Credit Spread Interdependencies of European States and Banks during the Financial Crisis

Adrian Alter , Yves Stephan Schüler*

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Abstract

This study analyzes the relationship between the default risk of several European states and financial institutions during the period June 2007 - May 2010. It investigates how bank bailout schemes affected this linkage. We consider sovereign credit default swap (CDS) spreads from seven Eurozone member states (France, Germany, Italy, Ireland, Netherlands, Portugal, and Spain) together with a selection of bank CDS series from these states. Our main findings suggest that in the period preceding government rescue schemes the contagion from bank credit spreads disperses into the sovereign CDS market. After government interventions, due to changes in the composition of both banks' and sovereign balance sheets, our results underline the augmented importance of the government CDS spreads in the price discovery mechanism of banks' CDS series. Furthermore, a financial sector shock affects more strongly the sovereign CDS spreads in the short-run, however the impact becomes insignificant at a long horizon. Our analysis emphasizes heterogeneous outcomes across countries but homogeneous across domestic banks.

JEL-Classification: C58, G01, G18, G21.
Keywords: credit default swaps, private-to-public risk transfer, bank bailout, cointegration, generalized impulse responses.

*University of Konstanz, Germany; Department of Economics; Chair of International Finance, Chair of Statistics and Econometrics; **adrian.alter@uni-konstanz.de**, **yves.stephan.schueler@uni-konstanz.de**

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"The scope and magnitude of the bank rescue packages also meant that significant risks had been transferred onto government balance sheets. This was particularly apparent in the market for CDS referencing sovereigns involved either in large individual bank rescues or in broad-based support packages for the financial sector."

(BIS, December 2008, p. 20)

1 Introduction

During the recent financial crisis extraordinary measures were taken by central banks and governments to prevent a potential collapse of the financial sector that threatened the entire economy. However, the effects on the interdependence of the financial and the sovereign sector were widely unknown. Gray (2009, p. 128) argues that "regulators, governments, and central banks have not focused enough on the interconnectedness between financial sector risk exposures and sovereign risk exposures and their potential interactions and spillovers to other sectors in the economy or internationally". The lack of theoretical macroeconomic models that are able to incorporate contagion mechanisms between government and financial sector amplified the uncertainty related to implications of government interventions. Nevertheless, regulators and policy makers need to understand the complex dynamics of the risk transmission in order to be able to formulate effective policies and to be aware of the risk transferred from the financial to the public sector.

Why should banks' and sovereign default risk be related? As pointed out by Gray et al. (2008), using arguments from the contingent claims analysis (CCA)[1], there are several channels linking the banking and sovereign sector, which are impacted on by the implicit as well as the explicit guarantees. A systemic banking crisis can induce a contraction of the entire economy, which weakens public finances (e.g. by a decrease of the present value of taxes) and, thus, transfers the distress to the government. This contagion effect is amplified when state guarantees exist for the financial sector. As a feedback effect, risk is further transmitted to holders of sovereign debt. An increase in sovereign debt costs leads to the devaluation of the government debt that impairs banks' balance sheets that hold these assets. In a contemporaneous paper, Acharya et al. (2011) use the term "two-way feedback" to describe these interdependencies. The authors construct a novel theoretical framework to model the link between bank bailouts and sovereign credit risk, emphasizing the role of a country's legacy of debt in formulating an effective rescue scheme for the financial sector.

Empirically, this interconnectedness has been detected in the context of the recent financial crisis as well. For instance, Gerlach et al. (2010) find that as a consequence of macroeconomic imbalances, especially for peripheral European countries (e.g. Greece, Ireland), a jump in bond and credit default swap (CDS) spreads for sovereigns is transmitted to the banking sector. Fur-

[1]This approach is based on Merton's and Black-Scholes'(1973) option pricing work. It can also be employed for measuring the sovereign-banks interaction, taking into account the implicit and explicit contingent liability for the financial system.

thermore, the authors claim that systemic and sovereign risk became more interwoven after governments issued guarantees for banks' liabilities. This result is supported by Ejsing and Lemke (2011) who argue that the sensitivity of sovereign CDS spreads to the intensifying financial crisis increases after the bailout of the financial sector. Dieckmann and Plank (2010) present evidence for a private-to-public risk transfer in the countries where governments stabilized the financial system after the Lehman Brothers' event as well. Banks' and sovereign CDS became closely linked: financial institutions hold important amounts of government debt and states bearing vital contingent liabilities for the financial system. Furthermore, Acharya et al. (2011) provide empirical evidence for the interconnection of the financial and sovereign sector credit risk implied by bailout programs.

This paper proposes a new way to investigate changes in the interdependence of bank and sovereign credit risk in the euro area. We study the lead-lag relation between government's and bank's default risk with a focus on the effect of bank bailouts in the midst of the recent financial crisis. First, we research whether prior to government interventions an increase in default risk of banks and states originates mainly from the financial sector. Furthermore, we try to answer if public contingent liabilities to the financial sector affected government's default risk. In tandem, this study examines whether default risk of the banking sector is influenced by the sovereign default risk. Finally, our paper investigates the following two questions: 1) Does the perceived degree of a bank's participation in a national rescue scheme influence its dependency on the development of the sovereign spread? 2) Are country-specific bailout characteristics reflected in the impact of government bailout programs?

Methodologically, we consider the relationship between government and banks' CDS spreads, as they provide a proxy for the risk of default.[2] We conduct this analysis by applying the theory of cointegration, Granger-causality, and impulse responses to CDS series, which are able to capture changes in the dynamic relation between government and bank credit risk. We consider sovereign CDS from seven EU member states (France, Germany, Italy, Ireland, Netherlands, Portugal, and Spain) together with a selection of bank CDS from these states. We divide the analyzed period, i.e. June 2007 until May 2010, into two periods: 1) before bank bailout programs and 2) during and after government interventions.

Our main findings suggest: *in the period preceding government interventions* the contagion from bank credit spreads disperses into the sovereign CDS market. This finding can be interpreted as evidence for the systemic feature of the recent financial crisis. The default risk spills over from the financial system to the entire economy and questions the government's capacity to repay its liabilities. *After government interventions*, due to changes in the composition of both banks' and sovereign balance sheets, we find augmented importance of the government CDS spreads in the price discovery mechanism of banks' CDS series. Furthermore, a financial sector shock affects more strongly the sovereign CDS spreads in the short-run, however the impact becomes insignificant at a long horizon. Differences in the perceived risk transferred from banks to the government

[2]The objective of this paper is not to investigate the accuracy of this proxy. Our research design takes this link as given, even though there might have been distortions in this proxy during the last turmoil.

leads to inconsistent results within the same country. Lastly, our cross-country analysis reveals noticeable differences in the outcomes of state interventions.

As also argued by Markose et al. (2010), there are only a few empirical studies that deal in depth with linkages within the financial system, especially through the usage of CDS spreads. Briefly, a CDS is a bilateral agreement that transfers the credit risk of a reference entity[3] from the "protection buyer" to the "protection seller". The former party pays a periodic fee to the latter party (the credit-risk taker), and in return is compensated in case of default (or similar credit event) of the underlying entity, with a payoff[4]. The CDS spread represents the insurance premium and is paid quarterly until either the contract ends or at the arrival of a credit event (e.g. default). CDS markets are intensively used as a proxy for credit risk. CDS volumes, in terms of total notional amount, peaked at $57 trillion in June 2008.[5]

The structure of this paper is organized as follows. In section 2 we discuss studies related to our research. Section 3 presents our hypotheses, the data, our sub-sample selection procedure, and the methodology. In Section 4 we present our results and Section 5 concludes.

2 Related Literature

A few papers analyze the effect of the financial crisis and the emerging government policies on the risk of default of financial or sovereign entities. Relying on a structural model,[6] Schweikhard and Tsesmelidakis (2009) conclude that credit and equity markets decoupled during the financial turmoil. They find support for the "too-big-to-fail" hypothesis, as some companies' debt holders benefited from government interventions and a shift of wealth from taxpayers to the creditors took place during the bailout programs. During the crisis some other factors might have influenced CDS prices (e.g. counterparty or liquidity risk). Researching on the determinants of CDS changes Collin-Dufresne et al. (2001) find that credit spreads are mostly driven by a systematic factor; however they are not able to identify it. Berndt and Obreja (2010) study determinant factors for European corporate CDS and identify the common factor, that explains around 50% of the variation, as the super-senior tranche of the iTraxx Europe index, referred as *"the economic catastrophe risk"*.[7]

Similar to our study, Dieckmann and Plank (2010) find evidence for a private-to-public risk transfer for the countries with government interventions in the financial system. By employing

[3]The reference entity can be a corporation, a sovereign, an index, or a basket of assets that bears credit risk.

[4]In the case of cash settlement only the difference between the par value of the bond (notional amount of the loan) and its recovery value when the credit event occurs is paid in cash by the protection seller. In the case of physical settlement the par value is paid in exchange for the physical underlying bond.

[5]According to the Bank for International Settlements (BIS, `http://www.bis.org/statistics/otcder/dt1920a.pdf`) at the end of June 2010 this market stood at around $30 trillion in terms of notional amounts outstanding. During this period the gross market value halved from about $3.2 trillion to $1.6 trillion.

[6]We use the term structural model to indicate a framework for pricing CDS spreads. In more detail, researchers try to replicate market prices by employing structural models or reduced-form ones. In this context, the well known Merton model can be regarded as a benchmark.

[7]The economic catastrophe risk can be interpreted as a total disfunction of the economy or as a sequence of sovereign defaults.

panel regressions the authors analyze the determinants of changes in sovereign CDS spreads and find that both domestic and international financial systems bear an important role in explaining the dynamics of the CDS spreads. They also argue that countries in the EMU[8] are more sensitive to the health of the financial system than non-EMU countries. Ejsing and Lemke (2011) use a seemingly unrelated regressions framework with time-varying coefficients in order to investigate the co-movement between the CDS spreads of Euro area countries and banks. Before October 2008 the common risk factor that explains much of the variation of these spreads is the iTraxx CDS index of non-financial corporations. The authors find that government bailout and guarantee programs for the financial sector induced a drop in the credit spreads for banks but a jump in governments' CDS spreads. Both papers identify as a structural break mid-October 2008, when first massive bank rescue packages were set up after the default of Lehman Brothers. Our study extends their analyses by providing details on the risk-transfer mechanism in several European countries via joining the cointegration and generalized impulse responses framework. Our research is one of the first studies to emphasize important changes in these linkages. We argue that our findings are mainly a consequence of the bank bailout programs and the heterogeneity in effects across European states is a result of the relative differences between the rescue schemes.

Using the contingent claims analysis for financial institutions, Castren and Kavonius (2009) identify the main channels that propagate risk within the euro area, by constructing a risk-based network from bilateral sector-level exposures. They claim that the financial sector plays an important role in transmitting shocks to the other sectors. Their paper reveals the mechanism that interconnects governments and financial institutions through the credit risk channel.

Furthermore, there are studies that solely investigate the sovereign bond market. Using a GARCH-in-mean model, Dötz and Fischer (2010) analyze the EMU sovereign bond spreads and find that the implied probability of default reached unprecedented values and the increased expected loss component made some sovereign bonds to loose their status of "safe haven" investment. Gerlach et al. (2010) analyze the determinants of Euro area sovereign bond spreads. They show that the size of the banking sector has an important explanatory value for the changes in bond spreads, suggesting that markets perceive countries with an important stake of this sector at higher risk of stepping up and rescuing the banks. Employing a dynamic panel Attinasi et al. (2009) highlight the main factors that explain the widened sovereign bond spreads in some Euro area countries for the period that covers the core part of the financial crisis in Europe.

Our study is also related to the literature that analyzes contributions to the price discovery of bond and CDS markets. For example Dötz (2007) studies European corporate entities listed in the iTraxx Europe index in a time-varying setup and finds support for a relatively equal contribution to the price discovery of both markets. During the credit turmoil in 2005, CDS markets' contribution fell dramatically, leaving space for the interpretation that CDS and bond markets are decoupling during turbulent times and that CDS prices might lag behind bond markets in price discovery for corporations. Since then, CDS markets consistently developed in terms of volume

[8] European Monetary Union

and market participants. Focusing on Euro area sovereigns, Fontana and Scheiche (2010) identify the main determinants of the bond and CDS spreads. They include in the set of explanatory factors proxies for market liquidity and global risk appetite and these are found to be significant. Furthermore, they employ a lead-lag analysis for bond and CDS markets and find that for Western economies[9] the cash market dominates, while for peripheral countries[10] the CDS market is more important in terms of price discovery.

3 Hypotheses, Data, and Econometric Methodology

3.1 Hypotheses

In this subsection we develop the hypotheses to be tested in our study. We firstly describe the main transmission channels that emerge when either a (systemic) banking crisis develops or sovereign distress appears. Based on Gray (2009) and IMF (2010), we present both directions of the contagion mechanism.

If a financial institution faces funding and/or liquidity issues, this can trigger a sharp rise in its default risk and may have specific contagion effects: *(I)* the bank cannot pay its obligations to another financial counterparty which in turn can set off funding/liquidity difficulties for the latter and increases its perceived default risk; *(II)* the state might intervene in order to prevent bankruptcy of banks. This private-to-public risk transfer augments the probability of default for the state and lowers the default risk of the financial institution. If *(I)* occurs, difficulties within the entire financial system (e.g. systemic banking crisis) might arise and translate into a contraction of the economy, which also weakens public finances (e.g. a decrease in the present value of taxes) and, thus, the sovereign default risk increases.

In the case of a country's distress, in the first wave, the contagion to other entities can be triggered via three direct channels (Chapter 1. of IMF (2010)): *(i)* from the affected state to other countries that are highly interconnected through bilateral trade, or share similar problems (e.g. public deficit, funding needs, etc.); *(ii)* from the distressed country to domestic banks as the market value of government bonds held by these banks decreases, and government support loses credibility;*(iii)* from the impaired state to foreign banks, that hold important government (or banks) bonds (or other assets) from the affected country.

Before government interventions, we argue that financial sector issues had a systemic component, leading to contagion mechanism *(I)*. Thus, the rising default risk of banks had an indirect effect on governments' credit risk. Additionally, state interventions in response to financial sector problems were possibly expected by market participants. Thus, the perceived sovereign default risk augmented but was considered of limited importance for heaving a visible impact on banks' default risk.

[9] France, Germany, Netherlands, Austria, and Belgium.
[10] Greece, Italy, Ireland, Spain, and Portugal.

Hypothesis 1. *Prior to state interventions, changes in the default risk of banks impact on the default risk of European governments, but not vice-versa.*

After government interventions, states do not only bear an asset exposure to the banking sector but their balance sheets contain contingent liabilities (e.g. government guarantees) as well. Thus, the sensitivity of government default risk to the banking sector risk is expected to increase. Furthermore, through the *credibility* of government contingent liabilities, changes in government default risk directly impact on the perceived risk of financial institutions.

Hypothesis 2 (a). *Changes in the default risk of banks impact on the default risk of states stronger in the period after government interventions than before.*

Hypothesis 2 (b). *After bailout programs, an increase/decrease in government's default risk affects the default risk of the domestic banks in the same direction.*

The following hypothesis links the sensitivity of the banks's default risk to the extent of government support.

Hypothesis 3. *The sensitivity of the bank to the government risk of default increases with the perceived risk transferred from the bank to the government.*

Our last hypothesis compares the outcome of bailout programs in different countries.

Hypothesis 4. *Heterogeneity of bailout programs across European countries translates into asymmetric interdependence between states' and banks' default risk.*

3.2 Bailout Specific Characteristics

In order to compare the selected countries, we relate our analysis to the specific bailout schemes provided in each country. Hence, we look at the magnitude of different support measures utilized by each country, while additionally considering the particular aid for each bank. Following Stolz and Wedow (2010), we categorize the general set of measures emphasizing the differences and similarities across countries. Even though there is a discrepancy in the number and types of institutions involved in the banking crisis management, there is less variation across countries in what types of support measures were applied. The financial aid programs can be classified into four broad categories: capital injections, guarantees for bank liabilities, asset support programs, and deposit insurance (see Table 1).

Based on the ratios of total commitment to GDP, the selected countries can be ranked (from high to low): Ireland, Netherlands, Germany, Spain, France, Portugal, and Italy. Furthermore, the set of countries can be clustered into three groups: Ireland (high commitment); Netherlands, Germany, Spain, France (medium commitment); Portugal and Italy (low commitment).

Table 1: Government Support Measures to Financial Institutions (October 2008 - May 2010)

Country	**Capital injection**		**Liability guarantees**		**Asset support**		**Total commitment**	**Deposit insurance**
	Within Schemes	Outside Schemes	Guaranteed issuance of bonds	Other guarantees, loans	Within Schemes	Outside Schemes	as % 2008 GDP	in EUR
France	8.3 (21)	3	134.2 (320)	0	- (-)	-	18%	70,000
Germany	29.4 (40)	24.8	110.8 (400)	75	17 (40)	39.3	25%	Unlimited
Ireland	12.3 (10)	7	72.5 (485)	0	8 (90)	-	319%	Unlimited
Italy	4.1 (12)	-	- (-)	0	- (50)	-	4%	103,291
Netherlands	10.2 (20)	16.8	54.2 (200)	50	- (-)	21.4	52%	100,000
Portugal	- (4)	-	5.4 (16)	0	- (-)	-	12%	100,000
Spain	11 (99)	1.3	56.4 (100)	9	19.3 (50)	2.5	24%	100,000

Note: All amounts are in billions of EUR, except for the last two columns. Figures (in brackets) denote totally committed funds and figures (outside brackets) are utilized amounts up to May 2010. "Within schemes" refer to a collective bailout program that can be accessed by any bank that fulfills the requirements for that particular aid scheme. "Outside schemes" refer to individually tailored aid measures (ad-hoc schemes). *Source*: Stolz and Wedow (2010)

3.3 Data and Sub-Sample Selection

We use daily CDS spreads collected from Datastream[11], for seven European countries together with two banks from each country, i.e. in total 21 institutions: **France (FR)**, BNP Paribas (BNP), Société Générale (SG), **Germany (DE)**, Commerzbank (COM), Deutsche Bank (DB), **Italy (IT)**, Intesa Sanpaolo (ISP), Unicredito (UCR), **Ireland (IR)**, Allied Irish Banks (AIB), Bank of Ireland (BOI), **Netherlands (NL)**, ABN Amro Bank (ABN), ING Group (ING), **Portugal (PT)**, Banco Comercial Portugues (BCP), Banco Espirito Santo (BES), and **Spain (SP)**, Banco Santander (BS), Banco Bilbao Vizcaya Argentaria (BBVA).[12] All banks are important financial institutions, with most of them belonging to the iTraxx Europe index (8 out of 14). The selection of bank and sovereign CDS series was restricted by data availability. In terms of CDS spreads we decided to use contracts on senior unsecured debt with 5 years maturity, as they are the most liquid ones.

Our sample covers the time span from 1 June 2007 until 31 May 2010 and includes 772 observations of daily data for each of the selected series.[13] Graphs of the development of the CDS levels for all 21 series are presented in Appendix B (in subsections for each country). Prior to the econometric analysis, we log-transform the CDS levels as suggested by Forte and Pena (2009). We further motivate this step by relatively low levels of the CDS for the sovereigns in the first stages as compared to the last stages (wide data range).

Our aim is to analyze the linkages between bank's and sovereign CDS spreads in a two sub-period setup: 1.)before and 2.)during and after bank aid schemes. In order to capture other structural breaks, we follow BIS (2009) and divide the entire time span into six stages[14]. We group the first two stages (i.e. Stage 1+2) to form the sub-period before government interventions and the last three stages (i.e. Stage 4+5+6) to constitute the sub-period during and after bank aid schemes.

[11] We downloaded CDS data from Datastream, which in turn is provided by Credit Market Analysis (CMA).

[12] In parentheses are defined the abbreviations for later use.

[13] In the case of Ireland the sample starts on 4 October 2007 because of inconsistencies with the data obtained from Datastream.

[14] BIS (2009) covers only our first five stages, starting with 1 June 2007 until 31 March 2009 when Stage 5 emerges. For the time span that was not included in the latter study we define a sixth stage. The last stage is selected to start based on developments in the sovereign CDS market at the end of 2009.

Stage 3 is regarded as a period of market adjustments and it is neglected. When issues concerning structural breaks appear in our stability analysis (see Section 3.4), we analyze stages in combinations (i.e Stage 4+5, Stage 5+6) or individually.

The first stage runs from June 2007 until mid-March 2008 and contains 203 observations. This period is characterized by financial stress which has been triggered by fears on losses due to US subprime mortgage loans and the spillover to European banks (e.g. IKB Deutsche Industriebank, BNP Paribas). Second stage emerges in March 2008, with the liquidity shortage of Bear Stearns. This time span consists of 126 observations and ends in mid-September 2008, with the collapse of Lehman Brothers. BIS (2009) defines the third stage from mid-September until late October 2008. As this stage includes only 30 observations we exclude it from our analysis. In this period, first government policy measures are taken.[15] Additionally, coordinated actions of major central banks try to control the situation. The fourth stage is defined from late October 2008 to mid-March 2009 and contains 98 observations. This period is marked by concerns about deepening global recession. By issuing the guidelines[16] for European states, the European Commission gives green light for government bailout programs. Stage 5 starts in mid-March 2009 when the first signs of recovery appear. Announcements of central banks concerning balance sheet expansions, the range and the amount of assets to be purchased lead to an important financial markets relief. The fifth stage ends on 30 November 2009, right before the inception of sovereign debt crisis in Europe. This stage includes 143 observations. Stage 6, the last one in our sample, begins in December 2009 and ends in May 2010. It consists of 172 observations. This period is driven by concerns about European sovereign debt. In May 2010, European governments set up a rescue fund for aiding states in trouble.

3.4 Econometric Methodology

In order to analyze the dynamics of the short- and long-run interdependency between selected CDS series, this study employs a bivariate vector error correction (VEC)[17] and bivariate vector autoregressive (VAR) framework. Besides interpreting the cointegration relations, we additionally conduct tests on Granger-causality and consider impulse responses in order to describe the entire dynamics between the CDS spreads.

We conduct our analysis by considering two main sub-periods: before and during/after government bailouts. Results from the Granger-causality and impulse response analysis are reported for these two periods. Only the study of the long-run relations, i.e. using the VEC framework, makes use of further sub-samples if required. In more detail, if tests (see below) do not provide evidence for cointegration relations for a certain stage we consider sub-periods. Also if stability

[15] E.g. UK authorities intervene in an attempt to relief the "pressure on financial stocks through a suspension of short selling" (BIS, 2009, p.27) on some financial products.

[16] IP/08/1495

[17] During tranquil times we believe that the CDS series of the financial as well as government sector are stationary. However, during times of market turmoil we argue that both CDS series (i.e. bank and sovereign CDS) are impacted by the same stochastic trend, because both are linked by channels as expressed in Subsection 3.1.

of a cointegration space is rejected we consider a finer grid for the time periods. For investigating this, we consider recursively estimated eigenvalues as proposed by Hansen and Johansen (1999).[18] If there is no evidence for a (stable) cointegration relation on the finer grid as well, we report none for the entire stage before or during/after government interventions. Please note, impulse responses are obtained using the VEC framework if available for the two main periods; in other words, if a specific setup passes our testing procedure just described. If not, we obtain the impulse responses from a VAR, in which variables are modeled in $\log$-levels. Granger-causality tests in this paper refer to Wald tests on lag augmented VARs as proposed by Dolado and Lütkepohl (1996). This test is chosen as it guarantees the validity of the asymptotic distribution of the test statistic even when there is uncertainty about the cointegration properties and stationarity of the variables.

Firstly, we apply the standard[19] unit root (stationarity) testing procedures to the respective time series in each sub-sample. We do not analyze systems of CDS series in a vector error correction model (VECM) if there is evidence that one or both series are stationary as in this case they cannot share a joint stochastic trend. For detecting a common stochastic trend, this study considers on the one hand Engle-Granger ADF test and on the other hand Johansen's trace and maximum eigenvalue tests. The latter tests focus only on the setup with a restricted constant, as argued before, any deterministic trend in the variables or cointegration relation is economically unjustified. When a common stochastic trend is detected by one of the previous tests and stability of the cointegration space is not rejected, we model the series in a VECM framework. If not, we proceed as described above. In finalizing our exact specifications of the models we determine the optimal lag order p by, on the one hand, minimizing one of the common information criteria[20] and on the other taking care of remaining serial correlation in the residuals.[21] The VECM is estimated by Johansen's maximum likelihood procedure and the VAR model via ordinary least squares. In our setup, i.e. with a sovereign CDS spread (in short $'Sov'$) and a selected domestic bank CDS spread (in short $'Bk'$), a VECM with $p-1$ lags can be written as follows:[22]

$$\begin{pmatrix} \Delta cds_{Sov,t} \\ \Delta cds_{Bk,t} \end{pmatrix} = \begin{pmatrix} \alpha_{Sov} \\ \alpha_{Bk} \end{pmatrix} (\beta_{Sov} cds_{Sov,t-1} + \beta_{Bk} cds_{Bk,t-1} + \beta_0) + \sum_{i=1}^{p-1} \begin{bmatrix} \gamma_{SovSov,i} & \gamma_{SovBk,i} \\ \gamma_{BkSov,i} & \gamma_{BkBk,i} \end{bmatrix} \begin{pmatrix} \Delta cds_{Sov,t-i} \\ \Delta cds_{Bk,t-i} \end{pmatrix} + u_t, \quad (1)$$

where $cds_{j,t}$ with $j \in (Sov, Bk)$ refers to $\log CDS_{j,t}$, i.e. the logarithmized CDS series of the

[18] Cointegration results are only reported for the stages that pass the stability test using the 1% critical value as a decision boundary.

[19] The tests utilized are the Augmented-Dickey-Fuller (ADF), Phillips-Perron (PP), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test.

[20] Aikaike information criterion, Hannan Quinn criterion, Schwarz criterion, and final prediction error

[21] When applicable, we also look at the plots of the cointegration relations in order to check whether these can be argued to be stable. The plot is expected to a show a time series that fluctuates nicely around some mean

[22] We use the notion of $p-1$ lags, to remind of the fact that a VECM($p-1$) has a VAR(p) representation.

country or bank. $\Delta cds_{j,t}$ denotes the first differences of $cds_{j,s}$. β_0 is a (restricted) constant, and u_t is assumed to be $wn(0, \Sigma_u)$[23]. γ coefficients portray the short-run dynamics. In contrast, the β coefficients describe the long-run relationship between banks and sovereign log-CDS spreads. β_{Sov} is normalized (i.e. $\beta_{Sov} = 1$) and only β_{Bk} is estimated. The loading coefficients, α, measure *the speed of adjustment* with which a particular CDS adjusts to the long-run relationship. The adjustment forces start acting, whenever the long-run relation (defined by $\beta' y_{t-1} = 0$, where $y_{t-1} = (cds_{Sov,t-1},\ cds_{Bk,t-1})'$) is out of equilibrium, i.e. if $\beta' y_{t-1} \neq 0$. In case that α_{Sov} is significant and has an opposite sign to β_{Sov} (i.e. in our setup $\alpha_{Sov} < 0$) it means that the "Sovereign" is driven by the error correction mechanism. Or put differently, that it adjusts back to the long-run equilibrium defined by $\beta' y_{t-1} = 0$, whenever $\beta' y_{t-1} \neq 0$. Equivalently, when α_{Bk} is significant and has an opposite sign to β_{Bk}, it shows the speed of adjustment of the "Bank" to the equilibrium. With both α-coefficients being significant and having opposite signs to their respective β-coefficients, the variables are said to be in a real cointegration relationship; both series are taking part in the error correction mechanism. Whenever one of the α-coefficients is not significant, it means that the respective variable can be argued to provide the stochastic trend that determines the long-run relation. This can be formally tested using a Likelihood Ratio test through a zero restriction on this parameter. If the restriction cannot be rejected, the variable of the respective α coefficient is called *weakly exogenous*. Furthermore, it is not adjusting at all in case that the variables are not in long-run equilibrium, $\beta' y_{t-1} \neq 0$. Whenever one α coefficient is significant but with the same sign as the respective β parameter, the variable is said not to be part of the error correction mechanism as the forces in the model do not attract both series back to equilibrium. Series in this setup can only define a long-run relation if the variable that is in a formal error correction relation adjusts faster to the new equilibrium than the other one. One can think of this phenomenon in a way that the variable which is not part of the error correction mechanism moves the entire equilibrium (i.e. when the variable increases in value the long-run equilibrium will be established with both series achieving a higher value). In the literature the term overshooting[24] is used to describe this occurrence.

The bivariate VAR setup with p-lags can be written as in the following:

$$\begin{pmatrix} cds_{Sov,t} \\ cds_{Bk,t} \end{pmatrix} = \nu + \sum_{i=1}^{p} \begin{bmatrix} \alpha_{SovSov,i} & \alpha_{SovBk,i} \\ \alpha_{BkSov,i} & \alpha_{BkBk,i} \end{bmatrix} \begin{pmatrix} cds_{Sov,t-i} \\ cds_{Bk,t-i} \end{pmatrix} + u_t, \tag{2}$$

where ν is a vector of intercepts and the αs refer to the respective VAR coefficients.[25]

For a global view on the interrelations of the series we employ *generalized impulse responses* (GIR) as proposed by Pesaran and Shin (1998). Routinely the analysis of impulse responses is carried out via the application of the Cholesky decomposition. However, the researcher has to

[23] wn stands for "white noise" and refers to a discrete time stochastic process of serially uncorrelated random variables with the above mentioned first two moments.

[24] For a discussion of a model with overshooting please refer to Hansen and Johansen (1998).

[25] The Granger-causality test (e.g. the bank does not Granger-cause the government CDS series if and only if the hypothesis $H_0 : \alpha_{SovBk,i} = 0$ for $i = 0, \ldots, p$ cannot be rejected) in this paper is carried out on a VAR with $p + 1$ lags.

specify some causal ordering of the variables. In our case, a theory which defines such ordering is hard to justify, especially in the context of daily data. Based on this argument, we decide to use GIR because no ordering is necessary and contemporaneous relations are allowed for. One can regard GIR as the effects of a shock in the structural error of the variable that is ordered first in the system of orthogonalized impulse responses. To model the uncertainty around our point estimates of the impulse responses we decided to use Hall's bootstrapped percentile confidence interval (95% level) using 2000 replications (Hall (1992)). The generalized impulse response function can be written in our bivariate setup as follows:

$$\begin{pmatrix} \psi_{Sov}^{Sov}(n) \\ \psi_{Sov}^{Bk}(n) \end{pmatrix} = \sigma_{(Sov,Sov)}^{-1/2} \Phi_n \Sigma_u \begin{pmatrix} 1 \\ 0 \end{pmatrix}, \qquad \begin{pmatrix} \psi_{Bk}^{Sov}(n) \\ \psi_{Bk}^{Bk}(n) \end{pmatrix} = \sigma_{(Bk,Bk)}^{-1/2} \Phi_n \Sigma_u \begin{pmatrix} 0 \\ 1 \end{pmatrix},$$

where $\sigma_{(j,k)}$ is the variance related to the error of variable j, k (again $j, k \in (Sov, Bk)$) and n denotes the period after which the impulse has occurred. Φ_n represents the matrix of the vector moving average coefficients at lag n, which can be calculated in a recursive way from the VAR coefficient matrices. It is worth emphasizing that, as we deal with possibly cointegrated VAR models, the effects of shocks may not die out asymptotically (Lütkepohl, 2007, pp. 18-23, 263). $\psi_{Bk}^{Sov}(n)$ denotes for example the response of the sovereign $\log CDS$ to a shock in Bk n periods ago. The exact interpretation of the impulse responses follows the usual reading for semi-elasticities. E.g. taking into account that $\Phi_0 = I_K$, an impulse in variable j in period 0 means a unit increase in the structural error that leads to an increase of the respective CDS series by $\sigma_{(j,j)}^{1/2}$%. In order to enable more easily a comparison of the results across banks and countries, we standardize each series of impulse responses, i.e. the responses caused by the same shock are divided by the standard deviation of the impulse variable. In the example above, our responses would be divided by $\sigma_{(j,j)}^{1/2}$, so that the initial response of the j-th variable to its own shock is equal to 1 or 100% of the initial shock of size one standard deviation. Responses can, thus, be interpreted as percentages of the initial shock in the impulse variable.

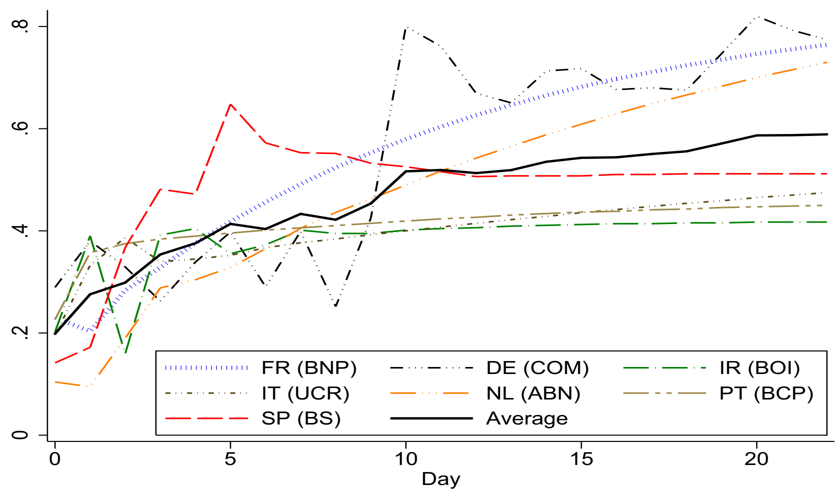
4 Results

This section presents the results for long-run and short-run relationships and, in addition, considers the generalized impulse responses. First, the cross country analysis is presented and second we report the specific results for three countries. In the appendix, Table 2 shows the results of all countries for Granger causality tests, Table 3 outlines the results from our cointegration analysis and Table 4 summarizes the generalized impulse responses for all countries.

4.1 Cross-country Analysis

The effects of the shocks originating from the banking sector on the sovereign CDS series are all significant in the long-run in the period before government interventions. This fact is argued by

Figure 1: Responses of Sovereign Spreads to Shocks in Bank spreads: Stage 1+2 (Before Government Interventions).



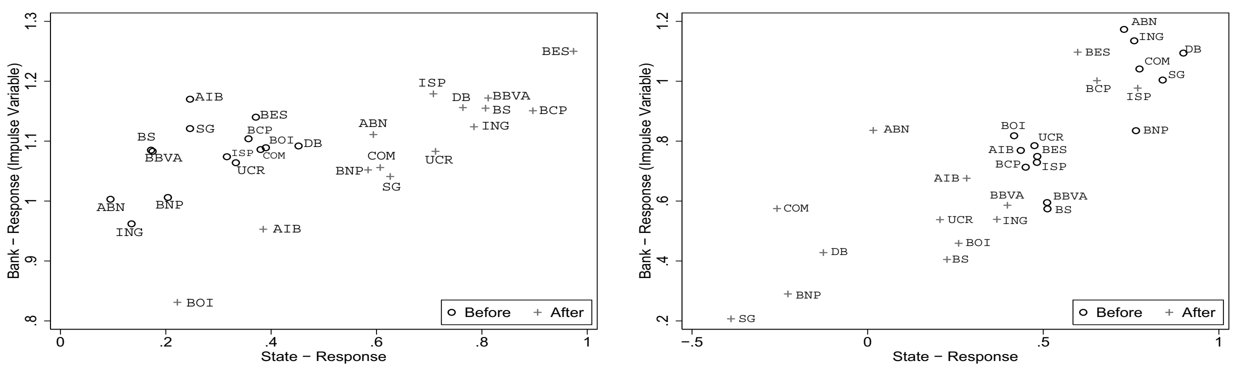
Note: Sources of the banking shock are written in parentheses. Shocks in banks spreads within the same country have very similar impact on the sovereign spread in the period before government interventions.(we have randomly picked one of the two banks in each country) The "Average" line represents the mean of the sovereign responses from a shock in the seven bank CDS spreads.

the systemic component of the crisis that originated from financial institutions and spilled over to the sovereign CDS market. As pictured in Figure 1, and referring to the long-run effects (after 22 days), countries can be separated into two groups: INNER composed by FR, DE, NL (with responses over 70%, after 22 days) and OUTER that consists of IR, IT, SP, PT (with responses below 50%). The solid line (the "Average" impulse responses) separates the two groups. The results for the INNER group can be argued by a weak interest (i.e. low liquidity of the CDS contracts) in insuring against the default of these countries in the period before Lehman Brothers' collapse. This could have led first to mispricing and then followed by a strong repricing effect, as the volume increased. On the other hand, in this period, OUTER countries were already at levels closely linked to their domestic banks' CDS spreads. Public imbalances and high debt burdens were already priced for the latter group. This result is also emphasized in Figure 2 (Right), which shows the long-run (at day 22) effects, and in which we find exactly these two clusters (INNER and OUTER) of banks before government interventions (circles). Additionally, this graph reveals that even the responses of the banks to their own shock can be grouped into these groups. The impulse of the OUTER group has a smaller effect on itself (y-axis). In general comparing shocks from the banking sector before and after the bailout programs, we see that the effects on states' CDS spread are mostly temporary in the period after, i.e. the effect dies out over time (+ in Figure 2 (Right)) as most long-run effects are not significant[26]. In the long run, shocks from the banking sector have a smaller impact in the period after (Figure 2 (Right): circles relative to pluses). Nonetheless, we observe that Portuguese banks and ISP become more sensitive to a shock from the banking sector

[26]At day 22 a shock from SG has no significant effect both on itself and on the state. BNP, COM, DB, AIB, BOI, UCR, ABN, and BS have no effect on the sovereign CDS, but the response remains significant on itself.

in the long-run (at day 22). Before bailout programs, states CDS series are affected progressively by a financial sector shock. Ireland seems to be most successful in limiting the risk of default stemming from the banking sector in the short-run, as both bank shocks have the lowest effects on itself and the sovereign among all banks (+ BOI, + AIB (lower left corner) Figure 2 (Left)).

Figure 2: Impulse from the Banking Sector: Effects on Bank's Spreads (y-axis) and Sovereign Spreads (x-axis): at day 1 (Left) and day 22 (Right).



Before: at day 1 no significant effect of a shock on the sovereign CDS spreads in the case of BNP, SG, ING, BBVA, and BS. At day 22 all are significant. After: at day 1 no significant effect of BOI on IR. In the long-run (day 22) no significant effect on the sovereign for a shock from BNP, SG, COM, DB, AIB, BOI, UCR, ABN, and BS. Additionally, there is no effect of a shock from SG on itself at day 22. For example, ○ ABN is located at (1,.1) indicating that a shock (at day 0, before government interventions) in the CDS series of ABN that leads to a 1% increase of the ABN spread impacts the Dutch CDS spread by 0.1% at day 1.

The second result of our paper shows that the importance of sovereign shocks augmented dramatically in the post intervention era. This result is not only backed by generalized impulse responses (Figure 3, especially left panel) but also by the long-run and short-run analysis[27]. By comparing the results from the GIR analysis, we are able to distinguish between financial institutions that are more sensitive to a shock of their government CDS spread. Figure 4 depicts the comparison among selected banks.

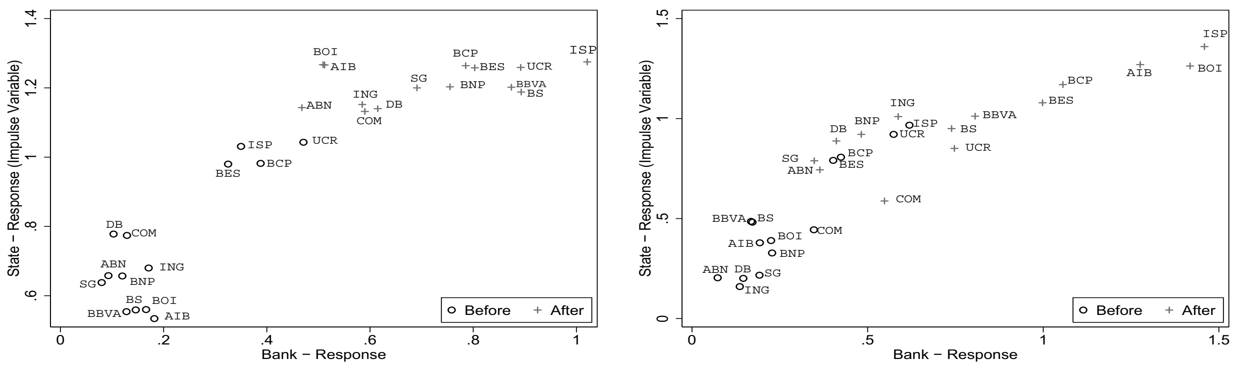
Sorting banks by the effect (in the long-run, e.g. after 22 days) of a sovereign shock we obtain the following ranking (from lowest effect to the highest): SG, ABN, DB, BNP, COM, ING, BS, UCR, BBVA, BCP, BES, AIB, BOI, ISP. Long-run responses of the banks from the same country are clustered. The only exception are the Italian banks, in which case ISP is more sensitive to a sovereign shock than UCR (146% compared to 75%). While SG is impacted only by 35% of the initial shock, the top three banks' impacts range from 128% to 146%. ISP and Irish banks respond the most to a sovereign shock. They are followed by the Portuguese and then the Spanish banks, where UCR ranks between BBVA and BS. At the bottom of this ranking are the Dutch, German, and French banks.

4.2 Specific Country Analysis

In this subsection the results for three countries are presented, i.e. Germany, Ireland, and Italy. These have been selected out of the group of countries considered as they differ strongly in their

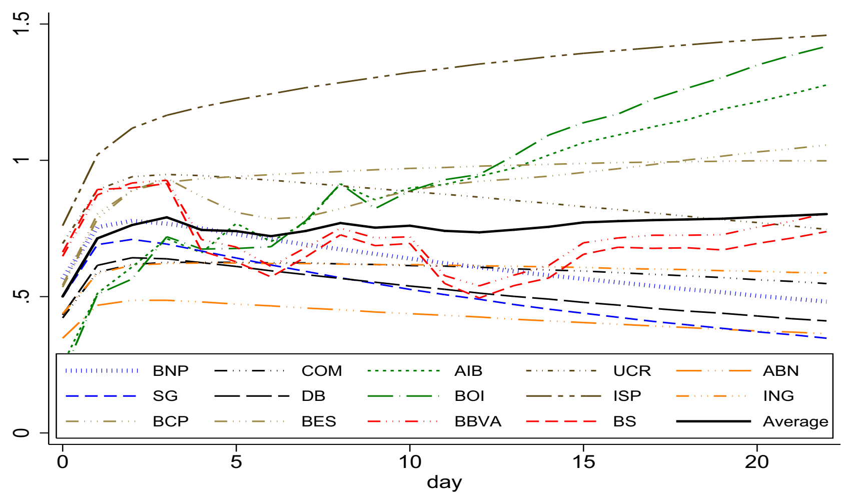
[27]The results from cointegration analysis are presented in the following subsection for three individual countries.

Figure 3: Impulse from the Government Sector: Effects on Sovereign Spreads (y-axis) and Bank's Spreads (x-axis): at day 1 (Left) and day 22 (Right).



Before: at day 1 there is no significant impact of the sovereign shock for ISP, ABN, and BBVA. At day 22 there is no significant effect on DB, AIB, BOI, ABN, BBVA, and BS. Furthermore, a shock of DE on itself is not significant as well. After: all shocks have significant effects in the short- and long-run.

Figure 4: Banks Responses to a Sovereign Shock: Stage 4+5+6 (After Government Interventions).



Note: The "Average" line represents the mean of the bank responses from a shock in the seven sovereign CDS spreads.

total commitment to the financial sector relative to their 2008 GDP. Ireland represents the country with the highest engagement and Italy with the lowest. Germany can be argued to range in the middle of these measures.

4.2.1 Germany

In the case of Germany we analyze the bivariate setups of the German (DE) sovereign CDS spread in relation to the CDS spread of Commerzbank (COM) and the CDS spread of Deutsche Bank (DB) respectively. The results for the tests on Granger-causality are depicted in Table 2, for cointegration relations in Table 3, and for impulse responses in Table 4 which are presented in the Appendix.[28]

Cointegration and Granger-Causality Analysis

For the entire period before government interventions (i.e. Stage 1+2) we find evidence for a stable long-run equilibrium relationship between the German CDS spread and both bank's CDS series. The hypothesis that both estimated β coefficients for the banks are equal to -1 cannot be rejected using a standard t-test. The error correction equation, e.g. for the relation with COM can be written as:

$$cds_{DE,t} = \underset{(0.170)}{1.083} \times cds_{COM,t} - \underset{(0.685)}{2.784} - ec_t,^{29}$$

where ec_t refers to the value of the long-run relation at time t and standard errors are provided in parentheses. As variables are measured in $\log$s, the β coefficients may be interpreted as elasticities, yielding to a bank-sovereign CDS equation. This relation implies, neglecting the rest of the estimated dynamics in the model, that a 1% increase in the CDS spread of COM leads to a 1% increase in the CDS spread of DE. For DB the same interpretation applies.

The loading coefficients indicate that the German CDS spread adjusts much faster (i.e. $|\hat{\alpha}_{DE}| = |-0.05| > |0.029| = |\hat{\alpha}_{COM}|$) to deviations from the long run equilibrium than the CDS spread of COM. The α-coefficients in the relation with DB suggest that the DB spread does not adjust to any deviations from the long-run equilibrium, while the German CDS spread adjusts with a rate of $\hat{\alpha}_{DE} = -0.122$. A formal test confirms this result as $cds_{DB,t}$ is tested to be weakly exogenous, which leads to the argument that DB provides the stochastic trend in this cointegration relation. Tests for Granger-causality indicate that only COM Granger-causes DE on a 1% significance level in the period before state interventions.

After government aid schemes the long-run relations change. Firstly we do not find a stable long-run relation for DE-COM for the entire post-intervention period, but only in Stage 5. Compared with the pre-intervention results, we find equal values for the β-coefficients, implying the same elasticities as mentioned above. However the constant changes from 2.28 (before) to insignificant (after) yielding the interpretation that the gap between the two CDS series vanished. In contrast we do find a cointegration relation for DE and DB for the entire post-intervention period. This relation implies, again not taking into account the entire dynamics of the model, that a 1% increase in $CDS_{DE,t}$ causes an about 3.4% increase in $CDS_{DB,t}$. Or put differently a 1% increase of the DB CDS series leads to a 0.29% rise of the German CDS spread, implying that the DB (DE) CDS series has become more (less) sensitive to changes in the DE (DB) CDS spread.

The relation for COM and DE in Stage 5 yields the conclusion that COM is weakly exogenous and DE adjusts with a rate of $\hat{\alpha}_{DE} = -0.045$, which is close to the α-value from the period before interventions. In the second cointegration relation, that takes together all three stages after

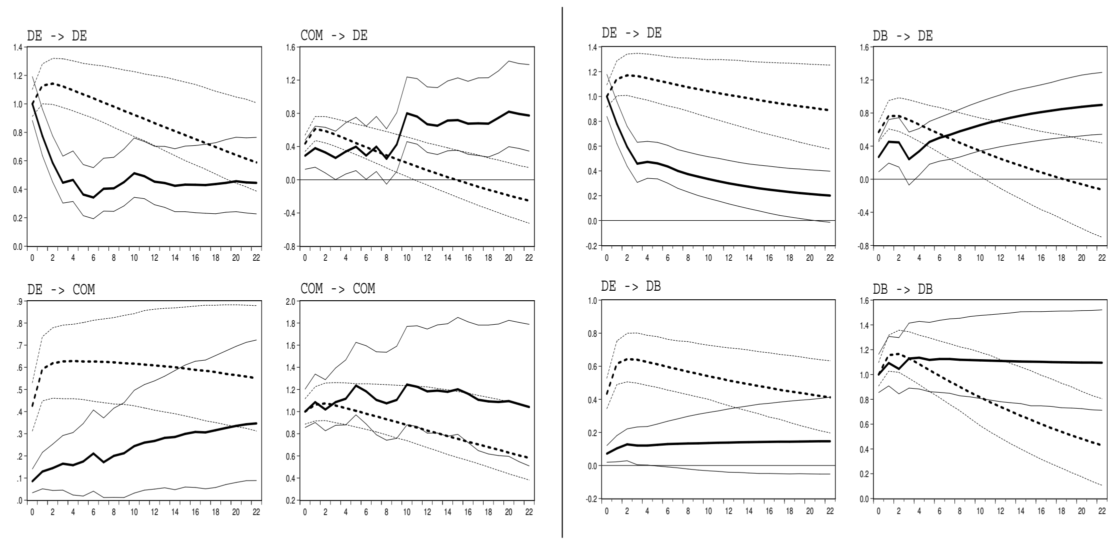
[28]Test results and the graph of the German sovereign CDS together with the German banks' CDS time series are presented in Appendix B.2.

[29]The cointegration graph is provided in Appendix B.2, Figure 10.

the bailout scheme, we find DE to move the equilibrium in the direction of its development (as DE's α and β coefficients are both positive). Granger-causality tests indicate further for the period during and after the state interventions that all variables Granger-cause each other on the 1% level.

Impulse Response Analysis

Figure 5: Generalized Impulse Responses for Germany: Before (solid) and During & After Government Interventions (dotted)



Note: Solid lines: responses before government interventions (bold) and the 95% bootstrapped confidence interval (thin). Dotted lines: responses during and after government interventions (bold) and the 95% bootstrapped confidence interval (thin). X-axis: number of days (after the shock). Y-axis: impact relative to one standard deviation shock of the impulse variable. ***[Left Panel]*** Upper-Left: DE (impulse variable) - DE (response variable). Lower-Left: DE (impulse var.) - COM (response var.). Upper-Right: COM (impulse var.) - DE (response var.). Lower-Right: COM (impulse var.) - COM (response var.). ***[Right Panel]*** Upper-Left: DE (impulse var.) - DE (response var.). Lower-Left: DE (impulse var.) - DB (response var.). Upper-Right: DB (impulse var.) - DE (response var.). Lower-Right: DB (impulse var.) - DB (response var.).

The results from the impulse response are depicted in Figure 5. The analysis before government interventions refers to the VECM setup; only in the period after we use a VAR framework for examining the relationship between DE and COM. In all graphs the three solid lines represent the impulse responses before interventions, where the light ones refer to the 95% bootsrapped confidence interval. The bold dotted line describes the responses during and after rescue schemes and the light dotted lines the bootstrapped confidence bands. Firstly, we observe that the pattern of the left panel resembles strongly the pattern depicted in the right panel. In the upper-right corner of each panel the effects of a shock from the bank CDS spread to German CDS are plotted. Before interventions (solid) a banking sector shock impacts permanently the government CDS series, while in the period after (dotted) there is only a temporary effect.

In the case of a government shock to the banking sector we notice that DB (right panel) is only affected in the very short-run ($t \leq 3$) before interventions, while COM is driven permanently by the latter shock. In the period after the bank bailouts, we find that both series react permanently to a shock stemming from the sovereign.

Additionally, the graphs show that the effects of a banking sector shock on itself are stronger in the pre-interventions period, as they are estimated to have a permanent effect. The responses after state interventions suggest a decrease of the impact of the latter in both cases. The shocks from the government CDS spread on itself have a stronger contemporaneous impact in both bivariate setups after interventions.

Discussion

From October 2008 until the end of May 2010, Germany provided a total support to the local financial sector of EUR 619.1bn or of 25% of total 2008 GDP. From a total committed amount of EUR 64.8bn for capital injections, EUR 54.5bn were demanded by German banks until the end of May 2010. Germany pledged EUR 475bn in form of liability guarantees, from which local banks utilized EUR 185.8bn until the end of our time frame.

SoFFin[30] granted COM[31] an individual guarantee for issuing EUR 15bn of debt securities. Furthermore, SoFFin participated with EUR 8.2bn in form of a silent equity holding ("silent participation") and COM's recapitalization by government amounted EUR 10bn.[32]. Although DB, the biggest German bank, resisted to state capital injections, we do not find strong differences in the dynamics of both CDS series in relation with the German sovereign CDS spread. Nonetheless, our results suggest that investors anticipated the direct support for COM as Granger-causality tests underpin that the CDS spreads of COM contain important information for determining the German spreads. Furthermore, a shock to the sovereign spread drives the CDS spread of COM permanently. Thus, before interventions we have evidence that the dynamics of the series differ, suggesting that the the link between the CDS series of COM and DE is more sensitive than the link between DB and DE.

The research design of our analysis enables us to draw inference only on outcomes. COM is known to have had severe difficulties during the last crisis, which led, SoFFin to provide extra support to this bank. The results of our empirical analysis, however, underline that the dynamics of the two banks do not substantially differ in the post-intervention period. Assuming that this similarity is a consequence of the extra support provided, we conclude that the rescue schemes in the case of Germany were successful. The extra funding for COM was necessary in order to induce a credible perception that the tail risk of the latter was absorbed by the state. We find that shocks of both banks have a weaker effect on themselves after bailout schemes are put into place. However, the result is stronger for DB. The cost for this positive aspect is a higher sensitivity of both banks to developments in the government CDS spreads. Interestingly, the German spread is not influenced at a long horizon by a banking sector shock after bailout measures are provided.

Altogether, the results highlight that the contagion emerged from the banking sector and spilled-over to German sovereign CDS spread in the period before rescue schemes. Thus, we

[30]The German Special Fund for Financial Market Stabilization (SoFFin) is in charge for managing the German financial support programs.

[31]`https://www.commerzbank.de/en/hauptnavigation/aktionaere/service/archive/ir-nachrichten_1/2008_5/ir_nachrichten_detail_08_2203.html`

[32]These capital injections became public on 3 November 2009.

find evidence for H1. The dependence in the other direction is weaker or only existent in the very short-run. Afterwards, future developments of the perceived default risk of all series are strongly interwoven as suggested by cointegration analysis and the results of the Granger-causality tests. Furthermore, impulse responses highlight a stronger interdependency of all series, while an unexpected change in the bank's CDS series has only a temporary effect on the sovereign CDS spread (H2a, H2b). Moreover, we find no strong differences in the dynamics of COM and DB in relation to changes in German CDS spreads (contradicting our H3). Our results suggest that the extra support for COM credibly transfered the default risk on the government's balance sheet.

4.2.2 Ireland

Within the set of analyzed countries, the results for Ireland reveal most clearly the impact of government interventions. As the dynamics for both setups, i.e. Ireland (IR) - Allied Irish Banks (AIB) and Ireland (IR) - Bank of Ireland (BOI), resemble strongly we report only one of them. Tests on Granger-causality are depicted in Table 2, cointegration relations in Table 3, and impulse responses in Table 4 which are presented in the Appendix.[33]

Cointegration and Granger-Causality Analysis

The cointegration analysis uncovers a long-run relation in Stage 2, in which $\hat{\beta}_{AIB} = -0.567$. Interpreting the cointegration coefficients for the period before interventions, a 1% increase in the banks CDS spread translates into a 1.76%[34] gain in the Irish spread. The gap (the constant from the cointegration equation) between the two cds series is insignificant.

Furthermore, in the period before government interventions there is evidence that the stochastic trend originates from the banking sector and impacts the sovereign CDS series. The estimated α coefficient for AIB is not significantly different from zero and the hypothesis of weak exogeneity for the banking sector series cannot be rejected. Thus, we conclude that the series of AIB influences IR in the long-run. In the short-run, Granger-causality is not significant in any of the two directions.

During and after interventions the dynamics change and now emphasize a different role of the Irish CDS spread, which we argue occurs because of government interventions. The error correction equation can be written as

$$cds_{IR,t} = \underset{(0.105)}{0.724} \times cds_{AIB,t} + \underset{(0.587)}{1.116} - ec_t.^{35}$$

Comparing elasticities, we now find an increase of $\hat{\beta}_{AIB}$ to 0.724, implying that a 1% increase in the Irish spread augments the bank spread by 0.724%. The gap between the two series is enlarged and it is significantly different from zero.

[33]Preliminary test results and the graph of the respective time series are presented in Appendix B.3.

[34]This number is obtained by normalizing the coefficients by the estimated β-coefficient of AIB.

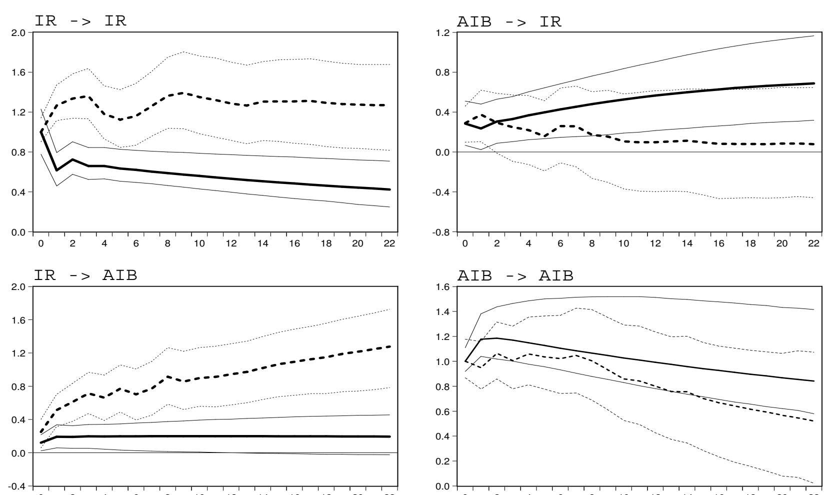
[35]The cointegration graph is provided in Appendix B.3, Figure 12.

The estimated α-coefficients suggest that during and after interventions the Irish spread provides the stochastic trend, as a test for weak exogeneity of this series cannot be rejected. Only the bank's CDS spread adjusts to deviations from the long-run equilibrium with a rate of $\hat{\alpha}_{AIB} = 0.06$. The prominent role of the Irish CDS series is also emphasized in the short-run dynamics, where we find that the CDS spread of IR Granger-causes the CDS spread of AIB but not vice versa during this period.

Impulse Response Analysis

The generalized impulse response, depicted in Figure 6, underline the shift in the dependence between the two CDS series. Firstly, the graph in the upper right corner indicates that a shock from the banking sector permanently influences the government CDS spread before interventions, and only temporarily ($t \leq 2$) in the second period. The opposite pattern is found for a government sector shock. In the pre-intervention period the graph in the lower left corner highlights that the latter shock only temporarily influences the CDS spread of AIB, while there is a permanent impact in the period during and after the rescue schemes. Moreover, the remaining two graphs (upper left and lower right corner) suggest that there has been a change in sensitivity to a shock from the same sector. A banking shock yields a permanent effect on itself before interventions with a strongly decreasing impact. For the Irish spread the GIR results show an opposite development. Whilst both deviations are permanent, the one during the second period is by far stronger.

Figure 6: Generalized Impulse Responses for Ireland: Before (solid) and After Government Interventions (dotted)



Note: Upper-Left: IR (impulse variable) - IR (response variable). Lower-Left: IR (impulse var.) - AIB (response var.). Upper-Right: AIB (impulse var.) - IR (response var.). Lower-Right: AIB (impulse var.) - AIB (response var.). Solid lines: responses before government interventions (bold) and the 95% bootstrapped confidence interval (thin). Dotted lines: responses after government interventions (bold) and the 95% bootstrapped confidence interval (thin). X-axis: number of days (after the shock). Y-axis: impact relative to one standard deviation shock of the impulse variable. Generalized impulse responses for BOI behave similarly to those of AIB.

Discussion

Not surprisingly the study of the Irish risk transfer mechanism depicts most clearly the change in the dynamics, as Ireland (IR) represents, by far, the one with the highest total commitment to the financial sector relative to its GDP. Remarkably it amounts to 319% of 2008's GDP; or put in monetary value EUR 592bn. Up to end of May 2010, EUR 99.8bn were required in total by Irish banks. This amount includes EUR 19.3bn that were used as capital injections (Table 1). Both banks in our study were recapitalized by the Irish government on the 21st of December 2008 and approved by the European Commission on 26/03/2009 (BOI) and 12/05/2009 (AIB).[36]. Under this scheme AIB and BOI were each provided EUR 3.5bn. Similar government aid structures for both banks lead to homogeneous findings, which supports our H3.

State interventions are shown to be most successful in the case of Ireland. The magnitude of the rescue scheme has been the highest (relative to GDP) among the countries analyzed, which led to the clearest results for the risk-transfer mechanism. The impact of a banking sector shock on itself decreases substantially after measures are provided. Furthermore, there is a significant impact on the government spreads only in the short-run. The flip side of the coin is the strong influence of a government sector shock on the banks after the rescue schemes, which amplified the serious issues of the Irish financial sector as the sovereign debt problems emerged.

Combining the results from the two analyses, we find strong evidence for H1, H2a, H2b. Before bailout programs the data shows that the channel through which risk is spread into the market originates from the banking sector rather than from the government. In the period after government interventions, the risk transfer mechanism puts more weight on the developments of the government CDS spread. As the government took over the tail risk from the banks, the development of the Irish CDS series plays an increasingly important role. Only in the very short-run changes in banks' CDS spreads impact on the government series during and after the state interventions. The effects of a banking sector shock on itself have weakened, underpinning the success of the Irish bailout schemes.

4.2.3 Italy

The main cointegration relations between Italy and the selected domestic banks (Intesa San Paolo (ISP) and Unicredito (UCR)) are presented in Table 3. Table 2 presents the findings for Granger-causality tests and Table 4 the generalized impulse responses.[37]

Cointegration and Granger-Causality Analysis

In the period preceding the government support for the Italian banking industry (i.e. Stage 1+2), we find that the banks' and sovereign CDS series are tied together in a long-run equilibrium. Interpreting the β coefficients, neglecting the remaining dynamics of the system, we argue that in the long-run a 1% increase in a ISP(UCR)'s CDS spread leads to a 0.71%(0.67%) increase in the CDS series of Italy. The gaps (i.e. the constants of the cointegration relations) between the two CDS series is in both setups estimated to be significantly different from zero. The speed of adjustment, reflected by the estimated α-coefficients, is faster for the CDS spreads of banks, i.e.

[36] IP/09/744 and IP/09/483

[37] Preliminary test results and the graph of the respective time series are presented in Appendix B.4.

$|\hat{\alpha}_{IT}| = 0.012 < 0.020 = |\hat{\alpha}_{ISP}|$ and $|\hat{\alpha}_{IT}| = 0.010 < 0.014 = |\hat{\alpha}_{UCR}|$. Regarding the short-run dynamics results reveal that Italy is Granger-caused by the developments in ISP's and UCR's CDS spread in Stage 1+2, consistent with our assumption that the information from the financial sector was systemically important.

During and after the Italian government bailout program for the financial sector the dynamics between the sovereign and banks' CDS spreads change. Firstly, UCR is found to be in a stable long-run equilibrium with the Italian government CDS series only during Stage 5. In this setup the estimated β-coefficients imply that a 1% increase in government's spreads induces an upward adjustment of UCR's CDS of 1.28%. The error correction mechanism of IT-ISP for the entire post-intervention period is as follows:

$$cds_{IT,t} = \underset{(0.087)}{0.864} \times cds_{ISP,t} + \underset{(0.385)}{0.922} - ec_t.$$ [38]

A marginal change of the Italian CDS series by 1% leads to an adjustment of cds_{ISP} by 0.86%. Elasticities of both banks cannot be compared as they refer to different stages of our sample. The constant is significantly different from zero in both setups.

In the period after government interventions, the loading coefficients indicate that Italy provides the stochastic trend, as the CDS series of the latter is tested to be weakly exogenous. This result implies that, although the Italian CDS spread does not adjust to deviations from the long-run equilibrium, the banks' CDS spreads react to these changes. In contrast with the results of the previous period, after state interventions the Italian CDS spread Granger-causes both bank's CDS spreads but not vice versa.

Impulse Response Analysis

The graph in the upper right corner of each panel depicts the effect of a banking shock to the sovereign CDS series. The solid line emphasizes that risk permanently spreads to the government CDS series before interventions, while after interventions the shock of UCR (right panel) shifts the Italian CDS series stronger but only temporarily ($t \leq 18$). A shock originating from ISP (left panel) is stronger than the one from UCR (right panel) and leads to a permanent shift in the government CDS spread. These findings support our H2a and H3. On the other hand, in the period before interventions (solid lines) the effects of a shock from the government sector (the lower-left graph in each panel) are in the short-run insignificant, but become permanently significant after $t = 5$ (UCR) and $t = 8$ (ISP). During/after interventions (dotted lines) the impact is stronger and permanent, in line with our H2b. The pattern of a bank shock on the series themselves is very similar in the two periods(the lower-right corner in each panel). A government shock on itself is stronger in the period afterwards for both setups, but temporary in the case of UCR.

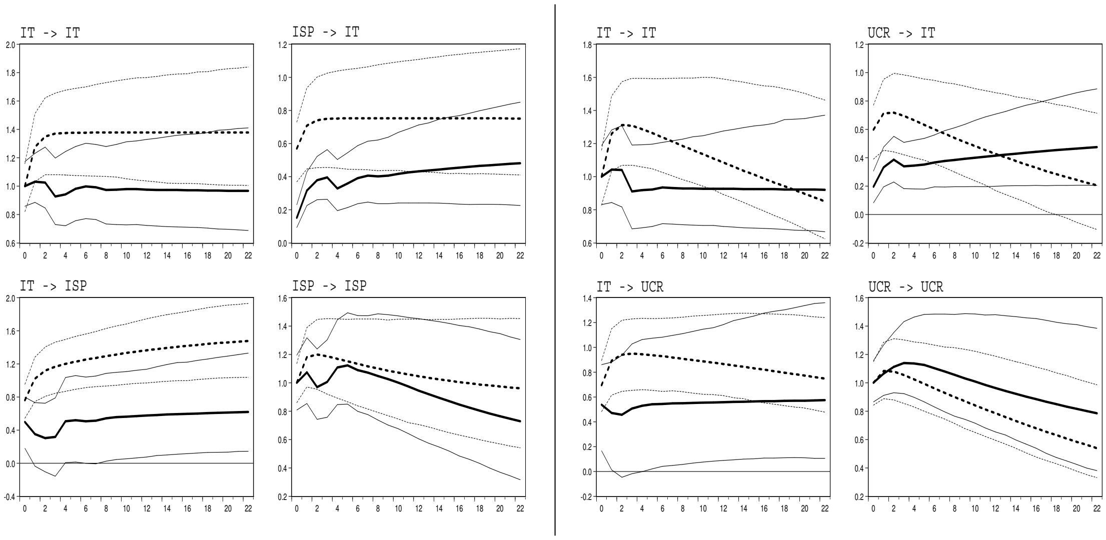
Discussion

Italy has one of the highest debt burdens[39] among European Union countries. This fact determined the Italian government to pledge in total EUR 62bn, that represents slightly above 4% of

[38]The cointegration graph is provided in Appendix B.4, Figure 14

[39]Italy's public debt was estimated around 105% of GDP in 2008.

Figure 7: Generalized Impulse Responses for Italy: Before (solid) and After Government Interventions (dotted)



Note: ***[Left Panel]*** Upper-Left: IT (impulse variable) - IT (response variable). Lower-Left: IT (impulse var.) - ISP (response var.). Upper-Right: ISP (impulse var.) - IT (response var.). Lower-Right: ISP (impulse var.) - ISP (response var.). ***[Right Panel]*** Upper-Left: IT (impulse var.) - IT (response var.). Lower-Left: IT (impulse var.) - UCR (response var.). Upper-Right: UCR (impulse var.) - IT (response var.). Lower-Right: UCR (impulse var.) - UCR (response var.). Solid lines: responses before government interventions (bold) and the 95% bootstrapped confidence interval (thin). Dotted lines: responses after government interventions (bold) and the 95% bootstrapped confidence interval (thin). X-axis: number of days (after the shock). Y-axis: impact relative to one standard deviation shock of the impulse variable.

the 2008 GDP. This ratio is the lowest among the analyzed countries in this paper. Capital injections accounted for EUR 4.1bn from a committed amount of EUR 12 bn. Italy also promised to support its domestic banks with an asset purchase scheme worth EUR 50bn. On 20 March 2009, ISP started the procedure to obtain EUR 4bn in state aid for recapitalization[40]. On the other hand, UCR which is the biggest Italian bank did not request any capital injection from the state of Italy. The formal inquiry of ISP for participating in the government aid scheme is reflected in our GIR analysis: the CDS series of ISP became more sensitive to unexpected changes in the Italian spread than the CDS series of UCR. This result and the cointegration relation between IT and ISP (in Stage 4+5+6) provide evidence for our third hypothesis (H3).

In the case of ISP, we also find that the rescue measures taken by the Italian government were not successful in absorbing partial risks of default from the latter bank.[41] A shock of the bank on itself has even a stronger effect after bailout schemes. The other finding underpins, that investors believed that the default risk of ISP would spread to the government sector. In the case of UCR, we detect a similar pattern like in other countries, since the effect of a banking sector shock on itself slightly decreases.

[40] `http://www.group.intesasanpaolo.com/scriptIsir0/si09/contentData/view/content-ref?id=CNT-04-000000003F8D4`
According to this document, on 29 September 2009 ISP decided not to participate anymore in the Italian aid program for the banking sector, so-called "the Tremonti Bonds" program, but to issue debt to private investors.

[41] This can be also seen as a result of ISP's decision not to subscribe for the "Tremonti bonds" program in the end.

Before Lehman Brothers' default, the systemic banking crisis spreads to the sovereign market, which can be supported by the results from Granger-causality analysis, or the permanent effect of a banking sector shock in the context of the GIR analysis. However, movements of IT's CDS spread have an effect on the bank spreads as well, which contradicts partially our H1. After state interventions, this relation becomes more pronounced as now IT Granger-causes both banks, provides the stochastic trend in the cointegration relations, and government shocks cause strong deviations in the banks' CDS series. Nonetheless, banks still influence the government CDS series, albeit UCR only temporarily. Bailout schemes seem not to limit the effects of a banking sector shock on itself as the intensity of the impact is almost the same as in the period before government interventions. On the other hand, sovereign spreads are more sensitive to shocks after bank support schemes.

5 Conclusions

The recent financial crisis led governments to tailor aid programs for financial institutions. The magnitude and dimension were unique in European history. A series of bank failures would threaten the functioning of the whole economy, as the important financial institutions incorporate a systemic component. Hence, governments, besides central banks, took crucial steps in the attempt to rescue the financial system. By arguing that government bailout programs marked an important event for investors, we derive our hypotheses about how the relations are expected to change. First, we hypothesize that the increase in default risk prior to interventions originates mainly from the financial sector. After bailout programs are set up by European governments, we argue that the sensitivity of the sovereign default risk to the financial sector increases due to the private-to-public risk transfer. Moreover, the default risk of the banking sector is asserted to be influenced strongly by the government sector. How the participation of a bank in the rescue schemes is perceived by market stakeholders should affect its CDS sensitivity to changes in sovereign credit risk. Finally, we argue that important determinants for the changes in linkages are country bailout-specific characteristics.

As stated in our first hypothesis, before government interventions, sovereign credit risk is strongly impacted by the movements in bank CDS spreads, while changes in the sovereign CDS spreads have a weak impact on both bank and sovereign CDS markets. Regarding the H1, our findings provide evidence for FR, DE, IR, NL, and SP but not for IT and PT. Portugal's and Italy's default risk seem to carry an important role in the development of their local banks' default risk even before the Lehman Brothers event.

For the second set of hypotheses (H2a, H2b), i.e. after government interventions, we can conclude homogeneously that changes in the sovereign CDS spreads contribute to the financial sector CDS spreads. On the other hand, changes in banks' risk of default are found to impact stronger in the short-run (i.e. at day 0 and at day 1) in all countries, while in the long-run (i.e. after 22 days) the effects are transitory (exceptions are IT, NL, and PT).

Furthermore, the variability in interdependencies between domestic banks and the government cannot be clearly related to differences in the perceived default risk transferred. Countries with similar state aid[42] for both analyzed banks show an equal bank CDS sensitivity to the changes in sovereign credit risk. Banks in Germany (DB and COM) and Italy (ISP and UCR) were differently involved in the rescue schemes, but we only find heterogeneous linkages between Italian banks' and sovereign CDS spreads. Our results possibly suggest that the extra aid provided to COM has been successful in absorbing partially the risk of default while the government willingness to help ISP strongly links the default risk of the latter to the development of the Italian CDS spread and amplifies its sensitivity to shocks in both, the banking and the sovereign sector. Furthermore, in the case of Ireland our results indicate that bailout schemes led to the desired results, in the sense that the spillover effects that originate from the financial sector are limited after the implementation of bank aid programs.

Lastly, the cross-country analysis reveals the heterogeneity of the impact of bank support programs. On the one hand, the effects of a sovereign shock to banks from the same country are closely linked, and on the other hand the effects of a sovereign shock to banks across countries can be clustered in INNER (FR, DE, NL) and OUTER (IR, IT, PT, SP).

This paper tries to capture the effects of the private-to-public risk transfer from the perspective of the CDS market. Applying a similar methodology, future research could shed light on the impact of the state-to-state risk transfer in the Eurozone and to compare the two situations.

[42] FR, IR, SP, and PT

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A Main Results

Table 2: Results of Granger-Causality Tests for all Countries.

Country	Period	Independent	Dependent	p-value	Independent	Dependent	p-value
France	Before	BNP	FR	0.948	SG	FR	0.662
		FR	BNP	**0.014**	FR	SG	**0.059**
	After	BNP	FR	**0.089**	SG	FR	**0.096**
		FR	BNP	**0.000**	FR	SG	**0.002**
Germany	Before	COM	DE	**0.005**	DB	DE	0.152
		DE	COM	0.711	DE	DB	0.772
	After	COM	DE	**0.008**	DB	DE	**0.003**
		DE	COM	**0.009**	DE	DB	**0.004**
Ireland	Before	AIB	IR	0.499	BOI	IR	**0.002**
		IR	AIB	0.333	IR	BOI	0.451
	After	AIB	IR	0.174	BOI	IR	0.216
		IR	AIB	**0.000**	IR	BOI	**0.000**
Italy	Before	ISP	IT	**0.000**	UCR	IT	**0.002**
		IT	ISP	0.156	IT	UCR	0.536
	After	ISP	IT	0.392	UCR	IT	0.348
		IT	ISP	**0.008**	IT	UCR	**0.002**
Netherlands	Before	ABN	NL	**0.062**	ING	NL	**0.012**
		NL	ABN	0.705	NL	ING	0.160
	After	ABN	NL	**0.003**	ING	NL	**0.040**
		NL	ABN	**0.059**	NL	ING	**0.033**
Portugal	Before	BCP	PT	**0.001**	BES	PT	**0.000**
		PT	BCP	0.909	PT	BES	0.846
	After	BCP	PT	0.871	BES	PT	0.871
		PT	BCP	**0.000**	PT	BES	**0.000**
Spain	Before	BBVA	SP	**0.001**	BS	SP	**0.000**
		SP	BBVA	**0.024**	SP	BS	**0.009**
	After	BBVA	SP	**0.023**	BS	SP	**0.020**
		SP	BBVA	**0.000**	SP	BS	**0.000**

Note: this table presents the Granger-causality tests for the entire period before government interventions and for the entire period during and after bailout programs. "Before" stands for *Stage 1+2* and "After" denotes *Stage 4+5+6*. We report the p-values of the tests. The significant results are emphasized in bold. The independent variable Granger-causes the dependent variable.

Table 3: Results of Cointegration Analysis for all Countries.

Country	Period	Sov - Bk_1	α_{Sov}	α_{Bk}	β_{Sov}	β_{Bk}	Constant
France	Stage 1 + 2	FR - BNP	-0.085	0.024	1.000	-1.059	2.031
			[-3.273]	**[2.050]**	-	**[-6.997]**	**[3.693]**
		FR - SG	-0.124	0.022	1.000	-0.892	1.584
			[-3.991]	**[1.864]**	-	**[-8.934]**	**[4.136]**
	Stage 4 + 5 + 6	FR - BNP	0.018	0.018	1.000	-2.795	8.237
			[3.582]	**[3.154]**	-	**[-5.636]**	**[3.889]**
		FR - SG	0.017	0.015	1.000	-3.821	13.769
			[3.712]	**[3.136]**	-	**[-5.614]**	**[4.425]**
Germany	Stage 1 + 2	DE - COM	-0.050	0.029	1.000	-1.083	2.784
			[-2.011]	**[2.125]**	-	**[-6.359]**	**[4.062]**
		DE - DB	-0.122	0.009	1.000	-0.930	2.087
			[-4.046]	[0.561]	-	**[-7.866]**	**[4.428]**
	Stage 5	DE - COM	-0.045	0.004	1.000	-1.007	1.330
			[-2.211]	[0.233]	-	**[-1.913]**	[0.541]
	Stages 4 + 5 + 6	DE - DB	0.015	0.011	1.000	-3.432	12.382
			[3.442]	**[3.068]**	-	**[-5.082]**	**[3.944]**
Ireland	Stage 2	IR - AIB	-0.278	0.008	1.000	-0.567	-0.520
			[-3.826]	[0.171]	-	**[-5.432]**	[-1.032]
		IR - BOI	-0.475	-0.043	1.000	-0.581	-0.349
			[-5.170]	[-0.655]	-	**[-10.122]**	[-1.212]
	Stage 4 + 5 + 6	IR - AIB	0.014	0.060	1.000	-0.724	-1.116
			[1.012]	**[4.582]**	-	**[-6.905]**	**[-1.903]**
		IR - BOI	-0.002	0.096	1.000	-0.694	-1.292
			[-0.086]	**[5.414]**	-	**[-10.794]**	**[-3.584]**
Italy	Stage 1 + 2	IT- ISP	-0.012	0.020	1.000	-1.404	2.003
			[-2.282]	**[2.078]**	-	**[-6.927]**	**[2.706]**
		IT - UCR	-0.010	0.014	1.000	-1.502	2.647
			[-2.110]	**[1.767]**	-	**[-5.845]**	**[2.658]**
	Stage 5	IT - UCR	0.021	0.097	1.000	-1.280	1.462
			[0.761]	**[3.318]**	-	**[-9.331]**	**[2.247]**
	Stage 4 + 5 + 6	IT - ISP	0.003	0.066	1.000	-0.864	-0.922
			[0.162]	**[3.167]**	-	**[-9.881]**	**[-2.393]**
Netherlands	Stage 1 + 2	NL - ABN	-0.097	0.002	1.000	-0.829	1.416
			[-3.865]	[0.146]	-	**[-8.708]**	**[3.734]**
		NL - ING	-0.152	-0.009	1.000	-0.741	1.013
			[-4.763]	[-0.410]		**[-13.565]**	**[4.787]**
	Stage 6	NL - ABN	-0.017	0.038	1.000	-1.596	4.158
			[-0.944]	**[2.929]**	-	**[-5.938]**	**[3.243]**
	Stage 4 + 5	NL - ING	0.007	0.042	1.000	-1.572	3.125
			[0.427]	**[3.353]**	-	**[-7.475]**	**[3.220]**
Portugal	Stage 2	PT - BCP	-0.031	0.128	1.000	-0.986	0.715
			[-1.030]	**[2.313]**	-	**[-8.592]**	[1.443]
		PT - BES	-0.151	0.072	1.000	-0.789	0.101
			[-2.916]	[0.682]	-	**[-15.128]**	[0.420]
	Stage 4 + 5 + 6	PT - BCP	0.021	0.037	1.000	-0.793	-0.701
			[1.808]	**[3.687]**		**[-4.811]**	[-0.892]
		PT - BES	-	-	-	-	-
Spain	Stage 1 + 2	SP - BBVA	-0.019	0.023	1.000	-1.631	3.658
			[-1.693]	**[2.975]**	-	**[-7.714]**	**[4.404]**
		SP - BS	-0.022	0.023	1.000	-1.619	3.632
			[-1.931]	**[2.871]**	-	**[-7.873]**	**[4.488]**
	Stage 4 + 5 + 6	SP - BBVA	0.032	0.061	1.000	-0.985	-0.009
			[1.927]	**[3.756]**	-	**[-5.796]**	[-0.012]
		SP - BS	0.043	0.072	1.000	-1.106	0.527
			[2.555]	**[4.258]**	-	**[-7.215]**	[0.743]

Note: this table presents the cointegration relationships which passed the stability test. Subperiods are only included if the longer period did not pass the stability test (see Subsection Econometric Methodology). Coefficients are labeled in reference to (1). β-coefficients describe the long-run relationship between banks and sovereign log-CDS spreads. The loading coefficients α measure *the speed of adjustment* with which a particular CDS, adjusts to the long-run relationship. In case that α_{Sov} is significant and has an opposite sign to β_{Sov} it means that the Sovereign adjusts back to the long-run equilibrium defined by $\beta' y_t = 0$, whenever $\beta' y_t \neq 0$. Whenever one of the α-coefficients is not significant, it means that the respective variable can be argued to provide the stochastic trend that determines the long-run relation and it is not adjusting at all to the long-run equilibrium. Whenever one α coefficient is significant but with the same sign as the respective β parameter, the variable moves the entire equilibrium. t-statistics are reported in square brackets.

Table 4: Generalized Impulse Responses

	Impulse	Response	Before Gvt. Interventions[1] Days 0	1	5	22	Remark	During/After Gvt. Interventions[2] Days 0	1	5	22	Remark
FR	FR	FR	1.000	0.657	0.579	0.328		1.000	1.203	1.186	0.921	
		BNP	0.046	0.120	0.150	0.228		0.565	0.755	0.729	0.482	
	BNP	BNP	1.000	1.006	0.942	0.835		1.000	1.052	0.891	0.290	
		FR	0.230	0.204^n	0.418	0.764		0.452	0.584	0.416	-0.227^n	
	FR	FR	1.000	0.638	0.495	0.217		1.000	1.200	1.145	0.789	
		SG	0.030^n	0.080	0.125	0.192		0.499	0.691	0.642	0.348	
	SG	SG	1.000	1.121	1.083	1.004		1.000	1.041	0.843	0.207^n	
		FR	0.202^n	0.246^n	0.502	0.840		0.520	0.626	0.383	-0.389^n	
DE	DE	DE	1.000	0.774	0.363	0.444		1.000	1.132	1.072	0.588	VAR
		COM	0.085	0.129	0.175	0.347		0.422	0.590	0.626	0.548	VAR
	COM	COM	1.000	1.086	1.234	1.041		1.000	1.056	1.002	0.575	VAR
		DE	0.289	0.380	0.398	0.774		0.429	0.607	0.440	-0.258^n	VAR
	DE	DE	1.000	0.778	0.461	0.201^n		1.000	1.140	1.128	0.888	
		DB	0.071	0.103	0.125^n	0.146^n		0.433	0.615	0.611	0.411	
	DB	DB	1.000	1.092	1.117	1.094		1.000	1.156	1.034	0.428	
		DE	0.268	0.452	0.450	0.899		0.570	0.764	0.602	-0.126^n	
IR	IR	IR	1.000	0.534	0.489	0.379	VAR	1.000	1.266	1.123	1.270	
		AIB	0.122	0.182	0.191	0.193^n	VAR	0.251	0.512	0.769	1.276	
	AIB	AIB	1.000	1.170	1.166	0.769	VAR	1.000	0.953	1.063	0.676	
		IR	0.265	0.246	0.341	0.436	VAR	0.291	0.385	0.221^n	0.282^n	
	IR	IR	1.000	0.560	0.500	0.390	VAR	1.000	1.267	1.116	1.263	
		BOI	0.108	0.166	0.203	0.225^n	VAR	0.211	0.509	0.677	1.418	
	BOI	BOI	1.000	1.089	1.140	0.818	VAR	1.000	0.831	0.807	0.459	
		IR	0.202	0.390	0.355	0.417	VAR	0.220	0.222^n	0.134^n	0.259^n	
IT	IT	IT	1.000	1.031	0.981	0.967		1.000	1.275	1.372	1.360	
		ISP	0.498	0.350^n	0.519^n	0.619		0.760	1.021	1.221	1.459	
	ISP	ISP	1.000	1.074	1.122	0.729		1.000	1.179	1.156	0.977	
		IT	0.152	0.316	0.359	0.482		0.570	0.708	0.758	0.769	
	IT	IT	1.000	1.043	0.923	0.921		1.000	1.259	1.263	0.851	VAR
		UCR	0.538	0.471	0.542	0.574		0.695	0.892	0.936	0.747	VAR
	UCR	UCR	1.000	1.064	1.125	0.785		1.000	1.083	0.992	0.538	VAR
		IT	0.196	0.333	0.352	0.475		0.598	0.712	0.631	0.206^n	VAR
NL	NL	NL	1.000	0.658	0.469	0.204		1.000	1.143	1.094	0.744	VAR
		ABN	0.047^n	0.093^n	0.094^n	0.073^n		0.348	0.468	0.472	0.364	VAR
	ABN	ABN	1.000	1.003	1.132	1.173		1.000	1.111	1.084	0.836	VAR
		NL	0.104	0.095	0.328	0.730		0.408	0.594	0.506	0.016^n	VAR
	NL	NL	1.000	0.680	0.434	0.160		1.000	1.152	1.164	1.010	VAR
		ING	0.109	0.171	0.184	0.136		0.437	0.585	0.623	0.587	VAR
	ING	ING	1.000	0.962	1.075	1.135		1.000	1.124	1.012	0.539	VAR
		NL	0.233^n	0.135^n	0.400	0.759		0.606	0.785	0.723	0.368	VAR
PT	PT	PT	1.000	0.982	0.948	0.807	VAR	1.000	1.264	0.990	1.170	
		BCP	0.341	0.388	0.406	0.424	VAR	0.535	0.785	0.809	1.056	
	BCP	BCP	1.000	1.104	1.022	0.713	VAR	1.000	1.151	1.105	1.002	
		PT	0.226	0.357	0.396	0.450	VAR	0.724	0.897	0.675	0.653	
	PT	PT	1.000	0.980	0.942	0.791	VAR	1.000	1.258	1.305	1.079	VAR
		BES	0.296	0.325	0.353	0.402	VAR	0.542	0.803	0.941	0.998	VAR
	BES	BES	1.000	1.140	1.065	0.749	VAR	1.000	1.250	1.298	1.097	VAR
		PT	0.207	0.371	0.421	0.483	VAR	0.793	0.974	0.954	0.598	VAR
SP	SP	SP	1.000	0.554	0.527	0.482		1.000	1.202	0.953	1.012	
		BBVA	0.061^n	0.128^n	-0.067^n	0.172^n		0.648	0.874	0.682	0.806	
	BBVA	BBVA	1.000	1.083	1.018	0.595		1.000	1.172	0.804	0.586	
		SP	0.133^n	0.175^n	0.605	0.511		0.651	0.812	0.537	0.398	
	SP	SP	1.000	0.559	0.552	0.486		1.000	1.188	0.897	0.950	
		BS	0.069^n	0.146	-0.053^n	0.168^n		0.663	0.893	0.628	0.739	
	BS	BS	1.000	1.085	0.999	0.574		1.000	1.155	0.690	0.405	
		SP	0.142^n	0.172^n	0.648	0.512		0.652	0.807	0.418	0.226^n	
Average	SOV	SOV	*1.000*	*0.745*	*0.619*	*0.484*		*1.000*	*1.211*	*1.129*	*0.993*	
		BK	*0.173*	*0.204*	*0.210*	*0.278*		*0.501*	*0.714*	*0.740*	*0.803*	
	BK	BK	*1.000*	*1.077*	*1.089*	*0.858*		*1.000*	*1.094*	*0.984*	*0.615*	
		SOV	*0.204*	*0.277*	*0.427*	*0.609*		*0.535*	*0.677*	*0.528*	*0.198*	

Note: Each impulse-variable has an effect on itself and the second variable of the bivariate system. A unit shock in the structural error leads to one standard deviation (in %) increase in the level of the impulse-variable. This effect is normalized to 1. The GIR of the second response-variable represent the percentage change of the levels given the normalized impulse. ^{n} denotes insignificant effects by considering bootstrapped 95% Hall percentiles with 2000 replications. [1] denotes Stage 1+2 and [2] denotes Stage 4+5+6. We report contemporaneous responses (Days = 0) and effects after 1 day (next day), 5 days (after one week), and 22 days (after one month). VAR means that we use a VAR in levels for obtaining the GIR. This is done when tests and/or cointegration relation checks do not indicate an equilibrium relation for entire Stage 1+2 or Stage 4+5+6. In "Average" section we provide the mean impulse responses from a schock in sovereign CDS spreads (SOV) and from a shock in bank CDS spreads (BK).

B Specific Country Analysis

B.1 France

Table 5: France: Unit Root Tests

Period	Variable	Log Levels						Log Differences					
		ADF		PP		KPSS		ADF		PP		KPSS	
Stage 1	FR	-0.786		-2.233		1.693	***	-12.272	***	-27.558	***	0.072	
	SG	-0.579		-0.706		1.446	***	-12.498	***	-12.536	***	0.086	
	BNP	-1.106		-1.139		1.360	***	-13.910	***	-13.923	***	0.098	
Stage 2	FR	-2.081		-2.719	*	0.437	*	-11.379	***	-18.105	***	0.336	
	SG	-2.057		-2.168		0.248		-9.884	***	-9.992	***	0.497	**
	BNP	-2.699	*	-2.674	*	0.178		-11.282	***	-11.278	***	0.578	**
Stage 1 + 2	FR	-1.441		-2.226		1.714	***	-15.364	***	-40.132	***	0.500	**
	SG	-1.930		-1.925		1.647	***	-15.813	***	-15.948	***	0.184	
	BNP	-2.324		-2.324		1.428	***	-17.741	***	-17.755	***	0.178	
Stage 4	FR	-0.907		-0.733		1.139	***	-6.809	***	-6.785	***	0.084	
	SG	-1.932		-1.756		0.550	**	-7.845	***	-7.840	***	0.066	
	BNP	-0.009		-0.152		0.907	***	-8.681	***	-8.630	***	0.205	
Stage 5	FR	-2.549		-2.558		1.323	***	-10.236	***	-10.343	***	0.183	
	SG	-2.220		-2.260		1.305	***	-11.683	***	-11.679	***	0.059	
	BNP	-2.356		-2.354		1.372	***	-11.077	***	-11.050	***	0.149	
Stage 6	FR	-1.017		-0.887		1.406	***	-10.076	***	-9.893	***	0.061	
	SG	-0.959		-1.018		0.779	***	-12.654	***	-12.682	***	0.145	
	BNP	-0.870		-0.768		1.185	***	-9.297	***	-13.129	***	0.124	
Stage 4 + 5	FR	-0.624		-0.520		1.261	***	-12.573	***	-12.658	***	0.205	
	SG	-2.368		-2.155		0.858	***	-13.575	***	-13.528	***	0.060	
	BNP	-1.661		0.450		0.529	**	-13.844	***	-13.806	***	0.105	
Stage 5 + 6	FR	-1.857		-1.793		0.662	**	-14.276	***	-14.129	***	0.564	**
	SG	-2.019		-1.968		0.369	*	-17.141	***	-17.166	***	0.331	
	BNP	-2.231		-2.238		0.467	**	-16.745	***	-16.764	***	0.559	**
Stage 4 + 5 + 6	FR	-1.346		-1.241		0.553	**	-16.019	***	-15.977	***	0.206	
	SG	-2.128		-2.166		0.485	**	-18.765	***	-18.782	***	0.141	
	BNP	-1.854		-1.783		0.268	**	-18.703	***	-18.760	***	0.123	

Note: all tests include an intercept in the respective test equation. ADF and PP test check the H_0 of a unit root, whereas the KPSS test examines the H_0 of stationarity. *, **, *** denote significance at the 10%, 5%, and 1% level.

Figure 8: France: CDS Level Series

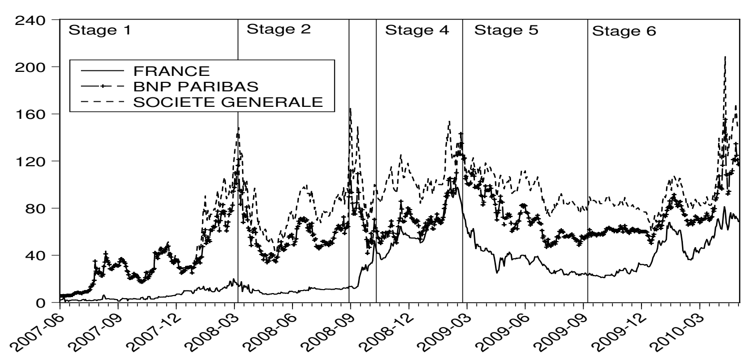


Table 6: France: Bivariate Cointegration Tests

Period	Variables	Lags	Trace Statistic		Max Eigenvalue		Engle-Granger Test
			$r = 0$	$r = 1$	$r = 0$	$r = 1$	
Stage 1	FR - BNP	0	**0.021**	0.212	**0.031**	0.212	-2.406
	FR - SG	0	**0.006**	0.119	**0.012**	0.119	**-4.446**
Stage 2	FR - BNP	*					
	FR - SG	1	**0.038**	0.332	**0.040**	0.332	**-5.701**
Stage 1 + 2	FR - BNP	1	**0.017**	0.109	**0.045**	0.109	**-3.102**
	FR - SG	1	**0.005**	0.147	**0.010**	0.147	**-4.455**
Stage 4	FR - BNP	6	*0.119*	0.130	0.296	0.130	-1.507
	FR - SG	5	0.764	0.779	0.706	0.779	-1.663
Stage 5	FR - BNP	2	0.321	0.290	0.477	0.290	-2.260
	FR - SG	8	**0.062**	0.124	0.158	0.124	**-3.101**
Stage 6	FR - BNP	1	0.611	0.583	0.631	0.583	-2.033
	FR - SG	1	0.507	0.504	0.554	0.504	-1.573
Stage 4 + 5	FR - BNP	1	0.282	0.735	0.192	0.735	-1.163
	FR - SG	1	0.295	0.944	0.142	0.944	-2.458
Stage 5 + 6	FR - BNP	1	0.211	0.447	0.216	0.447	-2.535
	FR - SG	1	**0.105**	0.297	0.138	0.297	-2.053
Stage 4 + 5 + 6	FR - BNP	1	**0.057**	0.313	**0.067**	0.313	-2.230
	FR - SG	1	**0.072**	0.514	**0.054**	0.514	-2.250

Note: Trace and Max Eigenvalue are the Johansen tests statistics (with a restricted constant). p-values are reported. The respective null hypothesis is denoted by $r = \{0, 1\}$, where e.g. $r = 1$ denotes one cointegration relation. * signifies that at least one of the series is stationary. For the Engle-Granger test the ADF test statistic is reported; critical values at 5% and 10% are -3.37 and -3.07 respectively.

B.2 Germany

Table 7: Germany: Unit Root Tests

Period	Variable	Log Levels						Log Differences					
		ADF		PP		KPSS		ADF		PP		KPSS	
Stage 1	DE	-2.447		-2.116		1.482	***	-11.440	***	-18.419	***	0.058	
	COM	-1.359		-1.374		1.152	***	-12.867	***	-12.875	***	0.143	
	DB	-1.282		-1.299		1.329	***	-12.901	***	-12.839	***	0.119	
Stage 2	DE	-1.710		-1.988		0.297		-11.399	***	-16.123	***	0.480	**
	COM	-3.364	**	-3.357	**	0.137		-10.672	***	-10.770	***	0.587	**
	DB	-3.157	**	-3.251	**	0.254		-10.388	***	-10.547	***	0.454	**
Stage 1 + 2	DE	-2.216		-2.784	*	1.425	***	-14.583	***	-24.944	***	0.164	
	COM	-2.547		-2.541		1.194	***	-16.445	***	-16.497	***	0.197	
	DB	-2.600	*	-2.598	*	1.473	***	-16.408	***	-16.361	***	0.171	
Stage 4	DE	-0.393		-0.612		1.185	***	-9.428	***	-9.659	***	0.101	
	COM	-0.155		-0.397		0.498	**	-8.157	***	-8.160	***	0.273	
	DB	-2.229		-2.144		0.160		-7.485	***	-7.485	***	0.251	
Stage 5	DE	-2.298		-2.360		1.323	***	-9.486	***	-9.241	***	0.153	
	COM	-0.569		-0.662		1.146	***	-11.326	***	-11.318	***	0.088	
	DB	-2.068		-2.207		0.735	**	-10.078	***	-10.063	***	0.113	
Stage 6	DE	-1.263		-1.331		1.199	***	-11.203	***	-11.203	***	0.067	
	COM	-0.666		-0.411		1.128	***	-12.934	***	-13.275	***	0.212	
	DB	-0.145		-0.053		1.097	***	-11.443	***	-11.354	***	0.235	
Stage 4 + 5	DE	-0.733		-0.742		0.954	***	-12.977	***	-12.977	***	0.224	
	COM	-1.653		-1.373		0.617	**	-13.494	***	-13.45	***	0.193	
	DB	-2.617	*	-2.593	*	0.803	***	-12.423	***	-12.418	***	0.048	
Stage 5 + 6	DE	-2.907	**	-2.886	**	0.453	*	-14.495	***	-14.324	***	0.41	*
	COM	-1.693		-1.656		0.877	***	-17.165	***	-17.192	***	0.372	*
	DB	-2.135		-2.006		0.504	**	-15.164	***	-15.058	***	0.447	*
Stage 4 + 5 +6	DE	-1.66		-1.389		0.754	***	-17.123	***	-17.135	***	0.12	
	COM	-1.71		-1.757		0.334		-18.658	***	-18.595	***	0.115	
	DB	-2.449		-2.032		0.896	***	-16.807	***	-16.663	***	0.218	

Note: all tests include an intercept in the respective test equation. ADF and PP test check the H_0 of a unit root, whereas the KPSS test examines the H_0 of stationarity. *, **, *** denote significance at the 10%, 5%, and 1% level.

Figure 9: Germany: CDS Level Series

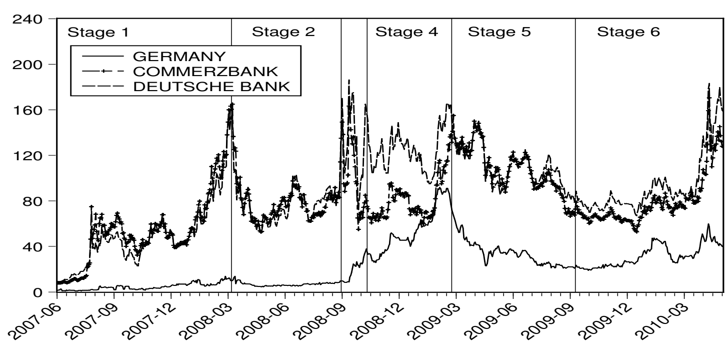
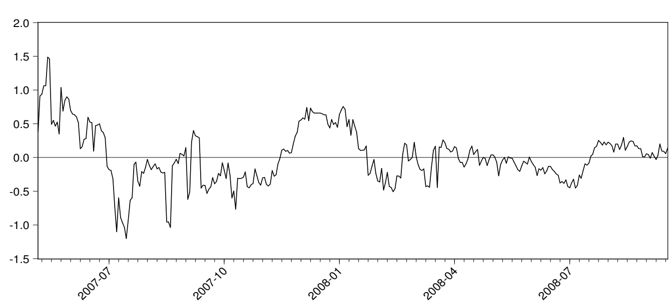


Table 8: Germany: Bivariate Cointegration Tests

Period	Variables	Lags	Trace Statistic		Max Eigenvalue		Engle-Granger Test
			$r=0$	$r=1$	$r=0$	$r=1$	
Stage 1	DE - COM	0	**0.044**	0.171	**0.086**	0.171	**-3.696**
	DE - DB	3	0.113	0.177	0.226	0.177	**-4.024**
	COM - DB	4	0.202	0.299	0.284	0.299	-2.423
Stage 2	DE - COM	*					
	DE - DB	*					
	COM - DB	*					
Stage 1 + 2	DE - COM	0	**0.001**	**0.051**	**0.003**	**0.051**	**-4.441**
	DE - DB	3	**0.005**	**0.048**	**0.027**	**0.048**	**-5.273**
	COM - DB	4	0.125	0.141	0.294	0.141	-2.933
Stage 4	DE - COM	1	0.413	0.663	0.350	0.663	-1.012
	DE - DB	1	**0.064**	0.331	**0.071**	0.331	-1.596
	COM - DB	0	**0.011**	0.654	**0.005**	0.654	-2.671
Stage 5	DE - COM	1	0.164	0.496	0.146	0.496	-2.983
	DE - DB	7	**0.0471**	0.117	0.124	0.117	-1.778
	COM - DB	1	**0.066**	0.823	**0.027**	0.823	-2.501
Stage 6	DE - COM	1	0.688	0.529	0.763	0.529	-1.368
	DE - DB	1	0.724	0.682	0.711	0.682	-0.900
	COM - DB	6	**0.074**	0.817	**0.031**	0.817	**-3.145**
Stage 4 + 5	DE - COM	1	**0.0421**	0.2814	**0.052**	0.2814	-1.485
	DE - DB	*					
	COM - DB	*					
Stage 5 + 6	DE - COM	*					
	DE - DB	*					
	COM - DB	1	0.372	0.5106	0.3812	0.5106	-2.283
Stage 4 + 5 +6	DE - COM	1	**0.0063**	0.1166	**0.0145**	0.1166	-1.774
	DE - DB	1	**0.0692**	0.2769	**0.0919**	0.2769	-2.088
	COM - DB	1	0.2559	0.4024	0.2957	0.4024	-3.086

Note: Trace and Max Eigenvalue are the Johansen tests statistics (with a restricted constant). p-values are reported. The respective null hypothesis is denoted by $r = \{0, 1\}$, where e.g. $r = 1$ denotes one cointegration relation. * signifies that at least one of the series is stationary. For the Engle-Granger test the ADF test statistic is reported; critical values at 5% and 10% are -3.37 and -3.07 respectively.

Figure 10: Cointegration Graph of Germany and Commerzbank (Before Government Interventions)



B.3 Ireland

Table 9: Ireland: Unit Root Tests

Period	Variable	Log Levels				Log Differences					
		ADF	PP	KPSS		ADF		PP		KPSS	
Stage 1	IR	-0.471	-2.035	1.459	***	-14.293	***	-28.076	***	0.030	
	AIB	-1.780	-1.780	1.567	***	-12.795	***	-12.781	***	0.132	
	BOI	-1.016	-1.022	1.601	***	-13.529	***	-13.521	***	0.097	
Stage 2	IR	-1.906	-2.348	0.621	**	-11.324	***	-19.901	***	0.231	
	AIB	0.082	-0.397	0.767	***	-8.892	***	-8.967	***	0.767	***
	BOI	0.211	0.001	0.779	***	-10.314	***	-10.385	***	0.648	**
Stage 1 + 2	IR	-0.961	-2.310	1.790	***	-18.003	***	-35.509	***	0.032	
	AIB	-2.525	-2.474	1.715	***	-15.853	***	-15.833	***	0.234	
	BOI	-1.819	-1.810	1.843	***	-16.992	***	-16.975	***	0.190	
Stage 4	IR	-1.651	-1.442	1.111	***	-6.507	***	-6.628	***	0.102	
	AIB	0.447	0.138	1.150	***	-8.393	***	-8.420	***	0.145	
	BOI	0.014	0.005	1.253	***	-9.683	***	-9.683	***	0.089	
Stage 5	IR	-1.830	-1.761	1.275	***	-9.305	***	-9.085	***	0.063	
	AIB	-0.562	-0.666	1.064	***	-11.244	***	-11.322	***	0.198	
	BOI	-0.882	-0.776	1.126	***	-6.231	***	-13.326	***	0.156	
Stage 6	IR	-0.241	-1.560	0.555	**	-10.784	***	-11.781	***	0.399	*
	AIB	-0.969	-0.831	0.438	*	-16.374	***	-16.158	***	0.147	
	BOI	-1.256	-1.584	0.464	**	-15.941	***	-15.941	***	0.078	
Stage 4 + 5	IR	-1.966	-1.84	0.477	**	-10.93	***	-10.93	***	0.362	*
	AIB	-1.562	-1.67	0.58	**	-12.88	***	-13.59	***	0.534	**
	BOI	-1.353	-1.48	0.451	*	-7.582	***	-15.65	***	0.666	**
Stage 5 + 6	IR	-0.241	-1.56	0.555	**	-10.78	***	-11.78	***	0.399	*
	AIB	-0.969	-0.83	0.438	*	-16.37	***	-16.16	***	0.147	
	BOI	-1.256	-1.58	0.464	**	-15.94	***	-15.94	***	0.078	
Stage 4 + 5 + 6	IR	-2.568	-2.34	0.792	***	-12.14	***	-15.23	***	0.127	
	AIB	-2.017	-2.11	0.328	*	-11.85	***	-20.89	***	0.182	
	BOI	-1.805	-1.86	0.667	**	-22.12	***	-22.08	***	0.238	

Note: all tests include an intercept in the respective test equation. ADF and PP test check the H_0 of a unit root, whereas the KPSS test examines the H_0 of stationarity. *, **, *** denote significance at the 10%, 5%, and 1% level.

Table 10: Ireland: Bivariate Cointegration Tests

Period	Variables	Lags	Trace Statistic		Max Eigenvalue		Engle-Granger Test
			$r = 0$	$r = 1$	$r = 0$	$r = 1$	
Stage 1	IR - AIB	2	0.429	0.620	0.389	0.620	-1.361
	IR - BOI	2	0.390	0.601	0.354	0.601	-1.325
Stage 2	IR - AIB	1	0.232	0.999	**0.080**	0.999	-2.577
	IR - BOI	1	**0.010**	0.997	**0.002**	0.997	**-3.376**
Stage 1 + 2	IR - AIB	2	0.323	0.354	0.421	0.354	-2.099
	IR - BOI	2	0.436	0.306	0.628	0.306	-2.155
Stage 4	IR - AIB	0	**0.016**	0.233	**0.021**	0.233	-1.806
	IR - BOI	1	0.260	0.330	0.349	0.330	-1.981
Stage 5	IR - AIB	1	0.227	0.183	0.445	0.183	-1.630
	IR - BOI	1	0.269	0.151	0.579	0.151	-2.149
Stage 6	IR - AIB	4	**0.049**	0.679	**0.024**	0.679	-1.918
	IR - BOI	4	0.177	0.786	**0.098**	0.786	-2.900
Stage 4 + 5	IR - AIB	1	**0.005**	0.129	**0.011**	0.129	-1.948
	IR - BOI	1	**0.027**	0.393	**0.023**	0.393	-1.892
Stage 5 + 6	IR - AIB	9	**0.003**	0.122	**0.005**	0.122	-3.080
	IR - BOI	9	**0.001**	0.117	**0.002**	0.117	-3.202
Stage 4 + 5 + 6	IR - AIB	9	**0.001**	0.057	**0.006**	0.057	-2.446
	IR - BOI	9	**0.000**	0.164	**0.000**	0.164	-3.055

Note: Trace and Max Eigenvalue are the Johansen tests statistics (with a restricted constant). p-values are reported. The respective null hypothesis is denoted by $r = \{0, 1\}$, where e.g. $r = 1$ denotes one cointegration relation. * signifies that at least one of the series is stationary. For the Engle-Granger test the ADF test statistic is reported; critical values at 5% and 10% are -3.37 and -3.07 respectively.

Figure 11: Ireland: CDS Level Series

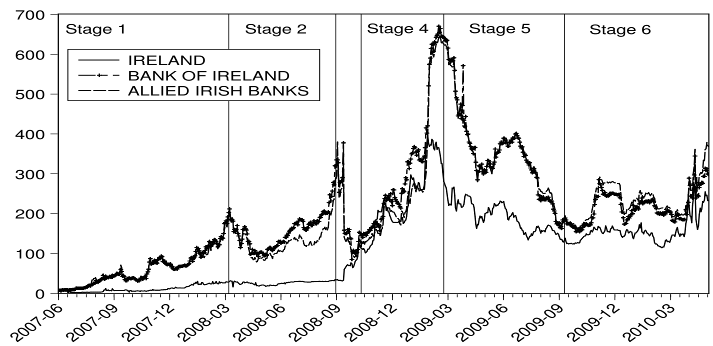
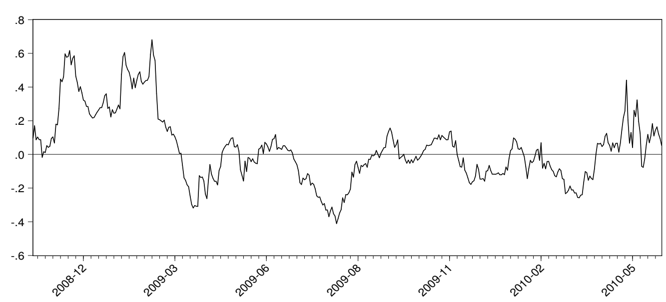


Figure 12: Cointegration Graph of Ireland and Allied Irish Banks (During and After Government Interventions)



B.4 Italy

Table 11: Italy: Unit Root Tests

Period	Variable	Log Levels						Log Differences					
		ADF		PP		KPSS		ADF		PP		KPSS	
Stage 1	IT	0.196		0.435		1.623	***	-14.387	***	-14.558	***	0.221	
	ISP	-1.179		-1.220		1.424	***	-11.427	***	-12.455	***	0.092	
	UCR	-1.113		-1.152		1.418	***	-12.928	***	-12.928	***	0.095	
Stage 2	IT	-1.245		-1.315		0.510	**	-8.121	***	-8.121	***	0.500	
	ISP	-2.933	**	-2.934	**	0.242		-11.767	***	-11.820	***	0.694	**
	UCR	-3.302	**	-3.304	**	0.218		-10.594	***	-10.621	***	0.604	**
Stage 1 + 2	IT	-1.037		-1.031		1.829	***	-17.275	***	-17.25	***	0.161	
	ISP	-2.476		-2.473		1.289	***	-16.560	***	-16.504	***	0.206	
	UCR	-2.424		-2.417		1.260	***	-16.514	***	-16.567	***	0.200	
Stage 4	IT	-1.458		-1.395		0.851	***	-7.525	***	-7.526	***	0.089	
	ISP	-1.194		-1.221		0.936	***	-6.994	***	-6.173	***	0.093	
	UCR	-0.485		0.063		0.992	***	-7.811	***	-7.793	***	0.349	*
Stage 5	IT	-2.174		-2.203		1.219	***	-9.062	***	-9.062	***	0.123	
	ISP	-2.174		-2.174		1.213	***	-11.021	***	-11.025	***	0.214	
	UCR	-2.548		-2.529		1.213	***	-10.666	***	-10.609	***	0.206	
Stage 6	IT	-0.402		-0.705		1.348	***	-9.178	***	-12.505	***	0.101	
	ISP	-0.742		-0.748		1.270	***	-11.903	***	-11.886	***	0.077	
	UCR	-1.357		-1.446		0.723	**	-12.886	***	-12.905	***	0.098	
Stage 4 + 5	IT	-0.753		-0.766		1.442	***	-11.694	***	-11.766	***	0.140	
	ISP	-1.154		-0.991		1.293	***	-11.585	***	-11.614	***	0.106	
	UCR	-1.103		-0.961		0.761	***	-12.813	***	-12.803	***	0.159	
Stage 5 + 6	IT	-2.089		-1.625		0.681	**	-13.318	***	-12.790	***	0.524	**
	ISP	-1.980		-2.039		0.465	**	-15.925	***	-15.855	***	0.728	**
	UCR	-3.213	**	-3.221	**	0.480	**	-16.614	***	-16.579	***	0.588	**
Stage 4 + 5 + 6	IT	-1.751		-1.394		0.669	**	-15.294	***	-14.746	***	0.206	
	ISP	-1.783		-1.537		0.723	**	-16.401	***	-16.184	***	0.187	
	UCR	-2.080		-1.936		0.755	***	-18.144	***	-18.054	***	0.140	

Note: all tests include an intercept in the respective test equation. ADF and PP test check the H_0 of a unit root, whereas the KPSS test examines the H_0 of stationarity. *, **, *** denote significance at the 10%, 5%, and 1% level.

Table 12: Italy: Bivariate Cointegration Tests

Period	Variables	Lags	Trace Statistic		Max Eigenvalue		Engle-Granger Test
			$r = 0$	$r = 1$	$r = 0$	$r = 1$	
Stage 1	IT - ISP	3	0.107	0.130	0.267	0.130	-1.948
	IT - UCR	3	0.140	0.180	0.278	0.180	-1.538
Stage 2	IT - ISP	1	**0.089**	0.919	**0.032**	0.919	-2.574
	IT - UCR	1	0.195	0.936	**0.083**	0.936	-1.797
Stage 1 + 2	IT - ISP	4	**0.052**	0.131	0.125	0.131	-2.313
	IT - UCR	3	**0.083**	0.108	0.236	0.108	-1.883
Stage 4	IT - ISP	1	0.761	0.561	0.829	0.561	-1.931
	IT - UCR	1	0.946	0.898	0.910	0.898	-1.696
Stage 5	IT - ISP	2	**0.091**	0.125	**0.231**	0.125	-2.334
	IT - UCR	2	**0.044**	0.143	**0.098**	0.143	-2.140
Stage 6	IT - ISP	4	0.248	0.389	0.293	0.389	**-3.125**
	IT - UCR	1	0.821	0.530	0.908	0.530	-1.762
Stage 4 + 5	IT - ISP	3	0.158	0.803	**0.082**	0.803	-2.181
	IT - UCR	1	0.590	0.584	0.605	0.584	-1.554
Stage 5 + 6	IT - ISP	4	**0.042**	0.768	**0.017**	0.768	-2.846
	IT - UCR	*					
Stage 4 + 5 + 6	IT - ISP	1	**0.059**	0.514	**0.042**	0.514	**-3.450**
	IT - UCR	1	0.284	0.256	0.453	0.256	-1.893

Note: Trace and Max Eigenvalue are the Johansen tests statistics (with a restricted constant). p-values are reported. The respective null hypothesis is denoted by $r = \{0, 1\}$, where e.g. $r = 1$ denotes one cointegration relation. * signifies that at least one of the series is stationary. For the Engle-Granger test the ADF test statistic is reported; critical values at 5% and 10% are -3.37 and -3.07 respectively.

Figure 13: Italy: CDS Level Series

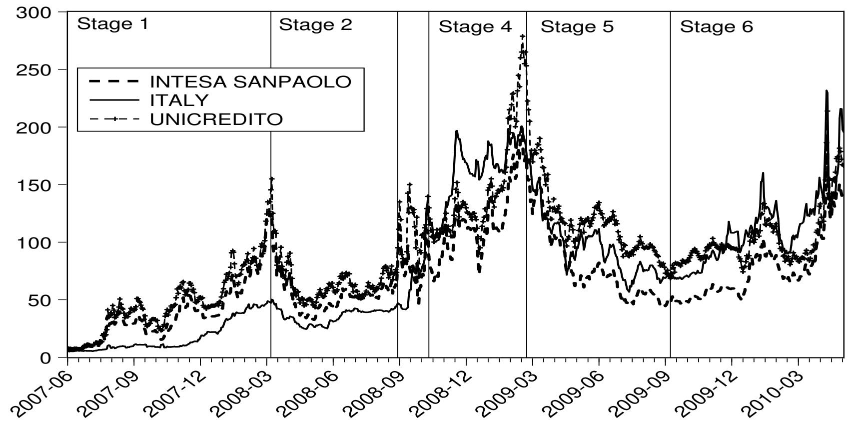
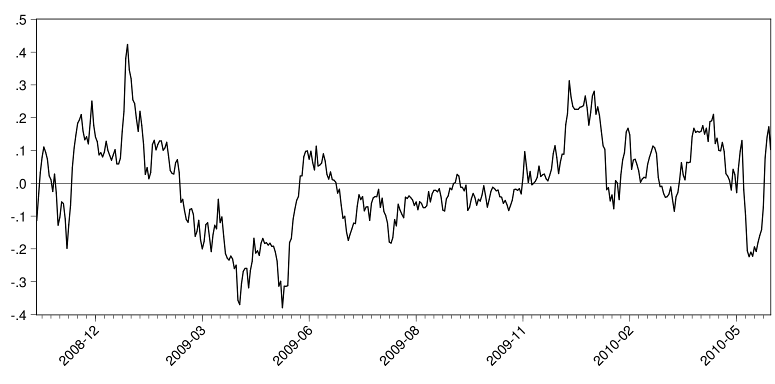


Figure 14: Cointegration Graph of Italy and Intesa San Paolo (During and After Government Interventions)



B.5 Netherlands

Table 13: Netherlands: Unit Root Tests

Period	Variable	Log Levels						Log Differences					
		ADF		PP		KPSS		ADF		PP		KPSS	
Stage 1	NL	-0.655		-0.950		1.669	***	-21.807	***	-11.499	***	0.058	
	ABN	-1.122		-1.120		1.418	***	-14.614	***	-14.615	***	0.117	
	ING	-0.6283		-0.594		1.521	***	-15.227	***	-15.207	***	0.083	
Stage 2	NL	-2.526		-4.035	***	0.241		-13.138	***	-18.328	***	0.181	
	ABN	-2.678	*	-2.715	*	0.238		-10.082	***	-10.233	***	0.543	**
	ING	-2.252		-2.279		0.300		-10.846	***	-10.963	***	0.756	***
Stage 1 + 2	NL	-1.649		-1.741		1.762	***	-14.881	***	-27.286	***	0.127	
	ABN	-2.435		-2.422		1.417	***	-17.809	***	-17.879	***	0.233	
	ING	-1.938		-1.938		1.544	***	-18.729	***	-18.728	***	0.180	
Stage 4	NL	-1.144		-1.257		1.083	***	-8.635	***	-8.868	***	0.092	
	ABN	0.227		0.094		0.997	***	-8.477	***	-8.423	***	0.428	*
	ING	-0.153		-0.496		0.661	**	-8.408	***	-8.417	***	0.219	
Stage 5	NL	-2.175		-2.248		1.320	***	-9.673	***	-9.606	***	0.215	
	ABN	-1.728		-1.754		1.130	***	-11.662	***	-11.664	***	0.070	
	ING	-2.125		-2.123		1.184	***	-9.642	***	-9.681	***	0.209	
Stage 6	NL	-1.421		-1.381		1.145	***	-11.804	***	-12.484	***	0.074	
	ABN	-2.214		-2.006		1.108	***	-9.480	***	-9.619	***	0.135	
	ING	-0.5797		-0.456		1.173	***	-12.092	***	-12.115	***	0.166	
Stage 4 + 5	NL	-0.6031		-0.692		1.126	***	-12.743	***	-12.942	***	0.312	
	ABN	-1.6007		-1.668		0.456	*	-14.363	***	-14.355	***	0.097	
	ING	-1.0929		-1.049		1.141	***	-12.688	***	-12.663	***	0.108	
Stage 5 + 6	NL	-3.4149	**	-3.514	***	0.901	***	-14.993	***	-14.825	***	0.553	**
	ABN	-1.3759		-1.495		0.919	***	-15.927	***	-15.845	***	0.225	
	ING	-2.6559	*	-2.593	*	0.603	**	-15.361	***	-15.237	***	0.657	**
Stage 4 + 5 + 6	NL	-1.3218		-1.257		1.463	***	-17.232	***	-17.249	***	0.163	
	ABN	-1.584		-1.467		1.164	***	-18.005	***	-17.919	***	0.066	
	ING	-1.7163		-1.621		1.134	***	-17.5	***	-17.419	***	0.175	

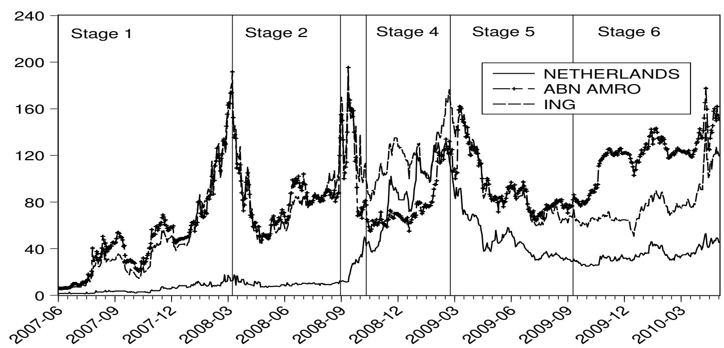
Note: all tests include an intercept in the respective test equation. ADF and PP test check the H_0 of a unit root, whereas the KPSS test examines the H_0 of stationarity. *, **, *** denote significance at the 10%, 5%, and 1% level.

Table 14: Netherlands: Bivariate Cointegration Tests

Period	Variables	Lags	Trace Statistic		Max Eigenvalue		Engle-Granger Test
			$r=0$	$r=1$	$r=0$	$r=1$	
Stage 1	NL - ABN	0	**0.029**	**0.099**	**0.085**	**0.099**	**-3.646**
	NL- ING	0	**0.007**	0.155	**0.014**	0.155	**-4.389**
Stage 2	NL - ABN	*					
	NL- ING	*					
Stage 1 + 2	NL - ABN	2	**0.005**	**0.059**	**0.021**	**0.059**	**-3.422**
	NL- ING	2	**0.002**	**0.145**	**0.004**	**0.145**	**-3.918**
Stage 4	NL - ABN	5	0.151	0.474	0.139	0.474	-2.419
	NL- ING	0	0.932	0.761	0.940	0.761	-1.385
Stage 5	NL - ABN	1	0.106	0.085	0.349	0.085	-2.801
	NL- ING	1	**0.095**	0.119	0.252	0.119	-2.662
Stage 6	NL - ABN	6	**0.082**	0.617	**0.051**	0.617	**-3.350**
	NL- ING	7	0.862	0.862	0.794	0.862	**-3.053**
Stage 4 + 5	NL - ABN	1	0.132	0.536	*0.104*	0.536	-1.622
	NL- ING	8	0.220	0.890	*0.107*	0.890	-2.243
Stage 5 + 6	NL - ABN	*					
	NL- ING	*					
Stage 4 + 5 + 6	NL - ABN	1	0.624	0.848	0.487	0.848	-1.422
	NL- ING	1	0.522	0.750	0.427	0.750	-2.372

Note: Trace and Max Eigenvalue are the Johansen tests statistics (with a restricted constant). p-values are reported. The respective null hypothesis is denoted by $r = \{0, 1\}$, where e.g. $r = 1$ denotes one cointegration relation. * signifies that at least one of the series is stationary. For the Engle-Granger test the ADF test statistic is reported; critical values at 5% and 10% are -3.37 and -3.07 respectively.

Figure 15: Netherlands: CDS Level Series



B.6 Portugal

Table 15: Portugal: Unit Root Tests

Period	Variable	Log Levels						Log Differences				
		ADF		PP		KPSS		ADF		PP		KPSS
Stage 1	PT	-0.152		0.054		1.669	***	-15.125	***	-15.437	***	0.106
	BES	-0.940		-0.914		1.427	***	-11.691	***	-11.693	***	0.116
	BCP	-1.031		-0.987		1.434	***	-12.064	***	-12.067	***	0.122
Stage 2	PT	-1.379		-1.452		0.396	*	-7.950	***	-8.004	***	0.477
	BES	-1.710		-1.710		0.471	**	-10.126	***	-10.115	***	0.664
	BCP	-2.329		-2.354		0.336		-10.799	***	-10.798	***	0.792
Stage 1 + 2	PT	-1.528		-1.542		1.866	***	-18.095	***	-18.102	***	0.221
	BES	-2.035		-2.089		1.608	***	-15.241	***	-15.197	***	0.193
	BCP	-2.336		-2.285		1.541	***	-15.797	***	-15.821	***	0.236
Stage 4	PT	-1.343		-1.373		1.054	***	-7.938	***	-8.055	***	0.085
	BES	-0.745		-0.399		1.079	***	-6.397	***	-6.338	***	0.204
	BCP	-0.785		-0.556		1.079	***	-7.504	***	-7.493	***	0.163
Stage 5	PT	-2.504		-2.485		1.036	***	-9.388	***	-9.392	***	0.106
	BES	-3.255	**	-3.178	**	0.605	**	-9.933	***	-9.829	***	0.196
	BCP	-2.402		-2.401		1.208	***	-11.416	***	-11.418	***	0.212
Stage 6	PT	-0.437		-0.765		1.459	***	-9.255	***	-9.981	***	0.052
	BES	0.098		0.542		1.254	***	-10.571	***	-10.661	***	0.307
	BCP	0.121		0.109		1.302	***	-10.725	***	-10.707	***	0.228
Stage 4 + 5	PT	-1.1993		-1.211		1.361	***	-12.276	***	-12.265	***	0.075
	BES	-2.1757		-1.951		0.478	**	-11.125	***	-11.056	***	0.074
	BCP	-1.9137		-1.817		0.498	**	-13.016	***	-12.987	***	0.089
Stage 5 + 6	PT	0.138		-0.233		1.301	***	-11.073	***	-12.978	***	0.413
	BES	0.0893		0.207		1.047	***	-14.3	***	-14.322	***	0.555
	BCP	0.1904		0.005		0.87	***	-14.961	***	-15.223	***	0.553
Stage 4 + 5 + 6	PT	-0.132		-0.536		0.747	***	-12.422	***	-15.062	***	0.285
	BES	-0.4541		-0.242		1.062	***	-15.383	***	-15.383	***	0.208
	BCP	-0.0853		-0.155		0.67	**	-16.743	***	-16.882	***	0.287

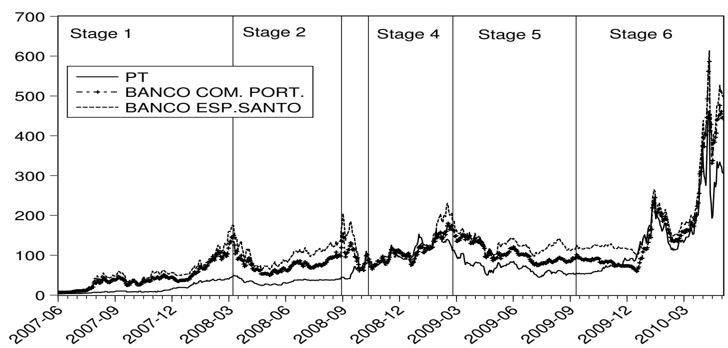
Note: all tests include an intercept in the respective test equation. ADF and PP test check the H_0 of a unit root, whereas the KPSS test examines the H_0 of stationarity. *, **, *** denote significance at the 10%, 5%, and 1% level.

Table 16: Portugal: Bivariate Cointegration Tests

Period	Variables	Lags	Trace Statistic		Max Eigenvalue		Engle-Granger Test
			$r=0$	$r=1$	$r=0$	$r=1$	
Stage 1	PT - BCP	1	0.272	0.420	0.307	0.420	-1.997
	PT - BES	3	0.280	0.464	0.293	0.464	-1.986
Stage 2	PT - BCP	1	*0.103*	0.599	**0.069**	0.599	**-3.570**
	PT - BES	2	**0.028**	0.688	**0.013**	0.688	**-3.374**
Stage 1 + 2	PT - BCP	0	**0.038**	0.078	0.135	0.078	-2.647
	PT - BES	0	**0.038**	0.093	*0.119*	0.093	-2.349
Stage 4	PT - BCP	6	0.291	0.717	0.206	0.717	-0.711
	PT - BES	6	0.257	0.874	0.135	0.874	-1.036
Stage 5	PT - BCP	1	0.302	0.182	0.584	0.182	-2.256
	PT - BES	*					
Stage 6	PT - BCP	1	**0.057**	0.596	**0.034**	0.596	-1.573
	PT - BES	1	0.188	0.546	0.157	0.546	-1.711
Stage 4 + 5	PT - BCP	1	0.344	0.411	0.408	0.411	-2.074
	PT - BES	1	0.318	0.643	0.258	0.643	-0.837
Stage 5 + 6	PT - BCP	1	**0.054**	0.652	**0.029**	0.652	-1.458
	PT - BES	1	0.349	0.659	0.283	0.659	-1.724
Stage 4 + 5 + 6	PT - BCP	1	**0.049**	0.472	**0.037**	0.472	-2.104
	PT - BES	1	0.378	0.571	0.355	0.571	-1.769

Note: Trace and Max Eigenvalue are the Johansen tests statistics (with a restricted constant). p-values are reported. The respective null hypothesis is denoted by $r = \{0, 1\}$, where e.g. $r = 1$ denotes one cointegration relation. * signifies that at least one of the series is stationary. For the Engle-Granger test the ADF test statistic is reported; critical values at 5% and 10% are -3.37 and -3.07 respectively.

Figure 16: Portugal: CDS Level Series



B.7 Spain

Table 17: Spain: Unit Root Tests

Period	Variable	Log Levels				Log Differences					
		ADF	PP	KPSS		ADF		PP		KPSS	
Stage 1	SP	0.108	0.060	1.661	***	-13.741	***	-22.846	***	0.186	
	BBVA	-0.851	-0.851	1.465	***	-12.266	***	-12.260	***	0.097	
	BS	-0.971	-1.013	1.492	***	-12.510	***	-12.474	***	0.088	
Stage 2	SP	-1.761	-2.083	0.537	**	-16.793	***	-17.933	***	0.297	
	BBVA	-2.398	-2.432	0.354	*	-10.731	***	-10.775	***	0.642	**
	BS	-2.258	-2.318	0.400	*	-10.741	***	-10.784	***	0.666	**
Stage 1 + 2	SP	-0.989	-0.953	1.887	***	-17.366	***	-28.654	***	0.104	
	BBVA	-2.227	-2.213	1.530	***	-16.024	***	-16.055	***	0.195	
	BS	-2.258	-2.243	1.536	***	-16.226	***	-16.221	***	0.185	
Stage 4	SP	-1.616	-1.289	1.088	***	-7.651	***	-7.857	***	0.088	
	BBVA	-1.502	-1.123	0.986	***	-6.397	***	-6.062	***	0.184	
	BS	-1.745	-1.437	0.984	***	-6.700	***	-6.663	***	0.200	
Stage 5	SP	-2.517	-2.421	0.994	***	-8.981	***	-8.898	***	0.093	
	BBVA	-2.355	-2.355	1.274	***	-10.976	***	-10.937	***	0.207	
	BS	-2.247	-2.250	1.298	***	-10.656	***	-10.604	***	0.199	
Stage 6	SP	-0.157	0.910	1.326	***	-10.345	***	-12.260	***	0.500	**
	BBVA	0.325	-0.404	1.202	***	-9.438	***	-11.650	***	0.146	
	BS	-0.040	-0.832	1.197	***	-9.771	***	-13.591	***	0.130	
Stage 4 + 5	SP	-1.642	-1.609	1.085	***	-11.814	***	-11.773	***	0.065	
	BBVA	-2.243	-2.036	0.645	**	-11.706	***	-11.642	***	0.057	
	BS	-2.285	-2.069	0.856	***	-11.872	***	-11.805	***	0.078	
Stage 5 + 6	SP	-0.245	-0.700	1.178	***	-11.759	***	-13.620	***	0.400	*
	BBVA	-1.073	-1.167	0.666	**	-11.344	***	-15.475	***	0.533	**
	BS	-1.024	-1.545	0.627	**	-11.745	***	-15.784	***	0.465	**
Stage 4 + 5 + 6	SP	-0.635	-1.064	0.523	**	-12.927	***	-15.542	***	0.220	
	BBVA	-1.896	-1.475	0.370	*	-16.294	***	-15.919	***	0.200	
	BS	-1.288	-1.865	0.347	*	-12.993	***	-16.541	***	0.215	

Note: all tests include an intercept in the respective test equation. ADF and PP test check the H_0 of a unit root, whereas the KPSS test examines the H_0 of stationarity. *, **, *** denote significance at the 10%, 5%, and 1% level.

Table 18: Spain: Bivariate Cointegration Tests

Period	Variables	Lags	Trace Statistic		Max Eigenvalue		Engle-Granger Test
			$r = 0$	$r = 1$	$r = 0$	$r = 1$	
Stage 1	SP - BBVA	1	0.130	0.148	0.296	0.148	-2.712
	SP - BS	1	**0.086**	0.146	0.196	0.146	-2.860
Stage 2	SP - BBVA	1	**0.017**	0.468	**0.011**	0.468	**-6.240**
	SP - BS	2	**0.020**	0.578	**0.011**	0.578	**-6.905**
Stage 1 + 2	SP - BBVA	1	0.013	0.102	**0.036**	0.102	**-3.851**
	SP - BS	1	**0.006**	0.090	**0.018**	0.090	**-3.420**
Stage 4	SP - BBVA	1	0.503	0.569	0.506	0.569	-1.395
	SP - BS	2	**0.026**	0.136	**0.058**	0.136	-2.000
Stage 5	SP - BBVA	1	0.507	0.407	0.628	0.407	-1.828
	SP - BS	1	0.545	0.441	0.651	0.441	-2.348
Stage 6	SP - BBVA	4	0.778	0.535	0.862	0.535	-2.008
	SP - BS	4	0.740	0.561	0.804	0.561	-2.108
Stage 4 + 5	SP - BBVA	1	0.300	0.416	0.345	0.416	-1.589
	SP - BS	2	**0.080**	0.243	0.121	0.243	-1.987
Stage 5 + 6	SP - BBVA	1	0.606	0.563	0.640	0.563	-2.088
	SP - BS	4	0.487	0.927	0.299	0.927	-2.012
Stage 4 + 5 + 6	SP - BBVA	11	**0.078**	0.459	**0.065**	0.459	-2.427
	SP - BS	1	**0.066**	0.184	0.124	0.184	-2.619

Note: Trace and Max Eigenvalue are the Johansen tests statistics (with a restricted constant). p-values are reported. The respective null hypothesis is denoted by $r = \{0, 1\}$, where e.g. $r = 1$ denotes one cointegration relation. * signifies that at least one of the series is stationary. For the Engle-Granger test the ADF test statistic is reported; critical values at 5% and 10% are -3.37 and -3.07 respectively.

Figure 17: Spain: CDS Level Series