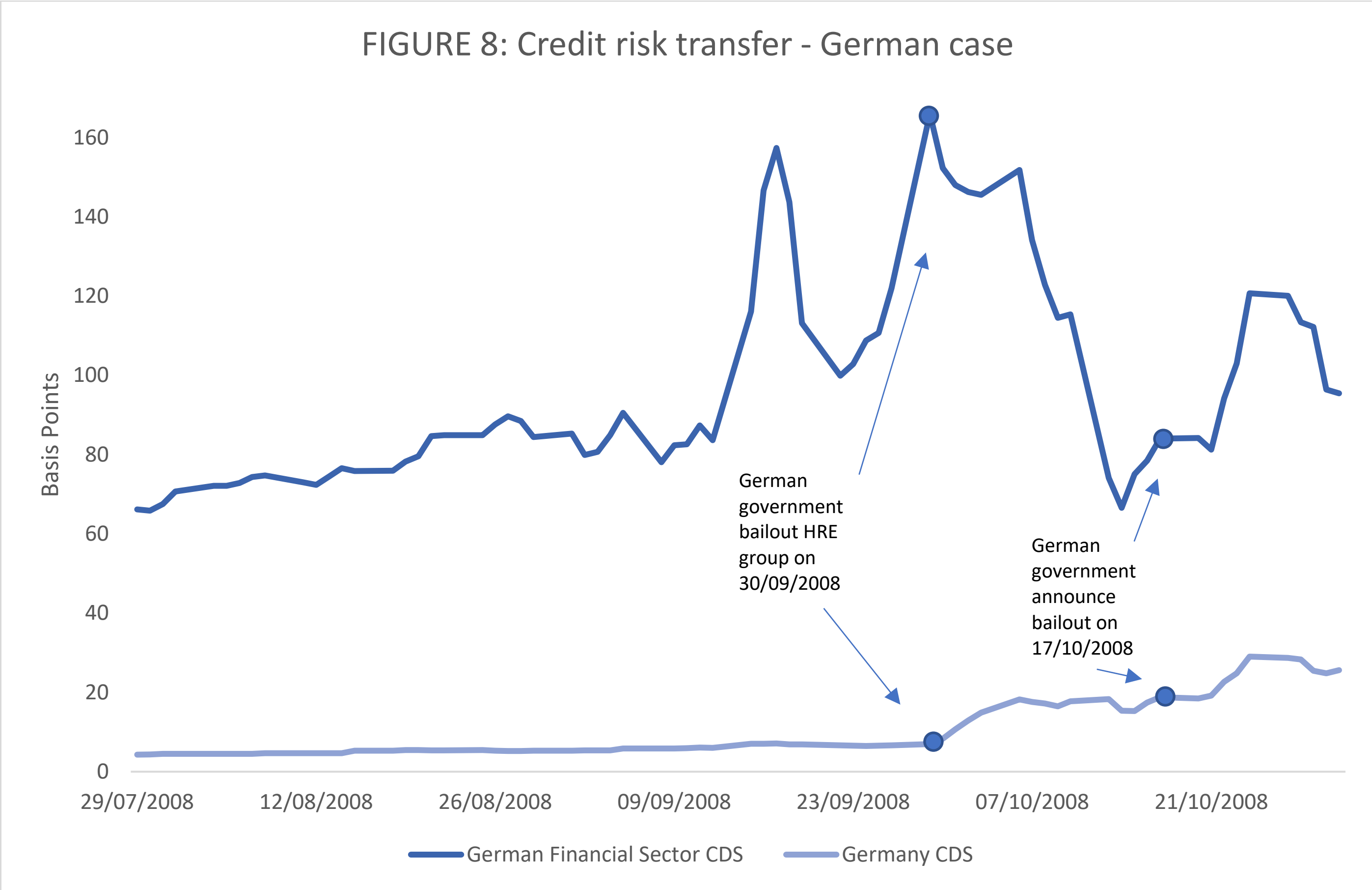
FIGURE 7: Credit risk transfer - Irish Case

Source: Bloomberg and author's calculation

2.2.4 Case study: Germany

German banks started suffering from the global crisis immediately after the Lehman Brothers collapse. Hypo Real Estate Holding, the second largest commercial property lender in Germany, was on the verge of bankruptcy due to liquidity issues, and the German government announced a €35 billion guarantee on September 30th, 2008. Few weeks later, on October 17th, 2008, the government announced a massive bailout plan. It ensured unlimited guarantee on all retail deposits in German banks and a rescue package of up to €400 billion of lending guarantees and up to €80 billion in state funds for banks recapitalisation. In the following days, several banks filed request for the use of capital injection: Bayern LB, West LB and Commerzbank among the largest ones.

FIGURE 8 plots CDS spread for the German financial sector and the sovereign one. The financial sector CDS spread is obtained as an equally weighted average between the CDS spreads of Deutsche Bank and Commerzbank. Even in this case study, results confirm what we expected. The first bailout announcement had the effect to decrease the credit risk in the banking sector and simultaneously increase the one in the sovereign sector. The second bailout announcement had a smaller effect than the first one and while the sovereign CDS spread increased, the financial sector one remained stable for few days.



Source: Bloomberg and author's calculation

2.3 The doom loop

The third claim of this study is the existence of a loop between the banking and the sovereign sector credit risks. The October 2008 bailouts triggered a risk transfer mechanism from the financial sector to the sovereign one and this established a vicious cycle. European countries were forced into a self-reinforcing loop characterized by sovereign difficulties, bank system troubles and economic recession. This spiral has been named "doom loop". Once the loop had been established, the trigger was not important anymore: the credit risk has moved from one sector to the other continuously, through different channels.

Historically, many times governments intervened to help or save distressed financial institutions, but the 2007-2008 Financial crisis was different because of the magnitude, and clearly the amount of public interventions required. That's the reason why economists believe we experienced the doom loop.

This loop has been often described as a spiral and not only a loop. Indeed, once a shock, in the financial sector or the sovereign one, has set in motion the risk transfer, the loop operates as a self-reinforcing feedback. If the crisis hit first sovereign, the risk would be transferred to the banking sector using one of the channels described in the next paragraph, and once this sector suffers the crisis, the government would be forced to step up paying this intervention through an increase in taxation, which generates recession and worsen the sovereign situation. At the same time, distressed banks experience problems in funding. This credit crunch leads to a greater recession, and, again, a worsening in the sovereign situation. And so again and again.

We'll now examine the different shocks that can happen in one sector and spread in the other through the doom loop, or vice versa.

2.3.1 Banking sector to sovereign channels

As already treated in the previous paragraph, the channel through which financial sector distress could affect the sovereign sector is the public intervention. Indeed, as government steps in to support troubled banks during a financial crisis, it needs an expansive fiscal policy. More taxes mean less consumption and investments, which translates in a recession.

In the previous paragraph we saw different case studies showing this mechanism. Now we'll take the Irish banking crisis as practical example [6] and deepen the analysis of this mechanism. Before 2007, Irish banks were lending continuously into Irish real estate market since mortgages exploded and house prices were rising hugely. In the meanwhile, they were borrowing huge amounts on international money markets, mainly from German and French banks. After the Lehman Brother collapse, the interbank market froze. With no possibility to get other funding abroad, both a liquidity and a solvency problem showed up: liquidity due to deposits' withdrawal; solvency due to the mismatch between liabilities and assets. Indeed, most of their assets were loans declining in value, so liabilities were considered greater. As already mentioned, to save Irish banks from collapse, Irish government issued on September 29th, 2008, a broad state guarantee to ensure existing Irish banks liabilities for two years. The measure was huge since the guarantee was made in respect of all retail, corporate and interbank deposits, senior unsecured debt, asset covered securities, and dated subordinated debt. This did not prevent completely the possibility of default. Few months later, on December 21st, 2008, Irish government announce a recapitalisation of the three major banks: Allied Irish Banks, Bank of Ireland and Anglo-Irish Bank. The rescue package consisted in taking €2 billion in preference shares in the first two and €1.5 billion in Anglo Irish Bank, practically nationalizing the latter with a 75% public share. Due to the massive interventions, public accounts experienced a couple of years of deficits and the public debt reached a giant amount. The real economy was characterized by recession and unemployment. The Irish state was not able to repay its lenders. Markets panicked, and Irish bonds yields leapt to 7%.

[6] Whelan (2015) "Ireland's Economic Crisis. The Good, the Bad and the Ugly".
Eichengreen, Barry (2013) "The Irish Crisis and the EU from a Distance".
European Commission (2012) "Ireland's economic crisis: how did it happen and what is being done about it?".

This example shows the risk transfer mechanism in action. From the suffering of the financial sector, through the bailouts, the public sector underwent a major crisis. Eventually, in November 2010, Irish state itself was bailed out from the European Central Bank and the International Monetary Fund[7] receiving €85 billion. In return, the Troika[8] imposed an austerity plan composed by government expenditures cut and tax raises.

2.3.2 Sovereign to banking sector channels

Let's start with a practical example[9], the Spanish crisis. Prior to 2007, the Spanish economy was characterized by a huge trade deficit, a loss of competitiveness against its main trading partners, an above-average inflation rate, a growing family indebtedness, a great increase in expenditure. But at the same time Spain was experiencing a housing bubble. Tax revenues from property investments were maintaining government's revenue in surplus and pulling the GDP growth. So, despite of all negative signals, none was expecting a crisis. In February 2009, Spain entered in recession. The crisis brought a strong economic downturn, a severe increase in unemployment, and bankruptcies of major companies. Spain was bailed out, agreeing with the Troika a €100 billion plan. The sovereign crisis was transferred to the financial sector, and in 2012 major Credit Rating Agencies[10] downgraded several Spanish banks to "non-investment grade" status. Bankia, the country's largest mortgage lender, was bailed out and afterwards nationalized on May 2012 to cover losses from failed loans.

We just described a situation where the trigger of the crisis was the sovereign sector, but once the doom loop is established, the risk moves from one sector to the other. Let's now analyse formally the sovereign to banks risk transfer channels.

Some factors operate via the liability side of the bank. One is the use of guarantees in bailouts programs to contrast the crisis. These guarantees reduced the bank risk premia on its liabilities, but the reduction was proportional to the sovereign creditworthiness. This means that a sovereign crisis could trigger bank problems since guarantees do not reduce the risk premia on liabilities anymore. Another factor operates via the liability side of the bank together with the relationship between the sovereign and the bank ratings. A sovereign downgrade leads to a downgrade of the domestic banks, reducing the value of their liabilities,

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[7] The International Monetary Fund or IMF is an international organization. As it describes itself on the website, it consists of "189 countries working to foster global monetary cooperation, secure financial stability, facilitate international trade, promote high employment and sustainable economic growth, and reduce poverty around the world."

[8] The Troika is the triumvirate of entities which represent the European Union in particular situations. After the 2007-2008 Financial crisis, the Troika is the one representing the European Union dealing with distressed sovereign entities. It is composed by the European Commission, the European Central Bank and the International Monetary Fund.

[9] Hidalgo (2012) "Looking at Austerity in Spain".
"Spanish banks to get up to 100bn euros in rescue loans". BBC News. 9 June 2012.
"EU Clears Spanish Bank Rescue". Wall Street Journal. 28 November 2012.

[10] They are Moody's, Fitch and Standard & Poor

since sovereign rating often represents a floor to the domestic private sector one. Indeed, this ceiling effect arises because sovereign entities have greater resources and policies at their disposal which mean that a higher non-sovereign rating is rarely justifiable[11]. This reduction in the bank liabilities value makes them no more eligible as collateral in funding operations or as an investment for entire categories of investors such as insurances or pension funds. It raises funding costs and liquidity needs.

One mechanism operates via the assets side of bank's balance sheet. It is the variation in markets belief on government's creditworthiness. It can cause losses or gains on bank's portfolios of sovereign securities and alter a bank reputation, via its existing loans to the government. It is not important the accounting convention: banking or trading book, market value or amortised cost change little when dealing with investor's concern on a probable default, and investors would evaluate every asset at its market value. One can say that this description would fit for any other claim, but the critical point is that sovereign exposure is a huge portion of assets in most European banks, and the main exposure inside this category is surely represented by domestic sovereign exposure. This phenomenon is called "home bias".

The home bias could derive from several factors among which hedging, small transaction costs, little informational frictions, but these reasons are shared by possible home bias even for different asset classes. Non- mutual exclusive factors leading to home bias for government debt instruments are the following.

- Since the bond market is less volatile and more globally integrated, the diversification with non-national government bonds not always is beneficial.

- Sovereign debt instruments have a fundamental role as collateral in securities financing and derivatives transactions and refinancing policy from the European Union.

- They are extremely liquid assets and are used to price other assets.

- The existent regulation gives to governments the opportunity to treat sovereign exposures in a preferred way, eliminating the concentration limits that exists for any other entity or choosing to apply reduced risk weights. In Europe, no existent or past regulations impose a zero-risk weight on sovereign debt, but de facto it is applied to every debt issued by European countries, especially in the Eurozone. We must admit that in Europe this treatment is granted to all banks for every debt issuance by sovereigns in euro, regardless if they are domestic or not: the preferential treatment is shared by European banks and sovereigns and should not contribute to the home bias. At most it can cause a bias for European debt instruments versus other instruments, but not specifically versus domestic debt instruments.

- Due to crisis reason, withdrawal by foreign investors which leave domestic banks as major public debt holders.

[11] Borensztein et al. (2013)

- The moral suasion of governments which exhort private domestic banks to give their support to the sovereign debt.

- A Carry Trade opportunity: undercapitalized banks may do a “gamble for resurrection”. Firstly, they get funds from the ECB exploiting low interest rates from expansive monetary policies. Afterwards, they invest them in domestic high-yield bonds suffering from crisis that absorb little or no capital.

- Banks replace foreign assets with national ones, to match assets and liabilities at a national level, with the goal of hedging redenomination risk. Redenomination is the process of changing a currency into another. In the Eurozone, it is used to indicate the possible return to old currencies of member states currently using the Euro. It represents a risk: holding assets and liabilities of different countries expose the bank to a greater risk of not being able to collect or pay in Euro in case of a redenomination. This operation is called Renationalization.

- Precautionary reason: the freeze in the wholesale markets made impossible for Euro banks to roll over their debt. At the same time, it costs too much the issuance of new debt. So, they used non-standard monetary policies from ECB, the LTRO, or Long-Term Refinancing Operation, to invest in government funds, since they were easy to liquidate and let banks repay maturing wholesale bonds.

- Similarly to Carry Trade, it could be a yield motive. It consists in exploiting the widening between returns on investing in national government bonds and returns on loans to resident clients. The difference is that banks in this case do not need to be undercapitalized: every bank could perform this strategy to improve its intermediation margin.

These reasons interact in different ways with the sovereign risk and the transmission of these risks to banks. Some of the reasons may play a role only during crisis times, while other reasons also affect bank holdings in normal times. The reality is that the home bias in past situation was seen as positive for mainly the following two explanations.

- Banks act as shock absorbers in times of distress investing stably in sovereign debt, diversely from external investors which leave the investment when shocks occur.

- Domestic banks holding the sovereign debt eliminates the agency problem. If national banks, which lend to home citizens, hold the sovereign debt, the sovereign entity is even more committed to avoid a default, which would hit mainly domestic deposits.

The reality is that it depends on the magnitude of the crisis. In most crisis we faced historically, the stress event was small or moderate. If the domestic sovereign exposure was relatively small before the shock, a greater home bias was positive and reduced the shocks for the aforementioned explanations. However, in serious stress events, it could aggravate the crisis making more dependent the two sectors. In this specific case, the magnitude of the crisis was the biggest ever experienced, and the home bias represented the most important factor in establishing a self-reinforcing loop of credit risks which is hard to vanquish. Indeed, following the Lehman Brothers collapse, when the Financial crisis reached its apex, European banks exposure to the domestic sovereign started to increase. The home bias was a consequence of the Financial crisis and not a cause and it was seen as a possible positive factor in defeating the financial turmoil. Afterwards, with sovereign exposures level already high and banks continuing to increase the exposure, it became a cause of the crisis, deepening greatly the dependence between the two sectors.

For the sake of completeness, other factors that probably cause spillovers from the sovereign sector to the banking one are risk aversion, crowding out effects and changes in risk management techniques.

2.4 Implemented measures against the credit risk rise and the doom loop

The fourth claim of our study is that responses to fight the rise of the credit risk during the crisis and eliminate this strong interdependence between the two sectors credit risks were not effective, and that still nowadays we need to debate how to overcome this vicious cycle.

2.4.1 Non-standard monetary policies implementation

In 2012, all European countries were suffering a recession due to increased taxation and expenditures, and the reason were the bailouts made to save the distressed financial institutions hit by the 2007-2008 Financial crisis. Not all countries were hit by the crisis so heavily: the German economy was performing much better compared to Italy, Spain, Portugal, Greece and Ireland, where years of deficits made the public debts bigger and bigger and the possibility of default was incredibly high and growing. Investors were already pricing in the government debt instruments not only the greater possibility of default but even the risk of redenominating the debt instrument in another currency, so a situation of dissolvency of the Euro currency union. Italian 10-years BTP were yielding 6% at that time, and the differential with the yield of a same maturity German Bund was at the maximum of 500 basis points. The situation for private sectors, especially the financial one, was not bright too and governments were unable to continue to bailout troubled institutions.

In May 2010, EU member states created the European Financial Stability Facility. The aim was to preserve financial stability in Europe, providing assistance to nations in difficulty. The EFSF could issue bonds or other obligations on the market to recapitalise banks or buy the sovereign debt. Many European distressed sovereign entities were bailed out from the IMF or other European member states through the EFSF. In April 2010, the Troika launched a €110 billion bailout to save Greece from default. In November 2010, Irish state was bailed out from the ECB and the IMF receiving €85 billion. Even Portugal in May 2011 received a €78 billion IMF-EU bailout package.

Other than the specific plans to save a defined country from collapse, other measures were already implemented in the Eurozone. The ECB started in May 2010 open market operations buying government and private debt securities for a total amount of €219.5 billion. At the same time, it changed its policy regarding the necessary credit rating for loan deposits, accepting as collateral all outstanding and new debt instruments issued or guaranteed by governments, regardless of the nation's credit rating. In December 2011, the ECB implemented the LTRO. Basically, it consisted in loans for an amount of €489 billion to 523 banks for three years at an interest rate of 1%.

Nevertheless, markets were sceptic and the crisis continued. On July 27th, 2012, on the verge of the break of the Eurozone and the Greece facing a real possibility of defaulting, Mario Draghi, Head of the ECB, made a famous speech. He announced that the ECB would do "whatever it takes" to save the Eurozone, anticipating the use of non-standard monetary policies. Markets reacted accordingly, and for the first time slightly improvements were seen, both in terms of credit risk and result on European stock markets. For the first time in years, the existence of the Eurozone and the recovery from the financial turmoil in Europe were no more doubted. The most important non-conventional monetary policy used was the Quantitative Easing. It was an expanded asset purchase programme of €60 billion per month of euro-area bonds from central governments, agencies and European institutions. It was planned to exist from March 2015 until September 2016, but the program was closed from January 1st, 2019.

These various stimuli implemented from the ECB had the intended effect of diminishing interest rates, saving financial institutions and governments from the impending bankruptcy. But on the other side, they did not reduce the strong dependence created with the bailouts in terms of credit risk. The doom loop was not weakened from these policies, actually it was strengthened.

As seen in the previous paragraph, the home bias was one of the most important channels of credit risk transmission from the sovereign sector to the financial one. The ECB monetary policies provided a cheaper and easier funding, and these funds were used for several reasons, from Carry Trade to yield motives, from private financial institutions to acquire domestic sovereign obligations increasing their portion into their balance sheets.

To sum up, the effect of reducing the default risk slightly improved the European economic situation, but the greater domestic sovereign exposure increased the dependence between the two sectors. The European financial sector even if not on the verge of a collapse was still a loaded gun ready to fire.

2.4.2 Regulatory measures

In the aftermath of the Financial crisis, were introduced different rules to reduce risks and stabilize the financial system in the Eurozone. The 1997 Stability and Growth Pact was updated on May 2013 with more severe criteria on fiscal provision. The European Stability Mechanism was created and started to operate on July 2012 to provide financial assistance programs to the failing member states. The Basel III Accord was implemented in June 2013 through the Capital Requirements Regulation and Directive IV. Its aim is to reinforce banks' balance sheet providing a framework on minimum capital, liquidity standards and leverage ratios.

To eliminate the interdependence between the sovereign and the banking sector affecting the different channels and limiting the idiosyncratic risk of both, the European Union decided to implement a series of reforms to create homogeneous rules with regard to the supervisory and resolution framework. The project is known as the European Banking Union. It consists of three pillars. In November 2014 was enforced the first, a Single Supervisory Mechanism which transfer the financial supervision of large institutions to the ECB. The Second pillar is a Single Resolution Mechanism, which defines common rules for resolutions of troubled financial institutions. It entered into force on January 1st, 2016. The Third pillar is a European Deposit Insurance Scheme, to guarantee deposits at a European level. This is still to be implemented.

To put the Single Resolution Mechanism at work, a legislative tool was needed. To this respect the Bank Recovery and Resolution Directive, or BRRD, was implemented between May 2014 a January 2016 in all member states. It harmonizes at European level the recovery and resolution of banks and financial institutions, avoiding the use of public funds. The main provisions are three. The preparation of recovery plans to avoid resolutions. The introduction of early intervention tools at the correct time. The introduction of resolution tools matched in each member state. Among them we can find the sale of business, the asset separation, but most importantly, we find the tool thought to defeat the doom loop, the bail-in.

The bail-in tool entered in force on January 1st, 2016. The idea is to manage big financial entities crisis avoiding bailouts, so the use of taxpayers' money. It imposes a so-called liability cascade. In case of bankruptcy, not only equity, but also debt instruments can be converted into equity. So, debtholders will become equityholders and their claims will be used to save the financial institution. If it is still insufficient to recapitalize the bank, also subordinated liabilities and finally deposits not covered by the deposit guarantee schemes will be used.

We expected the vicious cycle of credit risk co-movement between the banking sector and the sovereign one to be reduced by the implementation of this tool. But in our opinion, the BRRD implementation by itself could not delete completely the doom loop. The elimination is far mainly for the growing magnitude of the home bias phenomenon, but also because the real implementation of this tool is far from complete. Recent examples of resolutions show us how even in case of small financial institutions, it is difficult to implement a resolution plan without the public intervention.

Veneto Banca and Banca Popolare di Vincenza were two Italian banks. They did not raise regulatory capital for loans issued for their shareholders. Once this mistake was discovered by Banca d'Italia, the resulting financial adjustments worried about a solvency issue. After been granted two state guarantees on their debt instruments for a total of €8.6 billion, with the financial situation not improving, Banca d'Italia opted for their resolution. The plan implemented involved the selling of part of the business to Intesa San Paolo, with a public cash injection of €4.8 billion in favour of the buyer, which absorb even the repayment of the guaranteed debt instruments. This operation appears to be completely in contrast with the new rules avoiding bailouts. The loophole is that many national legislators asked to introduce bail-in by steps: only debtholders which knew at the time of their subscription of the bail-in rule should be absorbing losses in case of default. In practice this means that the bail-in was not applied.

3. Empirical analysis

In this section, we present different analysis to support or reject what we discussed in the second chapter. Firstly, we will examine data through graphs, statistical measures and the computation of correlation coefficients. Secondly, we will introduce the econometric model. These two parts will evaluate all the claims we made in the second chapter. Finally, a third part will look empirically at data regarding the home bias phenomenon.

3.1 Risk measure

Our study is focused on the existing relationship between the credit risk for the sovereign and the banking sector. The first task needed is to identify a fundamental variable, the one that let us evaluate the credit risk associated to a specific player, that could be a bank or a state. It could be measured in different ways and each one has positive and negative aspects. We focus on the three main characteristics a risk measure should possess, at least to a certain degree, to be used in empirical studies: availability, liquidity and standardization. In existing literature, the three main measures considered are the following.

3.1.1 The credit rating

Credit rating is an evaluation, performed through different methods by different credit rating agencies or CRAs, on the creditworthiness of a singular bond issue. It is true that the rating should be an attribute of just the bond issue, but since usually all obligations issued by the same company have the same rating, we could use this measure as an evaluation of the entire company credit risk.

Acharya et al. (2013) use credit ratings. They indeed use Moody's Investor Services rating for financial institutions with and without government support[12] and from the difference between the two obtain the direct measure of the value of government guarantees, called Moody's rating uplift. As measure of the sovereign credit risk, Acharya et al. (2013) employs Country Rating or Moody's Long-term issuer Rating (domestic).

Advantages of this approach are clearly the standardization and the availability. But it suffers from a main drawback: the measure is not adjusted following short-term changes in investors belief on the risk. Indeed CRAs, when publishing the credit rating, have the fundamental objective of rating stability. They level up ratings to avoid "rating reversal", so sudden and subsequent downgrades and upgrades of the risk measure

[12] Moody's Investor Services rating for financial institutions with government support is called Long-term Issuer Rating. The one without government support is called instead Bank Financial Strength Rating.

and change the rating only if fundamentals show that the downsize or upsize will be effective in the long term.

3.1.2 The government bond yield

The government bond yield is the interest rate paid on a government obligation. It is the rate of interest at which the government can borrow funds. It is a measure of credit risk. Indeed, the higher the investors evaluate your probability to not repay the obligation, the higher they will ask to lend the funds. Differently from credit ratings, it is not the result of an evaluation made by a single market player, the CRA, but it is determined by all market players together, which clearly will adjust their evaluation to adapt to all small changes in the credit condition of the security. So, among the advantages, there is liquidity. Drawbacks of this method are mainly two. Firstly, the existence of different maturities, and secondly, the need of selecting a risk-free rate to use as base. Different choices can change the values obtained. Clearly, the government bond yield is not a standardized credit risk measure.

Even the availability is a serious issue: the bond yield for governments is easy to find on data provider, but the same data with the same maturity is not so common for private banks. That's the main reason why Acharya et al. (2013) use government bond yields as a measure of sovereign credit risk and use bank CDS spread to measure the financial sector credit risk.

3.1.3 The credit default swap

The CDS or credit default swap is a protection bought against a "credit event": an investor buys an insurance from a seller that is obliged to repay in case of default or credit rating deterioration of a reference asset, typically a bond. Practically, the buyer obtains the right to sell the reference bond for its face value when a credit event occurs and pays a premium to the seller. The premium is expressed in basis points per year of the contract's notional amount. The premium is paid until the credit event or the end of the life of the CDS. The total amount paid per year, as a percentage of the notional principal, is called CDS spread. It is clearly a measure of the credit risk of the asset: the higher the CDS spread, so the higher the price at which is possible to buy a protection against default of that asset, the higher the credit risk associated. This measure embraces all the characteristics required for a measure of credit risk to be used in an empirical study. Indeed, since it is a market base risk measure, it is liquid and available. With respect to the different specifications needed to select a bond yield, there is no need to choose a risk-free rate, and so it has a greater standardization.

Acharya et al. (2013), Covy Eydmann (2016) and all the studies cited in the relating literature paragraph of our study[13] use this measure in most of their analysis.

3.2. Data selection

In our study, we decided to use CDS spread as the main credit risk measure to use for the empirical analysis. Our focus is on the relationship between the banking and the sovereign sector in the context of the European crisis. Accordingly, we choose as risk measure the 5 years CDS spread, expressed in Euro, and collect a panel[14] of countries and banks, using the data providers Bloomberg and Thomson Reuters DataStream.

Countries sample is composed by all Eurozone countries which had publicly traded CDS at the time of the Financial crisis and for which was possible to obtain data on a 5 years CDS spread, so Greece, Ireland, Belgium, France, Germany, Italy, Netherlands, Spain, Portugal and Austria are included. We added Denmark, Sweden, UK and Norway, for a total of 14 countries.

Through the European Banking Authority website, we found the lists of G-SII and O-SII financial institutions throughout Europe. The G-SII or "Global Systemically Important Institution" are those European banks with a leverage ratio greater than €200 billion and which respects the Basel II requirements for systemically significance. The last are called G-SIB or "Globally Systemically Important Banks". So, basically, G-SII is the group of European G-SIBs. The O-SII or "Other Systemically Important Institution" are European banks financially significative, with a systemic importance, but that do not respect every requirement to be a G-SIB. In our sample we select all G-SII and O-SII banks that were active before Financial crisis, had publicly traded CDS throughout the analysis period and for which was possible to obtain those data from the aforementioned data providers. If possible, we selected a minimum of two banks for each country, to avoid a country bias. The only exceptions are Greece, for which we collected data only on Alpha Bank; Denmark, for which we obtained data on Danske Banks and Norway, for which we found only data on DNB. The total sample is made by 29 European banks. We checked if the chosen banks had also public traded equity throughout the period, and then collected the time series on common stock prices.

TABLE 1: Banks Summary

TABLE 1 provides the list of banks included in our sample. For each bank it is indicated the headquarters' country, the total amount of assets and the shareholders' equity amount, expressed in Euro, at 31/12/2006.

[13] Among them, Alter and Beyer (2014), Alter and Schueler (2012), Fratzscher and Rieth (2015).
[14] Panel data or longitudinal data are multi-dimensional data with observations of multiple phenomena obtained over multiple time periods for the same player.

Bank	Country	Total Assets	Total Equity
Erste Bank	AT	181.703.205.000	10.904.207.000
Raiffeisen Bank International A.G.[15]	AT	55.866.995.000	4.589.583.000
KBC Group N.V.	BE	325.400.000.000	18.453.000.000
Dexia Group	BE	566.743.000.000	18.435.000.000
Commerzbank Aktiengesellschaft	DE	608.339.000.000	15.311.000.000
Deutsche Bank	DE	1.126.230.000.000	32.808.000.000
Danske Bank	DK	367.403.567.597	12.764.484.978
Banco Santander	ES	833.873.000.000	40.062.000.000
Banco Bilbao Vizcaya Argentaria	ES	411.916.000.000	22.318.000.000
BNP Paribas	FR	1.440.343.000.000	54.824.000.000
Crédit Agricole S.A.	FR	1.380.666.000.000	58.743.000.000
Société Générale	FR	956.841.000.000	33.432.000.000
Alpha Bank S.A. [16]	GR	54.684.289.000	4.291.264.000
Allied Irish Banks plc	IE	158.526.000.000	9.912.000.000
Bank of Ireland	IE	162.354.000.000	5.373.000.000
Intesa Sanpaolo S.p.A.	IT	575.512.000.000	26.568.000.000
UniCredit S.p.A.	IT	823.284.214.000	30.938.438.000
Banca Monte dei Paschi di Siena S.p.A.	IT	158.556.000.000	7.775.000.000
ING Groep N.V.	ND	1.226.307.000.000	41.215.000.000
Rabobank Groep N.V.	ND	556.455.000.000	29.377.000.000
DNB	NO	160.262.442.340	8.061.786.841
Banco Comercial Português	PT	79.259.000.000	7.775.000.000
Caixa Geral de Depositos	PT	96.246.000.000	5.014.000.000

[15] in 2007 was named Raiffeisen Zentralbank Österreich. In 2017 Raiffeisen Bank International A.G. reverse merged its parent company.

[16] Data on Alpha Bank are at December 31st 2007 since at the previous year they were not available

Nordea Bank	SWE	346.890.000.000	15.322.000.000
Svenska Handelsbanken	SWE	197.744.000.000	7.316.050.000
Barclays Bank plc	UK	1.478.240.000.000	40.619.400.000
HSBC Holdings plc	UK	1.409.380.000.000	87.048.900.000
Lloyds Bank plc	UK	509.556.000.000	11.507.000.000
Standard Chartered Bank	UK	394.629.000.000	25.796.800.000

Source: Banks' websites old financial statements

The timeframe selected to analyse the existence of the doom loop is composed by observations between January 2nd, 2007 and August 31st, 2018. The beginning of the time frame is selected to collect enough observations previously to the starting of the Financial crisis and the subsequent massive use of bailout programmes.

The timeframe is divided into five different subperiods. The first bailout in Europe was the partial nationalization of Fortis from Benelux governments, and it was announced on September 27th, 2008. So, we build a pre-bailout period, composed by all observations from the beginning of the timeframe until the September 26th, 2008. The second period is the one-month period in which all European countries announced a rescue programme for banks and started the first public interventions in troubled financial institutions, from September 27th, 2008 to October 28th, 2008. This last date is the day after the last important bailout announcement in a Eurozone country, Sweden. The third subperiod, or post-bailout period, involves all the observations remaining from the bailout period to July 26th, 2012. That is the date in which ECB's president Mario Draghi made his famous speech "whatever it takes". The fourth subperiod lasts from Draghi's speech to when the bail-in provision comes into force on January 1st, 2016. This period is studied to see the effect of the non-conventional monetary policy implemented by the ECB. As mentioned in the previous chapter, the bail-in tool is a provision of the BRR Directive, a milestone in European regulation. Last period involves all remaining observations until the end of the time frame. We will study this last to look at the effect of the bail-in introduction.

In the first and second part of our empirical study, we will use the following approach. Firstly, we study the claim of the inexistent relationship between the banking sector and the sovereign sector credit risks before the Financial crisis using the pre-bailout period. Secondly, we test the existence of a risk transfer mechanism due to bailouts examining the bailout subperiod. We analyse the establishment of the vicious cycle between the banking and the sovereign credit risk, using the post-bailout period. Afterwards, we use the last two subperiods to investigate the possible conclusion or persistence of this phenomenon after the two main interventions made in the last years, the former concerning the regulatory framework, the latter the conduct of the ECB monetary policy. Only the third part, which is focused on the home bias, will have a slightly different scheme.

3.3 First empirical verification

This first empirical analysis looks at the absolute and log changes in CDS spread, then plots the pattern and compute the correlation between the two sectors, in all the subperiods.

In the first period, the pre-bailout one, we expect the sovereign CDS spread to be almost absent and the banking sector credit risk to be higher in absolute value and in log change: we should remember that the pre-bailout period includes the Lehman Brothers collapse and the start of the Financial crisis in the US in March 2007, so at the bank level credit risk was already growing.

TABLE 2: Pre-Bailout Period

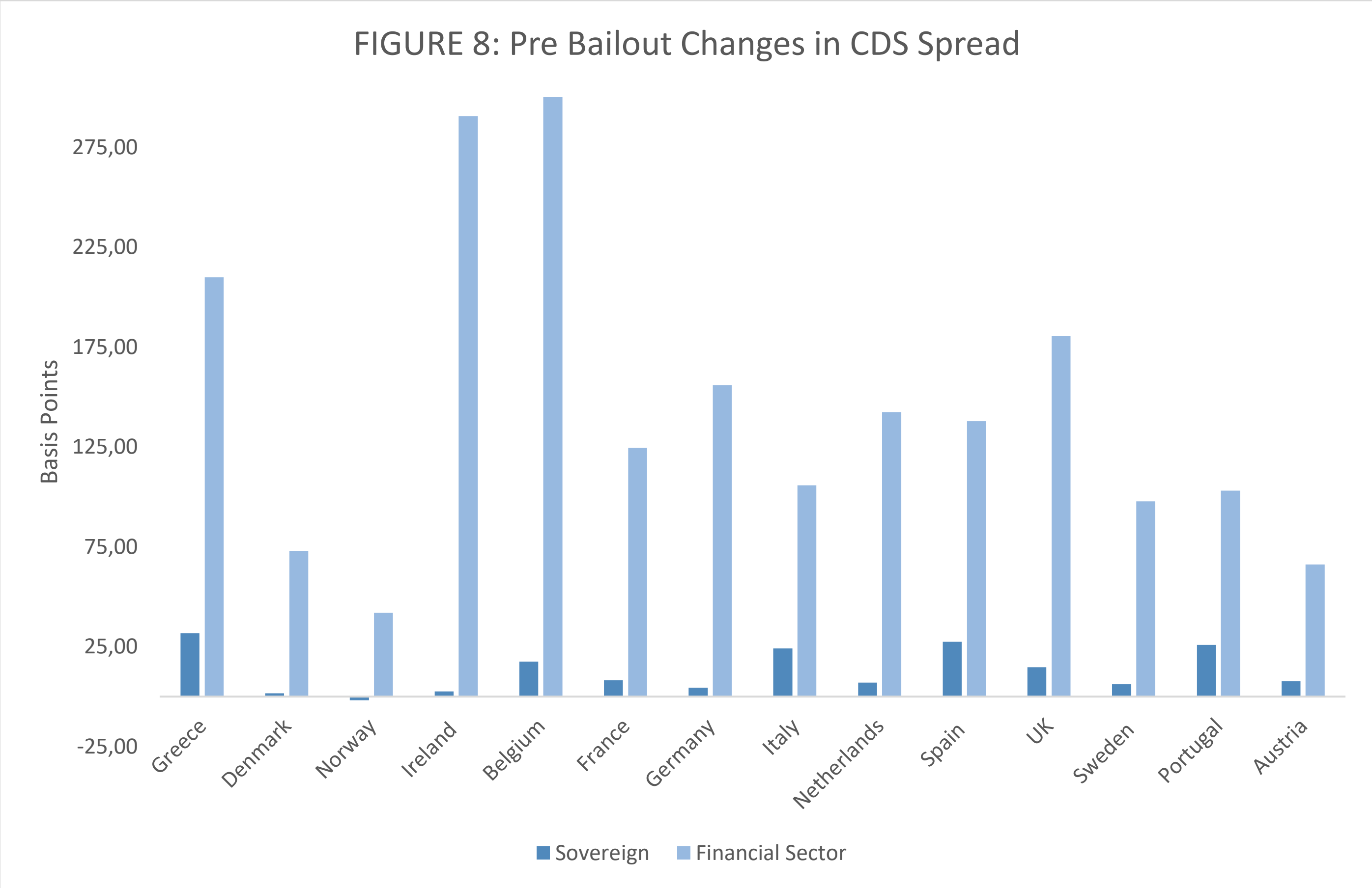
Tables from 2 to 6 report the mean and the standard deviation associated for changes in absolute value and in the daily percentage for both sovereign and financial Sector CDS spread, in the pre-bailout period, from 2/1/2007 to 26/9/2008, in the bailout period, from 29/9/2008 to 28/8/2008, in the post-bailout period, from 29/8/20008 to 26/7/2012, in the period in which where introduced non-standard monetary policy, from 26/7/2012 to 31/12/2015 and finally in the bail-in introduction period, from the 1/1/2016 until 31/8/2018. The financial sector CDS spread value is obtained from an equally weighted average among each country financial sector CDS spread. The last one, was obtained similarly as an equally weighted average among banks CDS spread in that country. The sovereign CDS spread is obtained as an equally weighted average among countries in our sample.

Variable	Mean	Standard Deviation
Sovereign CDS	12,67	10,86
Financial Sector CDS	152,95	97,88
Daily change Sovereign CDS	1,58%	1,04%
Daily change Financial Sector CDS	0,81%	0,28%

Source: Bloomberg and author's calculation

As TABLE 2 clearly shows, our prevision is confirmed. There is very small evidence of credit risk in the sovereign sector since the sovereign CDS spread is very low: sovereign CDS were poorly traded prior to the financial crisis, since the idea of protecting against the default of a developed country such as a European one was considered useless. The financial sector credit risk was already high. Differently, daily changes measures show an important daily increase for both variables. While it was expected for the financial sector, it was not predictable for the sovereign one. This last fact could be due to some investors which already know or were expecting for some reasons (maybe insider trading) a massive public intervention.

Let's look to the evolution even graphically in FIGURE 8 of the two sectors credit risk during the pre-bailout period, so from the beginning of 2007 to the day before the first public intervention in Europe, on September 27th, 2008. We plot for each country the change in the sovereign CDS spread and the one in the financial sector. The financial sector CDS spread for each country is computed as the equally weighted average of all CDS spread traded by G-SII and O-SII banks.



Source: Bloomberg and author's calculation

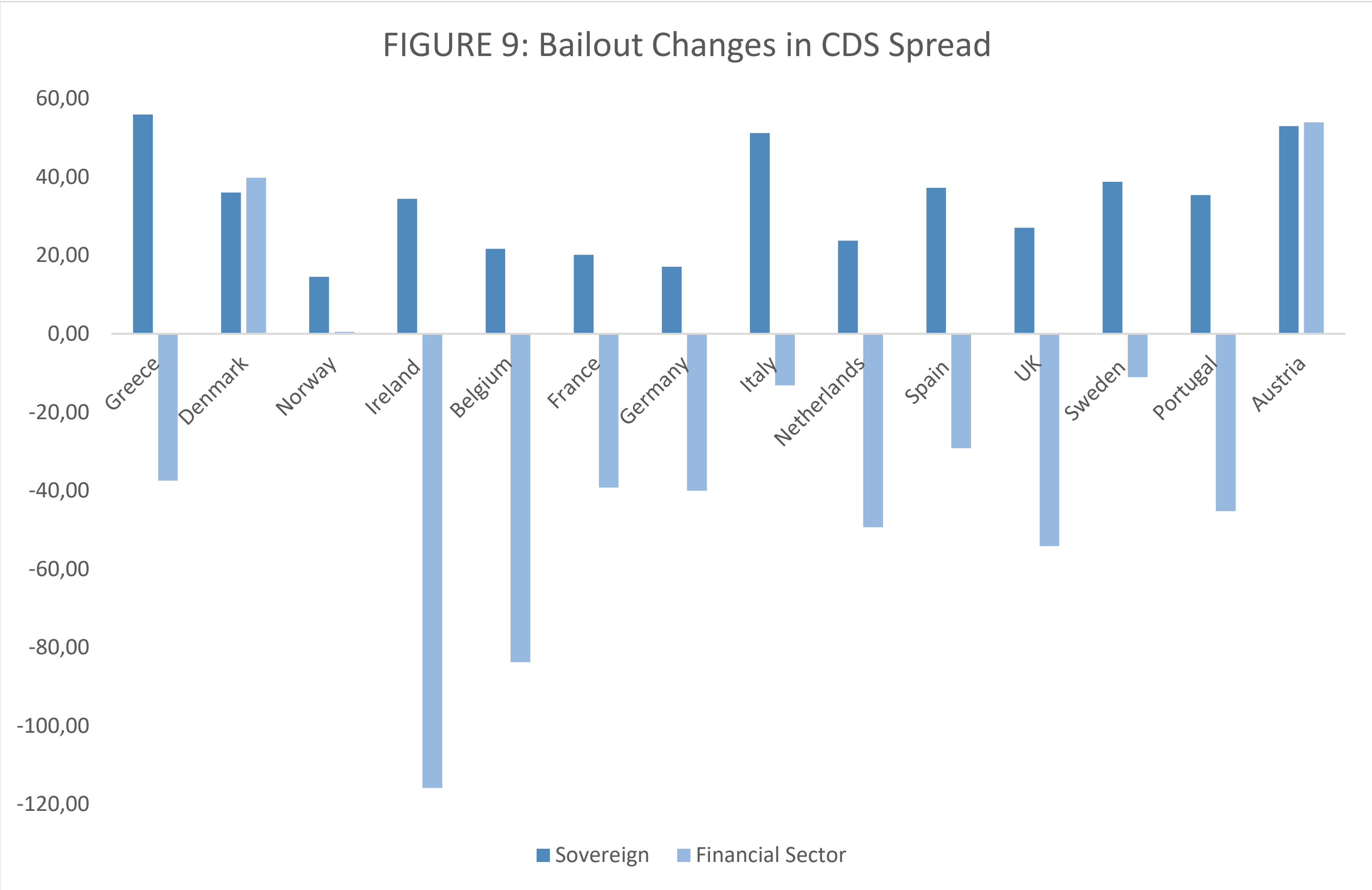
FIGURE 8 confirms what said about the analytical data and the table: there is an important increase in bank CDS and almost no change in the sovereign ones. For example, let's look at the Belgian and Irish situations. We picked the first two European countries where the financial crisis hit heavily, and a public intervention was needed. In the period before the bailouts, we can observe how the banks CDS spread was rising hugely compared to almost no increase in the sovereign sector one. Results for other countries are similar.

In the bailout period, we expect the financial sector credit risk to reduce and the sovereign one to jump up.

TABLE 3: Bailout Period

Variable	Mean	Standard Deviation
Sovereign CDS	33,30	13,39
Financial Sector CDS	-34,90	60,29
Daily change Sovereign CDS	6,62%	1,81%
Daily change Financial Sector CDS	-0,68%	1,53%

As expected, the sovereign CDS spread rise while contemporary the financial sector CDS decrease of almost the same amount. Interesting data is the huge daily change compared to the one of the previous subperiod. It shows that the change happened fast, especially in the sovereign sector.



Source: Bloomberg and author's calculation

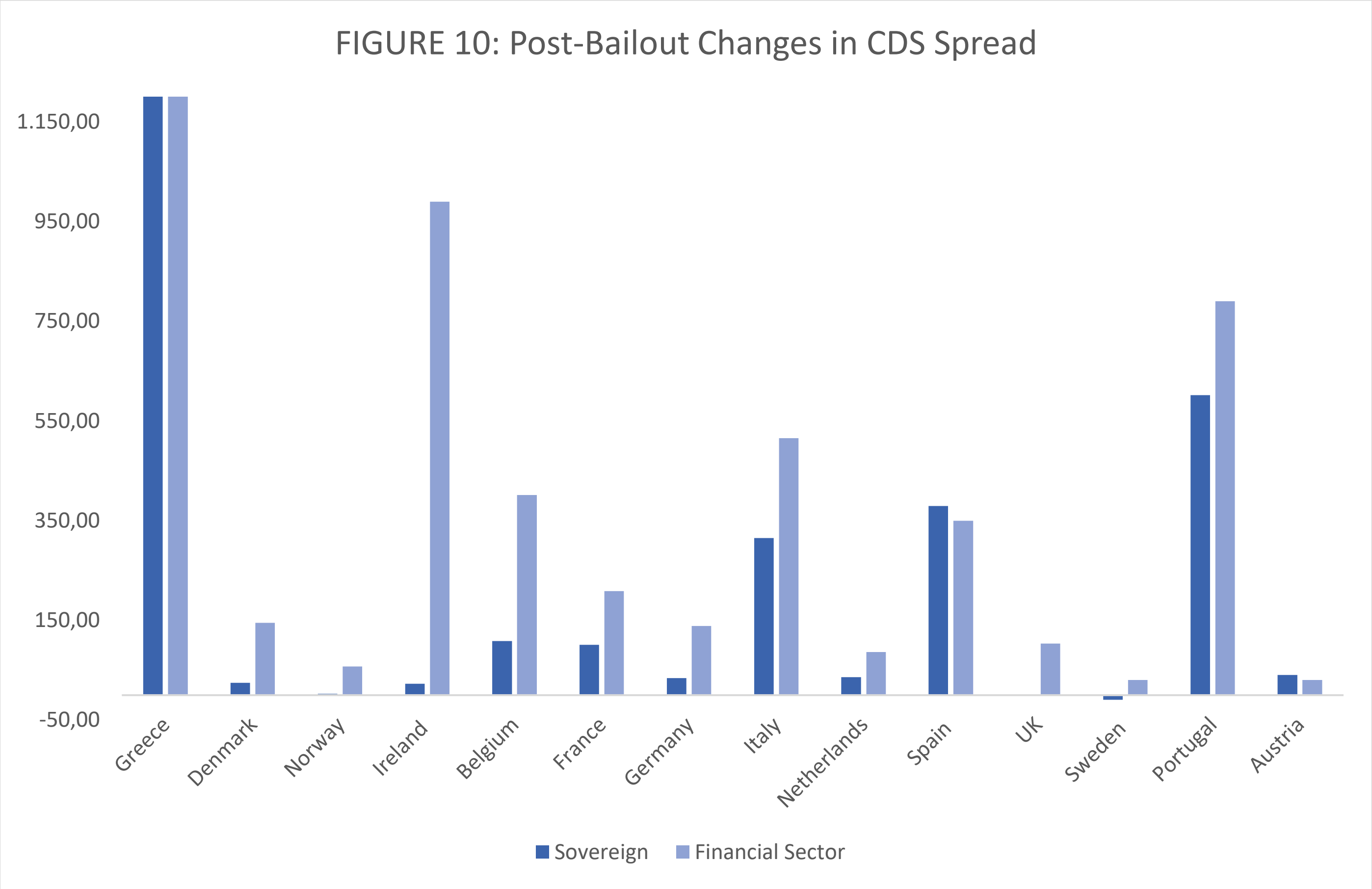
Graphically, FIGURE 9 shows the pattern synthetized in TABLE 3 for each country. There are few exceptions where the effect of the bailout measures was lower, and risk continued to increase even for the financial sectors. This happened in Austria. It was caused by the different announcement made with respect to the other countries. While other governments immediately in the first days of October 2008 provided huge guarantees and funds to recapitalize banks or buy deteriorated assets, the Austrian government just created legal basis to intervene. Probably Austrian banks′ investors did not consider the choice as safe as the one made by other governments and continued to protect themselves against Austrian banks default.

Coming back to the previous examples, once the Irish government announced a state guarantee for all Irish banks liabilities, the burden was moved to the sovereign sector. The same happened with the Belgian case. Once the government nationalized Fortis, and bailed out both KBC and Dexia, the financial sector credit risk decreased and was transferred to the sovereign sector. So, to sum up, taken together the table and the graphical representation, we can confirm the existence of a risk transfer mechanism: bailouts triggered a rise in the sovereign credit risk and a contemporary reduction in the banking sector one, moving this risk from the second sector to the first.

Let′s plot the change in the credit risk and compute the statistics in the post bailout period. As briefly discussed in the introduction, the post bailout period should be characterized by an increase in both CDS spreads, since the risk transfer should have triggered a vicious cycle in which the risk is moved from one sector to the other.

TABLE 4: Post-Bailout Period

Variable	**Mean**	**Standard Deviation**
Sovereign CDS	1.115,75	3.702,07
Financial Sector CDS	373,77	459,65
Daily change Sovereign CDS	0,24%	0,17%
Daily change Financial Sector CDS	0,19%	0,09%



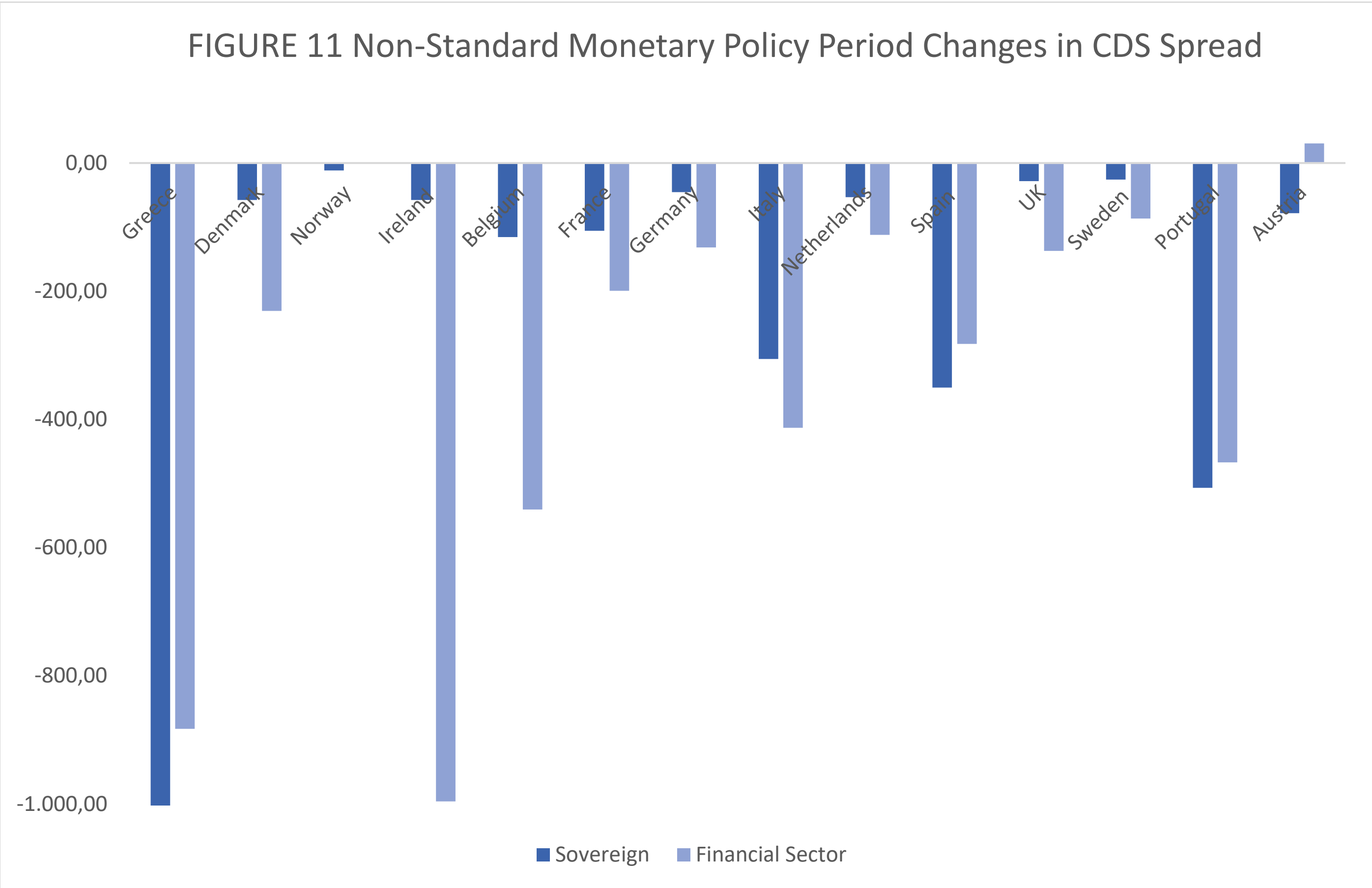
Source: Bloomberg and author's calculation

As expected, the post bailout period is characterized by an increase of both the sovereign and the banking sector CDS spreads in all the countries. The absolute value is greater for the sovereign sector, but the magnitude is big for both sectors, especially compared to the previous period. The percental change is similar for the two sectors, confirming the existence of a strong interdependence between the two measures in this period. In FIGURE 10, we cannot appreciate the level of increase that happened in both the sovereign and the financial sectors in Greece, and thus we reduced the scale of the graph. As we'll cover largely in the next paragraphs, Greece experienced a sovereign crisis when it was discovered that the government falsified public accounts to respect Eurozone parameters about debt. The change we observe in the post bailout period for the Greek sovereign CDS spread is 13.963, extremely greater than all the other variations for the other countries, that are still incredibly big in magnitude with respect to previous periods. This value clearly influenced the data shown in TABLE 4, where the average values in Europe would be high but not that much if Greece was not considered. Same reasoning could apply to for the financial sector, even if the magnitude is different: the change in the post bailout period for the Greek financial sector CDS spread is 2.072. Portugal was one of the countries majorly hit by the crisis, and one of the main actors of the 2011 European debt crisis. So, we could observe an increase in both the banking sector CDS and in the sovereign one of great magnitude (790 and 601). As we discussed in the previous chapter, Ireland was the first country to suffer a banking crisis, and that is reflected in the considerable increase observed in the financial sector CDS spread.

Let's draw the table which summarize the mean and the standard deviation of the change in CDS spread in the fourth subperiod. After the implementation of non-conventional monetary policies, we expect a huge drop in the sovereign credit risk. We expect also that the doom loop would not be scratched by these policies, on the contrary it would be reinforced through the home bias increasing mechanism. Clearly this result could not be detected by this study of percental and absolute changes, but we can expect the two CDS spreads to commove.

TABLE 5: Non-Standard Monetary Policy Period

Variable	Mean	Standard Deviation
Sovereign CDS	-1.061,29	3.472,72
Financial Sector CDS	-336,20	296,30
Daily change Sovereign CDS	-0,01%	0,12%
Daily change Financial Sector CDS	-0,01%	0,08%



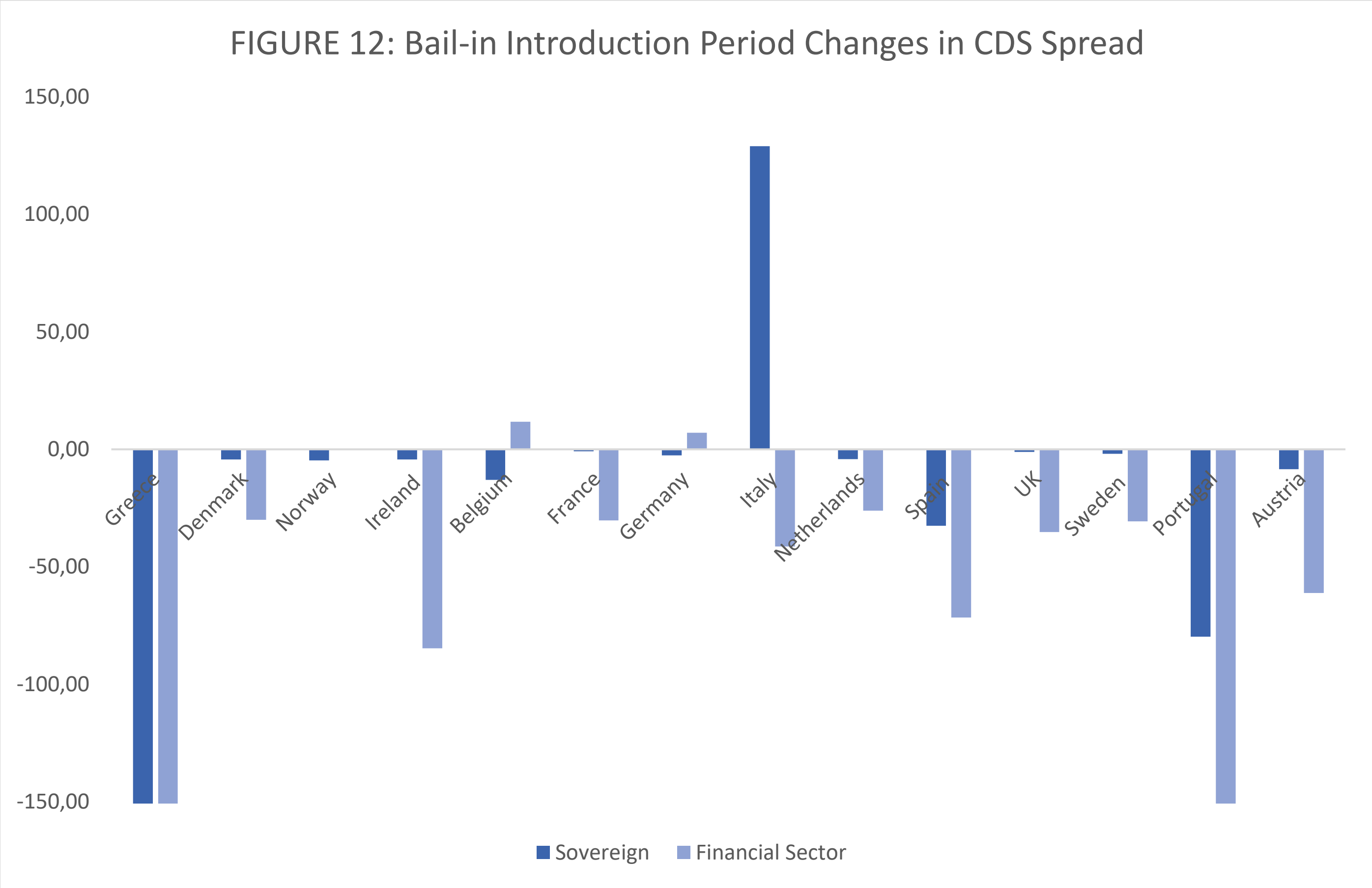
Source: Bloomberg and author's calculation

As expected, both the financial sector and the sovereign credit risks dropped in all Europe countries. Excluding the Greek values, reductions were similar in amount as we can detect from the graphical representation. As before, we cannot appreciate the magnitude of the Greek reductions on the graph. The percental change is exactly the same in the two sectors: doom loop is still active and non-standard monetary policies only strengthened it.

The fifth subperiod should be influenced by the introduction in Europe of the BRR Directive and in particular of the bail-in tool. We should observe again a reduction in both the banking sector and the sovereign sector credit risk measure. This regulatory framework should even slightly reduce the effect of the doom loop.

TABLE 6: Bail-in Introduction Period

Variable	Mean	Standard Deviation
Sovereign CDS	-50,82	186,99
Financial Sector CDS	-81,34	162,18
Daily change Sovereign CDS	-0,01%	0,06%
Daily change Financial Sector CDS	-0,01%	0,08%



Source: Bloomberg and author's calculation

As expected, there is a reduction in both the financial sector and the sovereign CDS spread as shown in TABLE 6. As in the last two graphs, we cannot appreciate, due to the magnitude, the reduction in both the Greek financial sector and the sovereign plotted in FIGURE 12 (-809,1 and -682,85). As described in the first chapter of this dissertation, in September 2018, markets started to be sceptic about a series of reform announced from the new Italian government coalition. The sovereign credit risk measure touched is minimum at the beginning of January 2018 but recently rose again to touch again levels above 200 basis points. That's the reason we observe a counterfactual in FIGURE 12 regarding the Italian sovereign CDS spread.

To sum up, monitoring the CDS spread changes in the five different subperiods, we proved firstly the existence of a risk transfer mechanism from the financial sector via public interventions. Secondly, we demonstrate how this risk transfer mechanism established a vicious cycle in the period afterwards. Finally, we showed how the regulatory framework and the ECB interventions affected the credit risk in the two sectors.

3.3.1 Correlation analysis

Now, let's analyse the correlation between the banking and the sovereign sector credit risks. It will help to check what we already demonstrate with the changes and will also let us investigate the response of the interdependence between the two sectors to the policies introduced to fight the crisis.

We plot in TABLE 7 the correlation between daily changes in the sovereign CDS spread and the ones in the banking sector CDS spread, dividing the analysis for each country in the sample. We expect to observe a zero or a very small correlation in the pre-bailout period, since investors did not expect any relationship between the banking and the sovereign sector credit risks. In the bailout period, our forecast affirms that the correlation should be negative and greater in absolute value than in the previous period: the risk transfer mechanism should conduct to a huge increase in the sovereign credit risk and a reduction in the financial sector one. In the post bailout period, as already mentioned, the risk transfer mechanism should have created a loop. This loop should manifest via in a high positive correlation between the two variables. We expect the fourth subperiod to see even a greater level in correlation with respect to the previous one: as already stated, the introduction of monetary policies increased through several channels the home bias and so the intensity of the doom loop. The last period should be characterized by a reduction in the correlation coefficients, but they should still be high with respect to the level prior the Financial crisis.

TABLE 7: Correlation between sovereign and financial sectors

The following table reports the correlation coefficients for the sovereign and the financial sectors CDS spreads distinguishing for countries, in the pre-bailout period, from 2/1/2007 to 26/9/2008, in the bailout period, from 29/9/2008 to 28/8/2008, in the post-bailout period, from 29/8/20008 to 26/7/2012, in the period in which where introduced non-standard monetary policy, from 26/7/2012 to 31/12/2015 and finally in the bail-in introduction period, from the 1/1/2016 until 31/8/2018. The financial sector CDS spread value is obtained from an equally weighted average among each banks CDS spread in that country. The sovereign CDS spread is obtained as an equally weighted average among countries in our sample.

Country	Pre-Bailout	Bailout	Post Bailout	First Non-Standard Monetary Policies Period	Bail-in Introduction Period
Greece	3,48%	8,05%	12,63%	2,82%	11,83%
Denmark	12,25%	10,26%	31,47%	20,41%	11,91%
Norway	-8,54%	-2,05%	19,73%	30,25%	NaN[17]
Ireland	7,58%	-11,72%	22,33%	3,16%	9,42%

[17] We have no available data for the Norwegian financial sector on this subperiod.

Belgium	20,11%	9,26%	45,96%	21,43%	6,46%
France	-0,78%	28,29%	53,59%	41,39%	39,43%
Germany	9,62%	33,27%	46,94%	23,37%	15,03%
Italy	13,70%	55,12%	65,88%	66,21%	46,90%
Netherlands	0,26%	31,29%	58,80%	19,44%	32,63%
Spain	10,21%	59,24%	63,26%	63,54%	46,11%
UK	4,70%	17,36%	66,20%	26,81%	40,37%
Sweden	4,36%	18,87%	40,43%	5,77%	4,90%
Portugal	9,29%	47,07%	60,17%	47,48%	40,31%
Austria	7,58%	-11,72%	22,33%	3,16%	9,42%
TOT	**6,70%**	**20,90%**	**43,55%**	**26,80%**	**24,21%**

Source: Bloomberg and author's calculation

TABLE 7 confirms our conjecture regarding the first subperiod. Results are not as expected in the second: it is true that the level of correlation increased, but we expected it to be negative while that result holds only in some countries such as Ireland, Austria or Norway. There is not an explanation for this counterfactual. Probably the small time period in which we collected the observation made and the difficulty to find providers of these data increased the possibility to have measurements error. The third shows high positive correlation coefficients across Europe. The introduction of non-conventional monetary policies reduced the coefficients, and this empirically diverges from our theoretically hypothesis. Probably the only explanation is that a simple correlation analysis cannot detect what we expected. Last period results confirm what we conjectured: the bail-in just slightly diminished the correlation and so the presence of the doom loop but its complete elimination is far from reached. Indeed, the level of correlation is still much higher than it was before the bailouts started the vicious cycle.

3.4 Second empirical verification

In this second part of our empirical analysis, we conduct an econometric investigation. It will be useful to prove or check all the claims, but, in particular, it proves and quantifies the loop between the sovereign and the banking sectors credit risk.

In the previous empirical analysis, through the changes in the credit risk measure, we proved the existence of a clear initial direction of causality in the transferring of credit risk. The causality was from the banking sector to the sovereign one via the public intervention. The model we are developing in this paragraph uses as assumption the existence of this risk transfer mechanism. Using this assumption, we can analyse the loop from just one perspective: we look at how changes in the sovereign sector credit risk cause changes in the financial sector one.

Basically, the linear regression model we develop answers to the question: "once the bailouts happened and the risk was moved from the banking sector to the sovereign one, do changes in the sovereign sector credit risk influence the banking sector?" Answering to this is equal to answer "does it exist a two-way loop or just a one-way risk transfer?".

3.4.1 Model specification

Our aim is to build an econometric model which can quantify the existing relationship between the banking sector credit risk and the sovereign sector one. The causality implied and studied in our model is from sovereign to the banking: the model will predict the amount by which a change in the sovereign credit risk will induce a change in the banking sector credit risk. Our independent variable is the sovereign sector CDS spread, while the dependent is the financial sector CDS spread. In econometrics, when dealing with causality, the main problem that can arise is endogeneity. It embraces the possibility of a commoving between the regressors and the independent variable, and so a bias in the regression estimates. Endogeneity can be caused by three different sources:

1) measurement error;

2) omitted variable bias;

3) reverse causality.

The first one is easy to understand and avoid. The omitted variable bias means the possible existence of an unobserved factor which influence both the dependent variable and the independent ones. The third embraces the possibility that not only the independent variable has a causality effect on the dependent, but even the opposite is true, so a simultaneity or interdependence between the two variables. In our context, both the omitted variable bias and the reverse causality are likely to impact the results. Omitted variables biases could be macroeconomic shocks, both at local or European level, and other factors participating in pricing the credit risk that could affect both the banking sector and the sovereign one. The reverse causality bias is intrinsic in our decision to study only one direction of causality and assuming the existence of the risk transfer. Indeed, if the risk transfer exists as assumed, the causality of the CDS spread will be also from the banking sector to the financial one.

We develop different models to face and solve possible bias due to endogeneity. The method will be the introduction of different control variables. The generic model specification is the following:

$$\Delta \log(Bank\ CDS_{it}) = \alpha_{it} + \delta_t + \mu_i + \beta \Delta \log(Sovereign\ CDS_{it}) + \gamma \Delta X_{it} + \varepsilon_{it}$$

where i refers to the country and t is the date. $\Delta \log(Bank\ CDS_{it})$ is the daily logarithmic change in the sovereign CDS spread of banks headquartered in the country i at the date t. α_{it} is the intercept of the regression. δ_t is the country fixed effect[18] measure and μ_i is the day fixed effect. $\Delta \log(Sovereign\ CDS_{it})$ is the daily logarithmic change in the CDS spread of country i at date t. ΔX_{it} is the daily change in the control variables. γ is the coefficient which measure the influence of changes in the control variables. ε_{it} is the error term. β is the coefficient which interests us the most, as it quantifies the effect of sovereign changes in CDS spread on banking sector CDS spread.

3.4.2 First model

In the first specification, we address the omitted variable bias adding some control variables. The first common factor that could influence both the sovereign and the banking sectors credit risk is a change in macroeconomic fundamentals expectation. An expected recession or a greater percentage of unemployed people means a greater credit risk for the government, but at the same time means people are less able to repay debt such as mortgages and greater credit risk for financial institutions. To solve this, we add as control variables day and country fixed effects. Day FE for macroeconomic shocks in the entire Euro area that affect all banks and countries, country FE for shocks specific to a country, that hit only the domestic financial institutions and the domestic government. The idea behind the use of the fixed effects is simple. We assume that we don’t know what’s the effect that the shock has on both the sovereign and the banking sectors, but at least it is the same at the same time.

The second common factor is a determinant of banking fundamentals. When pricing the credit risk of an institution or of a sovereign entity, an important factor is the aggregate volatility in the financial markets. We add to our regression model the daily change in the VDAX as a control variable. The VDAX indicates in percentage points the volatility to be expected in the next 30 days for the DAX, the main stock market index

[18] Fixed effects or FE are parameters fixed in the model.

of German companies traded in Frankfurt. It is the German version of the VIX for the S&P500 index in US, and it is the main volatility indicator used when dealing with European markets.

TABLE 8: Pre-Bailout Period

Following tables show the effect of the sovereign CDS spread and other control variables on the banking sector CDS spread in the pre-bailout period, from 2/1/2007 to 26/9/2008, in the bailout period, from 29/9/2008 to 28/8/2008, in the post-bailout period, from 29/8/20008 to 26/7/2012, in the period in which where introduced non-standard monetary policy, from 26/7/2012 to 31/12/2015 and finally in the bail-in introduction period, from the 1/1/2016 until 31/8/2018. $\Delta \log(Sovereign\ CDS_{it})$ is the daily logarithmic change in the CDS spread of country i at the date t. ΔVolatility is the daily change in the VDAX index. In parenthesis are shown the robust standard errors. Stars show statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Variables	**Δlog (Bank CDS)**
Δlog (Sovereign CDS)	0.0118 (0.0106)
ΔVolatility	2.168*** (0.486)
Constant	-2.166*** (0.494)
Observations	3,849
Number of idcountry	14
R-squared	0.519
Country Fixed Effects	YES
Day Fixed Effects	YES

As expected, the coefficient for the sovereign CDS spread is small and not significant, showing the non-existence of a feedback effect of sovereign risk to bank risk prior the Financial crisis. The volatility on financial markets have a strong statistical and numerical influence on the banking sector credit risk. Clearly, the last result was expected: as previously described, the volatility is an important factor to consider when pricing the credit risk. Indeed, greater volatility on the market means more probability to observe bigger variations in the stock price of a financial institutions. This fact would increase the probability the company has to do not repay its obligations.

TABLE 9: Bailout Period

Variables	Δlog (Bank CDS)
Δlog (Sovereign CDS)	-0.115 (0.0710)
ΔVolatility	-0.119 (0.250)
Constant	0.0868 (0.240)
Observations	308
Number of idcountry	14
R-squared	0.413
Country Fixed Effects	YES
Day Fixed Effects	YES

In the bailout period, both the volatility and the sovereign CDS spread coefficients show a low statistical significance, probably due to a low number of observations in the just one-month period. The effect of changes in the sovereign CDS spread on the banking sector one is negative: a 10% increase in the former becomes a 1,15% decrease in the latter.

Unexpected is the result regarding volatility. We expected it to be positive as in the first case: the higher the volatility of financial markets, the higher in theory the amount of CDS bought for protection from investors. Empirically we found the opposite. But there is an explanation. It is true that the crisis was spreading in the bailout period and the volatility was increasing, but it is also true that due to bailouts the banking sector credit risk was diminishing, and an increase in volatility makes bailouts more likely.

TABLE 10: Post Bailout Period

Variables	Δlog (Bank CDS)
Δlog (Sovereign CDS)	0.0510** (0.0190)
ΔVolatility	0.855*** (0.237)
Constant	-0.861*** (0.238)
Observations	13,148
Number of idcountry	14
R-squared	0.490
Country Fixed Effects	YES
Day Fixed Effects	YES

In the post bailout period we observe a strong positive relationship between the regressor and the dependent variable: a 10% increase in the sovereign CDS spread translates into a 0,5% increase in the financial sector CDS spread. Statistical significance makes the result stronger. Thanks to this evidence, we prove the existence of a loop: the causality is not only from banks to sovereign through bailouts, but the other way around. In this period, we confirm what expected in term of volatility. An increase in the market volatility means more people buying CDS to protect themselves from the default risk of a financial institution.

TABLE 11: Non-Standard Monetary Policy Implementation Period

Variables	Δlog (Bank CDS)
Δlog (Sovereign CDS)	0.0551** (0.0232)
ΔVolatility	0.855*** (0.144)
Constant	-0.576*** (0.147)
Observations	11,402
Number of idcountry	14
R-squared	0.327
Country Fixed Effects	YES
Day Fixed Effects	YES

We observed in our previous analysis a counterfactual. We originally conjectured that the Draghi's "whatever it takes" speech and the introduction of non-conventional monetary policies would reduce the absolute value of credit risk in both the financial and the banking sector, but at the same time would increase the correlation between the two, strengthening the doom loop phenomenon. In reality, we observed in the correlation analysis a slight reduction. Differently, this regression model supports our conjecture: a change in the sovereign CDS spread have a strong statistically significant effect on the banking sector one. As already mentioned, a possible explanation is that it is true that the introduction of non-standard monetary policy heavily reduced the possibility to fail of both sovereign entities and financial institutions, but it is also true that it increased the domestic sovereign exposure in the financial sector, or home bias phenomenon, and we discussed how the giant domestic sovereign exposure observed in Europe was the main factor in the transmission of risk from on sector to the other. The volatility coefficient continues to be positive and statistically significative as expected.

TABLE 12: Bail-in Introduction Period

Variables	Δlog (Bank CDS)
Δlog (Sovereign CDS)	0.0736*** (0.0181)
ΔVolatility	1.391** (0.502)
Constant	-1.549** (0.566)
Observations	7,585
Number of idcountry	13
R-squared	0.282
Country Fixed Effects	YES
Day Fixed Effects	YES

The regression model shows a reduction but still a great positive coefficient for the sovereign CDS spread even after the introduction of the bail-in measure. The result is reinforced by a strong statistical significance. This fundamental result shows how the new framework thought to break the vicious cycle empirically does not work and the relationship among the two sectors is still existent and strong: a 10% increase in the sovereign CDS spread is translated into a 0,7% increase in the banking sector CDS spread.

3.4.3 Second model

In the second specification of the regression model, we add two control variables in order to reduce even more the possibility of an omitted variable bias in terms of country specific macroeconomics shocks that affect both the banking sector and the sovereign sector credit risk. We exploit a feature of bailouts. Most of them were made in the form of a guarantee. As provided by Acharya et al. (2013), in the absence of a guarantee, the equity return captures the debt return. In the presence of a guarantee, capturing the debt return requires both the equity return and the government bond return. This implies that sovereign-specific shocks should have a disproportionate impact on the price of debt relative to equity compared to other shocks. So, in theory, if it does not exist any doom loop phenomenon, after we control for the bank equity price, the sovereign CDS spread should not be a predictor of the banking sector one.

The first variable added is a matrix of common stock prices for the banks in the sample, to control for equity variation at the single institution level. The second variable is a stock market index, the Eurostoxx 600 Banks. It includes the 600 best European financial institutions classified for their market capitalization. We add the latter assuming that equity level changes in the sector could have a role in determining the credit risk value for a bank.

TABLE 13

The following table shows the effect of the sovereign CDS spread and other control variables on the banking sector CDS spread in the pre-bailout period, from 2/1/2007 to 26/9/2008, in the bailout period, from 29/9/2008 to 28/8/2008, in the post-bailout period, from 29/8/20008 to 26/7/2012, in the period in which where introduced non-standard monetary policy, from 26/7/2012 to 31/12/2015 and finally in the bail-in introduction period, from the 1/1/2016 until 31/8/2018. $\Delta\log(Sovereign\ CDS_{it})$ is the daily logarithmic change in the CDS spread of country i at the date t. ΔVolatility is the daily change in the VDAX index. ΔEquity is the daily change in the common stock price for banks in country i at the date t. ΔEurostoxx600Banks is the daily change in the stock market index Eurostoxx 600 Banks. In parenthesis are shown the robust standard errors. Stars show statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

	Δlog (Bank CDS)				
VARIABLES	**Pre-Bailout**	**Bailout**	**Post-Bailout**	**Non-standard monetary policies**	**Bail-in Introduction**
Δlog (Sovereign CDS)	0.0120 (0.0106)	-0.0993 (0.0658)	0.0496** (0.0191)	0.0848*** (0.0272)	0.0726*** (0.0179)
ΔVolatility	-0.669 (0.902)	0.699 (0.457)	0.188 (0.117)	0.739** (0.265)	0.386*** (0.0783)
ΔEquity	-0.0834 (0.0662)	-0.160 (0.109)	-0.0162 (0.0179)	-0.0141 (0.0380)	-0.00123 (0.00100)
ΔEurostoxx600Banks	-2.191*** (0.558)	0.740 (0.525)	-1.913** (0.698)	0.235 (0.282)	0.836** (0.302)

Constant	2.873* (1.420)	-1.483 (0.979)	1.789** (0.764)	-0.995* (0.530)	-1.228*** (0.375)
Observations	3,812	306	12,907	11,216	7,375
Number of idcountry	14	14	14	14	13
R-squared	0.529	0.421	0.495	0.353	0.290
Country Fixed Effects	YES	YES	YES	YES	YES
Day Fixed Effects	YES	YES	YES	YES	YES

We observe few changes in this version of the regression model with respect to the previous one. The introduction of the equity control variable and of the Eurostoxx600Banks do not change the results and our conjecture about the existence of the doom loop. The pattern of the beta coefficient which shows the causality of daily logarithmic changes in the sovereign CDS spread on the banking sector sovereign one is the same for the first three periods. There is no relationship prior to the bailout, it is negative in the one-month period of massive public interventions and it is strong and positive in the three following subperiods. Empirically now we observe an even stronger risk transfer from the sovereign sector to the banking one after the introduction of non-standard monetary policies, which is only slightly reduced by the introduction of the bail-in tool.

The coefficient of the equity variable are negatives throughout the entire time frame, as expected. Indeed, an increase in the common stock price makes investors safer when looking at the default possibility of the bank. This means a reduction in the CDS spread. Different instead is the result obtained with the stock market index Eurostoxx600Banks. We expected it to be negative, exactly as the change in the common stock price for the single bank. The expectation is confirmed in the first and third period, but it is not in the others.

3.4.4 Third model

The third and last step we take is aimed at dealing with the endogeneity induced by reverse causality. Following the existing literature, in particular Covy, Eydmann (2016), we build a specification which involves as control variable the lagged dependent variable. We add the daily logarithmic change in the banking sector CDS spread at $t-1$. The idea is that it is possible that the reverse causality happens in the same period, but it is rare that happen with variables at different time periods.

TABLE 14

The following table shows the effect of the sovereign CDS spread and other control variables on the banking sector CDS spread in the pre-bailout period, from 2/1/2007 to 26/9/2008, in the bailout period, from 29/9/2008 to 28/8/2008, in the post-bailout period, from 29/8/20008 to 26/7/2012, in the period in which where introduced non-standard monetary policy, from 26/7/2012 to 31/12/2015 and finally in the bail-in introduction period, from the 1/1/2016 until 31/8/2018. $\Delta\log(Sovereign\ CDS_{it})$ is the daily logarithmic change in the CDS spread of country i at the date t. ΔVolatility is the daily change in the VDAX index. ΔEquity is the daily change in the common stock price for banks in country i at the date t. ΔEurostoxx600Banks is the daily change in the stock market index Eurostoxx 600 Banks. Δlog (Bank CDS) at t-1 is the daily logarithmic change in the CDS spread of country i at the date $t-1$. In parenthesis are shown the robust standard errors. Stars show statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

	Δlog (Bank CDS)				
Variables	**Pre-Bailout**	**Bailout**	**Post-Bailout**	**Non-standard monetary policies**	**Bail-in Introduction**
Δlog (Sovereign CDS)	0.0120 (0.0104)	-0.0842 (0.0695)	0.0504** (0.0192)	0.0844*** (0.0271)	0.0713*** (0.0181)
ΔVolatility	0.785 (0.503)	0.216 (0.487)	-0.930** (0.400)	0.778** (0.268)	-0.712* (0.365)
ΔEquity	-0.0829 (0.0581)	-0.172 (0.111)	-0.0162 (0.0179)	-0.0165 (0.0373)	-0.00140 (0.000997)
ΔEurostoxx600Banks	2.683 (4.075)	0.974* (0.485)	1.636*** (0.516)	0.258 (0.276)	-3.166** (1.371)
Δlog (Bank CDS) at t-1	-0.0563* (0.0317)	-0.0590 (0.0703)	-0.0199 (0.0257)	-0.0775* (0.0411)	-0.149** (0.0552)
Constant	-3.477 (4.573)	-1.233 (0.958)	-0.907*** (0.298)	-1.058* (0.527)	3.866** (1.732)
Observations	3,783	293	12,893	11,213	7,360
Number of idcountry	14	14	14	14	13
R-squared	0.527	0.428	0.495	0.357	0.305

Country Fixed Effects	YES	YES	YES	YES	YES
Day Fixed Effects	YES	YES	YES	YES	YES

There are no substantial changes with respect to the previous specification. Coefficients are similar both in statistically and numerically. The lagged variable seems to have a negative impact on itself at the following period, reinforced by a solid statistical significance in most periods.

3.5 Home bias empirical analysis

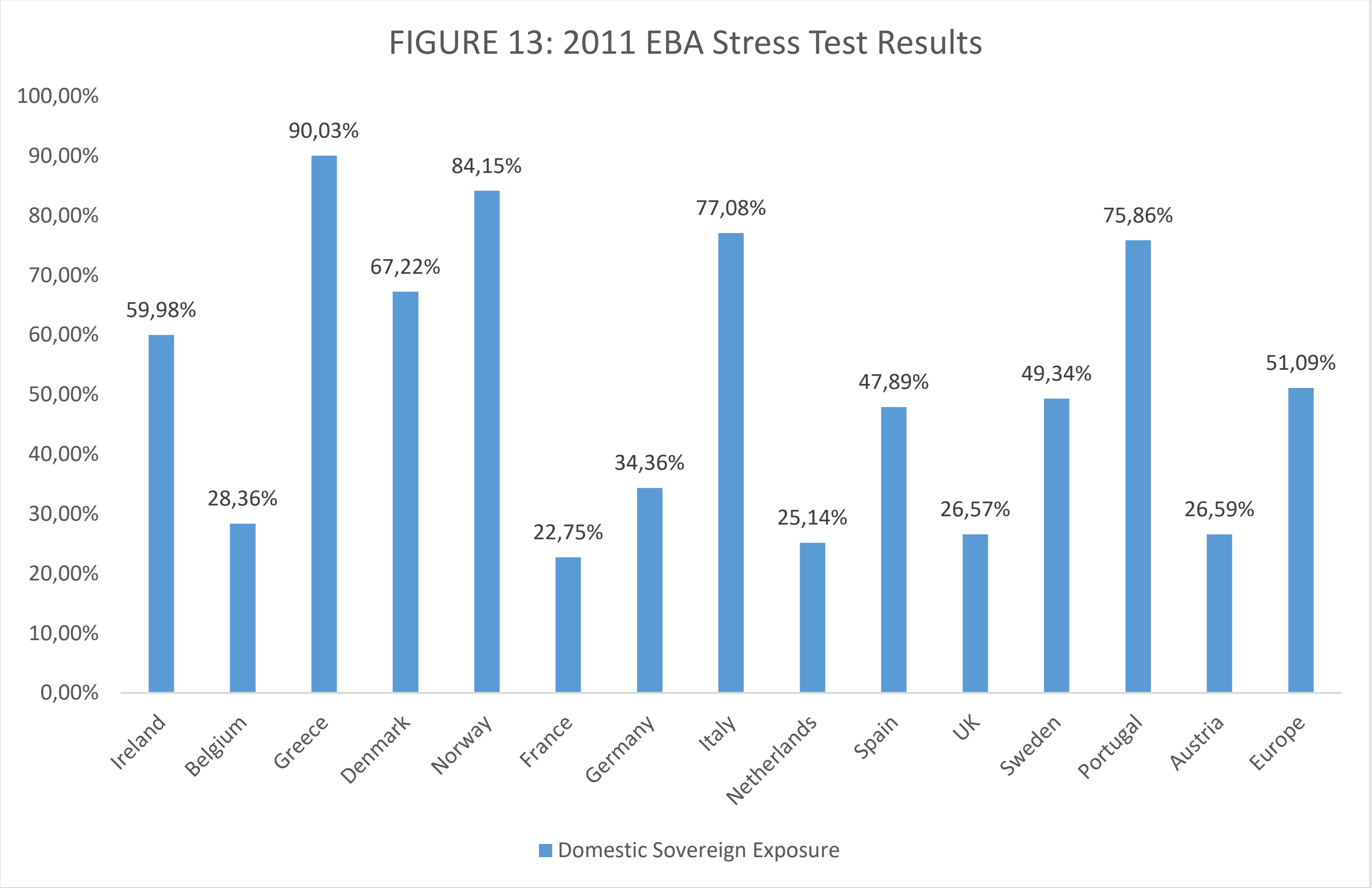
Our aim is to analyse the development of the home bias phenomenon in the last years, as channel of transmission of credit risk from sovereign to banking sector. To analyse the home bias, we should look at the sovereign exposure for European banks, and this could be done easily looking at the data released by the European Banking Authority.

The EBA is the institution created to establish orderly functioning financial markets and maintain stability in the financial system. EBA monitors market developments, trends and potential risks at a micro-prudential level. The main tool used to scan European financial markets is the EU-wide stress test exercise. It is a test, made by National Authorities in concert with the European Systemic Risk Board. The goal of this test is to assess systemic risk in the European financial system. One of the factors analysed in the stress tests is the sovereign exposure.

Stress tests were performed yearly from 2009 to 2011, and then from 2014 every two years. The 2009 exercise was made initially to be confidential, and even when published online, was not perceived as transparent by investors. The 2010 one still has some troubles: Irish banks passed the test and were bailed out few months later. Same criticisms in the 2011 one respect to Dexia bank, which failed after passing the test. From the 2011 exercise, data on sovereign exposures were started to be released. In following years, approach and methodologies were changed, the exercise became system-wide, and even more data were released, in particular about sovereign exposure.

That's the reason why we collected data from the 2011, 2014 and 2016 exercises. We are interested in the domestic sovereign exposures of the European banking sector. In practice, we use data for the banks we selected, we make an equally weighted average to elaborate data for the entire financial sector and repeat the process for each country in our sample.

The main problem in the following graphical representation is the composition of the sample. In this study, to find data on publicly traded CDS, we had to consider very big banks for each country, and often even for giant financial institutions was not possible to find these data. Considering the sovereign exposure for such big banks, the amount of domestic one is reduced with respect to the one of smaller financial institutions. Indeed, giant banks, which operate through branches in different countries or all over the world, are more likely to diversify their exposures with respect to banks whose main operations are all in the same country. Nevertheless, we believe that the data are indicative and show a trend coherent with the evolution of the doom loop dynamic in Europe.



Source: EBA Stress Test 2011 and author's calculation

FIGURE 13 plots the domestic sovereign exposure as a percentage of the total sovereign exposure. Results are consistent with what we expected: when the 2011 exercise was launched, in the middle of the European debt crisis, the domestic sovereign exposure was high throughout the entire Europe, with a 51.09% for the financial sector intended as a whole. As we can clearly see, data are higher for Southern Europe countries and Ireland. Indeed, the results of the 2011 stress test let us see the effect on the financial sector from the 2011 European debt crisis.

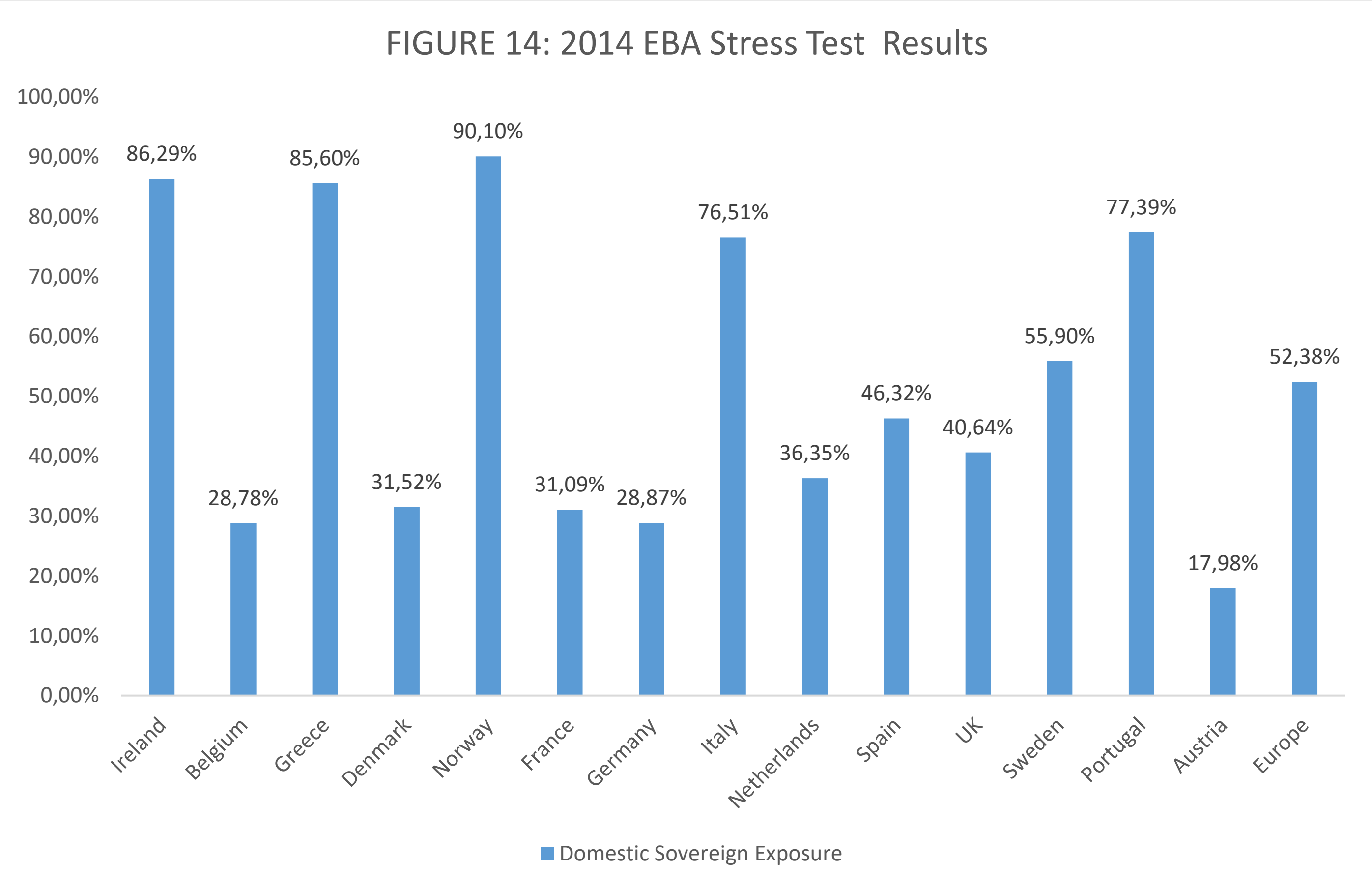
With this name, it is indicated the period, from 2009 onwards, where several Eurozone member states[19] were unable to repay or refinance their government debt or to bailout over-indebted banks without the assistance of third parties like other European countries, the ECB or the IMF. Basically, the mixture of huge bailouts needed for their banks, the effect of the Financial crisis on the real economy and a less sound financial sector, increased public debt while GDP decreased. Governments in order to avoid default were forced to be bailed out by third parties.

Let's consider the Greek case[20], possibly the most known one. To stay within the Eurozone required parameters, Greek government for many years simply misreported economic statistics. At the beginning of 2010 it was discovered that part of its debt was hidden, using cross currency swap, to slip out Eurostat official statistics on debt instruments. The Greek debt, one recalculated, was the highest in Europe. In April 2010, after publication of GDP data, CRA downgraded Greek bonds to junk status. This froze private capital markets and put Greece in danger of sovereign default without a bailout. The Troika launched a €110 billion bailout. In 2011, recession worsened, and the government did not meet conditions required in the bailout. The Troika convinced private creditors, mostly foreign banks, to a 53.5% voluntary haircut on their Greek bonds, lower rates and extended maturities. Afterwards, the Troika launched the second bailout worth €130 billion. This included a bank recapitalization package worth €48 billion. The recession hit seriously the already fragile financial sector. Indeed, Greek banks, whose main problem was the giant amount of bad loans in their books, suffered this debt crisis at a sovereign level. Of the 40 existing banks in Greece before 2008, only 7 still operates nowadays, and the main 4 which are considered systemic were recapitalized three times during the crisis. This happened mainly because as foreign investors withdrew from their investments in Greek debt, domestic banks were major holder of public debt. Successive rating downgrades, ending in a debt restructuring, hit heavily Greek banks.

So, that's one of the main reasons for which we could observe an already high percentage of sovereign exposures in the first EBA stress test exercise: with the European countries suffering, foreign investors sold off their European government bonds, leaving banks as holder of public debt.

[19] Among them, the most important were Greece, Portugal, Ireland and Spain.

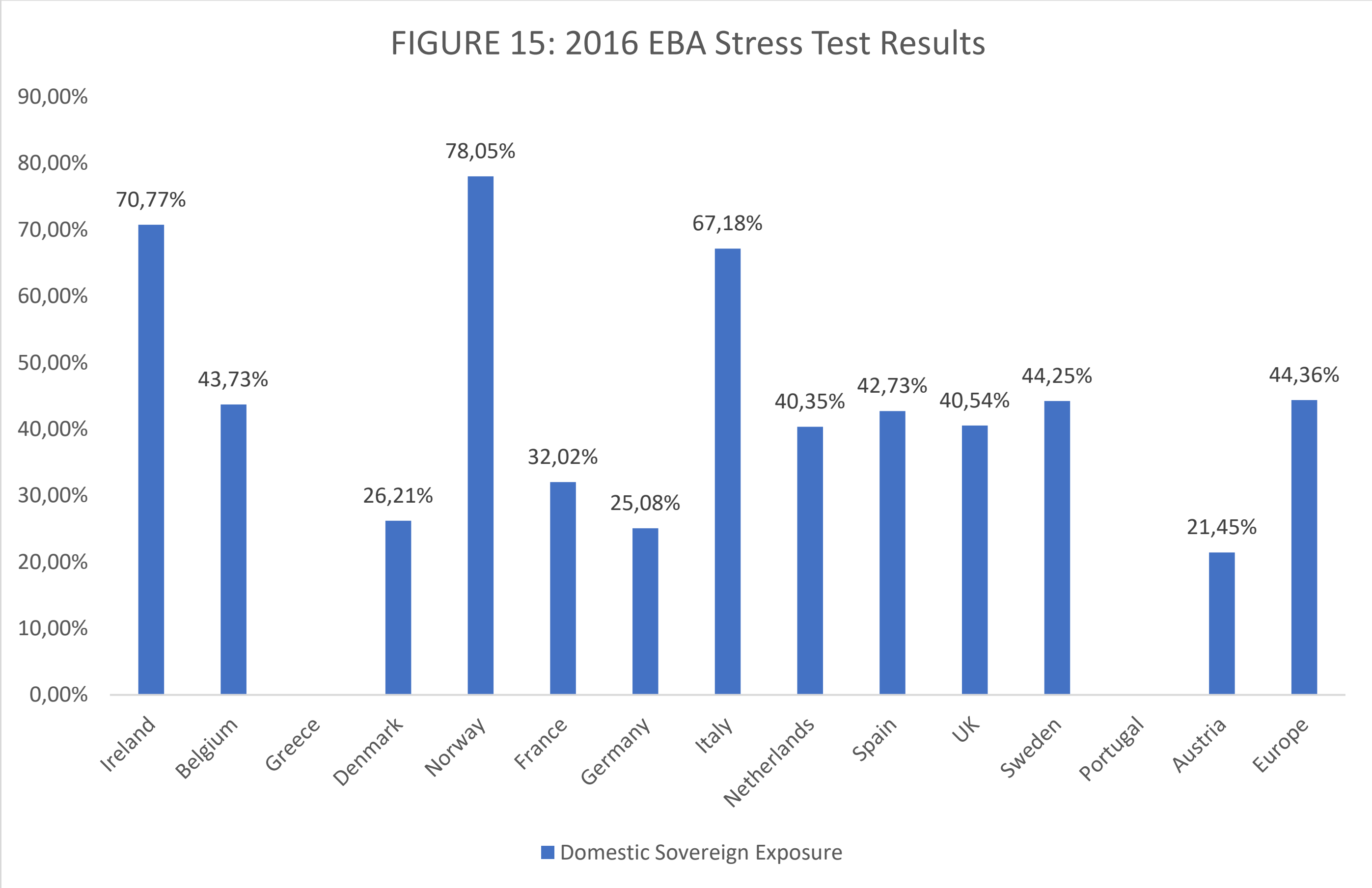
[20] Skartsis (2018) "2010-2018 Greek Debt Crisis and Greece's Past: Myths, Popular Notions and Implications".
Gulati et al. (2014) "The Greek debt restructuring: an autopsy".
Kosmidou et al. (2015) "The impact of the EU/ECB/IMF bailout programs on the financial and real sectors of the ASE during the Greek sovereign crisis".



Source: EBA Stress Test 2014 and author's calculation

In FIGURE 14 we present data relative to the stress test run in 2014. The amount of sovereign exposures increased in Europe as a whole and in most countries.

In 2012, the ECB, in order to decrease market interest rates and preserve the Euro, launched a purchase of Eurozone countries' short-term obligations in secondary market. The programme was announced on July 26th, 2012 by the ECB's president Mario Draghi with the famous speech "Whatever it takes": the size of the measure introduced was unlimited. From that moment onwards, the ECB implemented various non-standard monetary policies to support the Euro, achieve a 2% inflation rate and reduce market interest rates. This interest rate reduction, and so the easier funding, was exploited by European banks to invest in domestic debt instruments for the reasons we already mentioned in the previous chapter. That's the reason why we observed an increase in overall sovereign exposures.



Source: EBA Stress Test 2016 and author's calculation

Results of 2016 EBA stress test[21] are shown in FIGURE 15. Looking at the data, we observe a slight reduction in the domestic sovereign exposure. We could think that the introduction of the CRD IV / CRR and of the BRRD, and the other reforms described in the second chapter, aimed at contrasting the European debt crisis and end the vicious cycle between the sovereign sector and the banking sector credit risk, were effective, but the reality is that EBA managed to exclude from the sample troubled banks, such as the Belgian Dexia bank, and we do not have any data on Portuguese and Greek financial sectors at all.

We already briefly discussed the Greek situation. Portugal[22] was the other Eurozone country heavily hit by the European debt crisis. After the Lehman Brothers collapse, Portugal announced on October 6th, 2008, an increase in the deposit guarantee scheme, and few days later a bailout programme of up to €20 billion in guarantees to help distressed financial institutions. In the 2008–2009 two-year period, the two Portuguese banks BPN, or Banco Português de Negócios, and BPP, or Banco Privado Português, had been

[21]Other than Portugal and Greek banks, data on Dexia are missing in 2016. Data on Standard Chartered are missing in all three EBA stress test exercises.
[22] Pereira and Wemans (2012) "Portugal and the Global Financial Crisis – short-sighted politics, deteriorating public finances and the bailout imperative".
Schwartz and Takagi (2017) "Background Papers for The IMF and the Crises in Greece, Ireland, and Portugal".
Reis (2015) "Looking for a Success in the Euro Crisis Adjustment Programs: The Case of Portugal".

accumulating losses for years due to bad investments and accounting fraud. To avoid a crisis, the banks were bailed out.

Due to these bailout measures and the amount spent for economics stimuli, the public debt was increasing sharply while GDP was not: the deficit had been one of the highest in Europe in 2009. Clearly the risk was transferring from the financial sector to the sovereign one. In the summer 2010, Moody declassed their sovereign bond rating. In September 2010, the Portuguese government announced a fresh austerity package following other Eurozone partners, through a series of tax hikes and salary cuts. In November 2010, risk premiums on Portuguese bonds were higher than ever, with investors believing in failure. When the yield on the 10-year government bond reached 7%, Portugal requested international help.

In the first half of 2011, Portugal requested a €78 billion IMF-EU bailout package in a bid to stabilise its public finance. The risk, due to the doom loop, has been transferred again from the sovereign sector to the financial one, and the country wass struggling both with a systemic banking crisis, and a public recession, due primarily by the lack of a convincing medium-term fiscal plan and the excessive public and private sector leverage. Banks have liquid assets due to bailouts, but possess weak asset quality and low interest margins, and slow lending growth remain a drag on their profitability. The process of balance sheet repair has moved slowly, with a large share of banking assets still tied up in low-productivity firms, thereby constraining economic activity.

To sum up, the home bias phenomenon is on an increasing pattern in the Eurozone. The greater domestic sovereign exposure of financial institutions strengthens the doom loop. The end of the vicious cycle and the perspective of a sound European financial sector are far from reached.

4. New proposals to reduce the doom loop

As already discussed in the previous chapters, to eliminate the interdependence between the sovereign and the banking sector, the European Union decided to create the Banking Union. It is the implementation of a series of reforms to create homogeneous rules with regard to supervisory and resolution framework. It consists of three pillars: the Single Supervisory Mechanism, implemented in 2014, the Single Resolution Mechanism, entered into force on January 1st, 2016 and a third pillar still to be implemented, the European Deposit Insurance Scheme, to guarantee deposits at a European level.

The Banking Union is thwarted by Northern Europe countries. In particular, they are holding over the implementation of the third pillar. Without an European scheme to guarantee depositors, the system could not work, and the Banking Union is failing to bring soundness to the financial sector. Northern Europe countries are worried to be asked to save more distressed countries such as Italy, Greece or Portugal and be drag into the crisis again.

ECB policies had the effect to diminish the overall level of credit risk on both banks and sovereign entities across Europe. As this dissertation strongly prove, the main problem still existent is the strong interdependence between the two sectors in all European countries, even if in some countries it is bigger than others.

In this chapter we are presenting and discussing proposals debated recently to end the vicious cycle between the sovereign and the banking sector credit risk. All the proposals regard the elimination of the home bias phenomenon. Indeed, the giant sovereign exposure is nowadays recognized as the main channel of the existing interdependence between the two sectors.

4.1 Limit to the sovereign exposure and the bail-in tool for states

In April 2016, an informal ECOFIN[23] reunion was held in Amsterdam under the Dutch presidency of the Council of the European Union. The concern was for the interdependence between the sovereign and the financial sectors. Jeroen Dijsselbloem and Wolfgang Schäuble, the Dutch and German finance ministers, proposed to introduce a limit on the amount of sovereign debt instruments that domestic banks can hold into their accounts. This proposal was vetoed by several member states: a limit would mean an imposition to sell for countries with a greater sovereign exposure, and so the sovereign credit risk would rise again for countries impacting badly a fragile economic situation.

[23] Economic and Financial Affairs Council is a configuration of the Council of the European Union. It is composed by the economics and finance ministers. It covers economic and financial topics, euro policies and it prepares, together with the European Parliament, the annual budget of the European Union.)

Later in 2016, the German Council of Economic Experts released a paper containing the idea of a bail-in even for troubled sovereign entities. Indeed, according to the German economists, some European countries put low efforts to reduce the giant amount of sovereign exposure and public debt contracted. The idea behind is that holders of sovereign debt instruments, so mainly domestic banks, funds and insurance companies, will contribute to save the public entity before the European Stability Mechanism kicks in and inject capital to save the failing government, but only for states with a public debt to GDP ratio of at least 60%.

The proposal provides a mixed system. When facing a liquidity issue or an even worse solvency problem, maturity of public bonds would be lengthened. Afterwards, the ESM would provide a debt restructuring together with a plan of public reforms. The debtholders would be clearly worse off with a longer maturity, but at least they would not be subordinated to the repayment of the loan to the ESM participating institutions like the IMF or the ECB. The main point would be to have more time to implement the reforms and a less likely possibility of contagion and depression of the economic performance. This mechanism would be adopted only for the issuing of new debt with a particular clause thanks to which subscribers would know the greater risk they are undertaking.

The main limit is clearly a greater credit risk for countries already facing a fragile situation and a great public debt. It is not applicable with the recent interruption of the ECB Quantitative Easing. Indeed, Quantitative Easing had the role to keep low the absolute value of credit risk in both the sovereign and the financial sector injecting capital in financial players throughout Europe.

The other main limit is linked to the dimension of the entity that is failing. We observed troubled financial institutions being bailed out. We observed even nations such as Greece, Ireland or Portugal on the verge of bankruptcy being bailed out by the IMF, the ECB and other member states. There is a great uncertainty that a country enormously bigger than those, such as Italy, could be bailed out. How can we introduce a rule about a sovereign entity bail-in?

4.2 The sovereign risk weights scheme

The BCBS, Basel Committee on Banking Supervision, is a committee of banking supervisory authorities. Its goal is to improve the quality of banking supervision worldwide. The ideas agreed in these meetings are contained in regulatory frameworks published in the Basel Accords. Several steps were made historically, from Basel I in the 80s to Basel III in 2010, and new proposal and meeting still happen nowadays.

The most important provision is the one regarding capital requirements for financial institutions computed as a percentage of the Risk Weighted Assets.

RWA indicates the assets of the financial institutions weighted for their risk. There are different ways to compute this measure depending on the dimension of the financial institution, but the idea behind is that the framework provides guidance to assign a certain risk weight to different assets: a debenture would have a higher one with respect to a government obligation.

The most important framework for the purposes of this dissertation is Basel III, agreed in 2010. In Europe it was implemented through the Capital Requirements Directives IV and the Capital Requirements Regulation. In this transposal, government debt instruments had the best regulatory treatment possible. Indeed, CRD IV states that the risk weights on sovereign debt instruments depend on the rating, but it exists a national discretion to apply a preferential risk weight for sovereign exposures denominated and funded in domestic currency. If the discretion is exercised, other national competent authorities might allow their domestic banks to apply the same risk weight to their exposures to that sovereign. In practice, all member states exercised this discretion and set a zero-risk weight for every government debt issue. The sovereign exposure framework at European level is completed by other rules such as the current not inclusion of sovereign into large exposures; the no limit policy on the eligibility of sovereign exposure as high quality liquid assets and the actual requirements of disclosing only the amount of sovereign exposure for financial institutions.

However, the Financial crisis highlighted that some sovereign debts are not risk free.

One idea proposed to break the home bias and the vicious cycle is to assign risk weights on sovereign obligations, exactly as any other debt instrument. Together the proposal provides slightly different rules on other related topics. This idea is formulated slightly differently from different authors. The Basel committee released in 2017 a discussion paper gathering all of them.

The paper divides the sovereign exposure in exposure to government, to central banks and to other sovereign entities. It assigns positive standardised risk weights for most sovereign exposures, both in the banking and trading book, with the only exception for exposures to central banks denominated in the domestic currency of the central bank. Practically it removes the discretion in applying preferential risk weights to central governments exposure. Another proposed distinction is the one between domestic currency and foreign currency sovereign exposure, with the first one defined as exposure to a sovereign entity denominated in the currency of the entity. Clearly the proposal inserts higher risk weights for the second category.

The paper proposes one example of a standardize risk weight scheme. The exposure to a central bank has a zero-risk weight, nevertheless the rating. A domestic currency exposure to a central government has a risk weight of 3 %, 6% or 9% depending if the rating is between triple A or single A, triple B or below. A foreign currency exposure to a central government has a risk weight of 10%, 50% or 100% depending on the rating. Same risk weights are applied to sovereign entities other than central banks and governments, nevertheless the currency. The paper recommends also a greater disclosure for the sovereign exposure, not only the amounts, but also the risk weight, the accounting classification and the entity.

But at the end the debate was closed, and the Committee decided to maintain the status quo. Basically, it happened since there was no consensus among supervisors, experts, and economists. Reasons are multiples and we already mentioned them in the previous chapter, but mainly it is because there is the fear to lose the stabilising role banks have acting as contrarian investors in period of crisis: they stick with the investment in sovereign obligations even when other investors leave reducing the increasing yield on governments debt instruments. The other important reason is that sovereign bonds are crucial for liquidity management and are the most commonly used form of collateral in many financial transactions and especially in monetary policy implementation. The pervasive idea is that adding risk weights, reducing the amount of the sovereign exposure, the benefit from reducing the interdependence would be less that the increase in tail risk, non-linear investors' reactions and market panic.

4.3 The creation of a safe asset

To reduce the home bias and the vicious cycle, in the last years it was debated the introduction of several forms of safe assets, one asset intended to be heavily held by the European banks while reducing the sensitivity of banks' portfolio to the sovereign risk.

The main safe asset thought is a Eurobond. It is a debt instrument issued directly from a European Union entity. The idea is that all Eurozone member states guarantee for this debt instrument together. Reactions to the proposal are different, but the main obstacles are two. The first is the opposition by northern countries, in particular Germany, to share the burden of a greater credit risk with Southern Europe countries which are suffering more the crisis. The second is the moral hazard that this reform could increase: Southern countries would borrow money at a better rate without making the required reforms or policies to ensure markets on their credit situation and restore their financial situation.

An interesting proposal[24] is to create a safe asset through the securitization of a well-diversified portfolio of debt instruments issued by the different Eurozone member states: a sovereign bond-backed security or SBBS. The securitization would create a junior and a senior tranche: the first could be held by funds and other actors more willing to undertake risk, while the senior tranche could be held by European banks. The idea is that the reduction of risk is not only caused by the decreased sensitivity with the sovereign credit risk, but also from the seniority. In contrast with the Eurobond proposal is the absence of joint liability. Indeed, the issuance of such a security would not require any form of "fiscal solidarity" among Eurozone countries: each government would remain entirely responsible for its own solvency, and the market price of its debt would remain a signal of its perceived solvency.

[24] Brunnermeier et al. (2016)

5. Conclusion

Our dissertation discussed the existence and the origin of the vicious cycle between the credit risk in the sovereign and the banking sector in Europe. But it showed also how the doom loop is still existent, it proved also that the current regulatory frameworks implemented and the proposals debated are not enough to eliminate it. This clearly represents a huge risk making the European financial sector a powder keg ready to explode.

ECB ended to sustain the Euro with the Quantitative Easing and the other non-standard monetary policies. Even if the discussion on new expansive monetary policies is opened, the credit risk could rise again in the short run, while the interdependence between the sovereign sector and the banking one will still be strong. This could launch governments and financial institutions in a new self-reinforcing spiral of recession. Politicians and economists really need to reopen the debate again and focalize on it.

I believe that the main point is that nowadays the risk is shared at a local level even if Europe is a complicated and interconnected ecosystem at a financial level. Member states want to be ensured at a European level with the Banking Union, but they are not willing to split the risk. The main point of failure of the European Union is the hesitation of member states to really embrace the project and give up their sovereignty in different sectors, with the aim of reaching a real unity. Exactly in the same way countries renounced at the monetary sovereignty to join the Eurozone while they are not willing to give up the fiscal one, even a little, to level up differences.

We should create a precise plan for each member state, an always more harmonized pattern for rules and make European countries stop thinking to their own domestic interest and safety but start reasoning at a European level.

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Code

All the quantitative analysis presented in this final dissertation was obtained running the following codes on Matlab and Stata.

```
%Firstly, we use Matlab

%Let's start uploading data on sovereign CDS, banks CDS, equity values, the volatility index VDAX and the Eurostoxx600banks index.

BANKS=xlsread('Data_Tesi_2.xlsx',1);

SOV=xlsread('Data_Tesi_2.xlsx',2);

EQUITY=xlsread('Data_Tesi_2.xlsx',3);

VDAX=xlsread('Data_Tesi_2.xlsx',4);

STXX600=xlsread('Data_Tesi_3.xlsx',5);

%The entire timeframe is the following

TF=size(SOV,1);

%The countries included in the study are the following

P=size(SOV,2);

%Let's divide the timeframe in four different subperiods: 1) the pre-bailout period: 1/2/2007 to 9/26/2008, from the beginning of the timeframe to the first announced bailouts in Europe;

SP1=454;

%2) the bailout period: 9/29/2008 to 10/28/2008, the one-month period in which many European countries announce rescues plans for their banks and financial institutions;

SP2=22;

%3) a post bailout period: 10/29/2008 to 7/26/2012, that last until Draghi's speech;

SP3=977;

%4) from Draghi's speech to Bail-in implementation;

SP4=895;

%5) All remaining.

SP5=623;


%First empirical analysis

%First, we create a table considering both the sovereign CDS spread and a financial sector CDS, an equally weighted CDS spread among banks CDS for each country;

Average_BANKS_IRE=nanmean(BANKS(:,4:5),2);

Average_BANKS_BEL=nanmean(BANKS(:,6:7),2);

Average_BANKS_FR=nanmean(BANKS(:,8:10),2);

Average_BANKS_DE=nanmean(BANKS(:,11:12),2);
```

```
Average_BANKS_IT=nanmean(BANKS(:,13:15),2);
Average_BANKS_NET=nanmean(BANKS(:,16:17),2);
Average_BANKS_ES=nanmean(BANKS(:,18:19),2);
Average_BANKS_UK=nanmean(BANKS(:,20:23),2);
Average_BANKS_SWE=nanmean(BANKS(:,24:25),2);
Average_BANKS_POR=nanmean(BANKS(:,26:27),2);
Average_BANKS_AT=nanmean(BANKS(:,28:29),2);

GRE_table=[BANKS(:,1), SOV(:,1)];
DEN_table=[BANKS(:,2), SOV(:,2)];
NO_table=[BANKS(:,3), SOV(:,3)];
IRE_table=[Average_BANKS_IRE, SOV(:,4)];
BEL_table=[Average_BANKS_BEL, SOV(:,5)];
FR_table=[Average_BANKS_FR, SOV(:,6)];
DE_table=[Average_BANKS_DE, SOV(:,7)];
IT_table=[Average_BANKS_IT, SOV(:,8)];
NET_table=[Average_BANKS_NET, SOV(:,9)];
ES_table=[Average_BANKS_ES, SOV(:,10)];
UK_table=[Average_BANKS_UK, SOV(:,11)];
SWE_table=[Average_BANKS_SWE, SOV(:,12)];
POR_table=[Average_BANKS_POR, SOV(:,13)];
AT_table=[Average_BANKS_AT, SOV(:,14)];

%Now we compute the banking sector daily percentage changes for all periods;
DailyCh_BANKS_GRE=(BANKS(1:TF-1,1)-BANKS(2:TF,1))./BANKS(2:TF,1);
DailyCh_BANKS_DEN=(BANKS(1:TF-1,2)-BANKS(2:TF,2))./BANKS(2:TF,2);
DailyCh_BANKS_NO=(BANKS(1:TF-1,3)-BANKS(2:TF,3))./BANKS(2:TF,3);
DailyCh_BANKS_IRE=(Average_BANKS_IRE(1:TF-1,1)-
Average_BANKS_IRE(2:TF,1))./Average_BANKS_IRE(2:TF,1);
DailyCh_BANKS_BEL=(Average_BANKS_BEL(1:TF-1,1)-
Average_BANKS_BEL(2:TF,1))./Average_BANKS_BEL(2:TF,1);
DailyCh_BANKS_FR=(Average_BANKS_FR(1:TF-1,1)-
Average_BANKS_FR(2:TF,1))./Average_BANKS_FR(2:TF,1);
DailyCh_BANKS_DE=(Average_BANKS_DE(1:TF-1,1)-
Average_BANKS_DE(2:TF,1))./Average_BANKS_DE(2:TF,1);
```

```
DailyCh_BANKS_IT=(Average_BANKS_IT(1:TF-1,1)-
Average_BANKS_IT(2:TF,1))./Average_BANKS_IT(2:TF,1);

DailyCh_BANKS_NET=(Average_BANKS_NET(1:TF-1,1)-
Average_BANKS_NET(2:TF,1))./Average_BANKS_NET(2:TF,1);

DailyCh_BANKS_ES=(Average_BANKS_ES(1:TF-1,1)-
Average_BANKS_ES(2:TF,1))./Average_BANKS_ES(2:TF,1);

DailyCh_BANKS_UK=(Average_BANKS_UK(1:TF-1,1)-
Average_BANKS_UK(2:TF,1))./Average_BANKS_UK(2:TF,1);

DailyCh_BANKS_SWE=(Average_BANKS_SWE(1:TF-1,1)-
Average_BANKS_SWE(2:TF,1))./Average_BANKS_SWE(2:TF,1);

DailyCh_BANKS_POR=(Average_BANKS_POR(1:TF-1,1)-
Average_BANKS_POR(2:TF,1))./Average_BANKS_POR(2:TF,1);

DailyCh_BANKS_AT=(Average_BANKS_AT(1:TF-1,1)-
Average_BANKS_AT(2:TF,1))./Average_BANKS_AT(2:TF,1);


%Now we compute the sovereign sector daily percentage changes for all periods;

DailyCh_SOV_GRE=(SOV(1:TF-1,1)-SOV(2:TF,1))./SOV(2:TF,1);

DailyCh_SOV_DEN=(SOV(1:TF-1,2)-SOV(2:TF,2))./SOV(2:TF,2);

DailyCh_SOV_NO=(SOV(1:TF-1,3)-SOV(2:TF,3))./SOV(2:TF,3);

DailyCh_SOV_IRE=(SOV(1:TF-1,4)-SOV(2:TF,4))./SOV(2:TF,4);

DailyCh_SOV_BEL=(SOV(1:TF-1,5)-SOV(2:TF,5))./SOV(2:TF,5);

DailyCh_SOV_FR=(SOV(1:TF-1,6)-SOV(2:TF,6))./SOV(2:TF,6);

DailyCh_SOV_DE=(SOV(1:TF-1,7)-SOV(2:TF,7))./SOV(2:TF,7);

DailyCh_SOV_IT=(SOV(1:TF-1,8)-SOV(2:TF,8))./SOV(2:TF,8);

DailyCh_SOV_NET=(SOV(1:TF-1,9)-SOV(2:TF,9))./SOV(2:TF,9);

DailyCh_SOV_ES=(SOV(1:TF-1,10)-SOV(2:TF,10))./SOV(2:TF,10);

DailyCh_SOV_UK=(SOV(1:TF-1,11)-SOV(2:TF,11))./SOV(2:TF,11);

DailyCh_SOV_SWE=(SOV(1:TF-1,12)-SOV(2:TF,12))./SOV(2:TF,12);

DailyCh_SOV_POR=(SOV(1:TF-1,13)-SOV(2:TF,13))./SOV(2:TF,13);

DailyCh_SOV_AT=(SOV(1:TF-1,14)-SOV(2:TF,14))./SOV(2:TF,14);


%Let's make a table considering both the financial sector and the sovereign daily change in CDS spread;

GRE_DC_table=[DailyCh_SOV_GRE, DailyCh_BANKS_GRE];

DEN_DC_table=[DailyCh_SOV_DEN, DailyCh_BANKS_DEN];

NO_DC_table=[DailyCh_SOV_NO, DailyCh_BANKS_NO];

IRE_DC_table=[DailyCh_SOV_IRE, DailyCh_BANKS_IRE];

BEL_DC_table=[DailyCh_SOV_BEL, DailyCh_BANKS_BEL];
```

```
FR_DC_table=[DailyCh_SOV_FR, DailyCh_BANKS_FR];
DE_DC_table=[DailyCh_SOV_DE, DailyCh_BANKS_DE];
IT_DC_table=[DailyCh_SOV_IT, DailyCh_BANKS_IT];
NET_DC_table=[DailyCh_SOV_NET, DailyCh_BANKS_NET];
ES_DC_table=[DailyCh_SOV_ES, DailyCh_BANKS_ES];
UK_DC_table=[DailyCh_SOV_UK, DailyCh_BANKS_UK];
SWE_DC_table=[DailyCh_SOV_SWE, DailyCh_BANKS_SWE];
POR_DC_table=[DailyCh_SOV_POR, DailyCh_BANKS_POR];
AT_DC_table=[DailyCh_SOV_AT, DailyCh_BANKS_AT];

%Let's compute in the first period the change in the CDS spread for the sovereign sector
change_SOV_SP1=SOV(TF-SP1,:)-SOV(TF,:);
%Let's adjust the previous formula for countries for which we miss the beginning observation
%Data regarding Belgium start on 8/1/2007
change_SOV_SP1(1,5)=SOV(TF-SP1,5)-SOV(3040,5);
%Data regarding Germany start on 3/1/2007
change_SOV_SP1(1,7)=SOV(TF-SP1,7)-SOV(TF-1,7);
%Data regarding Netherlands start on 2/2/2007
change_SOV_SP1(1,9)=SOV(TF-SP1,9)-SOV(3021,9);
%Data regarding UK start on 13/11/2007
change_SOV_SP1(1,11)=SOV(TF-SP1,11)-SOV(2819,11);
%Data regarding Sweden start on 21/11/2007
change_SOV_SP1(1,12)=SOV(TF-SP1,12)-SOV(2813,12);
%Data regarding Portugal start on 8/5/2007
change_SOV_SP1(1,13)=SOV(TF-SP1,13)-SOV(2954,13);

%Let's compute in the first period the change in the CDS spread for banks
change_BANKS_SP1=BANKS(TF-SP1,:)-BANKS(TF,:);
%Let's adjust the previous formula for countries for which we miss the beginning observation
%Data regarding Danske Bank start on 12/12/2007
change_BANKS_SP1(1,2)=BANKS(TF-SP1,2)-BANKS(2798,2);
%Data regarding DNB Bank start on 6/5/2008
change_BANKS_SP1(1,3)=BANKS(TF-SP1,3)-BANKS(2694,3);
%Data regarding Bank of Ireland start on 14/12/2007
```

```
change_BANKS_SP1(1,5)=BANKS(TF-SP1,5)-BANKS(2796,5);
%Data regarding KBC start on 3/1/2007
change_BANKS_SP1(1,6)=BANKS(TF-SP1,6)-BANKS(3043,6);
%Data regarding Standard Chartered start on 4/1/2007
change_BANKS_SP1(1,23)=BANKS(TF-SP1,23)-BANKS(3042,23);
%Data regarding Caixa Geral start on 18/6/2008
change_BANKS_SP1(1,27)=BANKS(TF-SP1,27)-BANKS(2663,27);
%Data regarding Erste Bank start on 11/1/2008
change_BANKS_SP1(1,28)=BANKS(TF-SP1,28)-BANKS(2776,28);
%Data regarding Raiffeisen start on 11/1/2008
change_BANKS_SP1(1,29)=BANKS(TF-SP1,29)-BANKS(2776,29);

%Let's compute in the first period the average change in CDS spread for banks in the same country
average_change_BANKS_SP1=NaN(1,P);
%Greece, Denmark, Norway have just one bank in the sample
%For Ireland we consider Allied Irish Banks and Bank of Ireland
average_change_BANKS_SP1_IRE=nanmean(change_BANKS_SP1(1,4:5));
%For Belgium we consider KBC and Dexia
average_change_BANKS_SP1_BEL=nanmean(change_BANKS_SP1(1,6:7));
%For France we consider BNP, Credit Agricole and Societe Generale
average_change_BANKS_SP1_FR=nanmean(change_BANKS_SP1(1,8:10));
%For Germany we consider Commerzbank and Deutsche Bank;
average_change_BANKS_SP1_DE=nanmean(change_BANKS_SP1(1,11:12));
%For Italy we consider Intesa San Paolo, Unicredit and MPS;
average_change_BANKS_SP1_IT=nanmean(change_BANKS_SP1(1,13:15));
%For Netherlands we consider ING and Rabobank;
average_change_BANKS_SP1_NET=nanmean(change_BANKS_SP1(1,16:17));
%For Spain we consider Banco Santander and BBVA;
average_change_BANKS_SP1_ES=nanmean(change_BANKS_SP1(1,18:19));
%For UK we consider Barclays, HSBC, Lloyds and Standard Chartered;
average_change_BANKS_SP1_UK=nanmean(change_BANKS_SP1(1,20:23));
%For Sweden we consider Nordea and Svenska Handelsbanken
average_change_BANKS_SP1_SWE=nanmean(change_BANKS_SP1(1,24:25));
%For Portugal we consider Banco Comercial Portugues and Caixa Geral;
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average_change_BANKS_SP1_POR=nanmean(change_BANKS_SP1(1,26:27));

%For Austria we consider Erste and Raiffeisen;

average_change_BANKS_SP1_AT=nanmean(change_BANKS_SP1(1,28:29));


%Let's do a table with all the first period changes in bank CDS spreads

average_change_BANKS_SP1(1,:)=[change_BANKS_SP1(1,1), change_BANKS_SP1(1,2),
change_BANKS_SP1(1,3), average_change_BANKS_SP1_IRE, average_change_BANKS_SP1_BEL,
average_change_BANKS_SP1_FR, average_change_BANKS_SP1_DE, average_change_BANKS_SP1_IT,
average_change_BANKS_SP1_NET, average_change_BANKS_SP1_ES, average_change_BANKS_SP1_UK,
average_change_BANKS_SP1_SWE, average_change_BANKS_SP1_POR, average_change_BANKS_SP1_AT];


%Let's put together for the first period the change in the sovereign and the banking sector for each country and build a
table

Greece_SP1=[change_SOV_SP1(1,1);average_change_BANKS_SP1(1,1)];

Denmark_SP1=[change_SOV_SP1(1,2);average_change_BANKS_SP1(1,2)];

Norway_SP1=[change_SOV_SP1(1,3);average_change_BANKS_SP1(1,3)];

Ireland_SP1=[change_SOV_SP1(1,4);average_change_BANKS_SP1(1,4)];

Belgium_SP1=[change_SOV_SP1(1,5);average_change_BANKS_SP1(1,5)];

France_SP1=[change_SOV_SP1(1,6);average_change_BANKS_SP1(1,6)];

Germany_SP1=[change_SOV_SP1(1,7);average_change_BANKS_SP1(1,7)];

Italy_SP1=[change_SOV_SP1(1,8);average_change_BANKS_SP1(1,8)];

Netherlands_SP1=[change_SOV_SP1(1,9);average_change_BANKS_SP1(1,9)];

Spain_SP1=[change_SOV_SP1(1,10);average_change_BANKS_SP1(1,10)];

UK_SP1=[change_SOV_SP1(1,11);average_change_BANKS_SP1(1,11)];

Sweden_SP1=[change_SOV_SP1(1,12);average_change_BANKS_SP1(1,12)];

Portugal_SP1=[change_SOV_SP1(1,13);average_change_BANKS_SP1(1,13)];

Austria_SP1=[change_SOV_SP1(1,14);average_change_BANKS_SP1(1,14)];


names={'Sovereign';'Banks'};

Table_SP1=table(Greece_SP1, Denmark_SP1, Norway_SP1, Ireland_SP1, Belgium_SP1, France_SP1,
Germany_SP1, Italy_SP1, Netherlands_SP1, Spain_SP1, UK_SP1, Sweden_SP1, Portugal_SP1, Austria_SP1,
'RowNames',names)


%Let's compute the average daily change for the sovereign sector in the first period

Average_DailyCh_SOV_GRE_SP1=nanmean(DailyCh_SOV_GRE(TF-SP1:TF-1,1));

Average_DailyCh_SOV_DEN_SP1=nanmean(DailyCh_SOV_DEN(TF-SP1:TF-1,1));

Average_DailyCh_SOV_NO_SP1=nanmean(DailyCh_SOV_NO(TF-SP1:TF-1,1));
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Average_DailyCh_SOV_IRE_SP1=nanmean(DailyCh_SOV_IRE(TF-SP1:TF-1,1));

Average_DailyCh_SOV_BEL_SP1=nanmean(DailyCh_SOV_BEL(TF-SP1:TF-1,1));

Average_DailyCh_SOV_FR_SP1=nanmean(DailyCh_SOV_FR(TF-SP1:TF-1,1));

Average_DailyCh_SOV_DE_SP1=nanmean(DailyCh_SOV_DE(TF-SP1:TF-1,1));

Average_DailyCh_SOV_IT_SP1=nanmean(DailyCh_SOV_IT(TF-SP1:TF-1,1));

Average_DailyCh_SOV_NET_SP1=nanmean(DailyCh_SOV_NET(TF-SP1:TF-1,1));

Average_DailyCh_SOV_ES_SP1=nanmean(DailyCh_SOV_ES(TF-SP1:TF-1,1));

Average_DailyCh_SOV_UK_SP1=nanmean(DailyCh_SOV_UK(TF-SP1:TF-1,1));

Average_DailyCh_SOV_SWE_SP1=nanmean(DailyCh_SOV_SWE(TF-SP1:TF-1,1));

Average_DailyCh_SOV_POR_SP1=nanmean(DailyCh_SOV_POR(TF-SP1:TF-1,1));

Average_DailyCh_SOV_AT_SP1=nanmean(DailyCh_SOV_AT(TF-SP1:TF-1,1));


Average_DailyCh_SOV_SP1=[Average_DailyCh_SOV_GRE_SP1, Average_DailyCh_SOV_DEN_SP1,
Average_DailyCh_SOV_NO_SP1, Average_DailyCh_SOV_IRE_SP1, Average_DailyCh_SOV_BEL_SP1,
Average_DailyCh_SOV_FR_SP1, Average_DailyCh_SOV_DE_SP1, Average_DailyCh_SOV_IT_SP1,
Average_DailyCh_SOV_NET_SP1, Average_DailyCh_SOV_ES_SP1, Average_DailyCh_SOV_UK_SP1,
Average_DailyCh_SOV_SWE_SP1, Average_DailyCh_SOV_POR_SP1, Average_DailyCh_SOV_AT_SP1];


%Let's compute the average daily change for the financial sector CDS in first the period

Average_DailyCh_BANKS_GRE_SP1=nanmean(DailyCh_BANKS_GRE(TF-SP1:TF-1,1));

Average_DailyCh_BANKS_DEN_SP1=mean(DailyCh_BANKS_DEN(TF-SP1:TF-1,1));

Average_DailyCh_BANKS_NO_SP1=nanmean(DailyCh_BANKS_NO(TF-SP1:TF-1,1));

Average_DailyCh_BANKS_IRE_SP1=nanmean(DailyCh_BANKS_IRE(TF-SP1:TF-1,1));

Average_DailyCh_BANKS_BEL_SP1=nanmean(DailyCh_BANKS_BEL(TF-SP1:TF-1,1));

Average_DailyCh_BANKS_FR_SP1=nanmean(DailyCh_BANKS_FR(TF-SP1:TF-1,1));

Average_DailyCh_BANKS_DE_SP1=nanmean(DailyCh_BANKS_DE(TF-SP1:TF-1,1));

Average_DailyCh_BANKS_IT_SP1=nanmean(DailyCh_BANKS_IT(TF-SP1:TF-1,1));

Average_DailyCh_BANKS_NET_SP1=nanmean(DailyCh_BANKS_NET(TF-SP1:TF-1,1));

Average_DailyCh_BANKS_ES_SP1=nanmean(DailyCh_BANKS_ES(TF-SP1:TF-1,1));

Average_DailyCh_BANKS_UK_SP1=nanmean(DailyCh_BANKS_UK(TF-SP1:TF-1,1));

Average_DailyCh_BANKS_SWE_SP1=nanmean(DailyCh_BANKS_SWE(TF-SP1:TF-1,1));

Average_DailyCh_BANKS_POR_SP1=nanmean(DailyCh_BANKS_POR(TF-SP1:TF-1,1));

Average_DailyCh_BANKS_AT_SP1=nanmean(DailyCh_BANKS_AT(TF-SP1:TF-1,1));


%We do not insert Denmark since it is NaN
```

```
Average_DailyCh_BANKS_SP1=[Average_DailyCh_BANKS_GRE_SP1, Average_DailyCh_BANKS_DEN_SP1, Average_DailyCh_BANKS_NO_SP1, Average_DailyCh_BANKS_IRE_SP1, Average_DailyCh_BANKS_BEL_SP1, Average_DailyCh_BANKS_FR_SP1, Average_DailyCh_BANKS_DE_SP1, Average_DailyCh_BANKS_IT_SP1, Average_DailyCh_BANKS_NET_SP1, Average_DailyCh_BANKS_ES_SP1, Average_DailyCh_BANKS_UK_SP1, Average_DailyCh_BANKS_SWE_SP1, Average_DailyCh_BANKS_POR_SP1, Average_DailyCh_BANKS_AT_SP1];

Average_DailyCh_BANKS_SP1_NODEN=[Average_DailyCh_BANKS_GRE_SP1, Average_DailyCh_BANKS_NO_SP1, Average_DailyCh_BANKS_IRE_SP1, Average_DailyCh_BANKS_BEL_SP1, Average_DailyCh_BANKS_FR_SP1, Average_DailyCh_BANKS_DE_SP1, Average_DailyCh_BANKS_IT_SP1, Average_DailyCh_BANKS_NET_SP1, Average_DailyCh_BANKS_ES_SP1, Average_DailyCh_BANKS_UK_SP1, Average_DailyCh_BANKS_SWE_SP1, Average_DailyCh_BANKS_POR_SP1, Average_DailyCh_BANKS_AT_SP1];


%Put together the average daily change for the sovereign and the financial sector in the same country in the first period

Greece_DC_SP1=[Average_DailyCh_SOV_GRE_SP1; Average_DailyCh_BANKS_GRE_SP1];

Denmark_DC_SP1=[Average_DailyCh_SOV_DEN_SP1; Average_DailyCh_BANKS_DEN_SP1];

Norway_DC_SP1=[Average_DailyCh_SOV_NO_SP1; Average_DailyCh_BANKS_NO_SP1];

Ireland_DC_SP1=[Average_DailyCh_SOV_IRE_SP1; Average_DailyCh_BANKS_IRE_SP1];

Belgium_DC_SP1=[Average_DailyCh_SOV_BEL_SP1; Average_DailyCh_BANKS_BEL_SP1];

France_DC_SP1=[Average_DailyCh_SOV_FR_SP1; Average_DailyCh_BANKS_FR_SP1];

Germany_DC_SP1=[Average_DailyCh_SOV_DE_SP1; Average_DailyCh_BANKS_DE_SP1];

Italy_DC_SP1=[Average_DailyCh_SOV_IT_SP1; Average_DailyCh_BANKS_IT_SP1];

Netherlands_DC_SP1=[Average_DailyCh_SOV_NET_SP1; Average_DailyCh_BANKS_NET_SP1];

Spain_DC_SP1=[Average_DailyCh_SOV_ES_SP1; Average_DailyCh_BANKS_ES_SP1];

UK_DC_SP1=[Average_DailyCh_SOV_UK_SP1; Average_DailyCh_BANKS_UK_SP1];

Sweden_DC_SP1=[Average_DailyCh_SOV_SWE_SP1; Average_DailyCh_BANKS_SWE_SP1];

Portugal_DC_SP1=[Average_DailyCh_SOV_POR_SP1; Average_DailyCh_BANKS_POR_SP1];

Austria_DC_SP1=[Average_DailyCh_SOV_AT_SP1; Average_DailyCh_BANKS_AT_SP1];


names={'Sovereign';'Banks'};

Table_DC_SP1=table(Greece_DC_SP1, Denmark_DC_SP1, Norway_DC_SP1, Ireland_DC_SP1, Belgium_DC_SP1, France_DC_SP1, Germany_DC_SP1, Italy_DC_SP1, Netherlands_DC_SP1, Spain_DC_SP1, UK_DC_SP1, Sweden_DC_SP1, Portugal_DC_SP1, Austria_DC_SP1, 'RowNames',names)


%Let's make a first period summary table

Sov_Mean_SP1=nanmean(change_SOV_SP1)

Bank_Mean_SP1=nanmean(change_BANKS_SP1)

Sov_SD_SP1=nanstd(change_SOV_SP1)
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Bank_SD_SP1=nanstd(change_BANKS_SP1)
Sov_DailyCh_SP1=mean(Average_DailyCh_SOV_SP1)
Bank_DailyCh_SP1=mean(Average_DailyCh_BANKS_SP1_SENZADEN)
Sov_DailyCh_SD_SP1=nanstd(Average_DailyCh_SOV_SP1)
Bank_DailyCh_SD_SP1=nanstd(Average_DailyCh_BANKS_SP1_SENZADEN)

%Now we redo the same for the second period
change_SOV_SP2=SOV(TF-SP1-SP2,:)-SOV(TF-SP1-1,:);
change_BANKS_SP2=BANKS(TF-SP1-SP2,:)-BANKS(TF-SP1-1,:);

average_change_BANKS_SP2=NaN(1,P);
average_change_BANKS_SP2_IRE=nanmean(change_BANKS_SP2(1,4:5));
average_change_BANKS_SP2_BEL=nanmean(change_BANKS_SP2(1,6:7));
average_change_BANKS_SP2_FR=nanmean(change_BANKS_SP2(1,8:10));
average_change_BANKS_SP2_DE=nanmean(change_BANKS_SP2(1,11:12));
average_change_BANKS_SP2_IT=nanmean(change_BANKS_SP2(1,13:15));
average_change_BANKS_SP2_NET=nanmean(change_BANKS_SP2(1,16:17));
average_change_BANKS_SP2_ES=nanmean(change_BANKS_SP2(1,18:19));
average_change_BANKS_SP2_UK=nanmean(change_BANKS_SP2(1,20:23));
average_change_BANKS_SP2_SWE=nanmean(change_BANKS_SP2(1,24:25));
average_change_BANKS_SP2_POR=nanmean(change_BANKS_SP2(1,26:27));
average_change_BANKS_SP2_AT=nanmean(change_BANKS_SP2(1,28:29));

average_change_BANKS_SP2(1,:)=[change_BANKS_SP2(1,1), change_BANKS_SP2(1,2),
change_BANKS_SP2(1,3), average_change_BANKS_SP2_IRE, average_change_BANKS_SP2_BEL,
average_change_BANKS_SP2_FR, average_change_BANKS_SP2_DE, average_change_BANKS_SP2_IT,
average_change_BANKS_SP2_NET, average_change_BANKS_SP2_ES, average_change_BANKS_SP2_UK,
average_change_BANKS_SP2_SWE, average_change_BANKS_SP2_POR, average_change_BANKS_SP2_AT];

Greece_SP2=[change_SOV_SP2(1,1);average_change_BANKS_SP2(1,1)];
Denmark_SP2=[change_SOV_SP2(1,2);average_change_BANKS_SP2(1,2)];
Norway_SP2=[change_SOV_SP2(1,3);average_change_BANKS_SP2(1,3)];
Ireland_SP2=[change_SOV_SP2(1,4);average_change_BANKS_SP2(1,4)];
Belgium_SP2=[change_SOV_SP2(1,5);average_change_BANKS_SP2(1,5)];
France_SP2=[change_SOV_SP2(1,6);average_change_BANKS_SP2(1,6)];
Germany_SP2=[change_SOV_SP2(1,7);average_change_BANKS_SP2(1,7)];
```

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Italy_SP2=[change_SOV_SP2(1,8);average_change_BANKS_SP2(1,8)];

Netherlands_SP2=[change_SOV_SP2(1,9);average_change_BANKS_SP2(1,9)];

Spain_SP2=[change_SOV_SP2(1,10);average_change_BANKS_SP2(1,10)];

UK_SP2=[change_SOV_SP2(1,11);average_change_BANKS_SP2(1,11)];

Sweden_SP2=[change_SOV_SP2(1,12);average_change_BANKS_SP2(1,12)];

Portugal_SP2=[change_SOV_SP2(1,13);average_change_BANKS_SP2(1,13)];

Austria_SP2=[change_SOV_SP2(1,14);average_change_BANKS_SP2(1,14)];


names={'Sovereign';'Banks'};

Table_SP2=table(Greece_SP2, Denmark_SP2, Norway_SP2, Ireland_SP2, Belgium_SP2, France_SP2,
Germany_SP2, Italy_SP2, Netherlands_SP2, Spain_SP2, UK_SP2, Sweden_SP2, Portugal_SP2, Austria_SP2,
'RowNames',names)


Average_DailyCh_SOV_GRE_SP2=nanmean(DailyCh_SOV_GRE(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_SOV_DEN_SP2=nanmean(DailyCh_SOV_DEN(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_SOV_NO_SP2=nanmean(DailyCh_SOV_NO(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_SOV_IRE_SP2=nanmean(DailyCh_SOV_IRE(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_SOV_BEL_SP2=nanmean(DailyCh_SOV_BEL(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_SOV_FR_SP2=nanmean(DailyCh_SOV_FR(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_SOV_DE_SP2=nanmean(DailyCh_SOV_DE(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_SOV_IT_SP2=nanmean(DailyCh_SOV_IT(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_SOV_NET_SP2=nanmean(DailyCh_SOV_NET(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_SOV_ES_SP2=nanmean(DailyCh_SOV_ES(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_SOV_UK_SP2=nanmean(DailyCh_SOV_UK(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_SOV_SWE_SP2=nanmean(DailyCh_SOV_SWE(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_SOV_POR_SP2=nanmean(DailyCh_SOV_POR(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_SOV_AT_SP2=nanmean(DailyCh_SOV_AT(TF-SP1-SP2:TF-SP1-1,1));


Average_DailyCh_SOV_SP2=[Average_DailyCh_SOV_GRE_SP2, Average_DailyCh_SOV_DEN_SP2,
Average_DailyCh_SOV_NO_SP2, Average_DailyCh_SOV_IRE_SP2, Average_DailyCh_SOV_BEL_SP2,
Average_DailyCh_SOV_FR_SP2, Average_DailyCh_SOV_DE_SP2, Average_DailyCh_SOV_IT_SP2,
Average_DailyCh_SOV_NET_SP2, Average_DailyCh_SOV_ES_SP2, Average_DailyCh_SOV_UK_SP2,
Average_DailyCh_SOV_SWE_SP2, Average_DailyCh_SOV_POR_SP2, Average_DailyCh_SOV_AT_SP2];


Average_DailyCh_BANKS_GRE_SP2=nanmean(DailyCh_BANKS_GRE(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_BANKS_DEN_SP2=mean(DailyCh_BANKS_DEN(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_BANKS_NO_SP2=nanmean(DailyCh_BANKS_NO(TF-SP1-SP2:TF-SP1-1,1));
```

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Average_DailyCh_BANKS_IRE_SP2=nanmean(DailyCh_BANKS_IRE(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_BANKS_BEL_SP2=nanmean(DailyCh_BANKS_BEL(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_BANKS_FR_SP2=nanmean(DailyCh_BANKS_FR(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_BANKS_DE_SP2=nanmean(DailyCh_BANKS_DE(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_BANKS_IT_SP2=nanmean(DailyCh_BANKS_IT(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_BANKS_NET_SP2=nanmean(DailyCh_BANKS_NET(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_BANKS_ES_SP2=nanmean(DailyCh_BANKS_ES(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_BANKS_UK_SP2=nanmean(DailyCh_BANKS_UK(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_BANKS_SWE_SP2=nanmean(DailyCh_BANKS_SWE(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_BANKS_POR_SP2=nanmean(DailyCh_BANKS_POR(TF-SP1-SP2:TF-SP1-1,1));

Average_DailyCh_BANKS_AT_SP2=nanmean(DailyCh_BANKS_AT(TF-SP1-SP2:TF-SP1-1,1));


Average_DailyCh_BANKS_SP2=[Average_DailyCh_BANKS_GRE_SP2, Average_DailyCh_BANKS_DEN_SP2,
Average_DailyCh_BANKS_NO_SP2, Average_DailyCh_BANKS_IRE_SP2, Average_DailyCh_BANKS_BEL_SP2,
Average_DailyCh_BANKS_FR_SP2, Average_DailyCh_BANKS_DE_SP2, Average_DailyCh_BANKS_IT_SP2,
Average_DailyCh_BANKS_NET_SP2, Average_DailyCh_BANKS_ES_SP2, Average_DailyCh_BANKS_UK_SP2,
Average_DailyCh_BANKS_SWE_SP2, Average_DailyCh_BANKS_POR_SP2,
Average_DailyCh_BANKS_AT_SP2];


Greece_DC_SP2=[Average_DailyCh_SOV_GRE_SP2; Average_DailyCh_BANKS_GRE_SP2];

Denmark_DC_SP2=[Average_DailyCh_SOV_DEN_SP2; Average_DailyCh_BANKS_DEN_SP2];

Norway_DC_SP2=[Average_DailyCh_SOV_NO_SP2; Average_DailyCh_BANKS_NO_SP2];

Ireland_DC_SP2=[Average_DailyCh_SOV_IRE_SP2; Average_DailyCh_BANKS_IRE_SP2];

Belgium_DC_SP2=[Average_DailyCh_SOV_BEL_SP2; Average_DailyCh_BANKS_BEL_SP2];

France_DC_SP2=[Average_DailyCh_SOV_FR_SP2; Average_DailyCh_BANKS_FR_SP2];

Germany_DC_SP2=[Average_DailyCh_SOV_DE_SP2; Average_DailyCh_BANKS_DE_SP2];

Italy_DC_SP2=[Average_DailyCh_SOV_IT_SP2; Average_DailyCh_BANKS_IT_SP2];

Netherlands_DC_SP2=[Average_DailyCh_SOV_NET_SP2; Average_DailyCh_BANKS_NET_SP2];

Spain_DC_SP2=[Average_DailyCh_SOV_ES_SP2; Average_DailyCh_BANKS_ES_SP2];

UK_DC_SP2=[Average_DailyCh_SOV_UK_SP2; Average_DailyCh_BANKS_UK_SP2];

Sweden_DC_SP2=[Average_DailyCh_SOV_SWE_SP2; Average_DailyCh_BANKS_SWE_SP2];

Portugal_DC_SP2=[Average_DailyCh_SOV_POR_SP2; Average_DailyCh_BANKS_POR_SP2];

Austria_DC_SP2=[Average_DailyCh_SOV_AT_SP2; Average_DailyCh_BANKS_AT_SP2];


names={'Sovereign';'Banks'};
```

```
Table_DC_SP2=table(Greece_DC_SP2, Denmark_DC_SP2, Norway_DC_SP2, Ireland_DC_SP2,Belgium_DC_SP2, France_DC_SP2, Germany_DC_SP2, Italy_DC_SP2, Netherlands_DC_SP2, Spain_DC_SP2, UK_DC_SP2, Sweden_DC_SP2, Portugal_DC_SP2, Austria_DC_SP2, 'RowNames',names)

%Let's make a second period summary table
Sov_Mean_SB2=nanmean(change_SOV_SP2)
Bank_Mean_SB2=nanmean(change_BANKS_SP2)
Sov_SD_SB2=nanstd(change_SOV_SP2)
Bank_SD_SB2=nanstd(change_BANKS_SP2)
Sov_DailyCh_SP2=mean(Average_DailyCh_SOV_SP2)
Bank_DailyCh_SP2=mean(Average_DailyCh_BANKS_SP2)
Sov_DailyCh_SD_SP2=nanstd(Average_DailyCh_SOV_SP2)
Bank_DailyCh_SD_SP2=nanstd(Average_DailyCh_BANKS_SP2)

%Now we redo the same for the third period
change_SOV_SP3=SOV(TF-SP1-SP2-SP3,:)-SOV(TF-SP1-SP2-1,:);
change_BANKS_SP3=BANKS(TF-SP1-SP2-SP3,:)-BANKS(TF-SP1-SP2-1,:);
%Data regarding Standard Chartered is missing so we use on 30/1/2014
change_BANKS_SP3(1,23)=BANKS(TF-SP1-SP2,23)-BANKS(1197,23);
%There's no data regarding Svenska Handelsbanken



average_change_BANKS_SP3=NaN(1,P);
average_change_BANKS_SP3_IRE=nanmean(change_BANKS_SP3(1,4:5));
average_change_BANKS_SP3_BEL=nanmean(change_BANKS_SP3(1,6:7));
average_change_BANKS_SP3_FR=nanmean(change_BANKS_SP3(1,8:10));
average_change_BANKS_SP3_DE=nanmean(change_BANKS_SP3(1,11:12));
average_change_BANKS_SP3_IT=nanmean(change_BANKS_SP3(1,13:15));
average_change_BANKS_SP3_NET=nanmean(change_BANKS_SP3(1,16:17));
average_change_BANKS_SP3_ES=nanmean(change_BANKS_SP3(1,18:19));
average_change_BANKS_SP3_UK=nanmean(change_BANKS_SP3(1,20:23));
average_change_BANKS_SP3_SWE=nanmean(change_BANKS_SP3(1,24:25));
average_change_BANKS_SP3_POR=nanmean(change_BANKS_SP3(1,26:27));
average_change_BANKS_SP3_AT=nanmean(change_BANKS_SP3(1,28:29));
```

```
average_change_BANKS_SP3(1,:)=[change_BANKS_SP3(1,1), change_BANKS_SP3(1,2), change_BANKS_SP3(1,3), average_change_BANKS_SP3_IRE, average_change_BANKS_SP3_BEL, average_change_BANKS_SP3_FR, average_change_BANKS_SP3_DE, average_change_BANKS_SP3_IT, average_change_BANKS_SP3_NET, average_change_BANKS_SP3_ES, average_change_BANKS_SP3_UK, average_change_BANKS_SP3_SWE, average_change_BANKS_SP3_POR, average_change_BANKS_SP3_AT];

Greece_SP3=[change_SOV_SP3(1,1);average_change_BANKS_SP3(1,1)];
Denmark_SP3=[change_SOV_SP3(1,2);average_change_BANKS_SP3(1,2)];
Norway_SP3=[change_SOV_SP3(1,3);average_change_BANKS_SP3(1,3)];
Ireland_SP3=[change_SOV_SP3(1,4);average_change_BANKS_SP3(1,4)];
Belgium_SP3=[change_SOV_SP3(1,5);average_change_BANKS_SP3(1,5)];
France_SP3=[change_SOV_SP3(1,6);average_change_BANKS_SP3(1,6)];
Germany_SP3=[change_SOV_SP3(1,7);average_change_BANKS_SP3(1,7)];
Italy_SP3=[change_SOV_SP3(1,8);average_change_BANKS_SP3(1,8)];
Netherlands_SP3=[change_SOV_SP3(1,9);average_change_BANKS_SP3(1,9)];
Spain_SP3=[change_SOV_SP3(1,10);average_change_BANKS_SP3(1,10)];
UK_SP3=[change_SOV_SP3(1,11);average_change_BANKS_SP3(1,11)];
Sweden_SP3=[change_SOV_SP3(1,12);average_change_BANKS_SP3(1,12)];
Portugal_SP3=[change_SOV_SP3(1,13);average_change_BANKS_SP3(1,13)];
Austria_SP3=[change_SOV_SP3(1,14);average_change_BANKS_SP3(1,14)];

names={'Sovereign';'Banks'};
Table_SP3=table(Greece_SP3, Denmark_SP3, Norway_SP3, Ireland_SP3, Belgium_SP3, France_SP3, Germany_SP3, Italy_SP3, Netherlands_SP3, Spain_SP3, UK_SP3, Sweden_SP3, Portugal_SP3, Austria_SP3, 'RowNames',names)

Average_DailyCh_SOV_GRE_SP3=nanmean(DailyCh_SOV_GRE(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));
Average_DailyCh_SOV_DEN_SP3=nanmean(DailyCh_SOV_DEN(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));
Average_DailyCh_SOV_NO_SP3=nanmean(DailyCh_SOV_NO(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));
Average_DailyCh_SOV_IRE_SP3=nanmean(DailyCh_SOV_IRE(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));
Average_DailyCh_SOV_BEL_SP3=nanmean(DailyCh_SOV_BEL(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));
Average_DailyCh_SOV_FR_SP3=nanmean(DailyCh_SOV_FR(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));
Average_DailyCh_SOV_DE_SP3=nanmean(DailyCh_SOV_DE(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));
Average_DailyCh_SOV_IT_SP3=nanmean(DailyCh_SOV_IT(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));
Average_DailyCh_SOV_NET_SP3=nanmean(DailyCh_SOV_NET(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));
Average_DailyCh_SOV_ES_SP3=nanmean(DailyCh_SOV_ES(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));
Average_DailyCh_SOV_UK_SP3=nanmean(DailyCh_SOV_UK(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));
```

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Average_DailyCh_SOV_SWE_SP3=nanmean(DailyCh_SOV_SWE(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));

Average_DailyCh_SOV_POR_SP3=nanmean(DailyCh_SOV_POR(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));

Average_DailyCh_SOV_AT_SP3=nanmean(DailyCh_SOV_AT(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));


Average_DailyCh_SOV_SP3=[Average_DailyCh_SOV_GRE_SP3, Average_DailyCh_SOV_DEN_SP3,
Average_DailyCh_SOV_NO_SP3, Average_DailyCh_SOV_IRE_SP3, Average_DailyCh_SOV_BEL_SP3,
Average_DailyCh_SOV_FR_SP3, Average_DailyCh_SOV_DE_SP3, Average_DailyCh_SOV_IT_SP3,
Average_DailyCh_SOV_NET_SP3, Average_DailyCh_SOV_ES_SP3, Average_DailyCh_SOV_UK_SP3,
Average_DailyCh_SOV_SWE_SP3, Average_DailyCh_SOV_POR_SP3, Average_DailyCh_SOV_AT_SP3];


Average_DailyCh_BANKS_GRE_SP3=nanmean(DailyCh_BANKS_GRE(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));

Average_DailyCh_BANKS_DEN_SP3=mean(DailyCh_BANKS_DEN(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));

Average_DailyCh_BANKS_NO_SP3=nanmean(DailyCh_BANKS_NO(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));

Average_DailyCh_BANKS_IRE_SP3=nanmean(DailyCh_BANKS_IRE(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));

Average_DailyCh_BANKS_BEL_SP3=nanmean(DailyCh_BANKS_BEL(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));

Average_DailyCh_BANKS_FR_SP3=nanmean(DailyCh_BANKS_FR(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));

Average_DailyCh_BANKS_DE_SP3=nanmean(DailyCh_BANKS_DE(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));

Average_DailyCh_BANKS_IT_SP3=nanmean(DailyCh_BANKS_IT(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));

Average_DailyCh_BANKS_NET_SP3=nanmean(DailyCh_BANKS_NET(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));

Average_DailyCh_BANKS_ES_SP3=nanmean(DailyCh_BANKS_ES(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));

Average_DailyCh_BANKS_UK_SP3=nanmean(DailyCh_BANKS_UK(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));

Average_DailyCh_BANKS_SWE_SP3=nanmean(DailyCh_BANKS_SWE(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));

Average_DailyCh_BANKS_POR_SP3=nanmean(DailyCh_BANKS_POR(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));

Average_DailyCh_BANKS_AT_SP3=nanmean(DailyCh_BANKS_AT(TF-SP1-SP2-SP3:TF-SP1-SP2-1,1));


Average_DailyCh_BANKS_SP3=[Average_DailyCh_BANKS_GRE_SP3, Average_DailyCh_BANKS_DEN_SP3,
Average_DailyCh_BANKS_NO_SP3, Average_DailyCh_BANKS_IRE_SP3, Average_DailyCh_BANKS_BEL_SP3,
Average_DailyCh_BANKS_FR_SP3, Average_DailyCh_BANKS_DE_SP3, Average_DailyCh_BANKS_IT_SP3,
Average_DailyCh_BANKS_NET_SP3, Average_DailyCh_BANKS_ES_SP3, Average_DailyCh_BANKS_UK_SP3,
Average_DailyCh_BANKS_SWE_SP3, Average_DailyCh_BANKS_POR_SP3,
Average_DailyCh_BANKS_AT_SP3];


Greece_DC_SP3=[Average_DailyCh_SOV_GRE_SP3; Average_DailyCh_BANKS_GRE_SP3];

Denmark_DC_SP3=[Average_DailyCh_SOV_DEN_SP3; Average_DailyCh_BANKS_DEN_SP3];

Norway_DC_SP3=[Average_DailyCh_SOV_NO_SP3; Average_DailyCh_BANKS_NO_SP3];

Ireland_DC_SP3=[Average_DailyCh_SOV_IRE_SP3; Average_DailyCh_BANKS_IRE_SP3];

Belgium_DC_SP3=[Average_DailyCh_SOV_BEL_SP3; Average_DailyCh_BANKS_BEL_SP3];

France_DC_SP3=[Average_DailyCh_SOV_FR_SP3; Average_DailyCh_BANKS_FR_SP3];
```

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Germany_DC_SP3=[Average_DailyCh_SOV_DE_SP3; Average_DailyCh_BANKS_DE_SP3];
Italy_DC_SP3=[Average_DailyCh_SOV_IT_SP3; Average_DailyCh_BANKS_IT_SP3];
Netherlands_DC_SP3=[Average_DailyCh_SOV_NET_SP3; Average_DailyCh_BANKS_NET_SP3];
Spain_DC_SP3=[Average_DailyCh_SOV_ES_SP3; Average_DailyCh_BANKS_ES_SP3];
UK_DC_SP3=[Average_DailyCh_SOV_UK_SP3; Average_DailyCh_BANKS_UK_SP3];
Sweden_DC_SP3=[Average_DailyCh_SOV_SWE_SP3; Average_DailyCh_BANKS_SWE_SP3];
Portugal_DC_SP3=[Average_DailyCh_SOV_POR_SP3; Average_DailyCh_BANKS_POR_SP3];
Austria_DC_SP3=[Average_DailyCh_SOV_AT_SP3; Average_DailyCh_BANKS_AT_SP3];

names={'Sovereign';'Banks'};
Table_DC_SP3=table(Greece_DC_SP3, Denmark_DC_SP3, Norway_DC_SP3, Ireland_DC_SP3,Belgium_DC_SP3,
France_DC_SP3, Germany_DC_SP3, Italy_DC_SP3, Netherlands_DC_SP3, Spain_DC_SP3, UK_DC_SP3,
Sweden_DC_SP3, Portugal_DC_SP3, Austria_DC_SP3, 'RowNames',names)

%Let's make a third period summary table
Sov_Mean_SB3=nanmean(change_SOV_SP3)
Bank_Mean_SB3=nanmean(change_BANKS_SP3)
Sov_SD_SB3=nanstd(change_SOV_SP3)
Bank_SD_SB3=nanstd(change_BANKS_SP3)
Sov_DailyCh_SP3=mean(Average_DailyCh_SOV_SP3)
Bank_DailyCh_SP3=mean(Average_DailyCh_BANKS_SP3)
Sov_DailyCh_SD_SP3=nanstd(Average_DailyCh_SOV_SP3)
Bank_DailyCh_SD_SP3=nanstd(Average_DailyCh_BANKS_SP3)


%Now we redo the same for the fourth period
change_SOV_SP4=SOV(TF-SP1-SP2-SP3-SP4,:)-SOV(TF-SP1-SP2-SP3-1,:);
change_BANKS_SP4=BANKS(TF-SP1-SP2-SP3-SP4,:)-BANKS(TF-SP1-SP2-SP3-1,:);
%DNB BANK has no more available data
%Svenska Handelsbanken has no more available data

average_change_BANKS_SP4=NaN(1,P);
average_change_BANKS_SP4_IRE=nanmean(change_BANKS_SP4(1,4:5));
average_change_BANKS_SP4_BEL=nanmean(change_BANKS_SP4(1,6:7));
average_change_BANKS_SP4_FR=nanmean(change_BANKS_SP4(1,8:10));
```

```
average_change_BANKS_SP4_DE=nanmean(change_BANKS_SP4(1,11:12));

average_change_BANKS_SP4_IT=nanmean(change_BANKS_SP4(1,13:15));

average_change_BANKS_SP4_NET=nanmean(change_BANKS_SP4(1,16:17));

average_change_BANKS_SP4_ES=nanmean(change_BANKS_SP4(1,18:19));

average_change_BANKS_SP4_UK=nanmean(change_BANKS_SP4(1,20:23));

average_change_BANKS_SP4_SWE=nanmean(change_BANKS_SP4(1,24:25));

average_change_BANKS_SP4_POR=nanmean(change_BANKS_SP4(1,26:27));

average_change_BANKS_SP4_AT=nanmean(change_BANKS_SP3(1,28:29));


average_change_BANKS_SP4(1,:)=[change_BANKS_SP4(1,1), change_BANKS_SP4(1,2),
change_BANKS_SP4(1,3), average_change_BANKS_SP4_IRE, average_change_BANKS_SP4_BEL,
average_change_BANKS_SP4_FR, average_change_BANKS_SP4_DE, average_change_BANKS_SP4_IT,
average_change_BANKS_SP4_NET, average_change_BANKS_SP4_ES, average_change_BANKS_SP4_UK,
average_change_BANKS_SP4_SWE, average_change_BANKS_SP4_POR, average_change_BANKS_SP4_AT];


Greece_SP4=[change_SOV_SP4(1,1);average_change_BANKS_SP4(1,1)];

Denmark_SP4=[change_SOV_SP4(1,2);average_change_BANKS_SP4(1,2)];

Norway_SP4=[change_SOV_SP4(1,3);average_change_BANKS_SP4(1,3)];

Ireland_SP4=[change_SOV_SP4(1,4);average_change_BANKS_SP4(1,4)];

Belgium_SP4=[change_SOV_SP4(1,5);average_change_BANKS_SP4(1,5)];

France_SP4=[change_SOV_SP4(1,6);average_change_BANKS_SP4(1,6)];

Germany_SP4=[change_SOV_SP4(1,7);average_change_BANKS_SP4(1,7)];

Italy_SP4=[change_SOV_SP4(1,8);average_change_BANKS_SP4(1,8)];

Netherlands_SP4=[change_SOV_SP4(1,9);average_change_BANKS_SP4(1,9)];

Spain_SP4=[change_SOV_SP4(1,10);average_change_BANKS_SP4(1,10)];

UK_SP4=[change_SOV_SP4(1,11);average_change_BANKS_SP4(1,11)];

Sweden_SP4=[change_SOV_SP4(1,12);average_change_BANKS_SP4(1,12)];

Portugal_SP4=[change_SOV_SP4(1,13);average_change_BANKS_SP4(1,13)];

Austria_SP4=[change_SOV_SP4(1,14);average_change_BANKS_SP4(1,14)];


names={'Sovereign';'Banks'};

Table_SP4=table(Greece_SP4, Denmark_SP4, Norway_SP4, Ireland_SP4,Belgium_SP4,France_SP4, Germany_SP4,
Italy_SP4, Netherlands_SP4, Spain_SP4, UK_SP4, Sweden_SP4, Portugal_SP4, Austria_SP4, 'RowNames',names)


Average_DailyCh_SOV_GRE_SP4=nanmean(DailyCh_SOV_GRE(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));

Average_DailyCh_SOV_DEN_SP4=nanmean(DailyCh_SOV_DEN(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));
```

```
Average_DailyCh_SOV_NO_SP4=nanmean(DailyCh_SOV_NO(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));
Average_DailyCh_SOV_IRE_SP4=nanmean(DailyCh_SOV_IRE(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));
Average_DailyCh_SOV_BEL_SP4=nanmean(DailyCh_SOV_BEL(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));
Average_DailyCh_SOV_FR_SP4=nanmean(DailyCh_SOV_FR(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));
Average_DailyCh_SOV_DE_SP4=nanmean(DailyCh_SOV_DE(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));
Average_DailyCh_SOV_IT_SP4=nanmean(DailyCh_SOV_IT(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));
Average_DailyCh_SOV_NET_SP4=nanmean(DailyCh_SOV_NET(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));
Average_DailyCh_SOV_ES_SP4=nanmean(DailyCh_SOV_ES(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));
Average_DailyCh_SOV_UK_SP4=nanmean(DailyCh_SOV_UK(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));
Average_DailyCh_SOV_SWE_SP4=nanmean(DailyCh_SOV_SWE(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));
Average_DailyCh_SOV_POR_SP4=nanmean(DailyCh_SOV_POR(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));
Average_DailyCh_SOV_AT_SP4=nanmean(DailyCh_SOV_AT(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));


Average_DailyCh_SOV_SP4=[Average_DailyCh_SOV_GRE_SP4, Average_DailyCh_SOV_DEN_SP4,
Average_DailyCh_SOV_NO_SP4, Average_DailyCh_SOV_IRE_SP4, Average_DailyCh_SOV_BEL_SP4,
Average_DailyCh_SOV_FR_SP4, Average_DailyCh_SOV_DE_SP4, Average_DailyCh_SOV_IT_SP4,
Average_DailyCh_SOV_NET_SP4, Average_DailyCh_SOV_ES_SP4, Average_DailyCh_SOV_UK_SP4,
Average_DailyCh_SOV_SWE_SP4, Average_DailyCh_SOV_POR_SP4, Average_DailyCh_SOV_AT_SP4];


Average_DailyCh_BANKS_GRE_SP4=nanmean(DailyCh_BANKS_GRE(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-
1,1));
Average_DailyCh_BANKS_DEN_SP4=mean(DailyCh_BANKS_DEN(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-
1,1));
Average_DailyCh_BANKS_NO_SP4=nanmean(DailyCh_BANKS_NO(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-
1,1));
Average_DailyCh_BANKS_IRE_SP4=nanmean(DailyCh_BANKS_IRE(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-
1,1));
Average_DailyCh_BANKS_BEL_SP4=nanmean(DailyCh_BANKS_BEL(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-
1,1));
Average_DailyCh_BANKS_FR_SP4=nanmean(DailyCh_BANKS_FR(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));
Average_DailyCh_BANKS_DE_SP4=nanmean(DailyCh_BANKS_DE(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-
1,1));
Average_DailyCh_BANKS_IT_SP4=nanmean(DailyCh_BANKS_IT(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));
Average_DailyCh_BANKS_NET_SP4=nanmean(DailyCh_BANKS_NET(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-
1,1));
Average_DailyCh_BANKS_ES_SP4=nanmean(DailyCh_BANKS_ES(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));
Average_DailyCh_BANKS_UK_SP4=nanmean(DailyCh_BANKS_UK(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-
1,1));
```

```
Average_DailyCh_BANKS_SWE_SP4=nanmean(DailyCh_BANKS_SWE(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));

Average_DailyCh_BANKS_POR_SP4=nanmean(DailyCh_BANKS_POR(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));

Average_DailyCh_BANKS_AT_SP4=nanmean(DailyCh_BANKS_AT(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,1));


Average_DailyCh_BANKS_SP4=[Average_DailyCh_BANKS_GRE_SP4, Average_DailyCh_BANKS_DEN_SP4, Average_DailyCh_BANKS_NO_SP4, Average_DailyCh_BANKS_IRE_SP4, Average_DailyCh_BANKS_BEL_SP4, Average_DailyCh_BANKS_FR_SP4, Average_DailyCh_BANKS_DE_SP4, Average_DailyCh_BANKS_IT_SP4, Average_DailyCh_BANKS_NET_SP4, Average_DailyCh_BANKS_ES_SP4, Average_DailyCh_BANKS_UK_SP4, Average_DailyCh_BANKS_SWE_SP4, Average_DailyCh_BANKS_POR_SP4, Average_DailyCh_BANKS_AT_SP4];


Greece_DC_SP4=[Average_DailyCh_SOV_GRE_SP4; Average_DailyCh_BANKS_GRE_SP4];

Denmark_DC_SP4=[Average_DailyCh_SOV_DEN_SP4; Average_DailyCh_BANKS_DEN_SP4];

Norway_DC_SP4=[Average_DailyCh_SOV_NO_SP4; Average_DailyCh_BANKS_NO_SP4];

Ireland_DC_SP4=[Average_DailyCh_SOV_IRE_SP4; Average_DailyCh_BANKS_IRE_SP4];

Belgium_DC_SP4=[Average_DailyCh_SOV_BEL_SP4; Average_DailyCh_BANKS_BEL_SP4];

France_DC_SP4=[Average_DailyCh_SOV_FR_SP4; Average_DailyCh_BANKS_FR_SP4];

Germany_DC_SP4=[Average_DailyCh_SOV_DE_SP4; Average_DailyCh_BANKS_DE_SP4];

Italy_DC_SP4=[Average_DailyCh_SOV_IT_SP4; Average_DailyCh_BANKS_IT_SP4];

Netherlands_DC_SP4=[Average_DailyCh_SOV_NET_SP4; Average_DailyCh_BANKS_NET_SP4];

Spain_DC_SP4=[Average_DailyCh_SOV_ES_SP4; Average_DailyCh_BANKS_ES_SP4];

UK_DC_SP4=[Average_DailyCh_SOV_UK_SP4; Average_DailyCh_BANKS_UK_SP4];

Sweden_DC_SP4=[Average_DailyCh_SOV_SWE_SP4; Average_DailyCh_BANKS_SWE_SP4];

Portugal_DC_SP4=[Average_DailyCh_SOV_POR_SP4; Average_DailyCh_BANKS_POR_SP4];

Austria_DC_SP4=[Average_DailyCh_SOV_AT_SP4; Average_DailyCh_BANKS_AT_SP4];


names={'Sovereign';'Banks'};

Table_DC_SP4=table(Greece_DC_SP4, Denmark_DC_SP4, Norway_DC_SP4, Ireland_DC_SP4,Belgium_DC_SP4, France_DC_SP4, Germany_DC_SP4, Italy_DC_SP4, Netherlands_DC_SP4, Spain_DC_SP4, UK_DC_SP4, Sweden_DC_SP4, Portugal_DC_SP4, Austria_DC_SP4, 'RowNames',names)


%Let's make a fourth period summary table

Sov_Mean_SB4=nanmean(change_SOV_SP4)

Bank_Mean_SB4=nanmean(change_BANKS_SP4)

Sov_SD_SB4=nanstd(change_SOV_SP4)
```

```
Bank_SD_SB4=nanstd(change_BANKS_SP4)
Sov_DailyCh_SP4=mean(Average_DailyCh_SOV_SP4)
Bank_DailyCh_SP4=mean(Average_DailyCh_BANKS_SP4)
Sov_DailyCh_SD_SP4=nanstd(Average_DailyCh_SOV_SP4)
Bank_DailyCh_SD_SP4=nanstd(Average_DailyCh_BANKS_SP4)

%Now we redo the same for the fifth and last period
change_SOV_SP5=SOV(TF-SP1-SP2-SP3-SP4-SP5,:)-SOV(TF-SP1-SP2-SP3-SP4-1,:);
%Observations for Italy, Germany, France end on 23/8/18
change_SOV_SP5(1,6)=SOV(7,6)-SOV(TF-SP1-SP2-SP3-SP4-1,6);
change_SOV_SP5(1,7)=SOV(7,7)-SOV(TF-SP1-SP2-SP3-SP4-1,7);
change_SOV_SP5(1,8)=SOV(7,8)-SOV(TF-SP1-SP2-SP3-SP4-1,8);
%Observations for Austria end on 30/7/18
change_SOV_SP5(1,14)=SOV(25,14)-SOV(TF-SP1-SP2-SP3-SP4-1,14);

change_BANKS_SP5=BANKS(TF-SP1-SP2-SP3-SP4-SP5,:)-BANKS(TF-SP1-SP2-SP3-SP4-1,:);
%There are no observation for Svenska Handelsbanken and DNB
%Observation for Credite Agricole ends on 24/8/18
change_BANKS_SP5(1,9)=BANKS(6,9)-BANKS(TF-SP1-SP2-SP3-SP4-1,9);
%Observation for Raiffeisen ends on 29/8/18
change_BANKS_SP5(1,29)=BANKS(3,29)-BANKS(TF-SP1-SP2-SP3-SP4-1,29);

average_change_BANKS_SP5=NaN(1,P);
average_change_BANKS_SP5_IRL=nanmean(change_BANKS_SP5(1,4:5));
average_change_BANKS_SP5_BEL=nanmean(change_BANKS_SP5(1,6:7));
average_change_BANKS_SP5_FR=nanmean(change_BANKS_SP5(1,8:10));
average_change_BANKS_SP5_DE=nanmean(change_BANKS_SP5(1,11:12));
average_change_BANKS_SP5_ITA=nanmean(change_BANKS_SP5(1,13:15));
average_change_BANKS_SP5_NET=nanmean(change_BANKS_SP5(1,16:17));
average_change_BANKS_SP5_ESP=nanmean(change_BANKS_SP5(1,18:19));
average_change_BANKS_SP5_UK=nanmean(change_BANKS_SP5(1,20:23));
average_change_BANKS_SP5_SWE=nanmean(change_BANKS_SP5(1,24:25));
average_change_BANKS_SP5_POR=nanmean(change_BANKS_SP5(1,26:27));
average_change_BANKS_SP5_AT=nanmean(change_BANKS_SP5(1,28:29));
```

```
average_change_BANKS_SP5(1,:)=[change_BANKS_SP5(1,1), change_BANKS_SP5(1,2), change_BANKS_SP5(1,3), average_change_BANKS_SP5_IRL, average_change_BANKS_SP5_BEL, average_change_BANKS_SP5_FR, average_change_BANKS_SP5_DE, average_change_BANKS_SP5_ITA, average_change_BANKS_SP5_NET, average_change_BANKS_SP5_ESP, average_change_BANKS_SP5_UK, average_change_BANKS_SP5_SWE, average_change_BANKS_SP5_POR, average_change_BANKS_SP5_AT];


Greece_SP5=[change_SOV_SP5(1,1);average_change_BANKS_SP5(1,1)];
Denmark_SP5=[change_SOV_SP5(1,2);average_change_BANKS_SP5(1,2)];
Norway_SP5=[change_SOV_SP5(1,3);average_change_BANKS_SP5(1,3)];
Ireland_SP5=[change_SOV_SP5(1,4);average_change_BANKS_SP5(1,4)];
Belgium_SP5=[change_SOV_SP5(1,5);average_change_BANKS_SP5(1,5)];
France_SP5=[change_SOV_SP5(1,6);average_change_BANKS_SP5(1,6)];
Germany_SP5=[change_SOV_SP5(1,7);average_change_BANKS_SP5(1,7)];
Italy_SP5=[change_SOV_SP5(1,8);average_change_BANKS_SP5(1,8)];
Netherlands_SP5=[change_SOV_SP5(1,9);average_change_BANKS_SP5(1,9)];
Spain_SP5=[change_SOV_SP5(1,10);average_change_BANKS_SP5(1,10)];
UK_SP5=[change_SOV_SP5(1,11);average_change_BANKS_SP5(1,11)];
Sweden_SP5=[change_SOV_SP5(1,12);average_change_BANKS_SP5(1,12)];
Portugal_SP5=[change_SOV_SP5(1,13);average_change_BANKS_SP5(1,13)];
Austria_SP5=[change_SOV_SP5(1,14);average_change_BANKS_SP5(1,14)];


names={'Sovereign';'Banks'};
Table_SP5=table(Greece_SP5, Denmark_SP5, Norway_SP5, Ireland_SP5,Belgium_SP5, France_SP5, Germany_SP5, Italy_SP5, Netherlands_SP5, Spain_SP5, UK_SP5, Sweden_SP5, Portugal_SP5, Austria_SP5, 'RowNames',names)


Average_DailyCh_SOV_GRE_SP5=nanmean(DailyCh_SOV_GRE(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));
Average_DailyCh_SOV_DEN_SP5=nanmean(DailyCh_SOV_DEN(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));
Average_DailyCh_SOV_NO_SP5=nanmean(DailyCh_SOV_NO(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));
Average_DailyCh_SOV_IRE_SP5=nanmean(DailyCh_SOV_IRE(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));
Average_DailyCh_SOV_BEL_SP5=nanmean(DailyCh_SOV_BEL(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));
Average_DailyCh_SOV_FR_SP5=nanmean(DailyCh_SOV_FR(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));
```

Average_DailyCh_SOV_DE_SP5=nanmean(DailyCh_SOV_DE(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_SOV_IT_SP5=nanmean(DailyCh_SOV_IT(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_SOV_NET_SP5=nanmean(DailyCh_SOV_NET(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_SOV_ES_SP5=nanmean(DailyCh_SOV_ES(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_SOV_UK_SP5=nanmean(DailyCh_SOV_UK(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_SOV_SWE_SP5=nanmean(DailyCh_SOV_SWE(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_SOV_POR_SP5=nanmean(DailyCh_SOV_POR(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_SOV_AT_SP5=nanmean(DailyCh_SOV_AT(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_SOV_SP5=[Average_DailyCh_SOV_GRE_SP5, Average_DailyCh_SOV_DEN_SP5, Average_DailyCh_SOV_NO_SP5, Average_DailyCh_SOV_IRE_SP5, Average_DailyCh_SOV_BEL_SP5, Average_DailyCh_SOV_FR_SP5, Average_DailyCh_SOV_DE_SP5, Average_DailyCh_SOV_IT_SP5, Average_DailyCh_SOV_NET_SP5, Average_DailyCh_SOV_ES_SP5, Average_DailyCh_SOV_UK_SP5, Average_DailyCh_SOV_SWE_SP5, Average_DailyCh_SOV_POR_SP5, Average_DailyCh_SOV_AT_SP5];

Average_DailyCh_BANKS_GRE_SP5=nanmean(DailyCh_BANKS_GRE(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_BANKS_DEN_SP5=mean(DailyCh_BANKS_DEN(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_BANKS_NO_SP5=nanmean(DailyCh_BANKS_NO(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_BANKS_IRE_SP5=nanmean(DailyCh_BANKS_IRE(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_BANKS_BEL_SP5=nanmean(DailyCh_BANKS_BEL(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_BANKS_FR_SP5=nanmean(DailyCh_BANKS_FR(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_BANKS_DE_SP5=nanmean(DailyCh_BANKS_DE(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_BANKS_IT_SP5=nanmean(DailyCh_BANKS_IT(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_BANKS_NET_SP5=nanmean(DailyCh_BANKS_NET(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_BANKS_ES_SP5=nanmean(DailyCh_BANKS_ES(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

```
Average_DailyCh_BANKS_UK_SP5=nanmean(DailyCh_BANKS_UK(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_BANKS_SWE_SP5=nanmean(DailyCh_BANKS_SWE(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_BANKS_POR_SP5=nanmean(DailyCh_BANKS_POR(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));

Average_DailyCh_BANKS_AT_SP5=nanmean(DailyCh_BANKS_AT(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,1));


Average_DailyCh_BANKS_SP5=[Average_DailyCh_BANKS_GRE_SP5, Average_DailyCh_BANKS_DEN_SP5, Average_DailyCh_BANKS_NO_SP5, Average_DailyCh_BANKS_IRE_SP5, Average_DailyCh_BANKS_BEL_SP5, Average_DailyCh_BANKS_FR_SP5, Average_DailyCh_BANKS_DE_SP5, Average_DailyCh_BANKS_IT_SP5, Average_DailyCh_BANKS_NET_SP5, Average_DailyCh_BANKS_ES_SP5, Average_DailyCh_BANKS_UK_SP5, Average_DailyCh_BANKS_SWE_SP5, Average_DailyCh_BANKS_POR_SP5, Average_DailyCh_BANKS_AT_SP5];

Average_DailyCh_BANKS_SP5_SENZANO=[Average_DailyCh_BANKS_GRE_SP5, Average_DailyCh_BANKS_DEN_SP5, Average_DailyCh_BANKS_IRE_SP5, Average_DailyCh_BANKS_BEL_SP5, Average_DailyCh_BANKS_FR_SP5, Average_DailyCh_BANKS_DE_SP5, Average_DailyCh_BANKS_IT_SP5, Average_DailyCh_BANKS_NET_SP5, Average_DailyCh_BANKS_ES_SP5, Average_DailyCh_BANKS_UK_SP5, Average_DailyCh_BANKS_SWE_SP5, Average_DailyCh_BANKS_POR_SP5, Average_DailyCh_BANKS_AT_SP5];


Greece_DC_SP5=[Average_DailyCh_SOV_GRE_SP5; Average_DailyCh_BANKS_GRE_SP5];

Denmark_DC_SP5=[Average_DailyCh_SOV_DEN_SP5; Average_DailyCh_BANKS_DEN_SP5];

Norway_DC_SP5=[Average_DailyCh_SOV_NO_SP5; Average_DailyCh_BANKS_NO_SP5];

Ireland_DC_SP5=[Average_DailyCh_SOV_IRE_SP5; Average_DailyCh_BANKS_IRE_SP5];

Belgium_DC_SP5=[Average_DailyCh_SOV_BEL_SP5; Average_DailyCh_BANKS_BEL_SP5];

France_DC_SP5=[Average_DailyCh_SOV_FR_SP5; Average_DailyCh_BANKS_FR_SP5];

Germany_DC_SP5=[Average_DailyCh_SOV_DE_SP5; Average_DailyCh_BANKS_DE_SP5];

Italy_DC_SP5=[Average_DailyCh_SOV_IT_SP5; Average_DailyCh_BANKS_IT_SP5];

Netherlands_DC_SP5=[Average_DailyCh_SOV_NET_SP5; Average_DailyCh_BANKS_NET_SP5];

Spain_DC_SP5=[Average_DailyCh_SOV_ES_SP5; Average_DailyCh_BANKS_ES_SP5];

UK_DC_SP5=[Average_DailyCh_SOV_UK_SP5; Average_DailyCh_BANKS_UK_SP5];

Sweden_DC_SP5=[Average_DailyCh_SOV_SWE_SP5; Average_DailyCh_BANKS_SWE_SP5];

Portugal_DC_SP5=[Average_DailyCh_SOV_POR_SP5; Average_DailyCh_BANKS_POR_SP5];

Austria_DC_SP5=[Average_DailyCh_SOV_AT_SP5; Average_DailyCh_BANKS_AT_SP5];


names={'Sovereign';'Banks'};
```

```
Table_DC_SP5=table(Greece_DC_SP5, Denmark_DC_SP5, Norway_DC_SP5, Ireland_DC_SP5,Belgium_DC_SP5, France_DC_SP5, Germany_DC_SP5, Italy_DC_SP5, Netherlands_DC_SP5, Spain_DC_SP5, UK_DC_SP5, Sweden_DC_SP5, Portugal_DC_SP5, Austria_DC_SP5, 'RowNames',names)


%Let's make a fifth period summary table
Sov_Mean_SB5=nanmean(change_SOV_SP5)
Bank_Mean_SB5=nanmean(change_BANKS_SP5)
Sov_SD_SB5=nanstd(change_SOV_SP5)
Bank_SD_SB5=nanstd(change_BANKS_SP5)
Sov_DailyCh_SP5=mean(Average_DailyCh_SOV_SP5)
Bank_DailyCh_SP5=mean(Average_DailyCh_BANKS_SP5_SENZANO)
Sov_DailyCh_SD_SP5=nanstd(Average_DailyCh_SOV_SP5)
Bank_DailyCh_SD_SP5=nanstd(Average_DailyCh_BANKS_SP5_SENZANO)


%Let's compute correlation in the five subperiods
%Now we compute correlation coefficients for the first period
Corr_GRE_SP1=corrcoef((GRE_DC_table(TF-SP1:TF-1,:)),'rows','complete');
Corr_DEN_SP1=corrcoef((DEN_DC_table(TF-SP1:TF-1,:)),'rows','complete');
Corr_NO_SP1=corrcoef((NO_DC_table(TF-SP1:TF-1,:)),'rows','complete');
Corr_IRE_SP1=corrcoef((IRE_DC_table(TF-SP1:TF-1,:)),'rows','complete');
Corr_BEL_SP1=corrcoef((BEL_DC_table(TF-SP1:TF-1,:)),'rows','complete');
Corr_FR_SP1=corrcoef((FR_DC_table(TF-SP1:TF-1,:)),'rows','complete');
Corr_DE_SP1=corrcoef((DE_DC_table(TF-SP1:TF-1,:)),'rows','complete');
Corr_IT_SP1=corrcoef((IT_DC_table(TF-SP1:TF-1,:)),'rows','complete');
Corr_NET_SP1=corrcoef((NET_DC_table(TF-SP1:TF-1,:)),'rows','complete');
Corr_ES_SP1=corrcoef((ES_DC_table(TF-SP1:TF-1,:)),'rows','complete');
Corr_UK_SP1=corrcoef((UK_DC_table(TF-SP1:TF-1,:)),'rows','complete');
Corr_SWE_SP1=corrcoef((SWE_DC_table(TF-SP1:TF-1,:)),'rows','complete');
Corr_POR_SP1=corrcoef((POR_DC_table(TF-SP1:TF-1,:)),'rows','complete');
Corr_AT_SP1=corrcoef((IRE_DC_table(TF-SP1:TF-1,:)),'rows','complete');


names={'Correlation'};
Corr_SP1=table(Corr_GRE_SP1(1,2), Corr_DEN_SP1(1,2), Corr_NO_SP1(1,2), Corr_IRE_SP1(1,2), Corr_BEL_SP1(1,2), Corr_FR_SP1(1,2), Corr_DE_SP1(1,2), Corr_IT_SP1(1,2), Corr_NET_SP1(1,2), Corr_ES_SP1(1,2), Corr_UK_SP1(1,2), Corr_SWE_SP1(1,2), Corr_POR_SP1(1,2), Corr_AT_SP1(1,2), 'RowNames',names)
```

```
%Now we compute correlation coefficients for the second period
Corr_GRE_SP2=corrcoef((GRE_DC_table(TF-SP1-SP2:TF-SP1-1,:)),'rows','complete');
Corr_DEN_SP2=corrcoef((DEN_DC_table(TF-SP1-SP2:TF-SP1-1,:)),'rows','complete');
Corr_NO_SP2=corrcoef((NO_DC_table(TF-SP1-SP2:TF-SP1-1,:)),'rows','complete');
Corr_IRE_SP2=corrcoef((IRE_DC_table(TF-SP1-SP2:TF-SP1-1,:)),'rows','complete');
Corr_BEL_SP2=corrcoef((BEL_DC_table(TF-SP1-SP2:TF-SP1-1,:)),'rows','complete');
Corr_FR_SP2=corrcoef((FR_DC_table(TF-SP1-SP2:TF-SP1-1,:)),'rows','complete');
Corr_DE_SP2=corrcoef((DE_DC_table(TF-SP1-SP2:TF-SP1-1,:)),'rows','complete');
Corr_IT_SP2=corrcoef((IT_DC_table(TF-SP1-SP2:TF-SP1-1,:)),'rows','complete');
Corr_NET_SP2=corrcoef((NET_DC_table(TF-SP1-SP2:TF-SP1-1,:)),'rows','complete');
Corr_ES_SP2=corrcoef((ES_DC_table(TF-SP1-SP2:TF-SP1-1,:)),'rows','complete');
Corr_UK_SP2=corrcoef((UK_DC_table(TF-SP1-SP2:TF-SP1-1,:)),'rows','complete');
Corr_SWE_SP2=corrcoef((SWE_DC_table(TF-SP1-SP2:TF-SP1-1,:)),'rows','complete');
Corr_POR_SP2=corrcoef((POR_DC_table(TF-SP1-SP2:TF-SP1-1,:)),'rows','complete');
Corr_AT_SP2=corrcoef((IRE_DC_table(TF-SP1-SP2:TF-SP1-1,:)),'rows','complete');


names={'Correlation'};
Corr_SP2=table(Corr_GRE_SP2(1,2), Corr_DEN_SP2(1,2), Corr_NO_SP2(1,2), Corr_IRE_SP2(1,2),
Corr_BEL_SP2(1,2), Corr_FR_SP2(1,2), Corr_DE_SP2(1,2), Corr_IT_SP2(1,2), Corr_NET_SP2(1,2),
Corr_ES_SP2(1,2), Corr_UK_SP2(1,2), Corr_SWE_SP2(1,2), Corr_POR_SP2(1,2), Corr_AT_SP2(1,2),
'RowNames',names)


%Now we compute correlation coefficients for the third period
Corr_GRE_SP3=corrcoef((GRE_DC_table(TF-SP1-SP2-SP3:TF-SP1-SP2-1,:)),'rows','complete');
Corr_DEN_SP3=corrcoef((DEN_DC_table(TF-SP1-SP2-SP3:TF-SP1-SP2-1,:)),'rows','complete');
Corr_NO_SP3=corrcoef((NO_DC_table(TF-SP1-SP2-SP3:TF-SP1-SP2-1,:)),'rows','complete');
Corr_IRE_SP3=corrcoef((IRE_DC_table(TF-SP1-SP2-SP3:TF-SP1-SP2-1,:)),'rows','complete');
Corr_BEL_SP3=corrcoef((BEL_DC_table(TF-SP1-SP2-SP3:TF-SP1-SP2-1,:)),'rows','complete');
Corr_FR_SP3=corrcoef((FR_DC_table(TF-SP1-SP2-SP3:TF-SP1-SP2-1,:)),'rows','complete');
Corr_DE_SP3=corrcoef((DE_DC_table(TF-SP1-SP2-SP3:TF-SP1-SP2-1,:)),'rows','complete');
Corr_IT_SP3=corrcoef((IT_DC_table(TF-SP1-SP2-SP3:TF-SP1-SP2-1,:)),'rows','complete');
Corr_NET_SP3=corrcoef((NET_DC_table(TF-SP1-SP2-SP3:TF-SP1-SP2-1,:)),'rows','complete');
Corr_ES_SP3=corrcoef((ES_DC_table(TF-SP1-SP2-SP3:TF-SP1-SP2-1,:)),'rows','complete');
Corr_UK_SP3=corrcoef((UK_DC_table(TF-SP1-SP2-SP3:TF-SP1-SP2-1,:)),'rows','complete');
```

```
Corr_SWE_SP3=corrcoef((SWE_DC_table(TF-SP1-SP2-SP3:TF-SP1-SP2-1,:)),'rows','complete');

Corr_POR_SP3=corrcoef((POR_DC_table(TF-SP1-SP2-SP3:TF-SP1-SP2-1,:)),'rows','complete');

Corr_AT_SP3=corrcoef((IRE_DC_table(TF-SP1-SP2-SP3:TF-SP1-SP2-1,:)),'rows','complete');


names={'Correlation'};

Corr_SP3=table(Corr_GRE_SP3(1,2), Corr_DEN_SP3(1,2), Corr_NO_SP3(1,2), Corr_IRE_SP3(1,2)
,Corr_BEL_SP3(1,2), Corr_FR_SP3(1,2), Corr_DE_SP3(1,2), Corr_IT_SP3(1,2), Corr_NET_SP3(1,2),
Corr_ES_SP3(1,2), Corr_UK_SP3(1,2), Corr_SWE_SP3(1,2), Corr_POR_SP3(1,2), Corr_AT_SP3(1,2),
'RowNames',names)


%Now we compute correlation coefficients for the fourth period

Corr_GRE_SP4=corrcoef((GRE_DC_table(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,:)),'rows','complete');

Corr_DEN_SP4=corrcoef((DEN_DC_table(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,:)),'rows','complete');

Corr_NO_SP4=corrcoef((NO_DC_table(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,:)),'rows','complete');

Corr_IRE_SP4=corrcoef((IRE_DC_table(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,:)),'rows','complete');

Corr_BEL_SP4=corrcoef((BEL_DC_table(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,:)),'rows','complete');

Corr_FR_SP4=corrcoef((FR_DC_table(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,:)),'rows','complete');

Corr_DE_SP4=corrcoef((DE_DC_table(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,:)),'rows','complete');

Corr_IT_SP4=corrcoef((IT_DC_table(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,:)),'rows','complete');

Corr_NET_SP4=corrcoef((NET_DC_table(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,:)),'rows','complete');

Corr_ES_SP4=corrcoef((ES_DC_table(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,:)),'rows','complete');

Corr_UK_SP4=corrcoef((UK_DC_table(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,:)),'rows','complete');

Corr_SWE_SP4=corrcoef((SWE_DC_table(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,:)),'rows','complete');

Corr_POR_SP4=corrcoef((POR_DC_table(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,:)),'rows','complete');

Corr_AT_SP4=corrcoef((IRE_DC_table(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,:)),'rows','complete');


names={'Correlation'};

Corr_SP4=table(Corr_GRE_SP4(1,2), Corr_DEN_SP4(1,2), Corr_NO_SP4(1,2),
Corr_IRE_SP4(1,2),Corr_BEL_SP4(1,2), Corr_FR_SP4(1,2), Corr_DE_SP4(1,2), Corr_IT_SP4(1,2),
Corr_NET_SP4(1,2), Corr_ES_SP4(1,2), Corr_UK_SP4(1,2), Corr_SWE_SP4(1,2), Corr_POR_SP4(1,2),
Corr_AT_SP4(1,2), 'RowNames',names)


%Now we compute correlation coefficients for the fifth period

Corr_GRE_SP5=corrcoef((GRE_DC_table(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,:)),'rows','complete');

Corr_DEN_SP5=corrcoef((DEN_DC_table(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,:)),'rows','complete');

Corr_NO_SP5=corrcoef((NO_DC_table(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,:)),'rows','complete');

Corr_IRE_SP5=corrcoef((IRE_DC_table(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,:)),'rows','complete');
```

```
Corr_BEL_SP5=corrcoef((BEL_DC_table(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,:)),'rows','complete');

Corr_FR_SP5=corrcoef((FR_DC_table(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,:)),'rows','complete');

Corr_DE_SP5=corrcoef((DE_DC_table(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,:)),'rows','complete');

Corr_IT_SP5=corrcoef((IT_DC_table(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,:)),'rows','complete');

Corr_NET_SP5=corrcoef((NET_DC_table(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,:)),'rows','complete');

Corr_ES_SP5=corrcoef((ES_DC_table(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,:)),'rows','complete');

Corr_UK_SP5=corrcoef((UK_DC_table(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,:)),'rows','complete');

Corr_SWE_SP5=corrcoef((SWE_DC_table(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,:)),'rows','complete');

Corr_POR_SP5=corrcoef((POR_DC_table(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,:)),'rows','complete');

Corr_AT_SP5=corrcoef((IRE_DC_table(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,:)),'rows','complete');


names={'Correlation'};

Corr_SP5=table(Corr_GRE_SP5(1,2), Corr_DEN_SP5(1,2), Corr_NO_SP5(1,2), Corr_IRE_SP5(1,2),
Corr_BEL_SP5(1,2), Corr_FR_SP5(1,2), Corr_DE_SP5(1,2), Corr_IT_SP5(1,2), Corr_NET_SP5(1,2),
Corr_ES_SP5(1,2), Corr_UK_SP5(1,2), Corr_SWE_SP5(1,2), Corr_POR_SP5(1,2), Corr_AT_SP5(1,2),
'RowNames',names)



%% Second empirical analysis

SOV(SOV==0)=NaN;


%Let's compute the bank CDS for each country as a mean of CDS of banks in that country

average_BankCDS_IRE=nanmean(BANKS(:,4:5),2);

average_BankCDS_BEL=nanmean(BANKS(:,6:7),2);

average_BankCDS_FR=nanmean(BANKS(:,8:10),2);

average_BankCDS_DE=nanmean(BANKS(:,11:12),2);

average_BankCDS_IT=nanmean(BANKS(:,13:15),2);

average_BankCDS_NET=nanmean(BANKS(:,16:17),2);

average_BankCDS_ES=nanmean(BANKS(:,18:19),2);

average_BankCDS_UK=nanmean(BANKS(:,20:23),2);

average_BankCDS_SWE=nanmean(BANKS(:,24:25),2);

average_BankCDS_POR=nanmean(BANKS(:,25:27),2);

average_BankCDS_AT=nanmean(BANKS(:,28:29),2);

BankCDS=[BANKS(:,1) BANKS(:,2) BANKS(:,3) average_BankCDS_IRE average_BankCDS_BEL
average_BankCDS_FR average_BankCDS_DE average_BankCDS_IT average_BankCDS_NET
average_BankCDS_ES average_BankCDS_UK average_BankCDS_SWE average_BankCDS_POR
average_BankCDS_AT];
```

```
%Let's compute the dependent and independent variables that we'll need in the regression: the log change in banks ank and sovereign CDS

Dimension_SovCDS=NaN(TF-1,P);

Dimension_BankCDS=NaN(TF-1,P);


for i=1:P

   Dimension_SovCDS(:,i)=SOV(1:TF-1,i)./SOV(2:TF,i);

end

for i=1:P

   Dimension_BankCDS(:,i)=BankCDS(1:TF-1,i)./BankCDS(2:TF,i);

end


log_SovCDS=log(Dimension_SovCDS);

log_BankCDS=log(Dimension_BankCDS);


%Let's compute the first set of control variables regarding banking fundamentals: aggregate volatility

Vdax=NaN(TF-1,1);

Vdax(1:TF-1,1)=VDAX(1:TF-1,1)./VDAX(2:TF,1);


%Let's compute the second set of control variables regarding banking fundamentals: equity returns for banks

average_BankEquity_IRE=nanmean(EQUITY(:,4:5),2);

average_BankEquity_BEL=nanmean(EQUITY(:,6:7),2);

average_BankEquity_FR=nanmean(EQUITY(:,8:10),2);

average_BankEquity_DE=nanmean(EQUITY(:,11:12),2);

average_BankEquity_ITA=nanmean(EQUITY(:,13:15),2);

average_BankEquity_NET=nanmean(EQUITY(:,16:17),2);

average_BankEquity_ES=nanmean(EQUITY(:,18:19),2);

average_BankEquity_UK=nanmean(EQUITY(:,20:23),2);

average_BankEquity_SWE=nanmean(EQUITY(:,24:25),2);

average_BankEquity_POR=nanmean(EQUITY(:,26:27),2);

average_BankEquity_AT=nanmean(EQUITY(:,28:29),2);

BankEquity=[EQUITY(:,1) EQUITY(:,2) EQUITY(:,3) average_BankEquity_IRE average_BankEquity_BEL average_BankEquity_FR average_BankEquity_DE average_BankEquity_ITA average_BankEquity_NET average_BankEquity_ES average_BankEquity_UK average_BankEquity_SWE average_BankEquity_POR average_BankEquity_AT];
```

```
Return_BankEquity=NaN(TF-1,size(BankEquity,2));
for i=1:size(BankEquity,2)
    Return_BankEquity(:,i)=BankEquity(1:TF-1,i)./BankEquity(2:TF,i)-1;
End

%Let's compute the third set of control variables regarding banking fundamentals: Eurostoxx600Banks
Stx600=NaN(TF-1,1);
Stxx600(1:TF-1,1)=STXX600(1:TF-1,1)./STXX600(2:TF,1);



%Let's compute the variables we need for the regression in the first period
D1=SP1*P;
BANKSSP1=log_BankCDS(TF-SP1:TF-1,:);
log_BankCDS_SP1=BANKSSP1(:,:);
SOVSP1=log_SovCDS(TF-SP1:TF-1,:);
log_SovCDS_SP1=SOVSP1(:,:);
VDAXSP1=Vdax(TF-SP1:TF-1,:);
EQUITYSP1=Return_BankEquity(TF-SP1:TF-1,:);
equity_SP1=EQUITYSP1(:,:);
 STXX600SP1=Stxx600(TF-SP1:TF-1,:);

%Let’s export this file
filename1='SP1.xlsx';
xlswrite(filename1,log_BankCDS_SP1,1);
xlswrite(filename1,log_SovCDS_SP1,2);
xlswrite(filename1,VDAXSP1,3);
xlswrite(filename1,equity_SP1,4);
xlswrite(filename1,STXX600SP1,5);

%Let’s redo the same for the second period
BANKSSP2=log_BankCDS(TF-SP1-SP2:TF-SP1-1,:);
log_BankCDS_SP2=BANKSSP2(:,:);
SOVSP2=log_SovCDS(TF-SP1-SP2:TF-SP1-1,:);
```

```
log_SovCDS_SP2=SOVSP2(:,:);
VDAXSP2=Vdax(TF-SP1-SP2:TF-SP1-1,:);
EQUITYSP2=Return_BankEquity(TF-SP1-SP2:TF-SP1-1,:);
equity_SP2=EQUITYSP2(:,:);
STXX600SP2=Stxx600(TF-SP1-SP2:TF-SP1-1,:);

filename2='SP2.xlsx';
xlswrite(filename2,log_BankCDS_SP2,1);
xlswrite(filename2,log_SovCDS_SP2,2);
xlswrite(filename2,VDAXSP2,3);
xlswrite(filename2,equity_SP2,4);
xlswrite(filename2,STXX600SP2,5);

%Let's redo the same for the third period
BANKSSP3=log_BankCDS(TF-SP1-SP2-SP3:TF-SP1-SP2-1,:);
log_BankCDS_SP3=BANKSSP3(:,:);
SOVSP3=log_SovCDS(TF-SP1-SP2-SP3:TF-SP1-SP2-1,:);
log_SovCDS_SP3=SOVSP3(:,:);
VDAXSP3=Vdax(TF-SP1-SP2-SP3:TF-SP1-SP2-1,:);
EQUITYSP3=Return_BankEquity(TF-SP1-SP2-SP3:TF-SP1-SP2-1,:);
equity_SP3=EQUITYSP3(:,:);
STXX600SP3=Stxx600(TF-SP1-SP2-SP3:TF-SP1-SP2-1,:);

filename3='SP3.xlsx';
xlswrite(filename3,log_BankCDS_SP3,1);
xlswrite(filename3,log_SovCDS_SP3,2);
xlswrite(filename3,VDAXSP3,3);
xlswrite(filename3,equity_SP3,4);
xlswrite(filename3,STXX600SP3,5);

%Let's redo the same for the fourth period
BANKSSP4=log_BankCDS(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,:);
log_BankCDS_SP4=BANKSSP4(:,:);
SOVSP4=log_SovCDS(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,:);
```

```
log_SovCDS_SP4=SOVSP4(:,:);
VDAXSP4=Vdax(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,:);
EQUITYSP4=Return_BankEquity(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,:);
equity_SP4=EQUITYSP4(:,:);
STXX600SP4=Stxx600(TF-SP1-SP2-SP3-SP4:TF-SP1-SP2-SP3-1,:);

filename4='SP4.xlsx';
xlswrite(filename4,log_BankCDS_SP4,1);
xlswrite(filename4,log_SovCDS_SP4,2);
xlswrite(filename4,VDAXSP4,3);
xlswrite(filename4,equity_SP4,4);
xlswrite(filename4,STXX600SP4,5);

%Let's redo the same for the fifth period
BANKSSP5=log_BankCDS(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,:);
log_BankCDS_SP5=BANKSSP5(:,:);
SOVSP5=log_SovCDS(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,:);
log_SovCDS_SP5=SOVSP5(:,:);
VDAXSP5=Vdax(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,:);
EQUITYSP5=Return_BankEquity(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,:);
equity_SP5=EQUITYSP5(:,:);
STXX600SP5=Stxx600(TF-SP1-SP2-SP3-SP4-SP5:TF-SP1-SP2-SP3-SP4-1,:);

filename5='SP5.xlsx';
xlswrite(filename5,log_BankCDS_SP5,1);
xlswrite(filename5,log_SovCDS_SP5,2);
xlswrite(filename5,VDAXSP5,3);
xlswrite(filename5,equity_SP5,4);
xlswrite(filename5,STXX600SP5,5);


%Now we upload the file on Stata and run the regression model
set more off
set mat 800
```

```
cd "C:\Users\Standard\Desktop\Tesi_Bottero"

*Let’s run a loop
forvalues f = 1/5 {
*Let’s run a loop to upload sheets which differentiate for country
	foreach sheet in "SOVCDS" "BANKCDS" "EQUITY" {
		import excel "SP`f'.xlsx", sheet("`sheet'") firstrow clear
		local n = 0
*Rename countries with a numerical id
		foreach var in GRE DEN NO IRE BEL FR DE IT NET ES UK SWE POR AT {
			local n = `n'+1
			ren `var' country`n'}
*Let’s generate the variable day
		gen day = _n
*Reshape: change the dataset to have every day a value for each country
		reshape long country@, i(day) j(idcountry)
*Rename the variable with the sheet name
		ren country `sheet'
		save "`sheet'", replace}
*Let’s upload the VDAX
	preserve
	import excel "SP`f'.xlsx", sheet("VDAX") firstrow clear
	gen day = _n
	ren VDAX Volatility
	save Volatility, replace
	restore

*Let’s upload the STXX600
	preserve
	import excel "SP`f'.xlsx", sheet("STXX600") firstrow clear
	gen day = _n
	ren STXX600 Eurostoxx600Banks
	save STXX600, replace
	restore
```

```
* Let's compone together the three dataset
	foreach sheet in "SovCDS" "BankCDS" {
		merge 1:1 idcountry day using `sheet', nogen}
	merge m:1 day using Volatility, nogen
	merge m:1 day using STXX600, nogen
* Let's set the panel data
	xtset idcountry day
	gen lag_BANKCDS = l.BANKCDS

*Compute the different version of the regression model
	xtreg BANKCDS SOVCDS  Volatility i.day, fe r
	outreg2 using regressioni_`f'_primo.doc, keep(BANKCDS SOVCDS Volatility) addtext(Fixed Effects, YES) replace

	xtreg BANKCDS SOVCDS  Volatility EQUITY i.day, fe r
	outreg2  using regressioni`f'_secondo.doc, keep(BANKCDS SOVCDS  Volatility EQUITY) addtext(Fixed Effects, YES) replace

	xtreg BANKCDS SOVCDS  Volatility EQUITY Eurostoxx600Banks i.day, fe r
	outreg2  using regressioni`f'_terzo.doc, keep(BANKCDS SOVCDS  Volatility EQUITY Eurostoxx600Banks) addtext(Fixed Effects, YES) replace

	xtreg BANKCDS SOVCDS  Volatility EQUITY Eurostoxx600Banks lag_BANKCDS i.day, fe r
	outreg2 using regressioni`f'_quarto.doc,keep(BANKCDS SOVCDS  Volatility EQUITY Eurostoxx600Banks lag_BANKCDS) addtext(Fixed Effects, YES) replace

}
```

Summary

This final dissertation aims to describe a complex phenomenon observable in Europe in the last decade and still active nowadays, the doom loop. This loop is a self-reinforcing cycle between the sovereign and the banking sector credit risk. It consists in a continuous transferring of credit risk from one sector to the other, without regard to where the shock started.

Our aim is to examine from every angle this vicious cycle. The first claim is that there was no relationship between the two sectors credit risks prior to the 2007-2008 Financial crisis. The second claim is that the public intervention, made by European governments to save distressed financial institutions after the Lehman Brothers collapse in 2008, instituted a credit risk transfer from the financial sector to the sovereign one. The third claim is that this transfer established a self-reinforcing loop where the credit risk is shared between the sovereign and the banking sector. After the bailouts, the credit risk moved quickly between them. The fourth claim is that measures thought to reduce or eliminate this self-reinforcing spiral were not effective, as shown in the above example. The fifth claim is that there is no real proposal able to bring the situation back to an uncorrelated relationship between the two.

The second chapter of the thesis will introduce the claims, show them graphically and discuss theories behind them. The third chapter will confirm or reject the claims through empirical analysis. The fourth chapter focuses on the fifth claim: it is a discussion on new proposals, not yet implemented, and their effectiveness, to mitigate the presence of the vicious cycle.

Several authors covered the themes dealt with in this study. We can divide their contributions into three main groups.

A first group analysed the initial risk transfer mechanism from the financial sector to the sovereign one and the role of bailouts. Among them, we can find the contributions of Acharya, Yorulmazer (2007), Attinasi, Checerita, Nickel (2009 and Ang, Longstaff (2011).

The main reference study for the topic is Acharya, Drechsler and Schnabl (2013). Their paper analysed the doom loop and the risk transfer mechanism from the banking sector to the sovereign via public intervention. They built a theoretical model, and together provided an empirical study confirming the existence of the doom loop.

A second group focused only on the existence of the vicious cycle. The main studies were done by Gennaioli, Martin, Rossi (2013), Alter and Beyer (2014), Alter and Schueler (2012), Fratzscher and Rieth (2015), Angelini, Grande & Panetta (2014).

The third group started from the assumption of an existing vicious cycle and tested proposals to eliminate the phenomenon. Authors in this group are Brunnermeier et al. (2011), Brunnermeier et al. (2016), Merler and Pisani-Ferry (2012), Covy, Eydman (2016) and Breton et al. (2012).

In this paper, we analyse the relationship between the credit risk in the banking sector and in the sovereign one in different periods. The timeframe selected to analyse the existence of the doom loop is composed by observations between January 2nd, 2007 and August 31st, 2018, divided into five different subperiods. We build a pre-bailout period, composed by all observations from the beginning of the timeframe until the September 26th, 2008. The second period is the one-month period in which all European countries announced a rescue programme for banks and started the first public interventions in troubled financial institutions, from September 27th, 2008 to October 28th, 2008. The third subperiod, or post-bailout period, involves all the observations remaining from the bailout period to July 26th, 2012. That is the date in which ECB's president Mario Draghi started the implementation of non-standard monetary policies. The fourth subperiod lasts from Draghi's speech to when the bail-in provision comes into force on January 1st, 2016. Last period involves all remaining observations until the end of the time frame.

The chosen variable to compute the credit risk is the 5-year CDS spread measured in Euro. This measure embraces all the characteristics required for a measure of credit risk to be used in an empirical study. Indeed, since it is a market base risk measure, it is liquid and available. There is no need to choose a risk-free rate, and so it has a greater standardization.

In our sample we select all G-SII and O-SII European banks, the one recognized by the European Banking Authority for their systemic relevance, with a that were active before Financial crisis, had publicly traded CDS throughout the analysis period and for which was possible to obtain those data, and all the European countries for which was possible to obtain those data.

Firstly, we prove that the banking sector and the sovereign sector were decoupled prior to the 2007-2008 Financial crisis, in terms of credit risk. Indeed, there was no documented relationship between the two sectors, meaning debt instruments issued by banks and governments were uncorrelated, and the prevailing view was that no relationship was expected to be in the future.

Secondly, we show that bailouts in Europe starting from the end of September 2008 transferred the credit risk from financial institutions to sovereign entities. We debate different case studies regarding several European countries, and we provide graphical proofs.

Thirdly, we analyse how these bailouts established a loop between the banking and the sovereign sector credit risks. European countries were forced into a self-reinforcing loop characterized by sovereign difficulties, bank system troubles and economic recession. This loop has been often described as a spiral and not only a loop. Indeed, once a shock, in the financial sector or the sovereign one, has set in motion the risk transfer, the loop operates as a self-reinforcing feedback. If the crisis hit first sovereign, the risk would be transferred to the banking sector using one of the channels described in the next paragraph, and once this sector suffers the crisis, the government would be forced to step up paying this intervention through an increase in taxation, which generates recession and worsen the sovereign situation. At the same time, distressed banks experience problems in funding. This credit crunch leads to a greater recession, and, again, a worsening in the sovereign situation. And so again and again.

In particular, there is a section that analyses the different channels form which financial sector distress could affect the sovereign sector and vice versa. A fundamental mechanism for our purpose is the home bias phenomenon. The home bias consist in the giant domestic sovereign exposure of European banks. This can cause a spread of the credit risk from the sovereign sector to the banking one since the variation in markets belief on government's creditworthiness can cause losses or gains on bank's portfolios of sovereign securities and alter a bank reputation, via its existing loans to the government.

Fourthly, we study the implemented measures to end the vicious cycle.

We study the introduction of non-standard monetary policy by the European Central Bank. Indeed, on July 27th, the ECB president Mario Draghi pronounced the famous speech "Whatever it takes", meaning that the ECB would have use all the tools necessary to support the troubled sovereign entities that were still suffering from the public interventions needed to save the financial institutions in the aftermath of the 2007-2008 Financial crisis. The most important one was the Quantitative Easing, an expanded asset purchase programme of €60 billion per month of euro-area bonds from central governments, agencies and European institutions. The result of these policies was clearly to decrease greatly the absolute value of the credit risk in both the financial and the government sector. But the unexpected result was to reinforce the doom loop phenomenon through the described channels and in particular the home bias.

We analyse also the implementation of the BRR Directive, the European regulatory framework thought to manage at a Community level the recovery and the resolution of financial institutions. In particular, we concentrate on the main provision, the bail-in tool, which is aimed to remove the burden of the bank' failure from taxpayers, sharing it between debt instruments holder through a so-called liability cascade. In case of bankruptcy, not only equity, but also debt instruments are converted into equity.

As empirical verification, we look graphically and numerically at the absolute and percental value change in the CDS spread for the banking sector and the government in all the countries in the sample. Then we run a correlation analysis between the daily observation in the financial sector and in the sovereign one. Finally, we assume the risk transfer mechanism from the financial sector to the sovereign one and build a regression model which prove how the sovereign sector changes had an effect on the banking sector too. Different versions of the model approach endogeneity problems that could arise, mainly the omitted variable bias and the reverse causality.

As shown in the final version of the model below, results prove:

1. the absence of any relations between the financial sector and the government one in the pre-bailout period;
2. the credit risk transfer mechanism effect from the banking sector to the sovereign one due to the bailouts;
3. the existence of a vicious cycle in the post bailout period;
4. the even greater interconnection between the sovereign and the banking sector credit risk, after the implementation of non-conventional monetary policies;
5. the slight reduction effect obtained with the bail-in tool introduction.

TABLE

The following table shows the effect of the sovereign CDS spread and other control variables on the banking sector CDS spread in the pre-bailout period, from 2/1/2007 to 26/9/2008, in the bailout period, from 29/9/2008 to 28/8/2008, in the post-bailout period, from 29/8/20008 to 26/7/2012, in the period in which where introduced non-standard monetary policy, from 26/7/2012 to 31/12/2015 and finally in the bail-in introduction period, from the 1/1/2016 until 31/8/2018. $\Delta \log(Sovereign\ CDS_{it})$ is the daily logarithmic change in the CDS spread of country i at the date t. ΔVolatility is the daily change in the VDAX index. ΔEquity is the daily change in the common stock price for banks in country i at the date t. ΔEurostoxx600Banks is the daily change in the stock market index Eurostoxx 600 Banks. Δlog (Bank CDS) at t-1 is the daily logarithmic change in the CDS spread of country i at the date $t-1$. In parenthesis are shown the robust standard errors. Stars show statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

	Δlog (Bank CDS)				
Variables	**Pre-Bailout**	**Bailout**	**Post-Bailout**	**Non-standard monetary policies**	**Bail-in Introduction**
Δlog (Sovereign CDS)	0.0120 (0.0104)	-0.0842 (0.0695)	0.0504** (0.0192)	0.0844*** (0.0271)	0.0713*** (0.0181)
ΔVolatility	0.785 (0.503)	0.216 (0.487)	-0.930** (0.400)	0.778** (0.268)	-0.712* (0.365)
ΔEquity	-0.0829 (0.0581)	-0.172 (0.111)	-0.0162 (0.0179)	-0.0165 (0.0373)	-0.00140 (0.000997)
ΔEurostoxx600Banks	2.683 (4.075)	0.974* (0.485)	1.636*** (0.516)	0.258 (0.276)	-3.166** (1.371)
Δlog (Bank CDS) at t-1	-0.0563* (0.0317)	-0.0590 (0.0703)	-0.0199 (0.0257)	-0.0775* (0.0411)	-0.149** (0.0552)
Constant	-3.477 (4.573)	-1.233 (0.958)	-0.907*** (0.298)	-1.058* (0.527)	3.866** (1.732)

Observations	3,783	293	12,893	11,213	7,360
Number of idcountry	14	14	14	14	13
R-squared	0.527	0.428	0.495	0.357	0.305
Country Fixed Effects	YES	YES	YES	YES	YES
Day Fixed Effects	YES	YES	YES	YES	YES

A specific section provides an analysis of the home bias phenomenon through the stress tests exercises conducted by the EBA. It shows how the domestic sovereign exposure was already high during the financial Crisis, confirming the main channel due to which the doom loop was established. It proves also how the expansive monetary policies implemented by the ECB increased the domestic sovereign exposure, worsening the vicious cycle in Europe.

The last part of the final dissertation discusses what are the main limits to the real implementation of a European Banking Union which would ensure soundness to the European financial sector eliminating the interdependence between the credit risk in the banking and in the sovereign sectors. It also analyses advantages and drawbacks of the main proposals thought to eliminate the vicious cycle.

Among them, we analyse firstly the introduction of a block to sovereign exposure and/or a bail-in tool for sovereign entities too, proposed from Dutch and German economists, and vetoed from almost all Community member states for the perspective of a worsening credit condition. Then we present the implementation of a risk weighted scheme even for the sovereign exposure in the capital requirements provision in the Basel Accords, already rejected at a European level for the fear to lose the stabilising role banks have acting as contrarian investors in periods of crisis. Finally, the last proposal analysed is the creation of a safe asset, in different forms. The idea is to create an asset to be held by European banks reducing the sensitivity of their portfolios to the sovereign risk. One proposal regards the creation of a Eurobond issued directly from a European Union entity, with the main drawback in the opposition of the northern Europe countries to share a greater credit risk with southern Europe ones. The other is to create a safe asset through the securitization of a well-diversified portfolio of debt instruments issued by the different Eurozone member states, with a senior tranche to be held by banks and a junior tranche interesting for investment firms.

The conclusion regards my opinion: the main problem in fighting the doom loop is intrinsic to the nature of the relationship between European member states nowadays. Indeed, every state is interested in getting the advantages of a Community while they are not interested in giving up their powers, not even a little, to reach a real unity. Member states want to be ensured at a European level with the Banking Union, but they are not willing to split the risk.