WORKING PAPER

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BRRD credibility and the bank-sovereign nexus[*]

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Abstract

We investigate the effectiveness of the Bank Recovery and Resolution Directive (BRRD) in mitigating the bank-sovereign nexus in the Euro Area. Using CDS spreads to measure bank and sovereign credit risk and a DCC-MIDAS model capturing the long-term component of bank-sovereign interconnectedness, we document that the dynamic correlation between banks and sovereigns has decreased in Euro Area countries since the introduction of the BRRD. Panel data analysis reveals that the decline in interconnectedness is not driven by the banks' capital adequacy, size or holdings of domestic sovereign securities.

JEL classification: C58; G28; G32.

Keywords: BRRD; Bank-sovereign nexus; CDS spread; Dynamic correlation; DCC-MIDAS.

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1 Introduction and motivation

The European sovereign debt crisis revealed the existence of a negative bank-sovereign feedback loop (De Bruyckere et al., 2013; Fratzscher & Rieth, 2019). As a reaction, European policy makers launched the European Banking Union. The second pillar of that architecture is a bank bail-in framework governed by the Bank Recovery and Resolution Directive (BRRD), in legal force since 1st January 2015. Since it is the explicit aim of the BRRD to sever the link between banks and their sovereign, we test its effectiveness by investigating whether or not bank-sovereign interconnectedness decreased under the BRRD regime. Establishing whether or not the BRRD bail-in regime is credible is an important policy issue since it is key to avoid taxpayer-funded bailouts in future periods of bank distress.

Empirically, the credibility of the BRRD as a crisis mitigation mechanism has been investigated with event studies. Schäfer et al. (2016) and Fiordelisi et al. (2020) analyze investors' reactions to policy decisions related to the BRRD or to actual bail-in announcements and report a decrease in investors' bailout expectations, which suggests that bail-in has become more credible. However, Pancotto et al. (2019) find that the gap between bank and sovereign CDS spreads narrows instead of widens in the BRRD period, suggesting the opposite. Moreover, it is unclear whether the bail-in framework would work in a banking crisis as Beck et al. (2020) report that systemic risk increases more for banks in countries with more comprehensive bank resolution frameworks after negative system-wide shocks.

A strong test of BRRD credibility should assess whether or not the BRRD has diminished the structural long-run interconnectedness between banks and their sovereigns. We contribute to this literature by investigating the effect of the BRRD on the time-varying structural bank-sovereign correlation, using a DCC-MIDAS methodology to disentangle short-run fluctuations in the bank-sovereign correlation from a long-run secular component. If this structural component decreases in the period in which the bail-in framework is operational, this would be consistent with the hypothesis that the doom loop has diminished in the BRRD era.

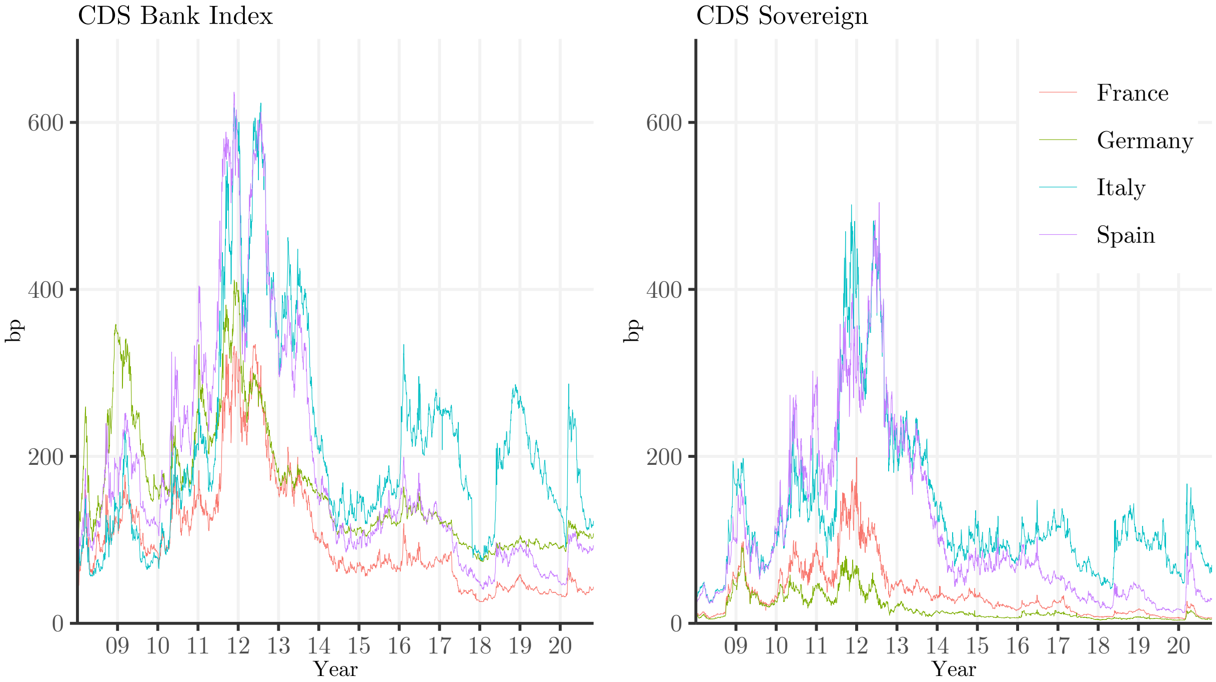
2 Data

Our empirical analysis focuses on 2 core (Germany, France) and 2 periphery (Italy, Spain) countries of the Euro Area. These countries host a sufficient number of banks with outstanding CDS contracts so that we can construct meaningful bank indices. We capture bank and sovereign default risk by their CDS spreads on 5-year senior bonds because they are a market-based, unbiased measure of default risk (Altavilla et al., 2018). Daily CDS spreads are retrieved from IHS Markit for the period 2008-2020 for the banks listed in Table 1.

Country	Banks
France	BNP Paribas, Crédit Agricole, Crédit Mutuel, Crédit Lyonnais, Natixis, SocGen
Germany	BayernLB, Commerzbank, Deutsche Bank, Hamburg Comm, IKB, LBBW, Portigon
Italy	Banca MPS, BNL, BPM, IntesaSanPaolo, Mediobanca, UniCredit, UBI Banca
Spain	BBVA, Bankia, Bankinter, Caixabank, Banco Popular, Banco Sabadell, Banco Santander

Table 1: List of all banks included in the sample.

To obtain a single measure capturing bank risk within a country we perform a factor analysis on the bank CDS spreads, similar to Bales & Burghof (2021). The first factor can be interpreted as the common driver of bank CDS spreads within each country which we henceforth call the *bank index*. Figure 1 displays the evolution of the sovereign CDS spread and bank index for each country. Four periods of heightened CDS spreads can be discerned: the global financial crisis, the sovereign debt crisis, the period 2016-2017 characterized by doubts concerning the viability of certain bank business models, and the COVID-19 pandemic. Some countries exhibit additional upward spikes, related to bank or country-specific events, e.g. political uncertainty in Italy in 2018-2019. Descriptive statistics for CDS spreads of banks and sovereigns, and bank variables are reported in Table 2.


CDS Bank Index

CDS Sovereign

Figure 1: CDS Bank Index and Sovereign CDS spreads

Variable	Description	Obs.	Mean	Std. D.	P1	P50	P99
DCC-MIDAS							
CDS_{Bank}	Bank 5-year CDS spread	3347	166.08	113.40	32.60	132.42	577.99
$CDS_{Sovereign}$	Sovereign 5-year CDS spread	3347	74.75	84.90	4.56	44.13	415.69
$\widehat{CORR}$	Long-term correlation in the DCC-MIDAS model	2218	0.43	0.21	0.05	0.45	0.79
Panel analysis							
CAP	Total equity to total assets (%)	2263	6.17	3.10	2.15	5.59	21.98
DEP	Deposits to total assets (%)	2263	44.39	15.71	7.62	42.04	71.02
LTA	Loans to total assets (%)	2263	51.31	16.84	15.47	55.18	78.43
NPL	Non-performing loans to total loans (%)	2263	5.34	4.80	0.33	3.91	19.89
ROA	Return on assets (%)	2263	0.17	0.95	-5.03	0.31	1.31
$SIZE$	Natural logarithm of total assets (€mn)	2263	19.56	1.34	15.41	19.62	21.55
$HOME\ EXP$	Exposure to home sovereign debt to total assets (%)	1299	7.26	4.43	0.85	6.89	18.25

Table 2: Descriptive statistics.

3 Methodology and findings

In order to assess the impact of the BRRD on the bank-sovereign nexus, we want to isolate the structural or secular component of the correlation because this should reflect fundamental changes in the interconnectedness between banks and sovereigns. Bales & Burghof (2021) use the DCC-GARCH model of Engle (2002) on a principal component of bank and sovereign CDS spread changes, but that approach implicitly assumes a constant long-run component. We propose a novel approach using a DCC-MIDAS model, based on Colacito et al. (2011), in order to disentangle the short and long-term components of the correlation. DCC-MIDAS is a natural extension of the DCC-GARCH model, in which shocks are mean-reverting around a time-varying long-run component, combining the Engle (2002) DCC model and the Engle et al. (2006) and Engle & Rangel (2008) GARCH-MIDAS.

The estimation of our DCC-MIDAS model proceeds in two steps. First, the univariate conditional volatility of the bank index and sovereign CDS spread is estimated using GARCH-MIDAS, from which standardized residuals of the log-returns are derived. In a second step these residuals are used to estimate the parameters of the DCC-MIDAS model.

We assume that the vector of bank and sovereign CDS changes $\boldsymbol{r_t}$ follows a stochastic process:

$$
\begin{aligned}
&\boldsymbol{r_t} \sim_{i.i.d.} N(\mu, H_t) \\
&H_t = D_t R_t D_t \qquad \text{with } D_t = \text{diag}\{\sqrt{m_{i,t} g_{i,t}}\} \\
&R_t = E_{t-1}\left[\varepsilon_t \varepsilon_t'\right] \qquad \text{with } \varepsilon_t = D_t^{-1}(\boldsymbol{r_t} - \mu) \sim_{i.i.d.} N(0, I_2) \qquad (1)
\end{aligned}
$$

where μ is the vector of unconditional means and H_t the conditional covariance matrix, which is decomposed in two parts: D_t, containing the conditional standard deviations on the diagonal axis and R_t, describing the conditional correlations of the standardized residuals ε_t.

The diagonal elements of D_t are estimated as follows:

$$g_{i,t} = (1-\alpha_i-\beta_i) + \alpha_i \frac{(r_{i,t-1}-\mu_i)^2}{m_{i,t-1}} + \beta_i g_{i,t-1} \qquad \text{with } i = \{\textit{bank, sovereign}\}$$

$$m_{i,t} = \bar{m}_i + \theta_i \sum_{l=1}^{K} \phi_l(\omega_i) RV_{i,t-l} \qquad \text{with } RV_{i,t} = \sum_{j=1}^{N} r_{i,t-j}^2$$

where $m_{i,t}$ describes the secular component of volatility, driven by a weighted sum of past realized variances, which are estimated as the sum of squared returns of the last N days. The weights $\phi_l(\omega_i)$ given to each of the K realized variances are obtained from a Beta distribution. After we obtain the standardized residuals of Equation 1, we estimate the conditional correlation matrix R_t:

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1}$$

$$Q_t^* = \text{diag}\{\sqrt{Q_t}\}$$

$$Q_t = (1-a-b)\bar{R}_t(\omega) + a\varepsilon_{t-1}\varepsilon_{t-1}' + bQ_{t-1}$$

Similar to the GARCH-MIDAS model, we include a long-run secular component $\bar{R}_t(\omega)$ which is a weighted average of realized correlations:

$$\bar{R}_t(\omega) = \sum_{l=1}^{K} \Phi_l(\omega) \odot C_{t-l}$$

$$C_t = \begin{pmatrix} \xi_{1,t} & 0 \\ 0 & \xi_{2,t} \end{pmatrix}^{-\frac{1}{2}} \left(\sum_{k=t-N}^{t} \varepsilon_k \varepsilon_k' \right) \begin{pmatrix} \xi_{1,t} & 0 \\ 0 & \xi_{2,t} \end{pmatrix}^{-\frac{1}{2}} \quad \text{with } \xi_{i,t} = \sum_{k=t-N}^{t} \varepsilon_{i,k}^2$$

where $\Phi_l(\omega) = \phi_l(\omega)\iota\iota'$ and $\odot$ stands for the Hadamard product. We optimize the estimation of the parameters $(\alpha_i, \beta_i, \bar{m}_i, \theta_i, \omega_i, a, b, \omega)$ using a quasi-maximum likelihood estimator.[1]

Figure 2 shows the results of the DCC-MIDAS model graphically. The blue curve represents the long-run component of the dynamic correlation around which the short-run component fluctuates, displayed by the green curve. The short-run component is thus captured

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[1] For a detailed description of the DCC-MIDAS model and estimation procedure, we refer the reader to Colacito et al. (2011). To guide the maximum likelihood estimation algorithm, we introduce boundaries on the a and b parameters.

by a mean-reverting DCC model, where the mean is determined by a MIDAS specification. The realized variances (RVs) are calculated with a rolling window of 1 month ($N = 22$ trading days), from which the long-run component is estimated over a period of 18 months ($K = 375$ trading days) for both the GARCH-MIDAS and the DCC-MIDAS. Therefore, the first observation of the long-run component is obtained after 36 months, which is 2011. The red line indicates full entry into force of the BRRD in 2015.[2] For Italy and Spain the long-run component effectively starts to decrease in 2015-16, suggesting that markets lend credibility to the bail-in regime. In levels the correlation decreases from 73% in the period 2010-14 to 56% in the period 2015-20 for Italy (from 66% to 52% for Spain). Interestingly, after a significant initial drop the correlation for Italy reverses temporarily from 2017 onwards. This can probably be ascribed to the contested resolution of two Venetian banks and the bailout of Banca MPS in June 2017, in which the Italian sovereign intervened with a partial recapitalization of the bank, using an exception clause in the BRRD, but thereby potentially undermining the credibility of bail-in under the BRRD. For Germany and France, the decline in bank-sovereign correlation starts well before the BRRD, but decreases further after the introduction (from 34% in the period 2010-14 to 21% in the period 2015-20 for Germany and from 43% to 35% for France). Hence, even in the core countries, where the bank-sovereign nexus was deemed to be less problematic by market participants, the BRRD regulation contributed to lowering bank-sovereign interconnectedness. When we run a Chow test for a structural break, 2015 is effectively identified as the timing of the regime switch. Hence, both graphically and statistically, bank-sovereign correlations exhibit a structural decrease in the BRRD era.

Next to the analysis of the association between bank and sovereign default risk using a bank index for each country, we perform a bank-level panel data analysis to investigate potential bank-specific drivers of the long-run correlation of each bank with its sovereign. The following model is estimated:

$$\widehat{CORR}_{i,t} = \alpha_i + \beta_k \sum_{k=1}^{K} BANK_{k,i,t} + \gamma BRRD_t + \varepsilon_{i,t} \tag{2}$$

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[2] Similar to Pancotto et al. (2019) we use 1^{st} January 2015 as treatment date.

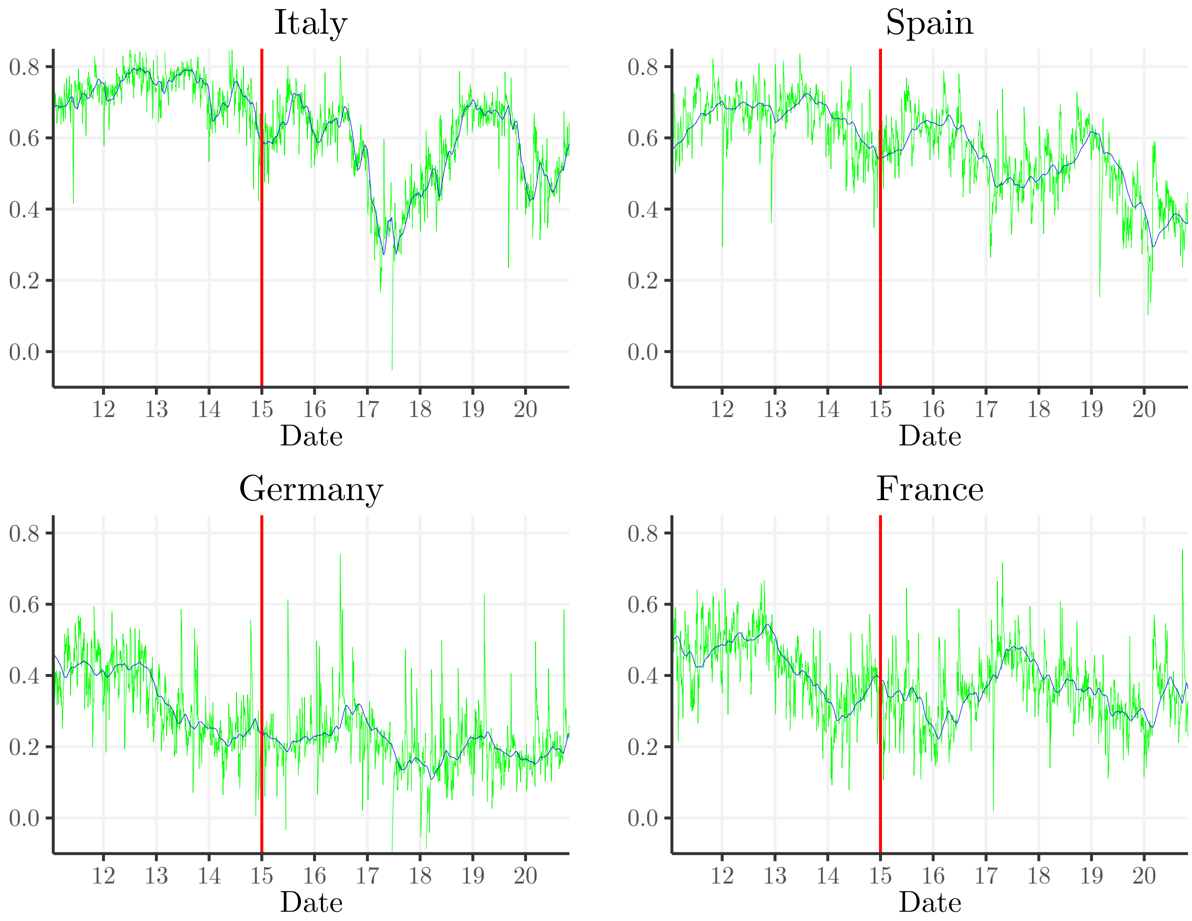

Figure 2: Dynamic conditional correlation between bank and sovereign CDS spreads, estimated through the DCC-MIDAS model.

where $\widehat{CORR}_{i,t}$ represents the long-term component of the dynamic correlation of bank i estimated with the DCC-MIDAS model. $BANK_{k,i,t}$ contains the k^{th} fundamental of bank i as described in Table 2. $BRRD_t$ is a dummy variable which takes the value 1 from 2015 onwards, capturing the period during which the BRRD was fully operational.

The results are presented in Table 3. In each specification the BRRD dummy is negative and highly significant, indicating that the full implementation of the BRRD is associated with a significant drop in the bank-sovereign default risk correlation. On average the correlation decreased by 7.8pp.

Interestingly, the bank-sovereign correlations are not associated with bank capital ratios, as a reflection of increasing capital buffers caused by the gradual implementation of Basel 3 during the period under investigation, with bank size, indicating the absence of any remaining

	DCC-MIDAS Long Run Correlation	
	(1)	(2)
BRRD_{2015}	-0.078^{***}	-0.050^{**}
	(0.017)	(0.020)
HOME EXP		0.006
		(0.005)
CAP	-0.009	0.013
	(0.007)	(0.010)
SIZE	-0.057	0.002
	(0.060)	(0.146)
LTA	0.004	0.007^{*}
	(0.003)	(0.004)
NPL	0.001	0.006
	(0.004)	(0.004)
ROA	0.037^{***}	0.028^{**}
	(0.008)	(0.012)
DEP	-0.006^{***}	-0.006^{***}
	(0.002)	(0.002)
Bank fixed effects	Yes	Yes
R^2	0.205	0.210
No. of banks	26	18
No. of obs	2,263	1,299

Table 3: Regression results explaining the drivers of the bank-sovereign long-run correlation using bank-specific variables, and BRRD implementation. Standard errors in parentheses are clustered at the bank level. *, ** and *** represent significance at the 10%, 5% and 1% percent level, respectively.

too-big-to-fail protection, or with the banks' holdings of domestic sovereign securities, which is a potential channel of bank-sovereign interconnectedness. BRRD appears to be the relevant game changer.

4 Conclusion

Based on a novel approach, using a DCC-MIDAS model, our analysis reveals that the structural dynamic correlation between bank and sovereign risk in the Euro Area has decreased substantially since the BRRD entered into legal force. In Germany and France the decline started before but continued following the introduction of the BRRD. In Italy and Spain the decline in bank-sovereign interconnectedness occurs after the BRRD was introduced. Hence, the BRRD has achieved its objective to mitigate the bank-sovereign doom loop. The Italian case highlights that a continuous commitment of the state to apply the BRRD bail-in rules is necessary to maintain the credibility of BRRD.

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