



DEPARTMENT OF ECONOMICS  
AND BUSINESS ECONOMICS  
AARHUS UNIVERSITY



# **The Bank-Sovereign Nexus: Evidence from a non-Bailout Episode**

**Massimiliano Caporin, Gisle J. Natvik, Francesco Ravazzolo  
and Paolo Santucci de Magistris**

**CREATES Research Paper 2017-25**

# The Bank-Sovereign Nexus: Evidence from a non-Bailout Episode\*

Massimiliano Caporin<sup>†</sup>      Gisle J. Natvik<sup>‡</sup>  
Francesco Ravazzolo<sup>§</sup>    Paolo Santucci de Magistris<sup>¶</sup>

<sup>†</sup>University of Padova

<sup>‡</sup>BI Norwegian Business School

<sup>§</sup>Free University of Bozen-Bolzano and BI Norwegian Business School

<sup>¶</sup>Aarhus University and CREATES

August 21, 2017

## Abstract

We explore the interplay between sovereign and bank credit risk in a setting where Danish authorities first let two Danish banks default and then left the country's largest bank, Danske Bank, to recapitalize privately. We find that the correlation between bank and sovereign credit default swap (CDS) rates changed with these events. Following the non-bailout events, the sensitivity to external shocks, proxied by CDS rates on the European banking sector, declined both for Danske Bank and for Danish sovereign debt. After Danske Bank's recapitalization, its exposure to the European banking sector reappeared while that did not happen for Danish sovereign debt. This decoupling between CDS rates on sovereign and private bank debt indicates that the vicious feedback loop between bank and sovereign risk was weakened after the non-bailout policies.

*JEL codes:* C21, G12, G21, G28.

*Keywords:* Bailout expectation, risk, CDS, spillover, quantile regression.

---

\*We thank Bruno Parigi, Roberto Rigobon, Valeriya Dinger and conference and seminar participants at the 8th International Conference on Computational and Financial Econometrics (CFE 2014) in Pisa, at the 23rd Symposium of the Society for Nonlinear Dynamics and Econometrics in Oslo, Bank of Italy, Osnabrueck University, LUISS university and Free University of Bozen/Bolzano for very useful comments. This paper is part of the research activities at the Centre for Applied Macro and Petroleum economics (CAMP) at the BI Norwegian Business School.

# 1 Introduction

In the years following the 2007-2008 financial crisis, several countries decided to bail out their local banks, shifting losses from the financial sector to the government. Shortly after the bailout events, the credit risk on many of these countries' sovereign bonds started to rise. Since then, it has been documented that the bank bailouts were an integral factor in fueling sovereign risk, see for instance Ejsing and Lemke (2011). It is even hypothesized that the bank bailouts backfired to some extent, as the subsequent rises in sovereign risks weakened the balance sheets of banks and thus re-ignited credit risk in the financial sector, as argued by for instance Acharya et al. (2014) and discussed by Arghyrou and Kontonikas (2012) and Fratzscher and Rieth (2015) in the context of the European sovereign debt crisis.

There are several more studies in this vein. Kallestrup et al. (2016) show that cross-border financial linkages affect sovereign risks to an extent that is beyond what can be explained by the simple exposure to common factors. Alter and Schuler (2012) document that bank bailout programs change the composition of both banks and government balance sheets, transferring the risks from the financial sector to the sovereign credit risk, while Alter and Beyer (2014) find evidence of an increase in bank-to-sovereign and sovereign-to-bank spillover during the European sovereign crisis, as in Lane (2012). De Bruyckere et al. (2013) show in a sample of European data over the period 2007-2012 that the success of government interventions depends on the type of intervention. Also before the European debt crisis erupted, the bank-sovereign nexus was understood as a potentially problematic issue, for instance Gray (2009) argued that the feedback and spillover effects between the risk exposures of the banking and sovereign sectors were important but only incompletely understood.<sup>1</sup>

A typical feature of the existing empirical studies is that they are based on episodes where bailouts were undertaken. However, these analyses cannot necessarily tell much about the counter-factual scenario, namely what *would* have happened if banks had *not* been rescued, but instead had been left to fail or raise additional capital in the market. In this study, we focus on one such episode which took place in Denmark. Differently from most of the previous literature on the topic of sovereign and bank credit risk, which has mostly analyzed the problem of contagion at a systemic level, we focus on a single episode where the national authorities let distressed banks default and made the country's largest bank recapitalize privately. In 2011 two Danish banks, Amagerbanken and Fjordbank, defaulted on outstanding bonds. In both cases, senior bond holders incurred substantial losses. The decision not to bail out these banks contrasted with the Danish crisis response in

---

<sup>1</sup>Other related studies include Demirgüç-Kunt and Huizinga (2013) who find that the value of the bank sector increases when the amount of government debt is lower, and Barth and Schnabel (2013) who suggest that banks are not too big to fail, but too systemic to fail and too big to save. The tight link between banks and sovereign credit risks is also increasingly emphasized in the literature on sovereign default, with Gennaioli et al. (2014) and Leonello (2017) as prominent examples.

2009, where the largest bank, Danske Bank, received considerable support. More broadly, the policy departed from the general Scandinavian practice of the early 1990s, where equity holders took most of the losses as banks collapsed, whereas bond holders were bailed out by the government, see e.g. Honkapohja (2009). Hence, the no-bailout decision was a sign that Danish authorities had changed to a more restrictive bailout policy in the past.<sup>2</sup> The following market-based recapitalization of Danske Bank and restitution of the 2009 funding provided by the government supported this tougher policy stance.

A priori, as reflected in the introductory discussion above, it is not obvious what consequences these policies might have. On the one hand, weaker perceived government guarantees could leave the debt of private banks exposed to external aggregate funding shocks. On the other hand, with a weaker link to the government, the bank risk should become less related to aggregate factors affecting the sovereign's solvency, and more dominated by idiosyncratic factors. Likewise, the sovereign debt might become more insulated from external disturbances if it is not expected to support its banks. However, if the lack of perceived bailout guarantees makes banks more vulnerable to external shocks, this could feed back to national balance sheets through tax base sensitivity to banking crisis. Hence, in this paper we seek to characterize how the sensitivity to external factors changed around the non-bailout events for Danish sovereign debt and the main Danish bank, Danske Bank. In particular, we provide empirical evidence to address whether private bank debt became more vulnerable after the non-bailout events and if the evolution of bank and sovereign debt became decoupled.

We study the evolution of credit default swap (CDS) rates on the bonds of Danske Bank and on Danish sovereign debt. As Figure 1 shows, the Danske Bank CDS rates did indeed increase after the non-bailout events, in particular after the second event (Fjordbank's default on June 24, 2011). This is consistent with the view that the two non-bailout episodes indicated a tougher policy stance on distressed banks. Moreover, a similar pattern is seen for Danish sovereign debt, displayed in Figure 2. At face value this might seem to indicate that the non-bailout policies were unsuccessful, as the reduction in bank guarantees were followed by greater bank and sovereign default risk. However, we also observe that both CDS rates decline toward the end of the sample and have remained low since Danske Bank was recapitalized. Hence, judging the merits of the non-bailout decisions from the immediate CDS responses would give a very different conclusion than a somewhat longer-run perspective. Several factors other than the non-bailout events may of course underlie such descriptive patterns, such as the European debt crisis in this specific period. For instance, even the CDS rates on German sovereign debt, by most standards a "safe haven

---

<sup>2</sup>Here there is an analogy between other bailout-events in Europe and how these events have influenced markets through signaling future bailout policy. For instance, Mink and de Haan (2013) study the period after it was made public that Greece might be bailed out, finding abnormal returns on a portfolio of European banks associated with the fact that "...news about the bailout are a signal of European governments' willingness in general to use public funds to combat the financial crisis...".

asset”, increased in mid-2011, as seen in Figure 3, a movement that obviously was not driven by Danish bailout policies.<sup>3</sup>

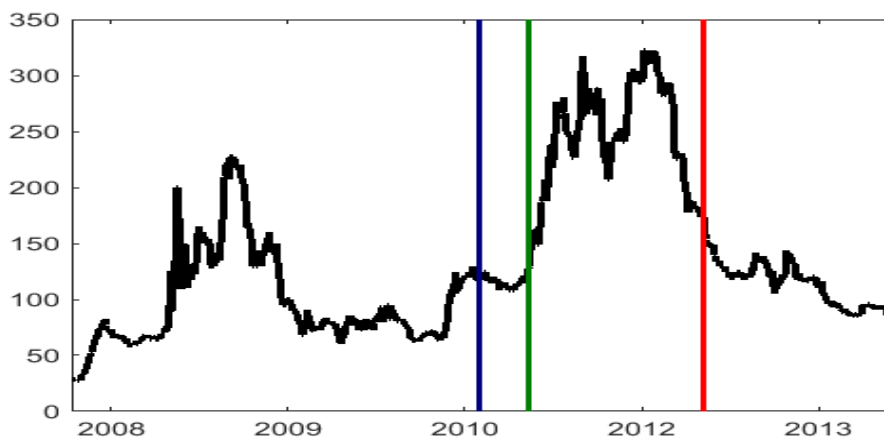


Figure 1: Danske Bank’s CDS level. The blue line refers to the default of Amagerbanken, the green line to the default of Fjordbank, and the red line to the recapitalization of Danske Bank.

For these reasons, we do not judge the effects of the non-bailout policies by the levels of Danish CDS rates alone. Instead, we develop an indirect testing strategy and study the sensitivity of Danske Bank and Danish CDS rates to the international CDS rates around the two non-bailout decisions and the subsequent recapitalization. We focus on the dynamics of the credit risk on a safe haven asset, as measured by the CDS on German sovereign bonds, and on the dynamics of the CDS index on the European banking sector. If the new non-bailout policy has affected market perceptions of credit risk determinants, that should turn up as time-variation in the regression coefficients of Danske Bank and Danish CDS rates on these variables.

We find that CDS rates on both Danske Bank and Danish sovereign debt became less sensitive to movements in CDS rates on the European banking sector immediately after Amagerbanken and Fjordbank were left to default. Later, after Danske Bank’s private recapitalization, the sovereign bonds remained less exposed to EU banking risk than before the non-bailout episodes, whereas Danske Bank’s sensitivity reverted to its pre-crisis levels. Hence, the overall effect of the non-bailout policy was to decouple sovereign from banking risk, but only after the private bank was recapitalized. Notably, the above results also emerge when we control for time varying sensitivity to CDS rates on German sovereign debt. The pattern of co-movement with the safe asset provided by German bonds is quite different from that with EU banking debt: the sensitivities of CDS rates on Danske Bank

<sup>3</sup>Acharya and Steffen (2015) find evidence that European bailout programs have supported European banks’ carry trade behavior by which they load positively on peripheral government bond returns and negatively on German government bond returns used as funding asset, increasing the differences in credit conditions among these countries.

and Danish sovereign debt to German sovereign debt move together over the period we consider. The default episodes are not associated with a change in co-movement for either assets, while both Danske Bank and Danish sovereign CDS rates respond less to movements in German sovereign CDS rates after the Danske Bank recapitalization.

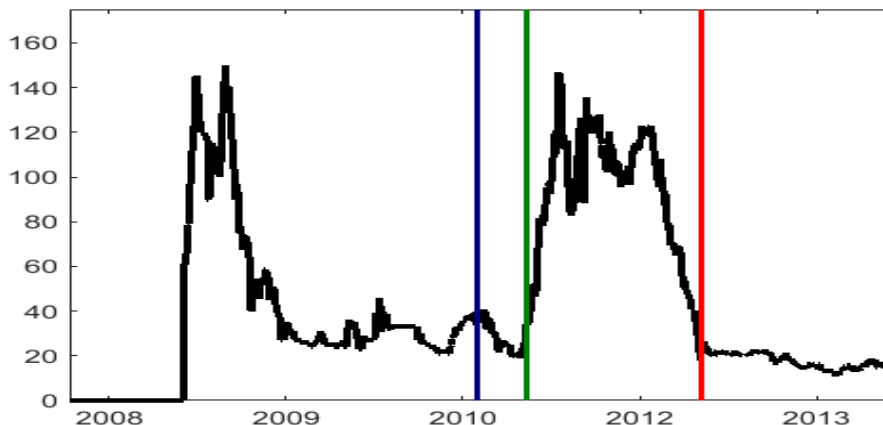


Figure 2: Danish Sovereign CDS level. The blue line refers to the default of Amagerbanken, the green line to the default of Fjordbank, and the red line to the recapitalization of Danske Bank.

Clearly, one may question if the empirical patterns are driven by the non-bailout events or other (domestic) factors that coincide in time. To shed some light on this issue, we control for an extensive set of variables, including the Danish housing price index and equity prices. Danske Bank equity prices are particularly important here, since bailouts primarily serve to shield debt holders rather than equity holders from losses. Hence, by controlling for swings in the Danske Bank stock price, we isolate the Danske Bank’s CDS co-movement with the CDS of the German sovereign debt and of the European banking sector, that is not due to factors that affect the market’s valuation of Danske Bank’s assets. Similarly, for the Danish sovereign CDS, by controlling for overall equity prices, we control for the market’s perception of the state of the Danish economy at large.

Importantly, we also address non-linearities, as the co-movement between variables could be different in crisis times than in more normal periods. Indeed, bailout events generally take place during extreme market conditions or in exceptional company-specific circumstances. In these situations, the response variables are subject to extremely large realizations and a linear model could produce biased results, see for example Caporin et al. (2014). We therefore extend our analysis with quantile regressions, which facilitate detecting and testing for differential impacts of the explanatory variables across the quantiles of the dependent variable. We apply the method to assess whether the new non-bailout policy had particular effects in different parts of the CDS distribution.<sup>4</sup>

<sup>4</sup>Quantile regressions have been extensively adopted in treatment effects analysis, typically in clinical

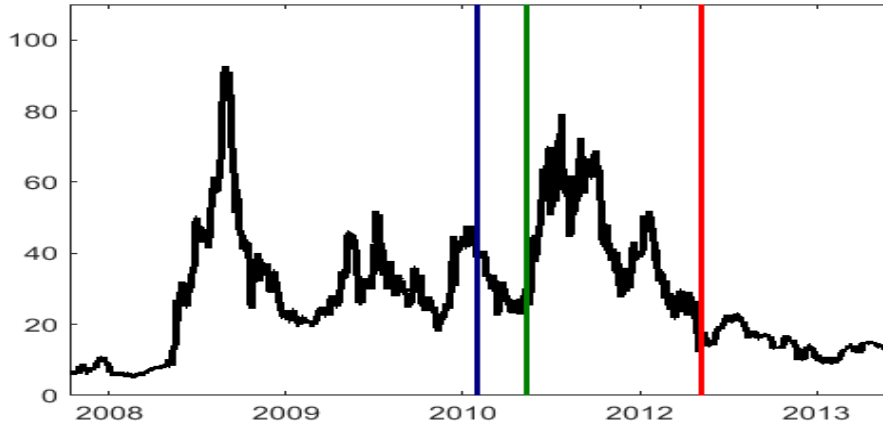


Figure 3: German Sovereign CDS level. The blue line refers to the default of Amagerbanken, the green line to the default of Fjordbank, and the red line to the recapitalization of Danske Bank.

The main findings from the non-linear analysis are consistent with the patterns revealed in the linear regression framework. Conditional upon being in high-volatility times, the co-movement between an average CDS of the larger European banks and Danske Bank CDS is markedly lower after the defaults of Amagerbanken and Fjordbank, whereas the co-movement of Danske Bank CDS and German CDS is stable. The same pattern emerges with Danish sovereign CDS rates. Then, after the Danske Bank recapitalization, the relationship of Danske Bank and Danish sovereign CDS rates with the European banking sector diverges with a positive significant coefficient for Dansk Bank and a flat zero coefficient for Danish CDS across quantiles. After the Danske Bank recapitalization, (i) CDS levels on both sovereign and private bank debt dropped, and (ii) sovereign and private bank risk were decoupled in their response to international banking risk. Taken together, these observations are consistent with a narrative where the different components of the non-bailout policy choices taken together, including recapitalization, contributed to curb the feedback loop between banking risk and sovereign risk.

This paper is organized as follows. Section 2 provides an overview of the data and the institutional setting. Emphasis is on how failing banks typically have been dealt with in Scandinavia and the particular events in Denmark that we study. Section 3 describes the results of our analysis applying linear and quantile regressions. Section 4 concludes.

---

trials where the interest is in how subjects respond to a specific treatment.

## 2 Data and Institutional Setting

### 2.1 Setting and Events

After the real estate crisis in the late 1980s and early 1990s, the Scandinavian governments, particularly in Norway and Sweden, nationalized defaulting banks by creating the system of so-called “bad banks”. In a nutshell, the shares of the bad banks lost their value while debt was repaid by the government. Hence, stock holders suffered all the losses, whereas bond holders were largely guaranteed, see e.g. Honkapohja (2009). The impression that bank bonds were protected by the government was strengthened during the financial turmoil of 2007-2008, when the governments in Scandinavia, as in many other economies, stepped in to support their largest banks with emergency credit lines. In 2009 the Danish government implemented a credit aid package intended to support Danske Bank, among other financial institutions. In particular, Danske Bank raised a perpetual hybrid loan of 26 billion Danish Krone (DKK) (equivalent to some 4.8 billion US Dollars at the time) with the Danish government, which allowed the bank to maintain its capitalization well above regulatory requirements (Standard and Poor’s, 2012).<sup>5</sup> Despite the support measures of the government, the Danish economy further deteriorated after 2009, and real estate prices plummeted. The collapse in house prices brought additional problems to the Danish banking sector. On February 6, 2011, the relatively small bank Amagerbanken was unable to meet its obligations and forced a 41% loss on its senior bond holders. The fact that the Danish government chose *not* to bail this bank and its senior bond holders out contrasted sharply with previous experience and marked a shift in bailout policy. On June 24, 2011, this restrictive policy line was confirmed when Fjordbank was left to default, and senior bond holders suffered substantial losses once again. On October 30 2012, Danske Bank initiated a significant recapitalization, with a DKK 7 billion equity rights issue. The recapitalization was a main ingredient in a new three-year plan of the group to improve its earnings capacity. The issue was partly motivated by tighter future regulatory capital requirements, and partly by the fact that the government support measures from 2009 were about to expire, and the cost of repaying the government was set to increase sharply after May 2014. Notably, in contrast to the case of the US government support to the local banks, the extraordinary 2009 government measures in Denmark were temporary. They had a precise deadline when funding was supposed to be repaid, in line with EU competition law. Part of the 2009 funding (DKK 2 billion) was repaid already in 2012.

---

<sup>5</sup>Danske Bank is the largest bank in Denmark. It serves clients in Finland, Norway, Sweden, and Denmark, with banking, insurance, and asset-management services. As of September 30, 2012, its assets totaled DKK 3.599 billion, equivalent to ca 500 billion Euros. Source: Standard and Poor’s (2012).



## 2.2 Data

Similarly to Kalbaska and Gatkowski (2012), the evolution of the credit risk is analyzed by means of the prices of the CDS contracts, which can be obtained from Datastream. We use daily observations of the stock prices ( $P^{DB}$ ) and CDS rates ( $CDS^{DB}$ ) of Danske Bank, covering the period December 2007 to April 2014. CDS contracts are designed to transfer the credit exposure of fixed income products between parties. The buyer of a credit default swap receives credit protection from the seller. In doing so, the risk of default is transferred from the holder of the fixed income security to the seller of the swap. Higher CDS values imply higher risk. Hence, the CDS rates proxy for the risk that Danske Bank will default on its debt. We also collect daily data on Danish sovereign CDS rates ( $CDS^{DK}$ ) with 5 years maturity, along with the German sovereign CDS rates with 5 years maturity ( $CDS^{DE}$ ), and a CDS index for the European banking sector ( $CDS^{EU}$ ). The latter is computed by Thomson-Reuters as the weighted average CDS spread of the constituents, with weights based on total debt outstanding at the index construction date.<sup>6</sup>

We develop our analysis based on a few assumptions:

**A1** German bonds are *safe* assets.

**A2** The credit risk on the Danish sovereign bonds does not influence the credit risk of German bonds.

**A3** The credit risk on the Danske Bank bonds does not influence the credit risk of European banks.

Assumption A1 is perhaps an exaggeration as there could be risks associated with German debt too (otherwise the CDS price would be zero). This assumption should be interpreted as the German sovereign bonds are safe relative to other bonds. A2 and A3 are simply motivated by the volumes of the alternative bonds, and the size of the economies. The sovereign debt of Germany is more than eighteen times the sovereign debt of Denmark.<sup>7</sup> The total debt of Danske Bank is less than 1.5% of the total loans of the European banks.<sup>8</sup>

In addition, we use daily data on four other international risk related measures: the Euro Stoxx 50 Index (STOXX), the Euro Stoxx 50 Volatility Index (VSTOXX), the Oil price (OIL), and the liquidity risk in the money market computed as the difference between the 1-month Euribor and the Repo spread (LIQ). The role of liquidity for credit risk is quite controversial. Early papers, such as Codogno et al. (2003), find a limited impact, while more recent contributions, such as Manganelli and Wolswijk (2009) and Beber et al.

---

<sup>6</sup>We also tried to use a total connectedness index of the CDS of the 52 largest European banking institutions, see Figure A.2. Results were qualitatively similar.

<sup>7</sup>In 2014 the GDP of Denmark was about 257 billion Euro and its debt-to-GDP ratio was 44.8%. For Germany, these numbers were 2904 billions and 74.7%, respectively. We recover these data from Eurostat.

<sup>8</sup>In 2014 the total debt of Danske Bank was below 200 billion Euro relative to more than 16 trillion Euro in all of Europe, as reported by Danske Bank and ECB.

(2009), show that “...while the bulk of sovereign yield spreads is explained by differences in credit quality, liquidity plays a nontrivial role...”. We also control for Danish house prices, using a monthly Danish house price index (HS) that we interpolate to the daily frequency.

### 3 Empirical Results

#### 3.1 Preliminary analysis

Figure 4 plots stock prices and log-returns ( $\Delta \log P^{DB}$ ) along with log differences of the CDS on Danske Bank ( $\Delta \log CDS^{DB}$ ) and on Danish sovereign debt ( $\Delta \log CDS^{DK}$ ). Both

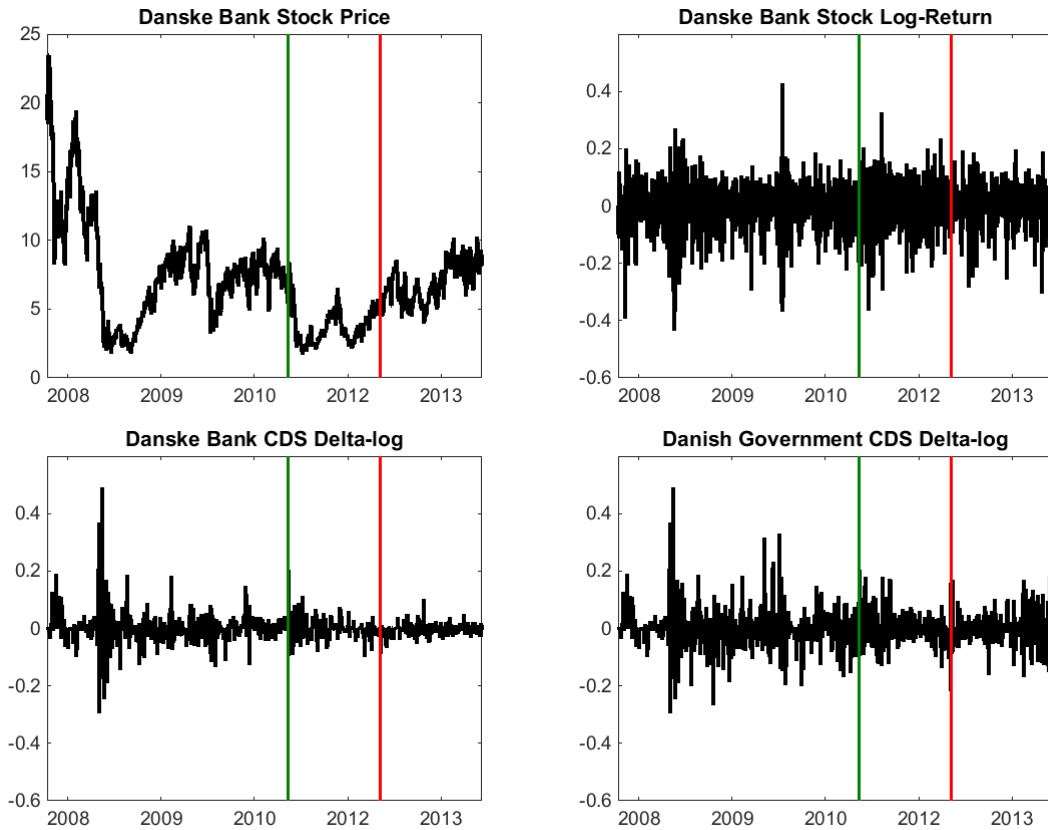


Figure 4: The green line identifies the default of Fjordbank while the red line identifies the recapitalization of Danske Bank.

stock prices and CDS levels (see Figures 1-2) display a break after the Fjordbank default in June 2011, with a large drop in stock prices and a large increase in CDS rates. Stock returns and CDS differences are also characterized by high volatility after this event. The effects of the recapitalization of Danske Bank in October 2012 are evident in the CDS, as it returns to its pre-2011 level after the recapitalization. This is natural, as more bank capital implies less risk for bond holders.

Importantly, the patterns in Figure 4 could stem from several other factors than the defaults of Amagerbanken and Fjordbank. We therefore study the dynamic interplay

between the CDS rates across countries and companies by means of the total connectedness index of Diebold and Yilmaz (2014). The TCI is defined as

$$TCI = \frac{1}{N} \sum_{i,j=1, i \neq j}^N \tilde{d}_{i,j}, \quad (1)$$

where  $N$  denotes the number of variables in the system, and  $\tilde{d}_{i,j}$  is the  $i, j$  entry of the standardized connectedness matrix  $\tilde{D}$ . The matrix  $\tilde{D}$  is defined as

$$\tilde{d}_{i,j} = \frac{d_{i,j}}{\sum_{j=1}^N d_{i,j}}, \quad (2)$$

with

$$d_{i,j} = \frac{\sigma_{jj}^{-1} \sum_{h=0}^H (e_i A_h \Sigma e_j)^2}{\sum_{h=0}^H (e_i' A_h \Sigma A_h' e_i)}, \quad (3)$$

where  $A_h$  is the impulse-response matrix at horizon  $h$  associated with a VAR(p) model,  $\Sigma$  is the covariance matrix of the errors, and  $e_i, e_j$  are  $N \times 1$  selection vectors. By construction,  $\sum_{j=1}^N \tilde{d}_{i,j} = 1$  and  $\sum_{i,j=1}^N \tilde{d}_{i,j} = N$ . Equation (3) defines the generalized forecast error decomposition, as introduced by Pesaran and Shin (1998). In other words, the TCI measures the average portion over  $N$  variables of the forecast error variation of variable  $i$  coming from shocks arising from the other  $j = 1, \dots, N - 1$  variables of the system. The TCI provides a characterization of the connectedness of a system that is richer than the one obtained with a simple linear correlation coefficient. Indeed, the TCI combines the information coming from both the contemporaneous and the dynamic dependence structure of the system through  $\Sigma$  and  $A_h$ , respectively. Moreover, by estimating the VAR model over rolling windows, it is possible to characterize the evolution of the dependence structure between two or more variables by looking at the variations of the TCI over time.

Figure 5 reports the pairwise rolling TCI between  $\Delta \log CDS^{DB}$ ,  $\Delta \log CDS^{DE}$ ,  $\Delta \log CDS^{DK}$ , and  $\Delta \log CDS^{EU}$ .<sup>9</sup> After the non-bailout event of Fjordbank and before the recapitalization of Danske Bank, the rolling TCI between  $\Delta \log CDS^{DB}$  and  $\Delta \log CDS^{DK}$  increased, but only after a decline at the beginning of the sample. After the recapitalization, the TCI index plunged and remained low and stable until the end of the sample. A similar pattern also arises from the TCI of  $\Delta \log CDS^{DB}$  and  $\Delta \log CDS^{DE}$ . The connectedness between  $\Delta \log CDS^{DB}$  and  $\Delta \log CDS^{EU}$ , the latter capturing systemic risk of other European banks, increases towards the end of the period, while it is very low between 2011 and 2012. This indicates that after the recapitalization, the dynamic behavior of credit risk associated with Danske Bank is connected to that of the rest of the European banking sector. Finally, the graphs in the bottom panels of Figure 5 display a general downward trend of the TCI between the CDS of Danish, German and the European banking sector

<sup>9</sup>See Figure A.1 in Appendix for rolling window correlations of the same variables.

without notable breaks after the recapitalization of Danske Bank.

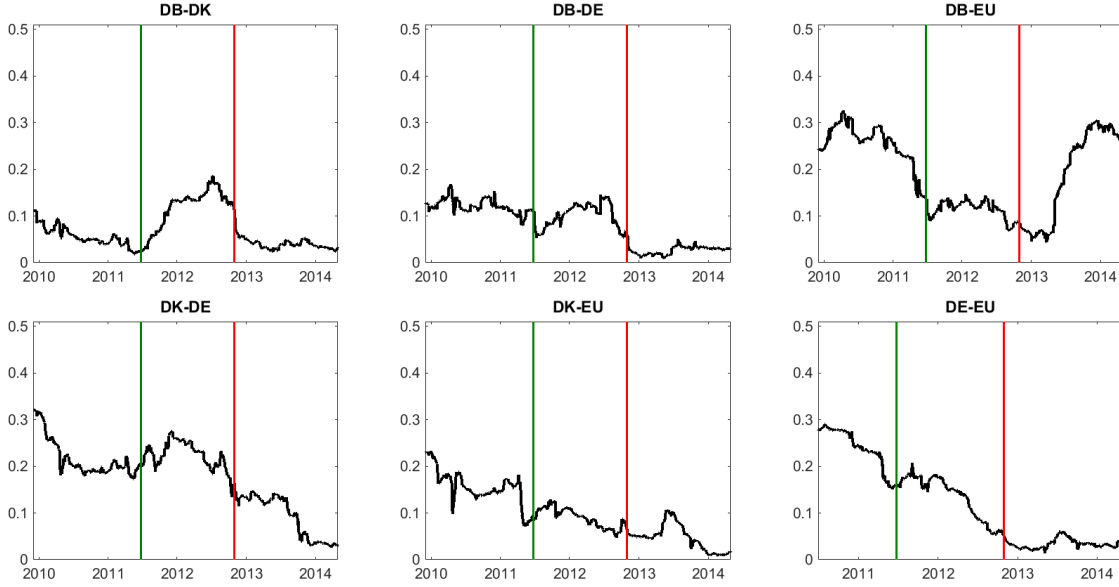


Figure 5: Rolling total connectedness index (one-year window) between the delta-logs of CDS on Danske Bank (DB), Danish sovereign debt (DK), German sovereign debt (DE), and the European banking sector (EU). The green line identifies the default of Fjordbank, while the red line denotes the recapitalization of Danske Bank. The total connectedness index is computed as in Diebold and Yilmaz (2014), based on a VAR with two lags ( $p=2$ ) and a horizon of  $H = 12$  days for the impulse-response functions.

### 3.2 Dependence on systemic risk after the non-bailout episodes

In order to further study the dynamics of credit risk in the Danish economy relative to the credit risk of the European system before and after the non-bailout events, we explore the sensitivity of Danske Bank and Danish sovereign CDS rates to movements in the CDS rates on European banks and German sovereign debt,  $\Delta \log CDS_t^{EU}$  and  $\Delta \log CDS_t^{DE}$ . We first consider a linear specification of the following form:

$$\begin{aligned} \Delta \log CDS_t^i &= \alpha_j^i + \beta_{j,1}^i \Delta \log CDS_t^{DE} + \beta_{j,2}^i \Delta \log CDS_t^{EU} + \beta_{j,3}^i \Delta \log P_t^{DB} + \quad (4) \\ &+ \beta_{j,4}^i \Delta \log HOUS_t + \delta_j^{i'} W_t + \varepsilon_t, \end{aligned}$$

where  $i = DB, DK$ .  $DB$  stands for Danske Bank and  $DK$  for Denmark, and the dependent variable is the log change in the CDS of Danske Bank or Danish sovereign debt;  $\varepsilon_t$  is the error term; and  $j = 1, 2, 3$  refer to the three periods we consider. These are: the period up to the default of Fjordbank (from December 18, 2007 to June 24, 2011), the period between the default and the recapitalization of Danske Bank (from June 25, 2011 to October 30, 2012), and the period after the recapitalization (from November 1, 2011 to April 29, 2014).

Note that we choose to use the Fjordbank default and not that of Amagerbanken, as it was only after the Fjordbank event that the CDS of Danske Bank reacted. This likely reflects that the market, only after the second event, interpreted the absence of bailout as a structural change in government policy.<sup>10</sup> The covariates are the log changes of German CDS, the log changes of the European banking sector CDS, the returns of Danske Bank equity, and the changes in the Danish housing index ( $\Delta \log HOUS$ ). Furthermore,  $W_t$  contains other financial variables related to global risk that are used as controls,  $\Delta \log OIL_t$ ,  $\Delta \log STOXX_t$ ,  $\Delta \log VSTOXX_t$ , and  $\Delta LIQ_t$ .

The results in Table 1 show that the estimated coefficient on  $\Delta \log CDS_t^{DE}$  is significantly positive in the two regressions, both in the first period and in the second period. Moreover, the values of the coefficients in the two samples are very similar. The credit risk on debt issued by both Danske Bank and the Danish government co-move with the German CDS rate, suggesting the relationship of the two assets with the safe haven has been constant. The observed signs make economic sense, since a general increase in global risk is likely to raise riskiness of the Danske Bank, and the Danish and German sovereign debts at the same time. In the last period  $\Delta \log CDS_t^{DE}$  has hardly moved, see Figure 3, which can explain why both the coefficients are close to zero here.

The evidence is different when focusing on the co-movement with  $\Delta \log CDS_t^{EU}$ . The coefficients for both regressions are always positive and significant in the three periods<sup>11</sup>, but with large differences across periods and between the two dependent variables. We find a substantial decrease of the coefficient in the second period for both dependent variables, from 0.741 to 0.156 and from 0.278 to 0.058 for DB and DK respectively, indicating that the exposure of Danske Bank and Danish government debt to international shocks decreased after the default of Fjordbank. We interpret this drop in co-movement as a sign that after the non-bailout episode, the systemic component became relatively less important than the *idiosyncratic* (company specific) component of Danske Bank's perceived riskiness. The pattern is consistent with the hypothesis that under a regime with a strong implicit bailout guarantee, bank debt is ultimately backed by the government and hence only sensitive to systemic risk, not idiosyncratic risk, even if the latter risk may be far greater than the former.<sup>12</sup> Then, once the bailout guarantee is weakened, holders of bank bonds become more strongly exposed to idiosyncratic risks instead of systemic risks. Before its recapitalization, Danske Bank's idiosyncratic risks were likely perceived as considerable.

---

<sup>10</sup>We also run a set of standard Chow-type tests on the covariates in equation (4) to evaluate our event-driven choice of splitting the sample. We verify that the pre-default period coefficients are equivalent, at the 1% level (p-value 0.04), to those obtained by running the model (4) on the data between the default. We also compare the latter coefficients to those obtained by a regression on the data between the Fjordbank default and the recapitalization. Now the null is rejected at the 1% level but with a p-value very close to the boundary (p-value 0.014). We thus read this as evidence supporting our choice. Tests for equality of coefficients among other periods always lead to a clear rejection of the null.

<sup>11</sup>For the  $\Delta \log CDS_t^{DK}$  in the last period only at 10% level.

<sup>12</sup>See for example Brunnermeier and Oehmke (2013) for an analysis of belief distortions in the presence of a bailout guarantee.

Notably, also the Danish sovereign CDS became less tightly correlated with the foreign banking sector after letting Fjordbank default, indicating that once bailouts were less likely, banking risk became less important for perceived sovereign risk. Importantly, after the recapitalization of Dansk Bank was finalized, the coefficients for the two parties diverge: for Danske Bank the coefficient increases toward the value it had before Fjordbank defaulted, whereas for the Danish CDS, it remains low and hardly significant. This indicates some success of the policy changes: The recapitalization leaves Danske Bank less exposed to idiosyncratic factors, and hence its perceived riskiness is again primarily driven by the credit risk of the international banking sector, but the recapitalization has no such effect for the Danish government. With weaker perceived bailout guarantees, the government remains less exposed to the international banking sector even though its largest bank still is.

We note that the above results hold when we control for both Danish house prices and for Danske Bank equity prices. Hence, the results do not seem driven by variation in the dynamics of house prices or in any other factor that might affect the market valuation of Danske Bank’s assets.

In principle, the reduced weights on German CDS in the third sample might be driven by the German CDS and the European banking CDS index proxying similar risks in the third sample, in which case the CDS index of European banks is enough to capture foreign shocks to the Danish economy. We therefore document the co-movement between these two series, regressing  $\Delta \log CDS_t^{DE}$  on  $\Delta \log CDS_t^{EU}$  using the three-period regressions in (4). The results in Table 1 show that the co-movement between the German CDS and the European banking sector decreases over time and becomes statistically insignificant at the end of the sample. Hence, correlation between these two series does not seem to be behind the declining weights on the German CDS in Table 1. More likely, the very low coefficients on German CDS at the end of the sample are related to the fact that changes in the German CDS were very limited and  $\Delta \log CDS_t^{DE}$  is often close to zero in this period, see also Figure 3.<sup>13</sup>

### 3.3 Default probabilities under different market conditions

Bailout events typically occur during extreme market conditions or under exceptional company-specific circumstances. In these scenarios our object of interest, the credit risk of bonds, might reach extreme values. Consequently, it might display a correlation structure with the credit risk on the bonds issued by other European countries that differs from the pattern in normal times. Our linear regression approach from the previous section ignores such possible different market conditions, and they might therefore bias our estimates and

---

<sup>13</sup>This observation can be related to the new European Central Bank (ECB) policy to protect the stability of the Euro-system following the “whatever it takes” speech by ECB president Mario Draghi on July 26, 2012, strengthening the rating of German sovereign debt.

		$\Delta \log CDS_t^{DE}$	$\Delta \log CDS_t^{DB}$	$\Delta \log CDS_t^{DK}$
$\alpha$	P1	0.001	0.000	0.000
	P2	-0.003	0.001	0.000
	P3	0.001	0.001	0.001
$\Delta \log CDS_t^{EU}$	P1	0.654 <sup>a</sup>	0.741 <sup>a</sup>	0.275 <sup>a</sup>
	P2	0.397 <sup>a</sup>	0.156 <sup>a</sup>	0.058 <sup>a</sup>
	P3	0.261	0.479 <sup>a</sup>	0.071 <sup>c</sup>
$\Delta \log CDS_t^{DE}$	P1		0.053 <sup>b</sup>	0.129 <sup>a</sup>
	P2		0.059 <sup>a</sup>	0.101 <sup>a</sup>
	P3		0.004	0.014 <sup>c</sup>
$\Delta \log P_t^{DB}$	P1		-0.041	-0.017
	P2		-0.063	-0.093 <sup>b</sup>
	P3		-0.067	-0.058
$\Delta \log HOUSE_t$	P1		-2.663 <sup>b</sup>	-1.224
	P2		-0.757	-1.322 <sup>c</sup>
	P3		-3.772 <sup>c</sup>	-1.939 <sup>c</sup>
Adj R2		0.156	0.249	0.344

Table 1: Linear Regression Results: OLS estimation results for Germany CDS log differences,  $\Delta \log CDS_t^{DE}$ , Danske Bank CDS log differences,  $\Delta \log CDS_t^{DB}$ , and Danish Sovereign CDS log differences,  $\Delta \log CDS_t^{DK}$ . The explanatory variables are: log differences of German CDS,  $\Delta \log CDS_t^{DE}$ ; log differences of a CDS index for the European banking sector computed by Thomson-Reuters,  $\Delta \log CDS_t^{EU}$ ; log-returns on Danske Bank stocks,  $\Delta \log P_t^{DB}$ ; differences of Danish real estate index,  $\Delta HOUSE_t$ . The coefficients are period-specific and refer to the three periods we consider in the analysis (P1, P2, and P3), namely: from the beginning of the sample up to the default of Fjordbank; from the default up to the recapitalization of Danske Bank; from the recapitalization up to the end of the sample. The regressions also include a set of control variables (coefficients available upon request): log differences of oil prices; log returns of the Euro 50 Stoxx Index; log differences of the Euro Stoxx 50 Volatility Index; difference of the liquidity risk in the money market computed as the difference between the 1-month Euribor and the Repo spread. Significant coefficients, computed with the Newey-West standard errors, are indicated as follows: 1%=a, 5%=b, and 10%=c. The last row reports the adjusted R-squared coefficients.

provide weak identification. Hence, we extend the analysis to assess if the time-variation in default-risk sensitivities occurred in particular parts of the distribution of credit risk. We are especially interested in whether they are more pronounced in the tails, so as to understand if there are different responses under normal circumstances than in more turbulent periods.

To this end we adopt a quantile regression method, where we hypothesize that a specific quantile of the density of the target variable (the CDS-change) is a linear function of a set of covariates. In recent years, financial applications of quantile regression methods have become increasingly common, see for instance Boyson et al. (2010), Baur (2013), and Caporin et al. (2014), among many others. We thus consider the quantile regression estimation of model (4), where the estimated parameters are associated with a specific quantile ( $\tau$ ). This allows recovering the  $\tau$ -quantile of the dependent variable conditional on the set of covariates. The model is defined as

$$Q_\tau(\Delta \log CDS_t^i) = \alpha_{j,\tau}^i + \beta_{j,1,\tau}^i \Delta \log CDS_t^{DE} + \beta_{j,2,\tau}^i \Delta \log CDS_t^{EU} + \beta_{j,3,\tau}^i \Delta \log P_t^{DB} + \delta_{j,\tau}^{i'} W_t, \quad (5)$$

where, similarly to the linear case,  $W_t$  contains several explanatory/control variables such as returns in the housing market and is included in all model specifications considered in this section. The quantile regression specification is comparable, in terms of choice of regressors, to that of equation (4). Therefore, the parameters of interest are still the same as those in (4), but they are now separately estimated for each particular quantile  $\tau$ . For details on quantile regression estimation, see Koenker (2005). In our analysis, we consider values of  $\tau$  ranging from 5% to 95% with a 5% step.

We start by analysing the quantile regression (5) for the CDS of Danske Bank. Panel a) of Figure 6 shows the coefficients associated with the German CDS, the CDS of EU banks and Danske Bank stock returns over the three periods.<sup>14</sup> The relation with the German CDS changes over the three periods. In the first period, the relationship is present throughout the quantile distribution. In period two, it is only present for upper quantiles, while for period three it disappears for all quantiles. Hence, the removal of the implicit bailout guarantee made Danske Bank riskier, and its correlation with the German CDS vanished. The only exception is those instances when the CDS on Danske Bank were in the riskiest quantile (right tail) in the second period. In this case, a positive increase in the German CDS was positively associated with the perceived credit risk of Danske Bank.

The coefficient associated with the CDS on the European bank system is always positive and significant in the first period. In the second period, the coefficients are substantially smaller than in the first period, and significant for the upper quantiles only. This aligns with the prior hypothesis that the large bank's credit risk becomes more dominated by

---

<sup>14</sup>Table A.2 in the Appendix reports the estimated coefficients.



idiosyncratic factors when bailout is less likely, factors which were considerable for Danske Bank before the recapitalization. After the recapitalization, these idiosyncratic risks necessarily fall in magnitude, and the coefficient on European-wide banking risks increases across all quantiles, returning to values comparable to those of period one. The third line of the panel shows that the relationship between the Danske Bank credit risk and the bank's stock prices is never significant, confirming that changes in perceived credit risk were not driven by omitted factors correlated with firm value.

To statistically validate the previous graphical evidence, we consider a more general model using dummy variables and derive a testing procedure from that model. The approach we follow comes from the extensive use of quantile regression methods in treatment effects analysis typical of clinical trials, where the interest is in the response of subjects to a specific treatment. Quantile regression allows detecting the so-called quantile treatment effect that postulates a possible different impact of the treatment across quantiles. Direct estimation of the quantile treatment effect is possible by means of dummies that identify subjects that have received the treatment. In this way, it is possible to disentangle the different impacts of the treatment: the absence of impact when dummy coefficients are all zero across quantiles; a simple location shift, with dummy coefficients that are constant across quantiles; the scale shift case, where dummy coefficients are symmetric; and the location and scale shift, where coefficients are neither constant across quantiles nor symmetric. In our setting, we might identify two different treatments: the absence of a government bailout and the recapitalization. Our interest is whether these treatments affect the relation between the CDS changes and the various covariates. We thus rewrite the model in (5) in the following way:

$$\begin{aligned}
Q_\tau (\Delta \log CDS_t^i) &= \alpha_{0,\tau} D_{0,t} + \alpha_{1,\tau} D_{1,t} + \alpha_{2,\tau} D_{2,t} + \\
&+ \beta_{1,1,\tau} D_{0,t} \Delta \log CDS_t^{DE} + \beta_{2,1,\tau} D_{1,t} \Delta \log CDS_t^{DE} + \beta_{3,1,\tau} D_{2,t} \Delta \log CDS_t^{DE} \\
&+ \beta_{1,2,\tau} D_{0,t} \Delta \log CDS_t^{EU} + \beta_{2,2,\tau} D_{1,t} \Delta \log CDS_t^{EU} + \beta_{3,2,\tau} D_{2,t} \Delta \log CDS_t^{EU} \\
&+ \beta_{1,3,\tau} D_{0,t} \Delta \log P_t^{DB} + \beta_{2,3,\tau} D_{1,t} \Delta \log P_t^{DB} + \beta_{3,3,\tau} D_{2,t} \Delta \log P_t^{DB} + \delta'_\tau W_t
\end{aligned} \tag{6}$$

where  $i = DB, DK$ , while  $D_{1,t}$ ,  $D_{2,t}$ , and  $D_{0,t} = 1 - D_{1,t} - D_{2,t}$  are step dummies.  $D_{1,t} = 1$  after the default of Fjordbank and up to the recapitalization of Danske Bank,  $D_{2,t} = 1$  after the recapitalization of Danske Bank, and both are zero otherwise.<sup>15</sup>

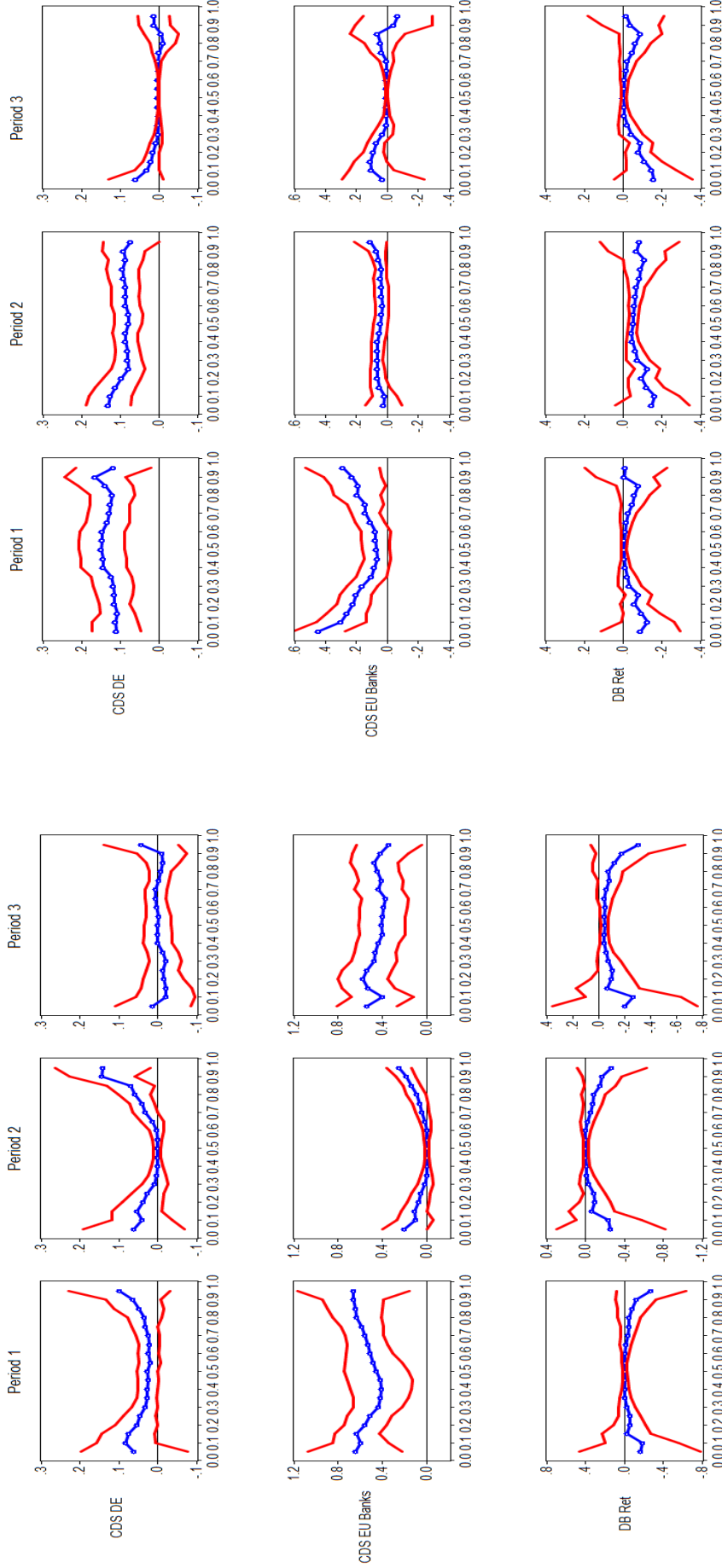
The estimation of model (6) for a given quantile  $\tau$  allows testing a null hypotheses of parameter stability across periods. We thus proceed to test the following null hypotheses

$$\begin{aligned}
i) \quad & H_0 : \beta_{1,j,\tau} = \beta_{2,j,\tau} \\
ii) \quad & H_0 : \beta_{1,j,\tau} = \beta_{3,j,\tau}
\end{aligned}$$

for  $j = 1, 2$ . The Wald-type test statistics can be easily derived given the asymptotic

---

<sup>15</sup>We also consider a version of the test associated with a model specification in which the covariates  $\Delta \log CDS_t^{DE}$  and  $\Delta \log CDS_t^{EU}$  and the intercept are excluded. Results are qualitatively similar.



(a) Danske Bank

(b) Danish sovereign bond

Figure 6: Variation of regression coefficients across quantiles. In Panel a) the dependent variable is the Delta-log of the Danske Bank CDS (DB), while in Panel b) the dependent variable is the Delta-log of the Danish sovereign CDS (DK). The covariates are the Delta-log of the Germany Sovereign CDS, the Delta-log of the CDS on the European banking sector (EU), and the log-return of Danske Bank equity. The three columns refer to the three subsamples we consider. The plot reports the estimated coefficients across quantiles and the 95% confidence interval obtained by a bootstrapping approach.

properties of quantile regression estimators, see Koenker (2005).

The results to the left in Table 2 show that for Danske Bank, the coefficients on German sovereign debt are significantly different only in the lower end of the quantile distribution, and these differences are primarily significant for period 3. In contrast, for period 2 the coefficients on European banks are significantly different from period 1 across the quantile distribution, while the difference is insignificant for period 3. This is the same pattern as we saw in Figure 6.

$\tau$	Danske Bank				Denmark			
	$\Delta \log CDS_t^{DE}$		$\Delta \log CDS_t^{EU}$		$\Delta \log CDS_t^{DE}$		$\Delta \log CDS_t^{EU}$	
	P2	P3	P2	P3	P2	P3	P2	P3
0.05	0.997	0.588	<b>0.073</b>	0.699	0.625	0.301	<b>0.000</b>	<b>0.007</b>
0.10	0.454	<b>0.068</b>	<b>0.001</b>	0.298	0.760	<b>0.013</b>	<b>0.002</b>	<b>0.080</b>
0.15	0.645	<b>0.038</b>	<b>0.000</b>	0.517	0.879	<b>0.000</b>	<b>0.003</b>	<b>0.066</b>
0.20	0.681	<b>0.070</b>	<b>0.000</b>	0.883	0.542	<b>0.000</b>	<b>0.007</b>	<b>0.033</b>
0.25	0.509	<b>0.057</b>	<b>0.000</b>	0.866	0.260	<b>0.000</b>	<b>0.009</b>	<b>0.020</b>
0.30	0.267	<b>0.044</b>	<b>0.000</b>	0.834	0.224	<b>0.000</b>	<b>0.071</b>	<b>0.028</b>
0.35	0.127	0.107	<b>0.001</b>	0.757	0.159	<b>0.000</b>	0.411	<b>0.054</b>
0.40	<b>0.073</b>	0.272	<b>0.003</b>	0.860	<b>0.065</b>	<b>0.000</b>	0.654	<b>0.079</b>
0.45	<b>0.097</b>	0.278	<b>0.004</b>	0.894	<b>0.087</b>	<b>0.000</b>	0.773	0.146
0.50	<b>0.078</b>	0.233	<b>0.001</b>	0.769	<b>0.037</b>	<b>0.000</b>	0.530	<b>0.084</b>
0.55	0.241	0.312	<b>0.000</b>	0.623	<b>0.035</b>	<b>0.000</b>	0.360	<b>0.073</b>
0.60	0.207	0.259	<b>0.000</b>	0.417	<b>0.065</b>	<b>0.000</b>	0.415	0.116
0.65	0.704	0.456	<b>0.000</b>	0.269	0.149	<b>0.000</b>	0.153	<b>0.022</b>
0.70	0.751	0.308	<b>0.000</b>	0.371	0.167	<b>0.000</b>	<b>0.042</b>	<b>0.008</b>
0.75	0.787	<b>0.090</b>	<b>0.000</b>	0.230	0.274	<b>0.000</b>	0.115	0.117
0.80	0.420	0.130	<b>0.000</b>	0.252	0.475	<b>0.000</b>	<b>0.047</b>	<b>0.095</b>
0.85	0.632	0.123	<b>0.000</b>	0.340	0.207	<b>0.001</b>	0.153	0.328
0.90	0.154	0.124	<b>0.002</b>	0.221	0.116	<b>0.001</b>	0.125	<b>0.084</b>
0.95	0.640	0.513	0.139	0.304	0.463	<b>0.059</b>	0.195	<b>0.032</b>

Table 2: Wald test for zero restrictions for the coefficients of the main covariates in equation (6). The null hypothesis is that covariates impact on the dependent variables ( $\Delta \log CDS_t^{DB}$  and  $\Delta \log CDS_t^{DK}$ ) equally across periods, as in equations (4) and (5). Column P2 compares the estimates in the second period in our analysis to estimates in the baseline first period, the null hypothesis in (4); column P3 compares estimates in the third period to estimates in the baseline first period, as in the null hypothesis (5). The covariates that we restrict and test are  $\Delta \log CDS_t^{DE}$  and  $\Delta \log CDS_t^{EU}$ . Bold numbers indicate p-values below 5%.

Next, we consider the quantile regression for the CDS of the Danish sovereign bonds. Panel b) of Figure 6 (and Table A.3 in Appendix) shows that the major difference from the results for Danske Bank is related to the coefficient on the European banking sector in period three. Across the quantiles considered the coefficient seems to drop from period one to period two. It then stays low from period two to period three. Hence, the dependence

between the risk of the Danish government debt and that of the foreign banking sector has disappeared after the non-bailout episodes, while it was present before the non-bailout events. The coefficients are approximately zero for some of the central quantiles. The Wald tests in Table 2 confirm the graphical evidence and imply that we can reject the null of equal coefficients for most quantiles when comparing the first with the third period. Moreover, the coefficient changes for the German sovereign CDS are statistically significant across the quantile distribution. This is also supported by the evidence on the upper-right panel of Figure 6. Overall, the combined non-bailout and recapitalization events were associated with a clear break in the relation between Danish sovereign risk and the covariates, indicating that the sovereign risk became less closely related to other risk factors.

To further dissect the empirical findings, we perform two specification tests on the outcomes of the quantile regression in equation (5). First, we verify coefficient stability across quantiles (the so-called “slope equality test”), contrasting the coefficients of the median with the coefficients of the upper 90% and 95% quantiles. The null hypothesis is the equality of the quantile regression coefficients at the three quantile levels, and its rejection suggests that the covariates have different impact at the different quantiles of the dependent variable. Table 3 reports results for the tests of stability of the coefficients associated with German CDS, European bank CDS, and Danske Bank log returns in the three periods. In the case of Danske Bank CDS, in the first period the coefficients associated with the three variables are stable across quantiles. For the second period, however, the coefficients for  $\Delta \log CDS_t^{DE}$  and  $\Delta \log CDS_t^{EU}$  are not stable, and the null is rejected. The evidence is opposite for the third period where the null hypothesis of coefficient stability is not rejected for any variable. The results are similar for the Danish sovereign CDS.

Second, we focus on a test that evaluates the symmetry of the coefficients. In particular, this test evaluates if the slopes of the coefficients change when moving from the left side of the median to the right side. Similarly to the previous set of tests considered, we are interested in evaluating if there is an asymmetric response after specific events. The quantile symmetry test is based on 0.05, 0.10, 0.50, 0.90, 0.95 quantiles, and the null hypothesis is symmetry in the impact of the covariates on the dependent variable, i.e.,  $\beta(0.05) + \beta(0.10) + \beta(0.90) + \beta(0.95) = 4\beta(0.5)$ , where  $\beta(\tau) = [\beta_{1,\tau}, \beta_{2,\tau}, \dots, \beta_{N,\tau}]'$  is the vector of parameters at a given quantile. The results reported in Table 3 provide a clear answer: as for the slope tests, the rejections only occur in the second period for the German CDS and European banking CDS.

The change in the bailout policy associated with the two defaults increases the idiosyncratic risk of Danske Bank, but if the Danske Bank CDS is in its upper tail, then increases in the German CDS and European banking CDS will affect Danske Bank, as one might expect. For the other two periods, the responses are more uniform across quantiles. Therefore, it seems that the defaults of Amagerbanken and Fjordbank resulted in a location and scale shift; the recapitalization of Danske Bank restored normality for Danske Bank and a

DB							
Slope Equality				Symmetry			
	DE	EU	DB	Interc.	DE	EU	DB
P1	0.50	0.32	0.32	0.77	0.21	0.30	0.40
P2	<b>0.00</b>	<b>0.00</b>	0.21	0.34	<b>0.01</b>	<b>0.00</b>	0.14
P3	0.34	0.76	0.32	0.66	0.23	0.92	0.26

DK							
Slope Equality				Symmetry			
	DE	EU	DB	Interc.	DE	EU	DB
P1	0.50	0.32	0.32	0.77	0.21	0.30	0.40
P2	<b>0.00</b>	<b>0.00</b>	0.21	0.34	<b>0.01</b>	<b>0.00</b>	0.14
P3	0.34	0.76	0.32	0.66	0.23	0.92	0.26

Table 3: Quantile regression specification tests (p-values) for slope equality on quantiles 0.50, 0.90, and 0.95 (columns 1, 2 and 3), and symmetry on quantiles 0.05, 0.10, 0.50, 0.90, and 0.95 (columns 4, 5 6 and 7) for the first period (row P1), the second period (row P2), and the third period (row P3). Results in the first panel refer to Danske Bank (DB) and in the second panel to Danish sovereign (DK) CDS with either Germany sovereign (DE), European banking sector (EU) CDS and Danske Bank stock log returns among the regressors. Bold numbers indicate p-values below 5%.

new regime for Danish government CDS.

## 4 Conclusion

New regulations limit the scope for governments to bail their banks out from financial stress. These regulations are at least partly motivated by the hypothesis that bailouts might fuel sovereign risk and backfire as greater sovereign riskiness weakens banks' balance sheets and thus re-ignites credit risk in the financial sector. We shed light on this channel in a setting where the authorities decided to let distressed banks default and left the main bank to privately recapitalize. Our evidence suggests that the no-bailout policy helped to curb the feedback between bank and sovereign risk, and reduce the exposure of the government to external conditions in the banking sector. This conclusion is based on an indirect testing approach to deal with endogeneity problems. This approach is based on both linear regressions and quantile regressions which account for possible asymmetries between crisis periods and normal times. We also present quantile regressions as a treatment effect approach. The purpose of this is to study whether the new policy was associated with a location shift, a slope shift, or both. The latter turns out to be the case.

Our analysis offers empirical support to regulation policies that limit bank bailouts and encourage market based solutions, such as recapitalization. It also provides new tools,

based on indirect testing and quantile regressions, to investigate the interplay between sovereign and private banking risks.

## References

- Acharya, V., Drechsler, I., and Schnabl, P. (2014). A Pyrrhic victory? Bank bailouts and sovereign credit risk. *The Journal of Finance*, 69(6):2689–2739.
- Acharya, V. V. and Steffen, S. (2015). The “greatest” carry trade ever? Understanding Eurozone bank risks. *Journal of Financial Economics*, 2(115):215–236.
- Alter, A. and Beyer, A. (2014). The dynamics of spillover effects during the European sovereign debt turmoil. *Journal of Banking and Finance*, (42):143–153.
- Alter, A. and Schuler, Y. S. (2012). Credit spread interdependencies of European states and banks during the financial crisis. *Journal of Banking and Finance*, 12(36):3444–3468.
- Argyrou, M. G. and Kontonikas, A. (2012). The EMU sovereign-debt crisis: Fundamentals, expectations and contagion. *Journal of International Financial Markets, Institutions and Money*, 22(4):658 – 677.
- Barth, A. and Schnabel, I. (2013). Why banks are not too big to fail. evidence from the cds market. *Economic Policy*, 74(28):335–369.
- Baur, D. G. (2013). The structure and degree of dependence: A quantile regression approach. *The Journal of Finance*, 37(3):786–798.
- Beber, A., Brandt, M. W., and Kavajecz, K. A. (2009). Flight-to-quality or flight-to-liquidity? Evidence from the euro-area bond market. *Review of Financial Studies*, 22(3):925–957.
- Boyson, N. M., Stahel, C. W., and Stulz, R. M. (2010). Hedge fund contagion and liquidity shocks. *The Journal of Finance*, 65(5):1789–1816.
- Brunnermeier, M. K. and Oehmke, M. (2013). Bubbles, financial crises, and systemic risk. *Handbook of the Economics of Finance*, 2.
- Caporin, M., Pelizzon, L., Ravazzolo, F., and Rigobon, R. (2014). Measuring sovereign contagion in Europe. Technical report, NBER.
- Codogno, L., Favero, C., and Missale, A. (2003). Yield spreads on EMU government bonds. *Economic Policy*, 18(37):503–532.

- De Bruyckere, V., Gerhardt, M., Schepens, G., and Vander Vennet, R. (2013). Bank/sovereign risk spillovers in the European debt crisis. *Journal of Banking and Finance*, 12(37):4793–4809.
- Demirgüç-Kunt, A. and Huizinga, H. (2013). Are banks too big to fail or too big to save? International evidence from equity prices and CDS spreads. *Journal of Banking and Finance*, 3(37):875–894.
- Diebold, F. X. and Yilmaz, K. (2014). On the network topology of variance decompositions: Measuring the connectedness of financial firms. *Journal of Econometrics*, 182(1):119–134.
- Ejsing, J. and Lemke, W. (2011). The Janus-headed salvation: Sovereign and bank credit risk premia during 2008-2009. *Economics Letters*, 110(1):28–31.
- Fratzscher, M. and Rieth, M. (2015). Monetary policy, bank bailouts and the sovereign-bank risk nexus in the Euro area. Technical report, C.E.P.R. Discussion Papers.
- Gennaioli, N., Martin, A., and Rossi, S. (2014). Sovereign default, domestic banks, and financial institutions. *Journal of Finance*, 2(69):819–866.
- Gray, D. F. (2009). Modeling financial crises and sovereign risks. *Annual Review of Financial Economics*, 1(1):117–144.
- Honkapohja, S. (2009). The 1990’s financial crises in nordic countries. Technical report, Bank of Finland Research Discussion Paper No. 5/2009.
- Kalbaska, A. and Gatkowski, M. (2012). Eurozone sovereign contagion: Evidence from the CDS market (2005-2010). *Journal of Economic Behavior and Organization*, 83(3):657–673.
- Kallestrup, R., Lando, D., and Murgoci, A. (2016). Financial sector linkages and the dynamics of bank and sovereign credit spreads. *Journal of Empirical Finance*, (38):374–393.
- Koenker, R. (2005). *Quantile regression*. Econometric Society Monographs, n. 38, Cambridge University Press, New York.
- Lane, P. R. (2012). The European sovereign debt crisis. *Journal of Economic Perspectives*, 3(26):49–67.
- Leonello, A. (2017). Government guarantees and the two-way feedback between banking and sovereign debt crises. Technical report, ECB - Working Paper series 2067.
- Manganelli, S. and Wolswijk, G. (2009). What drives spreads in the Euro area government bond market? *Economic Policy*, 24:191–240.

Mink, M. and de Haan, J. (2013). Contagion during the Greek sovereign debt crisis. *Journal of International Money and Finance*, 34:102–113.

Pesaran, H. and Shin, Y. (1998). Generalized impulse response analysis in linear multivariate models. *Economics Letters*, 58(1):17–29.

Standard and Poor's (2012). Danske bank outlook revised to positive on announced recapitalization measures; 'A-/A-2' ratings affirmed. Technical report, Standard and Poor's Ratings Services - Research Update.



# APPENDIX

$\tau$	Intercept			EU Banks CDS		
	P1	P2	P3	P1	P2	P3
0.05	-0.072 <sup>a</sup>	-0.079 <sup>a</sup>	-0.051 <sup>a</sup>	0.782 <sup>a</sup>	0.297	0.792 <sup>c</sup>
0.1	-0.045 <sup>a</sup>	-0.060 <sup>a</sup>	-0.029 <sup>a</sup>	0.650 <sup>a</sup>	0.398 <sup>a</sup>	0.770 <sup>a</sup>
0.15	-0.032 <sup>a</sup>	-0.045 <sup>a</sup>	-0.02 <sup>a</sup>	0.565 <sup>a</sup>	0.368 <sup>a</sup>	0.524 <sup>a</sup>
0.2	-0.023 <sup>a</sup>	-0.038 <sup>a</sup>	-0.014 <sup>a</sup>	0.513 <sup>a</sup>	0.333 <sup>a</sup>	0.346 <sup>b</sup>
0.25	-0.016 <sup>a</sup>	-0.029 <sup>a</sup>	-0.009 <sup>a</sup>	0.454 <sup>a</sup>	0.299 <sup>a</sup>	0.316 <sup>b</sup>
0.3	-0.010 <sup>a</sup>	-0.022 <sup>a</sup>	-0.004 <sup>a</sup>	0.446 <sup>a</sup>	0.363 <sup>a</sup>	0.187 <sup>c</sup>
0.35	-0.006 <sup>a</sup>	-0.014 <sup>a</sup>	-0.002 <sup>a</sup>	0.393 <sup>a</sup>	0.360 <sup>a</sup>	0.156 <sup>b</sup>
0.4	-0.004 <sup>a</sup>	-0.010 <sup>a</sup>	-0.001	0.383 <sup>a</sup>	0.395 <sup>a</sup>	0.083
0.45	-0.002 <sup>b</sup>	-0.006 <sup>b</sup>	0.000	0.395 <sup>a</sup>	0.375 <sup>a</sup>	0.042
0.5	0.000	-0.001	0.000	0.394 <sup>a</sup>	0.369 <sup>a</sup>	0.036
0.55	0.002 <sup>b</sup>	0.001	0.001 <sup>b</sup>	0.475 <sup>a</sup>	0.370 <sup>a</sup>	0.019
0.6	0.003 <sup>a</sup>	0.003 <sup>b</sup>	0.002 <sup>a</sup>	0.479 <sup>a</sup>	0.356 <sup>a</sup>	0.047
0.65	0.006 <sup>a</sup>	0.007 <sup>a</sup>	0.003 <sup>a</sup>	0.489 <sup>a</sup>	0.378 <sup>a</sup>	0.027
0.7	0.010 <sup>a</sup>	0.014 <sup>a</sup>	0.005 <sup>a</sup>	0.513 <sup>a</sup>	0.432 <sup>a</sup>	0.053
0.75	0.015 <sup>a</sup>	0.022 <sup>a</sup>	0.009 <sup>a</sup>	0.596 <sup>a</sup>	0.327 <sup>a</sup>	0.045
0.8	0.024 <sup>a</sup>	0.029 <sup>a</sup>	0.014 <sup>a</sup>	0.772 <sup>a</sup>	0.342 <sup>a</sup>	0.089
0.85	0.032 <sup>a</sup>	0.042 <sup>a</sup>	0.024 <sup>a</sup>	0.842 <sup>a</sup>	0.442 <sup>a</sup>	0.119
0.9	0.047 <sup>a</sup>	0.058 <sup>a</sup>	0.036 <sup>a</sup>	0.939 <sup>a</sup>	0.594 <sup>a</sup>	-0.037
0.95	0.078 <sup>a</sup>	0.085 <sup>a</sup>	0.060 <sup>a</sup>	0.818 <sup>a</sup>	0.661 <sup>a</sup>	0.155

Table A.1: Quantile regression results for delta-logs Germany Sovereign CDS across a range of quantiles (first column). The conditional quantile specification includes control variable whose coefficients are not included in the present table. Coefficients reported refers to the intercept and the Delta-logs of EU Banks CDS across the three subsamples of our analysis. Significant coefficients are indicated as follows: 1%=a, 5%=b and 10%=c.. Standard errors computed by bootstrap.

$\tau$	Intercept			EU Banks CDS			Germany Sovereign CDS			Danske Banks Equity			Housing index changes		
	P1	P2	P3	P1	P2	P3	P1	P2	P3	P1	P2	P3	P1	P2	P3
0.05	-0.044 <sup>a</sup>	-0.034 <sup>a</sup>	-0.019 <sup>a</sup>	0.647 <sup>a</sup>	0.201 <sup>b</sup>	0.544 <sup>a</sup>	0.061	0.061	0.012	-0.16	-0.259	-0.204	0.288	-1.867	-12.263 <sup>a</sup>
0.1	-0.028 <sup>a</sup>	-0.019 <sup>a</sup>	-0.012 <sup>a</sup>	0.597 <sup>a</sup>	0.107	0.403 <sup>a</sup>	0.082 <sup>b</sup>	0.041	-0.02	-0.183	-0.238	-0.268	1.365	-1.511	-5.625 <sup>c</sup>
0.15	-0.02 <sup>a</sup>	-0.014 <sup>a</sup>	-0.008 <sup>a</sup>	0.632 <sup>a</sup>	0.117 <sup>b</sup>	0.531 <sup>a</sup>	0.075 <sup>b</sup>	0.054	-0.022	-0.022	-0.063	-0.071	0.009	-2.142	-4.333 <sup>b</sup>
0.2	-0.013 <sup>a</sup>	-0.009 <sup>a</sup>	-0.006 <sup>a</sup>	0.558 <sup>a</sup>	0.078	0.579 <sup>a</sup>	0.054 <sup>b</sup>	0.038	-0.015	-0.056	-0.095	-0.102	-0.36	-2.424 <sup>c</sup>	-3.81 <sup>b</sup>
0.25	-0.009 <sup>a</sup>	-0.005 <sup>a</sup>	-0.005 <sup>a</sup>	0.515 <sup>a</sup>	0.057	0.541 <sup>a</sup>	0.046 <sup>b</sup>	0.026	-0.012	-0.056	-0.09	-0.108 <sup>c</sup>	0.182	-1.809 <sup>c</sup>	-1.914
0.3	-0.006 <sup>a</sup>	-0.001	-0.004 <sup>a</sup>	0.443 <sup>a</sup>	0.015	0.476 <sup>a</sup>	0.033 <sup>b</sup>	0.007	-0.02	-0.027	-0.035	-0.078	0.207	-0.349	-0.136
0.35	-0.003 <sup>a</sup>	0.000	-0.002 <sup>a</sup>	0.419 <sup>a</sup>	0.004	0.468 <sup>a</sup>	0.028 <sup>b</sup>	0.001	-0.013	-0.011	-0.014	-0.056 <sup>c</sup>	0.145	-0.085	-0.814
0.4	-0.002 <sup>a</sup>	0.000	-0.001	0.414 <sup>a</sup>	0.003	0.444 <sup>a</sup>	0.026 <sup>c</sup>	0.001	0.000	-0.01	-0.008	-0.046 <sup>b</sup>	0.085	-0.033	-0.934
0.45	-0.001 <sup>c</sup>	0.000	-0.001	0.423 <sup>a</sup>	0.002	0.4 <sup>a</sup>	0.024 <sup>c</sup>	0.001	-0.001	-0.009	-0.005	-0.045 <sup>a</sup>	-0.03	-0.017	0.056
0.5	0.000	0.000	0.000	0.459 <sup>a</sup>	0.002	0.407 <sup>a</sup>	0.027 <sup>c</sup>	0.001	0.000	-0.005	-0.005	-0.049 <sup>a</sup>	-0.344	0.004	-0.165
0.55	0.001 <sup>c</sup>	0.000	0.001	0.484 <sup>a</sup>	0.002	0.403 <sup>a</sup>	0.019	0.001	-0.002	-0.002	-0.002	-0.047 <sup>a</sup>	-0.816	0.025	0.239
0.6	0.002 <sup>a</sup>	0.000	0.001 <sup>b</sup>	0.517 <sup>a</sup>	0.003	0.395 <sup>a</sup>	0.024 <sup>c</sup>	0.003	0.002	-0.01	-0.005	-0.048 <sup>b</sup>	-1.239 <sup>c</sup>	0.04	1.251
0.65	0.003 <sup>a</sup>	0.001	0.002 <sup>b</sup>	0.534 <sup>a</sup>	0.017	0.377 <sup>a</sup>	0.021	0.013	0.006	-0.013	-0.017	-0.047	-1.64 <sup>c</sup>	0.141	1.117
0.7	0.006 <sup>a</sup>	0.004 <sup>b</sup>	0.004 <sup>a</sup>	0.564 <sup>a</sup>	0.045	0.439 <sup>a</sup>	0.025	0.032 <sup>c</sup>	0.004	-0.032	-0.051	-0.063	-1.976 <sup>c</sup>	-0.065	0.465
0.75	0.008 <sup>a</sup>	0.006 <sup>a</sup>	0.005 <sup>a</sup>	0.586 <sup>a</sup>	0.064 <sup>c</sup>	0.414 <sup>a</sup>	0.033 <sup>c</sup>	0.04 <sup>b</sup>	-0.003	-0.049	-0.076	-0.084 <sup>c</sup>	-2.243 <sup>c</sup>	0.083	0.327
0.8	0.012 <sup>a</sup>	0.011 <sup>a</sup>	0.006 <sup>a</sup>	0.631 <sup>a</sup>	0.098 <sup>b</sup>	0.45 <sup>a</sup>	0.034	0.059 <sup>a</sup>	-0.007	-0.048	-0.081	-0.074	-3.875 <sup>b</sup>	1.058	-0.29
0.85	0.017 <sup>a</sup>	0.016 <sup>a</sup>	0.009 <sup>a</sup>	0.647 <sup>a</sup>	0.137 <sup>a</sup>	0.478 <sup>a</sup>	0.047	0.069 <sup>b</sup>	-0.014	-0.083	-0.149 <sup>c</sup>	-0.122	-4.621 <sup>c</sup>	1.103	-1.293
0.9	0.026 <sup>a</sup>	0.024 <sup>a</sup>	0.014 <sup>a</sup>	0.668 <sup>a</sup>	0.19 <sup>a</sup>	0.422 <sup>a</sup>	0.063 <sup>c</sup>	0.143 <sup>a</sup>	-0.012	-0.118	-0.176 <sup>c</sup>	-0.184 <sup>c</sup>	-9.204 <sup>a</sup>	-1.267	-3.488
0.95	0.043 <sup>a</sup>	0.035 <sup>a</sup>	0.019 <sup>a</sup>	0.661 <sup>b</sup>	0.252 <sup>a</sup>	0.343 <sup>b</sup>	0.098	0.142 <sup>b</sup>	0.043	-0.277	-0.271	-0.304	-9.852 <sup>c</sup>	-0.611	-3.266

Table A.2: Quantile regression results for delta-logs Danske Bank CDS across a range of quantiles (first column). The conditional quantile specification includes control variable whose coefficients are not included in the present table. Coefficients reported refers to the intercept, the Delta-logs of EU Banks CDS, the Delta-Log of Germany Sovereign CDS, the Danske Bank equity return, and the Housing index changes, across the three subsamples of our analysis, P1=first period, P2= second period, P3=third period. Significant coefficients are indicated as follows: 1%=a, 5%=b and 10%=c. Standard errors computed by bootstrap.

$\tau$	Intercept			EU Banks CDS			Germany Sovereign CDS			Danske Banks Equity			Housing index changes		
	P1	P2	P3	P1	P2	P3	P1	P2	P3	P1	P2	P3	P1	P2	P3
0.05	-0.023 <sup>a</sup>	-0.018 <sup>a</sup>	-0.014 <sup>a</sup>	0.444 <sup>a</sup>	0.023	0.028	0.109 <sup>a</sup>	0.13 <sup>a</sup>	0.059	-0.091	-0.153	-0.158	0.516	0.788	2.674
0.1	-0.015 <sup>a</sup>	-0.014 <sup>a</sup>	-0.008 <sup>a</sup>	0.298 <sup>a</sup>	0.019	0.106	0.113 <sup>a</sup>	0.125 <sup>a</sup>	0.031 <sup>c</sup>	-0.13 <sup>c</sup>	-0.164 <sup>b</sup>	-0.148 <sup>b</sup>	-0.771	-0.57	1.018
0.15	-0.011 <sup>a</sup>	-0.01 <sup>a</sup>	-0.005 <sup>a</sup>	0.262 <sup>a</sup>	0.048	0.111 <sup>b</sup>	0.107 <sup>a</sup>	0.112 <sup>a</sup>	0.021 <sup>c</sup>	-0.098 <sup>b</sup>	-0.121 <sup>b</sup>	-0.111 <sup>b</sup>	-1.493	-0.227	-0.513
0.2	-0.009 <sup>a</sup>	-0.008 <sup>a</sup>	-0.003 <sup>a</sup>	0.221 <sup>a</sup>	0.061 <sup>b</sup>	0.09 <sup>a</sup>	0.114 <sup>a</sup>	0.095 <sup>a</sup>	0.014 <sup>c</sup>	-0.059	-0.1 <sup>a</sup>	-0.081 <sup>b</sup>	-1.256 <sup>c</sup>	-0.788	-0.51
0.25	-0.006 <sup>a</sup>	-0.006 <sup>a</sup>	-0.001 <sup>c</sup>	0.205 <sup>a</sup>	0.063 <sup>a</sup>	0.073 <sup>b</sup>	0.114 <sup>a</sup>	0.079 <sup>a</sup>	0.007	-0.081 <sup>b</sup>	-0.127 <sup>a</sup>	-0.094 <sup>a</sup>	-0.843	-0.512	-0.9
0.3	-0.004 <sup>a</sup>	-0.005 <sup>a</sup>	0.000	0.161 <sup>a</sup>	0.067 <sup>a</sup>	0.03	0.118 <sup>a</sup>	0.079 <sup>a</sup>	0.001	-0.037	-0.079 <sup>a</sup>	-0.044	-0.758	-0.484	-0.522
0.35	-0.002 <sup>a</sup>	-0.004 <sup>a</sup>	0.000	0.105 <sup>b</sup>	0.064 <sup>a</sup>	0.007	0.122 <sup>a</sup>	0.08 <sup>a</sup>	0.000	-0.023	-0.064 <sup>a</sup>	-0.024	-0.452	-0.601	-0.224
0.4	-0.001	-0.003 <sup>a</sup>	0.000	0.084 <sup>c</sup>	0.061 <sup>a</sup>	0.004	0.143 <sup>a</sup>	0.085 <sup>a</sup>	0.000	-0.011	-0.051 <sup>a</sup>	-0.009	-0.307	-0.813	-0.065
0.45	0.000	-0.002 <sup>a</sup>	0.000	0.063	0.049 <sup>b</sup>	0.003	0.142 <sup>a</sup>	0.086 <sup>a</sup>	0.000	-0.009	-0.047 <sup>a</sup>	-0.007	-0.05	-0.881 <sup>c</sup>	-0.038
0.5	0.000	-0.001 <sup>b</sup>	0.000	0.072 <sup>c</sup>	0.043 <sup>c</sup>	0.002	0.148 <sup>a</sup>	0.079 <sup>a</sup>	0.000	-0.006	-0.053 <sup>a</sup>	-0.005	-0.128	-0.758 <sup>c</sup>	-0.018
0.55	0.000	0.000	0.000	0.079 <sup>c</sup>	0.035	0.002	0.147 <sup>a</sup>	0.077 <sup>a</sup>	0.000	-0.009	-0.058 <sup>a</sup>	-0.007	-0.15	-0.898 <sup>b</sup>	-0.032
0.6	0.001	0.001 <sup>c</sup>	0.000	0.075	0.034	0.003	0.145 <sup>a</sup>	0.086 <sup>a</sup>	0.000	-0.012	-0.058 <sup>a</sup>	-0.008	-0.067	-1.014 <sup>c</sup>	-0.053
0.65	0.001 <sup>b</sup>	0.002 <sup>a</sup>	0.000	0.112 <sup>b</sup>	0.039	0.004	0.132 <sup>a</sup>	0.086 <sup>a</sup>	0.000	-0.019	-0.067 <sup>a</sup>	-0.016	-0.387	-0.462	-0.167
0.7	0.003 <sup>a</sup>	0.004 <sup>a</sup>	0.001	0.142 <sup>a</sup>	0.036	0.006	0.128 <sup>a</sup>	0.086 <sup>a</sup>	0.001	-0.03	-0.069 <sup>a</sup>	-0.025	-0.752	-0.894	-0.266
0.75	0.004 <sup>a</sup>	0.005 <sup>a</sup>	0.002	0.144 <sup>b</sup>	0.046 <sup>b</sup>	0.036	0.126 <sup>a</sup>	0.092 <sup>a</sup>	-0.001	-0.052 <sup>c</sup>	-0.086 <sup>a</sup>	-0.05	-0.768	-1.223 <sup>c</sup>	-0.813
0.8	0.007 <sup>a</sup>	0.007 <sup>a</sup>	0.004 <sup>a</sup>	0.197 <sup>b</sup>	0.039 <sup>b</sup>	0.043	0.12 <sup>a</sup>	0.094 <sup>a</sup>	-0.011	-0.059	-0.091 <sup>b</sup>	-0.064	-0.432	-1.434 <sup>c</sup>	-2.298
0.85	0.01 <sup>a</sup>	0.01 <sup>a</sup>	0.005 <sup>a</sup>	0.189 <sup>b</sup>	0.055 <sup>a</sup>	0.066	0.138 <sup>a</sup>	0.086 <sup>a</sup>	-0.006	-0.081	-0.114 <sup>c</sup>	-0.09	-0.516	-2.105 <sup>b</sup>	-1.944
0.9	0.015 <sup>a</sup>	0.014 <sup>a</sup>	0.01 <sup>a</sup>	0.225 <sup>b</sup>	0.067 <sup>b</sup>	-0.041	0.165 <sup>a</sup>	0.09 <sup>a</sup>	0.011	-0.009	-0.071	-0.039	-2.86	-2.996 <sup>a</sup>	-4.04 <sup>b</sup>
0.95	0.024 <sup>a</sup>	0.021 <sup>a</sup>	0.012 <sup>a</sup>	0.29 <sup>b</sup>	0.11 <sup>b</sup>	-0.069	0.117 <sup>b</sup>	0.071 <sup>c</sup>	0.013	-0.014	-0.089	-0.017	-2.895	-3.247	-3.773

Table A.3: Quantile regression results for delta-logs Danish sovereign CDS across a range of quantiles (first column). The conditional quantile specification includes control variable whose coefficients are not included in the present table. Coefficients reported refers to the intercept, the Delta-logs of EU Banks CDS, the Delta-Log of Germany Sovereign CDS, the Danske Bank equity return, and the Housing index changes, across the three subsamples of our analysis, P1=first period, P2= second period, P3=third period. Significant coefficients are indicated as follows: 1%=a, 5%=b and 10%=c. Standard errors computed by bootstrap.

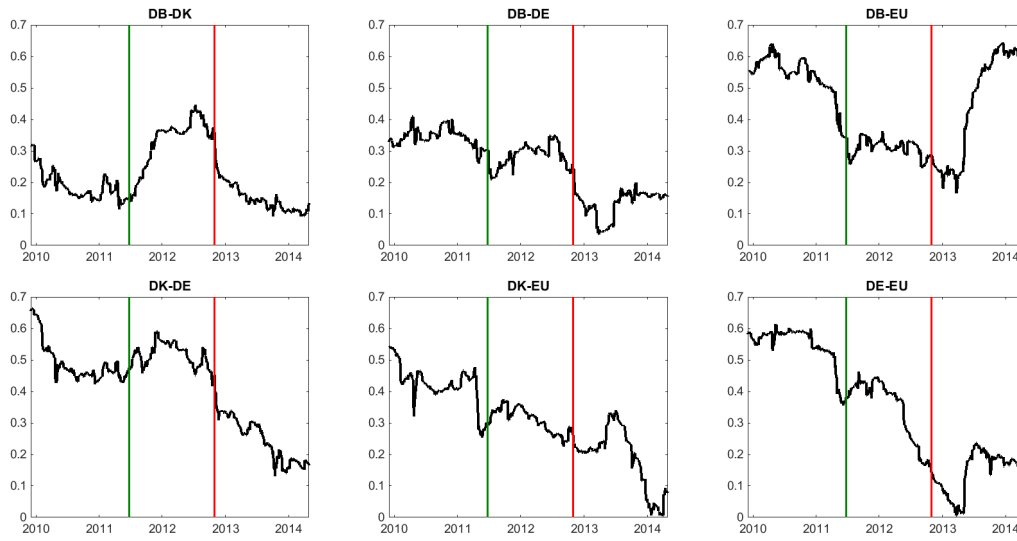


Figure A.1: Rolling correlations (one-year window) between the CDS delta-logs of Danske Bank (DB), Danish Sovereign (DK), Germany Sovereign (DE) and European banking sector (EU). The green line identifies the default of Fjordbank while the red line identifies the recapitalization of Danske Bank.

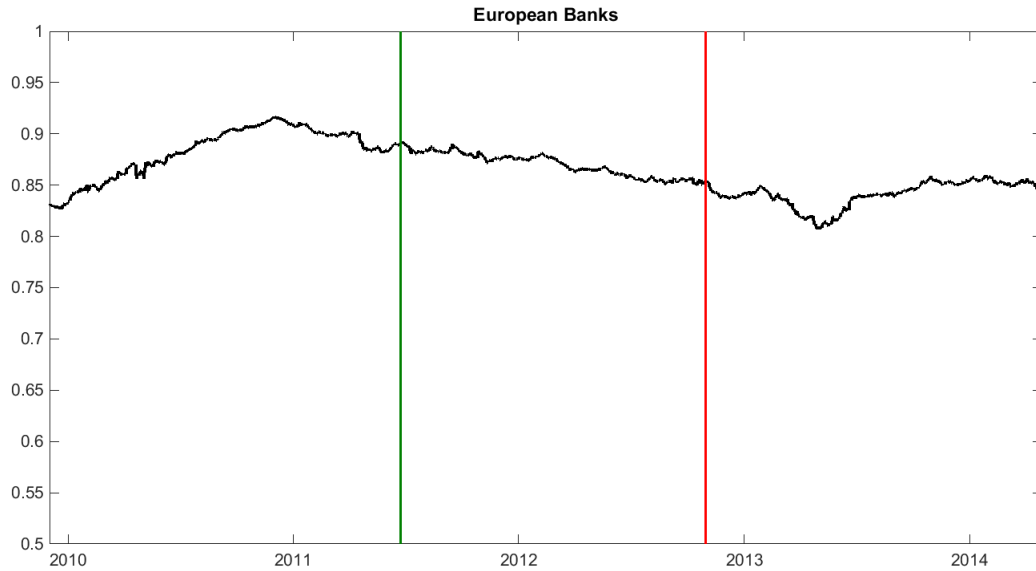


Figure A.2: Rolling total connectedness index (one-year window) between the CDS delta-logs of the 52 largest European institutions. The green line identifies the default of Fjordbank while the red line identifies the recapitalization of Danske Bank. The total connectedness index is computed as in Diebold and Yilmaz (2014), based on a VAR with two lags ( $p=2$ ) and an horizon of  $H = 12$  days for the impulse-response functions.

# Research Papers 2017



- 2017-08: Malene Kallestrup-Lamb and Carsten P.T. Rosenskjold: Insight into the Female Longevity Puzzle: Using Register Data to Analyse Mortality and Cause of Death Behaviour Across Socio-economic Groups
- 2017-09: Thomas Quistgaard Pedersen and Erik Christian Montes Schütte: Testing for Explosive Bubbles in the Presence of Autocorrelated Innovations
- 2017-10: Jeroen V.K. Rombouts, Lars Stentoft and Francesco Violante: Dynamics of Variance Risk Premia, Investors' Sentiment and Return Predictability
- 2017-11: Søren Johansen and Morten Nyboe Tabor: Cointegration between trends and their estimators in state space models and CVAR models
- 2017-12: Lukasz Gatarek and Søren Johansen: The role of cointegration for optimal hedging with heteroscedastic error term
- 2017-13: Niels S. Grønborg, Asger Lunde, Allan Timmermann and Russ Wermers: Picking Funds with Confidence
- 2017-14: Martin M. Andreasen and Anders Kronborg: The Extended Perturbation Method: New Insights on the New Keynesian Model
- 2017-15: Andrea Barletta, Paolo Santucci de Magistris and Francesco Violante: A Non-Structural Investigation of VIX Risk Neutral Density
- 2017-16: Davide Delle Monache, Stefano Grassi and Paolo Santucci de Magistris: Does the ARFIMA really shift?
- 2017-17: Massimo Franchi and Søren Johansen: Improved inference on cointegrating vectors in the presence of a near unit root using adjusted quantiles
- 2017-18: Matias D. Cattaneo, Michael Jansson and Kenichi Nagasawa: Bootstrap-Based Inference for Cube Root Consistent Estimators
- 2017-19: Daniel Borup and Martin Thyrgaard: Statistical tests for equal predictive ability across multiple forecasting methods
- 2017-20: Tommaso Proietti and Alessandro Giovannelli: A Durbin-Levinson Regularized Estimator of High Dimensional Autocovariance Matrices
- 2017-21: Jeroen V.K. Rombouts, Lars Stentoft and Francesco Violante: Variance swap payoffs, risk premia and extreme market conditions
- 2017-22: Jakob Guldbæk Mikkelsen: Testing for time-varying loadings in dynamic factor models
- 2017-23: Roman Frydman, Søren Johansen, Anders Rahbek and Morten Nyboe Tabor: The Qualitative Expectations Hypothesis: Model Ambiguity, Concistent Representations of Market Forecasts, and Sentiment
- 2017-24: Giorgio Mirone: Inference from the futures: ranking the noise cancelling accuracy of realized measures
- 2017-25: Massimiliano Caporin, Gisle J. Natvik, Francesco Ravazzolo and Paolo Santucci de Magistris: The Bank-Sovereign Nexus: Evidence from a non-Bailout Episode