Bank Capital Regulation and the Sovereign-Bank Nexus: Evidence from European Banks

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List of Abbreviations

AEX	Amsterdam Exchange Index
ATX	Austrian Traded Index
ATX	Athens Stock Exchange Composite Share Price Index
BCBS	Basel Committee on Banking Supervision
BEL20	Belgian 20 Index
BP	Basis Point
CAC	Cotation Assistee en Continu
CDS	Credit Default Swap
CQS	Credit Quality Step
CRD	Capital Requirements Directive
CRR	Capital Requirements Regulation
DAX	Deutscher Aktienindex
EBA	European Banking Authority
ECAI	External Credit Assessment Institution
ECB	European Central Bank
EJBies	European Junior Bonds
EMU	European Monetary Union
EONIA	European Overnight Index Average
ESBies	European Save Bonds

EU	European Union
EURIBOR	European Interbank Offered Rate
FTSE	Financial Times Stock Exchange Index
GDP	Gross Domestic Product
GIIPS	Greece, Ireland, Italy, Portugal and Spain
HQLA	High Quality Liquid Assets
IBEX	Iberia Index
ICAAP	Internal Capital Adequacy Assessment Process
IRBA-CR	Internal Ratings-Based Approach for Credit Risk
IRS	Interest Rate Swap
ISDA	International Swaps and Derivatives Association
ISEQ	Irish Stock Exchange Overall Index
LCR	Liquidity Coverage Ratio
LGD	Loss Given Default
M	(Effective) Maturity
MIB	Milano Indice di Borsa
NSFR	Net Stable Funding Ratio
OECD	Organisation for Economic Co-Operation and Development
PD	Probability of Default

PP Percentage Point

PSI Portuguese Stock Index

ROA Return on Assets

RSF Required Amount of Stable Funding

RWA Risk-Weighted Assets

SA-CR Standardized Approach for Credit Risk

SA-MR Standardized Approach for Market Risk

SREP Supervisory Review and Evaluation Process

SRM Single Resolution Mechanism

SSM Single Supervisory Mechanism

TA Total Assets

VaR Value at Risk

List of Symbols

α	Constant of regression model
β	Regression coefficient
Δ	Change
ϵ	Residual of regression model
τ	Time fixed effects
θ	Control variables
ζ	Bank fixed effects
b	Maturity adjustment
$G(\cdot)$	Inverse cumulative normal distribution function
i	Bank indicator
j	Country indicator
$N(\cdot)$	Cumulative normal distribution function
R	Asset correlation
t	Time indicator

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Abstract

European sovereign debt benefits from privileges in banking regulation throughout all risk categories. In contrast to the risk-based approach applied to other asset classes, it does not have to be backed by equity, can be fully financed by short-term, unstable funding sources, is treated as liquid as cash and is not subject to exposure limits, regardless of its actual riskiness. We explore the effects of these regulatory privileges on the co-variation between sovereign and bank sector credit risks—the so-called sovereign-bank nexus. Examining sovereign bond portfolios of large European banks between 2010 and 2020, we show that additional capital buffers stemming from non-zero sovereign risk weights would indeed weaken the sovereign-bank nexus and thus serve as a reasonable starting point for the future regulatory treatment of sovereign debt. However, the impact of banks' domestic sovereign exposures is state-dependent and the sovereign-bank nexus is not strongest for banks with the highest risk-weighted sovereign exposures. As a result, the impact of capital requirements based on traditional risk-weighting schemes would be limited.

Keywords: Sovereign-bank nexus, risk transmissions, sovereign exposures, zero risk weight, credit risks, liquidity risks, concentration risks, Basel II, Basel III, CRR, CRD, moderated multiple regression analysis, three-way interaction.

JEL classification: G21 (Banks, Depository Institutions, Micro Finance Institutions, Mortgages), G28 (Government Policy and Regulation).

1 Introduction

Sovereign debt issued by members of the European Union (EU) benefits from privileges in banking regulation throughout all risk categories, contrasting the risk-based approach applied to other asset classes. First and most importantly, in minimum capital requirements for credit and market risks, sovereign exposures in the banking and trading books are not subject to default risk capital charges based on risk-weighting schemes, independent from actual credit risks. Second, in minimum liquidity requirements, they are treated as highly liquid to the same extend as cash in the liquidity coverage ratio and can be financed by short-term and unstable funding sources in the net stable funding ratio, independent from actual liquidity risks. Third, they are exempt from size limitations in the large exposures framework, independent from actual concentration risks. These regulatory privileges allow EU banks to hold excessively large and highly risky sovereign bond portfolios without risk-adequate capital and overstated liquidity buffers. This in turn might make banks more prone to sovereign risk spillovers and induce feedback effects that emphasize the linkage between sovereign and bank sector credit risks. This so-called sovereign-bank nexus has been declared as a root of the European sovereign debt crisis by European Systemic Risk Board (2015) and Lagarde (2012) emphasizes the need to break it. However, Basel Committee on Banking Supervision (2017b) acknowledges that there is no consensus inside the committee regarding regulatory changes.

In this paper, we empirically explore the effect of bank capital regulation—and especially regulatory privileges for sovereign debt—on the sovereign-bank nexus based on sovereign exposures of large European banks between 2011 and 2020 published by the European Banking Authority (EBA). As starting point, we estimate the sovereign-bank nexus as the co-variation between daily changes in sovereign and bank Credit Default Swaps (CDS) in a panel regression following Acharya et al. (2014). We then disentangle the measure of *missing capital* for EU sovereign debt proposed by Kirschenmann et al. (2020) into the components exposure size and exposure risk and assess their impact on the sovereign-bank nexus step-wise using a (three-way) interaction approach as suggested by Dawson and Richter (2006). Finally, we add the impact of banks' financial strengths and compare the co-variation between sovereign and bank CDS at high and low levels of the size of banks' domestic sovereign exposures, sovereign risks and banks' capitalization. Moreover, as both sovereign and bank CDS are expected to depend on the overall state of the economy, we carefully control for macroeconomic conditions.

Drawing implications for policymakers, our main contributions are two-fold. Regarding the funding side of banks' balance sheets, the sovereign-bank nexus is weaker for better capitalized banks. On the assets side, the effect of banks' domestic sovereign exposures is state-dependent. In countries with relatively low sovereign risks, increasing exposure to the domestic sovereign strengthens the sovereign-bank nexus, consistent with risk transmissions between sovereigns and banks through an asset channel. In countries with relatively high sovereign risks that are almost inevitable also plagued by an economic crisis due to the close connection between sovereign and broader country risk, this effect is reversed, arguably because sovereign debt makes banks less prone to macroeconomic shocks and offers advantages in refinancing operations. This allows for the joint conclusion that additional capital buffers stemming from non-zero sovereign risk weights would serve as a reasonable starting point for the future regulatory treatment of sovereign debt. However, as the sovereign-bank nexus is mainly determined by general country risks and is not necessarily strongest for banks with the highest risk-weighted sovereign exposure, the effect of traditional risk-weighting schemes would be limited.

The remainder of this paper is organized as follows: Section 2 reviews related literature and gives an overview of the regulatory framework. Section 3 derives hypotheses and specifies our methodological approach. Section 4 summarizes our data set and presents our regression results as well as robustness tests. Section 5 concludes.

2 Literature Review and Contribution

2.1 Sovereign-Bank Nexus

In this section, we review the literature related to the sovereign-bank nexus and provide an overview of regulatory requirements for sovereign debt, including the market impact of regulatory privileges for exposures to members of the EU. Sovereigns and domestic banks are naturally interconnected through different channels that lead to a positive co-movement between sovereign and bank sector credit risks—the so-called sovereign-bank nexus. Figure 1 visualizes major transmission channels between sovereigns and banks as identified by Committee on the Global Financial System (2011).

[INSERT FIGURE 1 ABOUT HERE]

On the one hand, risks can originate in the sovereign sector and spill over to domestic banks mainly via four transmission channels.[1] First, through an *asset channel* to the asset side of banks' balance sheets by impairments of their sovereign bond portfolios. Second, through a *liquidity channel* to the funding side of banks' balance sheets by impaired collateral values in refinancing operations, expressed as haircuts on eligible collateral and margin calls on pledged collateral.[2] Third, through a *rating channel* since downgrades of sovereigns tend to be followed by downgrades of domestic banks and the fact that ratings of private companies are usually capped at a country ceiling that is closely derived from the sovereign's issuer credit rating.[3] Fourth, through a *guarantee channel* since systematically important banks usually benefit from implicit and explicit government

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[1]Committee on the Global Financial System (2011) also identifies five additional channels but with inconclusive results.

[2]This channel has been blocked by the European Central Bank (ECB) through the suspension of minimum rating thresholds for financially distressed countries in collateral eligibility requirements, see for example European Central Bank (2010) for Greece and European Central Bank (2011) for Ireland.

[3]Only exceptionally strong private entities that have implemented measures to mitigate country risks can be rated above the country ceiling, see for example Fitch Ratings (2017) or Moody's Investors Service (2019). Borensztein et al. (2013) show that sovereign ratings are a significant determinant of corporate ratings, although country ceiling policies have been relaxed in recent times.

guaranties that reduce their perceived riskiness and consequently their funding costs. If government guarantees become less credible, this uplifting effect is weakened.[4]

On the other hand, risks can originate in the banking sector and spill over to the domestic sovereign mainly via two transmission channels. First, directly through a *bailout channel* since state aids for banks drain public resources.[5] Second, indirectly through an *economy channel* as hampered financial intermediation weakens the non-financial sector, which reduces a government's tax revenues and increases unemployment.

Ultimately, risk transmissions between sovereigns and domestic banks can induce feedback effects that pose a threat to the financial stability of a country. European Systemic Risk Board (2015) points out that such linkages are the root of crises in several EU member states. As a primary example of a feedback loop originating in the sovereign sector, Bank of Greece (2012) reports on the required recapitalization and restructuring of the Greek banking sector between 2012 and 2014 predominantly caused by the Greek sovereign crisis. Greece requested international assistance in 2010 (European Commission, 2010). As part of the restructuring of Greek sovereign debt through *private sector involvement*, Greek banks exchanged existing Greek sovereign bonds with a face value of B€ 48.6 against new issuances at an average loss of 78%, or B€ 37.7. The resulting capital needs of Greek banks were estimated at B€ 40.5 and revised to B€ 50, which in turn had to be covered by public resources. As a primary example of a feedback loop originating in the banking sector, Honohan (2010) examines the conduct of Irish banks that led to the need for government support in 2008 in a report to the Irish Minister for Finance. As the liquidity and funding situation of Irish banks tightened, par. 8.17 states the consensus view of the Irish central bank, financial regulator and department of finance that *"no Irish bank should be allowed to fail"*. Consequently, the Irish government introduced a

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[4]Ueda and Di Weder Mauro (2013) label this safety net a *structural subsidy for systematically important financial institutions* and estimate reduced funding costs between 60 to 80 basis points (BP). Demirgüç-Kunt and Huizinga (2013) find a diminishing effect of bank size on market valuations of banks' equity and liabilities and conclude that banks can become *too big to save* compared to their home country's financial capabilities. Additionally, valuations suffer in countries with highly leveraged banking sectors, indicating a *too many to save* effect.

[5]For an overview of state aids for banks in the EU see European Commission (2021).

two-year, blanket, system-wide guarantee covering deposits as well as senior and certain subordinated debt that comprised around B€400. As the Irish banking crisis unfolded, this contingent liability became reality and Ireland requested international assistance in 2010 (European Commission, 2011).[6]

Ejsing and Lemke (2011) is one of the first studies that analyzes the joint dynamics of sovereign and bank CDS in Europe. They find that both are driven by a common risk factor and that bank bailouts by sovereigns induce a convergence of CDS indicated by a decline in bank and an increase in sovereign spreads. Moreover, after bailouts banks become less and sovereigns more sensitive to systematic risks. Consequently, we carefully control for macroeconomic risk factors in our econometric specification.

Acharya et al. (2014) theoretically model and empirically test a feedback loop originating from a banking crisis. Pre-crisis, they show that sovereign and bank risks were virtually independent. During crisis, bailouts and guarantees induced a private-to-public risk transfer, resulting in a short-term convergence of sovereign and bank credit spreads. Post-crisis, increased sovereign risks transmitted back to local banks, leading to a long-term synchronization of spreads. As sovereigns sacrifice their own creditworthiness to rescue local banks, the authors label state aids a "pyrrhic victory". We use their model as a basis to estimate the impact of bank capital regulation on the sovereign-bank nexus.

Gennaioli et al. (2014) theoretically model and empirically test a feedback loop originating from a sovereign crisis. They find that a sovereign default reduces credit flows from banks to the non-financial sector. This *pass-through of sovereign risks* becomes stronger with greater sovereign bond holdings as well as better creditor rights. Opposing this, the probability of sovereign default decreases with increasing sovereign bond holdings and creditor rights. They conclude that sovereign debt in the domestic banking sector has a disciplining effect on the sovereign to repay, since a default would lead to a banking crisis that in turn would reduce economic activity in the non-financial sector. Gennaioli

[6] Singh et al. (2016) apply granger causality tests in eleven members of the European Monetary Union (EMU) and find a strengthening of the sovereign-bank nexus during the sovereign debt crisis with causality of risk transmissions changing direction several times within and differently between countries.

et al. (2018) further establish this direct pass-through of sovereign risks from banks to the non-financial sector. They analyze sovereign bond holdings of banks located in 191 countries and find a negative correlation to their loan-to-assets ratio in times of sovereign distress. This effect is stronger in economically and financially less developed countries. They base this observation on a reduced supply of credit to firms due to the damage that a sovereign crisis causes on banks' balance sheets.[7] Schnabl (2012) establishes an international *pass-through of sovereign risks* to the real economy. He shows that banks in a country hit by a sovereign default reduce international inter-bank lending, which in turn results in foreign banks reducing lending to the domestic non-financial sector.

Schnabel and Schüwer (2017) identify determinants of the sovereign-bank nexus. At the bank level, the co-variation between sovereign and bank CDS is stronger with an increasing home bias in sovereign bond portfolios of banks located in financially distressed countries and declining capital buffers, although this effect is statistically insignificant at conventional levels in combined analyses, which the authors base on multicollinearity issues. On the sovereign level, the nexus is stronger in countries with a higher ratio of debt to Gross Domestic Product (GDP) and low sovereign efficiency.

Covi and Eydam (2020) analyze the development of the sovereign-bank nexus in the EU between 2012 to 2016 and find a structural break from 2015 onwards with a significant weakening of co-movements, which they base on the implementation of the first two pillars of the European Banking Union.[8]

Brunnermeier et al. (2016) propose to securitize a well-diversified portfolio of European sovereign bonds consisting of a senior tranche called European Save Bonds (ESBies) and a junior tranche called European Junior Bonds (EJBies) to eliminate the sovereign-bank

[7] Bocola (2016) estimates that the Italian crisis of 2011 led to an average increase in the financing costs of the non-financial economy of 60 BP and a reduction in economic growth of 1.4%.

[8] As its first pillar, European Parliament and Council (2013a) implements the Single Supervisory Mechanism (SSM) that shifts supervision of significant institutions from the national to supranational level. As its second pillar, European Parliament and Council (2014) implements the Single Resolution Mechanism (SRM) which defines a cascade of investors that can be bailed-in in case of a bank default before public support can be accessed and requires banks to set up a Single Resolution Fund. Its third pillar, a Europe-wide deposit insurance scheme, has not been implemented during that time.

nexus. Due to diversification and seniority, ESBies would have little exposure to sovereign risks and thus would protect banks from risk transmissions from sovereigns.

Cooper and Nikolov (2018) theoretically identify key measures to weaken the sovereign-bank nexus. On the bank side, adequate equity buffers for sovereign exposures would allow banks to absorb losses incurred by a sovereign crisis. On the sovereign side, ex ante no-bailout commitments would eliminate contingent liabilities for the national banking sector. This in turn would motivate banks to treat sovereign risks adequately. However, since no-bailout commitments are usually not credible due to the severe effects of a banking crisis on economic activity, banks anticipate bailouts and thus have no incentives to build up adequate equity buffers.

2.2 Regulatory Privileges of Sovereign Debt

As a fundamental principle of banking regulation, par. 28 of Basel Committee on Banking Supervision (1988)—known as Basel I—set capital requirements in relation to the relative riskiness of exposures, which has been carried to later reforms and expanded to other risk categories. However, regarding exposures to member states, the EU deviates from this risk-based approach. Due to this divergence and the fact that our observation period covers different regulatory regimes, we briefly review the development of regulation through time as intended by the Basel Committee on Banking Supervision (BCBS) and its implementation into binding law.[9] Table 1 gives an overview of requirements for third-country sovereign debt as well as privileges for debt issued by members of the EU.

[INSERT TABLE 1 ABOUT HERE]

Addressing credit risks in the banking book, the foundation of regulatory requirements of sovereign debt were laid in par. 36 and annex 2 of Basel I. Sovereign exposures denominated and funded in national currency and exposures to members of the Organisation

[9]The BCBS is the global standard setter for banking regulation. For implementation, it relies on its member states' commitment, see Basel Committee on Banking Supervision (2021).

for Economic Co-Operation and Development (OECD) received a risk weight of 0%. Otherwise, 100% were applied. In the Standardized Approach for Credit Risk (SA-CR) introduced by Basel II in Basel Committee on Banking Supervision (2006), par. 53 and 54 assigned risk weights between 0% and 150% depending on ratings of External Credit Assessment Institutions (ECAI), but allowed for lower risk weights for exposures to the domestic sovereign at national discretion given denomination and funding in the domestic currency. In its Internal Ratings-Based Approach for Credit Risk (IRBA-CR), par. 259 and 285 allowed a Probability of Default (PD) for sovereigns below the PD-floor of 0.03% and to switch to the SA-CR for positions that were immaterial in terms of size and risk profile. During the transition to and finalization of Basel III in Basel Committee on Banking Supervision (2010a, 2017a), these requirements remained unchanged. The EU generally adopted these principles for exposures to third countries, but privileged exposures to member states. Under the Basel I regime, art. 6(1a3) of European Council (1989) and art. 43(1a3) of European Parliament and Council (2000) set risk weights for European communities to 0% regardless of currency requirements and OECD membership. During the Basel II era, this general zero risk weight was subsumed in the SA-CR for exposures to members of the EU denominated and funded in the counterparty's domestic currency in annex VI, part 1, point 4 of European Parliament and Council (2006a)—known as Capital Requirements Directive (CRD) I.[10] In the IRBA-CR, annex VII, part 2 CRD I nullified the PD-floor and the *permanent partial use* codified in art. 89(1d) CRD I allowed to switch to the SA-CR for exposures to EU members given that they would receive a risk weight of 0% under it. Under Basel III, European Parliament and Council (2013b, 2019)—usually referred to Capital Requirements Regulation (CRR) I and II—art. 114(4), 150(1d) and 160(1) adopted previous rules.[11]

Addressing credit risks in the trading book, Basel Committee on Banking Supervision

[10] Art. 153 CRD I relaxed currency requirements to any currency of member states until 31 Dec. 2012.

[11] Art. 114(5 and 6) CRR I extended currency relaxation until 31 Dec. 2017, with phasing out till 2020. A technical standard on the mapping of ECAI ratings to Credit Quality Steps (CQS) as required by art. 136 CRR I can be found in Joint Committee of the European Supervisory Authorities (2014).

(1996) amended Basel I to incorporate market risks. Sovereign debt held in the trading book—including certain derivatives on it—received a specific risk capital charge of 0% at national discretion in par. 4, 5 and 23. In Basel II, par. 710 and 711 derived specific risk capital charges between 0% and 12% from ECAI ratings and the position's residual maturity, but allowed for lower charges at national discretion for sovereign debt denominated and funded in the domestic currency. This option was carried through the *fundamental review of the trading book* conducted in Basel Committee on Banking Supervision (2016, 2019a) by a 0% default risk capital requirement at national discretion in the Standardized Approach for Market Risk (SA-MR) in par. 137 of the 2016 and 22.7 of the 2019 market risk frameworks.[12] The EU aligned specific risk capital charges to risk weights under the SA-CR in annex 1, point 14 of European Parliament and Council (2006b) and art. 336(1) CRR I, resulting in a specific market risk capital charge of 0% for exposures to EU members.

To mitigate weaknesses in and provide a backstop to risk-weighting schemes, par. 151 to 167 of the Basel III capital accord introduced the Leverage Ratio as a bank-wide unweighted minimum capital requirement with further details in Basel Committee on Banking Supervision (2014a). Its European equivalents are art. 429 and 430(1) CRR I and European Parliament and Council (2015b). Unlike risk weight privileges, sovereign exposures are fully included in the exposure measure of the Leverage Ratio and thus potentially induce additional bank-wide minimum capital requirements.

Addressing liquidity risks, par. 4 of Basel Committee on Banking Supervision (2010b) introduced the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR). Basel Committee on Banking Supervision (2013) details the LCR. Par. 50(c and e) and 52(a) treat claims on sovereigns with a risk weight of 0% under the SA-CR as level 1 High Quality Liquid Assets (HQLA), which require no haircuts or position limits. A risk weight of 20% leads to an assignment to level 2A with a haircut of 15% and limit of 40%

[12] In internal models for market risks, par. 186(c) of the 2016 and 33.21(1) of the 2019 market risk frameworks state that sovereign debt has to be included in default risk charges.

of HQLA. Claims with greater risk weights are usually not eligible in the HQLA, equivalent to a haircut of 100%.[13] Basel Committee on Banking Supervision (2014b) details the NSFR. Par. 37, 39(a), 40(e) and 43(c) link the Required Amount of Stable Funding (RSF) for claims on sovereigns to their HQLA status. Level 1 leads to an RSF factor of 0%, level 2A to 15% and non-HQLA to 50% with residual maturity smaller than one year and 100% otherwise. For claims on third countries, these requirements are transferred to European law without changes. However, for the LCR, claims on EU member states receive general level 1 status irrespective of risk weights in art. 10(1c), 10(2), 11(1b) and 11(2) of European Parliament and Council (2015a). For the NSFR, this induces a zero RSF factor based on art. 428r(1a), 428x, 428ad(c) and 428ag(c) CRR II.

Addressing concentration risks, Basel Committee on Banking Supervision (1991, 2014b) defined an exposure as large if it exceeded 10% of a bank's eligible capital with associated detailed reporting requirements and suggested a general limit to large exposures of 25%, but allowed to exempt sovereign exposures from it, see par. 18 to 20 and par. 13 to 16 respectively. The EU made use of this exemption by setting a limit to large exposures of 25% of a bank's own funds but exempting sovereign exposures with a risk weight of 0% under the SA-CR from it, see European Council (1992) art. 3(1, 2) and 4(1, 7), European Parliament and Council (2000) art. 48(1), 49(1) and 49(7(b), CRD I art. 111(1) and 113(3a), CRR I art. 392, 395(1) and 400(1a).

In summary, exposures to members of the EU are privileged in banking regulation throughout all risk categories. First, they are zero-weighted in risk-weighting schemes and are thus not subject to minimum capital requirements, regardless of actual credit risks. Second, they are treated as liquid as cash and can be fully financed by unstable funding sources, regardless of actual liquidity risks. Third, they are exempt from position limits, regardless of actual concentration risk. Basel Committee on Banking Supervision (2014b) criticizes that a general zero risk weight for sovereign exposures—and

[13]As an exception, par. 50 (d and e) allow to recognize foreign currency sovereign debt in level 1 up to the amount of cash outflows in that currency. Par. 44 encourages diversification within and between asset classes of HQLA, but explicitly exempts domestic sovereign debt.

especially the IRBA-CR *permanent partial use*—goes well beyond the intentions of the BCBS, is materially non-compliant with the Basel framework and leads to a material overstatement of regulatory capital ratios of EU banks. Basel Committee on Banking Supervision (2017b) discusses the future regulatory treatment of sovereign exposures but acknowledges that there is no consensus inside the committee and thus will not conduct any changes at this stage. As smallest common denominator, Basel Committee on Banking Supervision (2019b) proposes a voluntary disclosure of sovereign exposures under pillar III from 2022 on, with jurisdictions free to implement them. European Systemic Risk Board (2015) argues that unweighted capital requirements based on the inclusion of sovereign exposures in the bank-wide Leverage Ratio mitigate exposure-specific zero risk weights, but show that a minimum Leverage Ratio of 3% would only induce additional capital requirements for banks with a ratio of Risk-Weighted Assets (RWA) to Total Assets (TA) of 35% or lower, as banks with a higher risk weight density are rather bound by risk-weighted capital requirements.[14]

Figure 2 compares risk measures of Germany and Spain from 2008 to 2020. From an economic perspective, an exposure to Spain is substantially riskier than to Germany measured by CDS on the primary ordinate and credit ratings on the secondary one. However, from a regulatory perspective, both countries are treated identically as being risk-free, contrasting the risk-based approach applied to other asset classes.

[INSERT FIGURE 2 ABOUT HERE]

Acharya and Steffen (2015) suggest that regulatory risk weights that are out of sync with market fundamentals offer banks incentives for regulatory capital arbitrage by investing in high risk—and therefore high yield—sovereign bonds financed by short-term debt while complying with regulatory standards. Indeed, they show that this behavior was pervasive among banks during the European debt crisis and led to the *"greatest carry trade ever"*. Moreover, they present evidence that this behavior might crowd out loans to the real

[14] Our sample of European banks exhibits an average RWA density of 39.91% with 50% of banks being above the critical value of 35%.

economy, resulting in an inefficient allocation of resources that impairs economic growth. Acharya and Rajan (2013) theoretically show that this crowding-out effect is wanted by myopic sovereigns to increase their borrowing and spending capacities.

Given that European sovereign bonds allow banks to comply with regulatory requirements more easily than other assets classes, Bonner (2016) finds evidence that a *"regulatory reaction"* of banks causes a substitution effect of increased lending to the public sector covered by reduced lending to the private sector around regulatory reporting days.

Claußen et al. (2018) empirically test whether regulatory privileges for EU sovereign debt distort market prices. They model regulatory cost of capital as a component of the bond yield spread between regulatorily privileged sovereign bonds and non-privileged corporate bonds and find that the unequal treatment serves as a *hidden subsidy of sovereigns* that reduces the required yield on sovereign bonds—respectively increases the yield of corporate bonds—to compensate for additional cost of capital.

Kirschenmann et al. (2020) construct a new measure of *missing capital* that aims to quantify the unfunded sovereign exposures of EU banks due to general zero risk weights. The authors show that the co-movement between sovereign CDS within the EU is stronger for countries where the domestic banking sector holds exposures to foreign sovereigns that are not funded with capital. They take this as evidence that *missing capital* for exposures to foreign sovereigns increases the expected bailout costs of the domestic banking sector, which in turn leads to an increase in the domestic sovereign's risk.[15] Such cross-country contagion is attenuated for countries that do not benefit from regulatory privileges and for banks with larger equity ratios.

As a main contribution, we build on the *missing capital* measure proposed by Kirschenmann et al. (2020), disentangle it into its components and provide an alternative explanation. We then expand the model of Acharya et al. (2014) to estimate the impact of the different components of bank capital regulation on the sovereign-bank nexus.

[15] More detailed, risks are transmitted from peripheral to core European countries but not vice versa.

3 Hypotheses and Methodology

3.1 Hypotheses Development

In this section, we develop our hypotheses and present our methodological approach to test them. The impact of regulatory privileges of EU sovereign debt on the sovereign-bank nexus is driven by three components that potentially oppose each other. The first is the size of banks' exposures to their domestic sovereign, the second is the sovereign's riskiness and the third is banks' financial strengths. Thus, we develop our model step-wise for each component and then assess their joint significance.

In general, we expect a positive co-variation between sovereign and bank sector credit risks due to their linkage through the rating, guarantee, bailout and economy channels. Regarding the asset side of banks' balance sheets, domestic sovereign exposures could impact the sovereign-bank nexus twofold. On the one hand, it could be stronger for highly exposed banks, since these allow for risk transmissions through the asset and liquidity channels. On the other hand, movement in the opposite direction could be possible due to close connection between sovereign and broader country risk. Banks with a greater share of sovereign debt on their balance sheets might be less prone to risk transmissions through the economy channel due to a lower exposure to the non-financial sector and the fact that sovereign debt is widely accepted and privileged in refinancing operations.[16] Since we have no clear direction, this remains an empirical question:

- *H1a* *The co-movement between sovereign and bank sector credit risk becomes stronger with banks holding more domestic sovereign exposures.*
- *H1b* *The co-movement between sovereign and bank sector credit risk becomes weaker with banks holding more domestic sovereign exposures.*

As the riskiness of banks' domestic sovereign exposures increases, risk transmission from

[16] E.g. during economic crises, European Central Bank (2010, 2011) suspended minimum rating thresholds for financially distressed countries in collateral eligibility requirements.

sovereigns to banks through the asset and liquidity channels potentially outweigh advantages of sovereign debt in times of economic crises:

H2 The co-movement between sovereign and bank sector credit risk becomes stronger with banks holding riskier domestic sovereign exposures.

Regarding the funding side of banks' balance sheets, we expect the sovereign-bank nexus to be weaker for financially stronger banks, as these are more able to absorb losses on sovereign exposures through the asset and liquidity channels and cope with macroeconomic shocks through the economy channel:

H3 The co-movement between sovereign and bank sector credit risk is weaker for better capitalized banks.

3.2 Estimating the Sovereign-Bank Nexus

Following Acharya et al. (2014), we estimate the two-way feedback loop between sovereign and bank sector credit risks—namely the sovereign-bank nexus—as the co-variation between sovereign and bank CDS. Equation 1 uses their model as a benchmark:

$$\Delta \ln(CDS^{Bank}_{i,j,t}) = \beta^N \cdot \Delta \ln(CDS^{Sov}_{j,t}) + \beta^C \cdot \Delta\theta_{i,j,t} + \zeta_i + \tau_t + \alpha + \epsilon_{i,j,t}. \tag{1}$$

$\ln(CDS^{Bank}_{i,j,t})$ denotes the natural logarithm of the CDS of bank i located in country j at day t. $\ln(CDS^{Sov}_{j,t})$ is the the corresponding CDS of country j. Δ marks the change from day $t-1$ to t. β^N estimates the percentage change in a bank's CDS if its sovereign's CDS changes by one percent. This represents our benchmark for the sovereign-bank nexus.[17] $\Delta\theta_{i,j,t}$ are daily changes in a set of control variables and τ_t are daily time fixed effects.

[17]As highlighted by Acharya et al. (2014), estimation on daily changes of logarithmic CDS provides a broad data set, logarithms reduce the impact of outliers, the relation between non-negative financial variables is typically log-linear and first differences mitigate autocorrelation issues. However, other authors also use logarithmic levels in a similar environment, e.g. Schnabel and Schüwer (2017).

These control measures mainly aim to capture changes in macroeconomic conditions and are further detailed in chapter 3.3. α and $\epsilon_{i,j,t}$ are the constant and residual of the regression model. All estimations include bank fixed effects ζ_i to control for unobserved factors that are constant through time but different across banks. Standard errors are clustered at the bank level to mitigate overstated precision due to autocorrelation of observations within entities and to allow for heteroscedasticity of unknown form. As daily data might be noisy, we re-estimate on lower observation frequencies in a robustness test.

We then expand this model step-wise. As we are interested how sovereign exposures moderate the sovereign-bank nexus, equation 2 adds an interaction term between the sovereign's CDS and a bank's domestic sovereign exposure scaled by total asset to control for bank size ($Exposure^{Sov}_{i,j,t}$) to test hypothesis H1:

$$\begin{aligned}\Delta \ln(CDS^{Bank}_{i,j,t}) = \beta^{N} \cdot \Delta \ln(CDS^{Sov}_{j,t}) + \beta^{E1} \cdot \Delta \ln(CDS^{Sov}_{j,t}) \cdot Exposure^{Sov}_{i,j,t} \\ + \beta^{E2} \cdot Exposure^{Sov}_{i,j,t} + \beta^{C} \cdot \Delta\theta_{i,j,t} + \zeta_i + \tau_t + \alpha + \epsilon_{i,j,t}.\end{aligned} \tag{2}$$

A statistically significant coefficient β^{E1} would indicate that the co-variation between sovereign and bank CDS changes at different percentiles of banks' domestic sovereign exposures. At means, this specification yields similar results to equation 1, while a positive sign would imply a strengthening of the sovereign-bank nexus through domestic sovereign exposures and a negative sign vice versa. As standard procedure in context of interaction terms, we include the main effects in β^{N} and β^{E2}.

Turning to hypothesis H2, equation 3 addresses the riskiness of banks' domestic sovereign exposures by weighting them using hypothetical, non-zero risk weights ($Risk^{Sov}_{j,t}$) following Kirschenmann et al. (2020):

$$RWExposure^{Sov}_{i,j,t} = Exposure^{Sov}_{i,j,t} \cdot Risk^{Sov}_{j,t}. \tag{3}$$

The authors weigh banks' foreign sovereign exposures by risk weights calculated from the foundation IRBA-CR. As risk parameters, they derive PD from external credit ratings using the assumptions of the stress tests conducted by the EBA and set Loss Given Default (LGD) and (Effective) Maturity (M) to the standard assumptions of 45% for senior unsecured exposures and 2.5 years as required in art. 161(1a) and 162(1) CRR I. Based on the strict assumption that banks only hold the absolute minimum amount of regulatory capital required under pillar 1, they interpret the resulting measure as *missing capital* for European sovereign debt resulting from the zero risk weight exemption. We build on this approach and use hypothetical IRBA-CR risk weights as our primary measure of exposure risk but apply a more general interpretation as risk-weighted sovereign exposure ($RWExposure^{Sov}_{i,j,t}$) for two reasons. First, the Internal Capital Adequacy Assessment Process (ICAAP) and Supervisory Review and Evaluation Process (SREP) might induce additional capital requirements under pillar 2 and banks might hold voluntary capital buffers in excess of pillars 1 and 2. Second, it is questionable whether the IRBA-CR induces economically-correct capital requirements, e.g. European Systemic Risk Board (2015) highlights the limitations of the portfolio model behind Basel risk weights that potentially lead to improperly calibrated sovereign risk weights.[18] To mitigate potential weaknesses of risk weighting schemes, we use different sovereign risk weights in a robustness test. Equation 4 exchanges the interaction term including banks' unweighted domestic sovereign exposures by risk-weighted ones, leading to a model specification similar to Kirschenmann et al. (2020):

$$\begin{aligned}\Delta \ln(CDS^{Bank}_{i,j,t}) = \beta^{N} \cdot \Delta \ln(CDS^{Sov}_{j,t}) + \beta^{E1'} \cdot \Delta \ln(CDS^{Sov}_{j,t}) \cdot RWExposure^{Sov}_{i,j,t} \\ + \beta^{E2'} \cdot RWExposure^{Sov}_{i,j,t} + \beta^{C} \cdot \Delta\theta_{i,j,t} + \zeta_i + \tau_t + \alpha + \epsilon_{i,j,t}.\end{aligned} \tag{4}$$

However, as banks' risk-weighted sovereign exposures are driven by a size and risk component, $\beta^{E1'}$ forces these potentially opposing effects through one coefficient. Thus,

[18] Appendix A.1 provides a detailed calculation of sovereign risk weights based on the IRBA-CR.

equation 5 disentangles the size and risk component via a three-way interaction term and adding all lower-level interactions as suggested by Dawson and Richter (2006):

$$\begin{aligned}\Delta \ln(CDS^{Bank}_{i,j,t}) = {} & \beta^{N} \cdot \Delta \ln(CDS^{Sov}_{j,t}) + \beta^{E1} \cdot \Delta \ln(CDS^{Sov}_{j,t}) \cdot Exposure^{Sov}_{i,j,t} \\ & + \beta^{R1} \cdot \Delta \ln(CDS^{Sov}_{j,t}) \cdot Risk^{Sov}_{j,t} \\ & + \beta^{ER1} \cdot \Delta \ln(CDS^{Sov}_{j,t}) \cdot Exposure^{Sov}_{i,j,t} \cdot Risk^{Sov}_{j,t} \\ & + \beta^{E2} \cdot Exposure^{Sov}_{i,j,t} + \beta^{R2} \cdot Risk^{Sov}_{j,t} \\ & + \beta^{ER2} \cdot Exposure^{Sov}_{i,j,t} \cdot Risk^{Sov}_{j,t} + \beta^{C} \cdot \Delta\theta_{i,j,t} + \zeta_i + \tau_t + \alpha + \epsilon_{i,j,t}.\end{aligned} \tag{5}$$

The two-way interaction term β^{E1} isolates the size of banks' domestic sovereign exposures. Analogously, β^{R1} isolates general country risk, with a positive coefficient indicating that the sovereign-bank nexus is stronger in riskier countries and vice versa. A statistically significant three-way interaction term β^{ER1} implies that the relation between sovereign and bank CDS varies across combinations of exposure size and sovereign risk. We then calculate the slope of the regression function for four groups of banks, i.e. high exposures with high sovereign risks, high exposures with low sovereign risks, low exposures with low sovereign risks and high exposures with high sovereign risks, defined by the 25% and 75% percentile of the respective interaction variable and test for statistically significant slope differences. In addition to estimations on a Europe-wide sample of banks, we also estimate on sub-samples of relatively low risk core European countries as well as high risk peripheral ones—namely Greece, Ireland, Italy, Portugal and Spain (GIIPS)—to investigate potentially different dynamics of the sovereign-bank nexus in these countries.[19]

Equation 6 presents our full model, which adds an interaction with a measure of banks' financial strengths ($Strength^{Bank}_{i,j,t}$) to test hypotheses H3:

[19]Dawson and Richter (2006) point out that moderated multiple regression analysis is superior to strategies such as comparisons based on sub-samples.

$$
\begin{aligned}
\Delta \ln(CDS^{Bank}_{i,j,t}) = {} & \beta^{N} \cdot \Delta \ln(CDS^{Sov}_{j,t}) + \beta^{E1} \cdot \Delta \ln(CDS^{Sov}_{j,t}) \cdot Exposure^{Sov}_{i,j,t} \\
& + \beta^{R1} \cdot \Delta \ln(CDS^{Sov}_{j,t}) \cdot Risk^{Sov}_{j,t} \\
& + \beta^{ER1} \cdot \Delta \ln(CDS^{Sov}_{j,t}) \cdot Exposure^{Sov}_{i,j,t} \cdot Risk^{Sov}_{j,t} \\
& + \beta^{E2} \cdot Exposure^{Sov}_{i,j,t} + \beta^{R2} \cdot Risk^{Sov}_{j,t} \\
& + \beta^{ER2} \cdot Exposure^{Sov}_{i,j,t} \cdot Risk^{Sov}_{j,t} \\
& + \beta^{S1} \cdot \Delta \ln(CDS^{Sov}_{j,t}) \cdot Strength^{Bank}_{i,j,t} + \beta^{S2} \cdot Strength^{Bank}_{i,j,t} \\
& + \beta^{C} \cdot \Delta\theta_{i,j,t} + \zeta_i + \tau_t + \alpha + \epsilon_{i,j,t}.
\end{aligned}
\tag{6}
$$

In line with regulatory standards, we use banks' total capital ratios as a primary measure of financial strength, with a negative and statically significant coefficient β^{S1} implying that the sovereign-bank nexus is weaker for financially stronger banks and vice versa. We use a non-regulatory measure of financial strength in a robustness test.

In summary, we investigate the impact of the different components of banking regulation—namely exposure size, exposure risk and capitalization—on the sovereign-bank nexus step-wise via an interaction approach. Our benchmark is the co-variation between sovereign and bank CDS at means of all components. We then compare it to high and low levels of the interaction variables. For ease of interpretation and to visualize the idea behind this interaction approach, equation 7 takes the first partial derivative of $\Delta \ln(CDS^{Bank}_{i,j,t})$ with respect to $\Delta \ln(CDS^{Sov}_{j,t})$:

$$
\begin{aligned}
\frac{\partial \Delta \ln(CDS^{Bank}_{i,j,t})}{\partial \Delta \ln(CDS^{Sov}_{j,t})} = {} & \beta^{N} + \beta^{E1} \cdot Exposure^{Sov}_{i,j,t} + \beta^{R1} \cdot Risk^{Sov}_{j,t} \\
& + \beta^{ER1} \cdot Exposure^{Sov}_{i,j,t} \cdot Risk^{Sov}_{j,t} + \beta^{S1} \cdot Strength^{Bank}_{i,j,t}
\end{aligned}
\tag{7}
$$

Holding sovereign risk constant, the impact of exposure size is captured by β^{E1} and β^{ER1}, with no clear expectation on the sign of β^{E1}. Analogously, at a constant size, the impact of sovereign risk is captured by β^{R1} and β^{ER1}, with β^{R1} expected to exhibit a positive sign. A significant coefficient β^{ER1} implies that the co-variation varies across different combinations of exposure size and sovereign risk. At constant levels of exposure size and sovereign risk, the impact of banks' capitalization is captured by β^{S1}, with an expected negative sign. We assess the joint significance of these effects to conclude whether regulatory privileges for sovereign debt strengthen the sovereign-bank nexus.

3.3 Controlling for the Macroeconomic Environment

As highlighted by Acharya et al. (2014), a major concern in studies on the sovereign-bank nexus is that sovereigns and banks are expected to be connected through the economy channel. As a result, this third factor could induce a positive co-variation between sovereign and bank CDS in absence of direct transmission channels between them. Indeed, Collin-Dufresne et al. (2001) point out that credit spread changes are mainly determined by a *single common factor* and contrary to theory, firm-specific factors only have limited explanatory power. If not properly controlled for in our regression specification, changes in macroeconomic conditions will be captured in the residual $\epsilon_{i,j,t}$, which in turn will then potentially be correlated with our main explanatory variable $\Delta \ln(CDS_{j,t}^{Sov})$, leading to biased estimates.

On the country level, our strategy to mitigate these endogeneity concerns is twofold. On the one hand, we directly control for changes in the macroeconomic environment in $\Delta\theta_{i,j,t}$ via a broad set of daily available control variables from three markets. First, from CDS markets by CDS indices of the European sovereign and banking sectors ($CDSIndex_t^{Sovs}$ and $CDSIndex_t^{Banks}$). Second, from debt markets by the level and slope of the term structure of interest rates modelled by the Euro OverNight Index Average ($EONIA_t$), the 12-months European Interbank Offered Rate ($EURIBOR_t^{12M}$) and the difference between the 30-year and 1-year Interest Rate Swap (IRS) rate ($TermSpread_t^{ISDA}$) from the International Swaps and Derivatives Association (ISDA). Third, from equity markets by the level and volatility of country-specific equity indices ($EqIndex_{j,t}^{Level}$ and

$EqIndex^{Vola}_{j,t}$). Generally, a countercyclical behavior of CDS is expected. On the other hand, we indirectly control for a cyclicity of the macroeconomic environment via daily time fixed effects in τ_t. These capture unobserved factors that are constant across entities but different through time. However, although our data set covers a large number of banks, they are located in a comparably small number of countries, which can broadly be divided into relatively low risk core EU countries and high risk peripheral EU ones. Thus, the variation of corresponding sovereign CDS across banks is rather small, so that daily time fixed effects are expected to absorb a major part of the explanatory power of our main independent variable.[20] Therefore, we estimate all regression specifications including direct macroeconomic control variables without time fixed effects and use daily time fixed effects as an alternative. We further address potential endogeneity concerns in a robustness test.

On the bank level, we control for default risks via banks' issuer credit ratings ($Rating^{Bank}_{i,j,t}$) from Moody's Investors Service, Standard & Poor's Financial Services and Fitch Ratings, mapped according to Bank for International Settlements (2021). In case of split ratings, we choose the second-best rating in line European Banking Authority (2019) and annex VI, part 3, 1(5-7) CRD I. Ratings are transformed to integer values such that the best rating is equal to one and worse ratings are ascending as in Acharya et al. (2014), which should be reflected in a positive coefficient sign.[21]

[20]We use daily time fixed effects that correspond to our observation frequency for consistency purposes. Related studies use less strict time fixed effects on daily data, for example Schnabel and Schüwer (2017) yearly, Kirschenmann et al. (2020) quarterly/weekly and Fiordelisi et al. (2020) monthly.

[21]Hereinafter, we use the S&P rating classifications.

4 Empirical Analyzes

4.1 Data and Summary Statistics

In this section, we present our data set and empirical results. Our primary data source are sovereign exposures of large European banks published as part of the EBA stress tests as well as capital and transparency exercises taken from European Banking Authority (2020). This data base determines the banks, countries and observation period considered. Table 2 gives an overview of the EBA investigations.[22] The EBA first published bank-level sovereign exposures as of 31 Dec. 2010 on 15 Jul. 2011. This marks the beginning of our observation period. From then on, the EBA has continued to disclose sovereign exposures on a yearly basis. We close our observation period on 30 Jun. 2020 after the publication of transparency exercise 2020, which covers roughly nine years. In a first step, we hand-collect information on banks' sovereign exposures from all EBA investigations. In a second step, as the EBA usually discloses its results more than half a year after the reporting date, we check the publication date of each investigation and map the ending balance of banks' sovereign exposures to it.[23] From this, we expect to model processing in financial markets more adequately since market participants have no information on banks' sovereign exposures before the publication date.

[INSERT TABLE 2 ABOUT HERE]

We then map the EBA data to bank- and country-specific information. Since the first EBA stress test, more than 200 banks have been part of one or more investigation. We use Datastream to identify entities for which CDS are available, resulting in a total of 65 banks.[24] Balance sheet and regulatory data from Worldscope as well as is-

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[22] Stress test 2016 covers the same reporting date as transparency exercise 2016 and is thus redundant. In stress test 2018, sovereign exposures were not disclosed.

[23] I.e. sovereign exposures disclosed in stress test 2011 for the reporting date 31 Dec. 2010 are shifted to their publication on 15 Jul. 2011 and so forth.

[24] More specifically, we take five-year CDS as these are the most liquid ones, cf. Blanco et al. (2005).

suer credit ratings from Refinitiv are available for 53 of these banks. We then focus on banks with publicly-traded equity to ensure a consistent data set throughout all analyzes. This yields our full data set of 41 banks. These banks are headquartered in 13 different European countries, which all have corresponding sovereign CDS and ratings available. Europe-wide macroeconomic control variables covering CDS indices ($CDSIndex_t^{Sovs}$ and $CDSIndex_t^{Banks}$), the level of the term structure of interest rates ($EONIA_t$ and $EURIBOR_t^{12M}$) and its slope ($TermSpread_t^{ISDA}$) are fully available in Datastream. Turning to country-specific control variables, the level of domestic equity indices is available for all countries considered in our data set. We take the Austrian Traded Index (ATX) for Austria, Belgian 20 Index (BEL20) for Belgium, OMX Copenhagen for Denmark, Cotation Assistee en Continu (CAC) for France, Deutscher Aktienindex (DAX) for Germany, Athens Stock Exchange Composite Share Price Index (ATX) for Greece, Irish Stock Exchange Overall Index (ISEQ) for Ireland, Milano Indice di Borsa (MIB) for Italy, Amsterdam Exchange Index (AEX) for Netherlands, Portuguese Stock Index (PSI) for Portugal, Iberia Index (IBEX) for Spain, OMX Stockholm for Sweden and Financial Times Stock Exchange Index (FTSE) for the United Kingdom. Equity volatility indices are only available for France (VCAC), Germany (VDAX), Netherlands (VAEX) and the United Kingdom (VFTSE). For the remaining countries, we take the Europe-wide VSTOXX as proxy.

As data preparation, we drop observations with two consecutive zero changes in sovereign and bank CDS to avoid stale quotes as in Acharya et al. (2014) and winsorize them at the 0.1% and 99.9% percentiles to mitigate the impact of outliers analogously to Claußen et al. (2021). Table 3 shows the sample distribution by banks grouped by countries. The full sample covers 41 banks from 13 European countries with a total of 56,612 daily observations. From these, 21 banks (31,987 obs.) are located in core Europe and 20 banks (24,625 obs.) in GIIPS.

[INSERT TABLE 3 ABOUT HERE]

Table 4 summarizes descriptive statistics. Regarding sovereign exposures, banks' balance sheets comprise on average B€ 672.61 total assets of which a substantial share of 5.85%—or B€ 24.97—stem from exposures to the domestic sovereign. Under a prudential application of the large exposures framework, banks would not have been allowed to expose themselves to 74.15%—or B€ 16.26—of these positions.[25] Addressing sovereign risks, sovereign ratings range from AAA to CC with a median of AA. Notably, a dichotomous distribution can be observed. While risks are rather low in core EU with a range from AAA to AA- and a median of AAA, they are substantially higher in GIIPS ranging from AA to CC and a median of BBB. Corresponding IRBA-CR weights calculated from equation 8 cover 13.16% to 230.92%, with an average of 39.74% and a standard deviation of 36.07%. Applying these risk weights results in an average risk-weighted domestic sovereign exposure of 3.28% of total assets—or B€ 10.56. Concerning banks' financial strengths, their average total capital ratio is 16.10% with a standard deviation of 3.70 percentage points (PP). Bank ratings range from AA to D with a median rating of BBB+. Again, a binary distribution of risks can be observed. Core EU banks are rated from AA to BBB with a median of A, indicating relatively low risks. GIIPS banks incur substantially higher risks with ratings between AA and D and a median of BBB-.

[INSERT TABLE 4 ABOUT HERE]

Figure 3 shows scatter plots of daily average bank CDS on the vertical axis and domestic sovereign CDS on the horizontal one. CDS levels in panel (a) exhibit a positive—but non-linear—relation between both. Average bank CDS of 181.52 BP flatten at 2,576.79 BP. Sovereign CDS are on average lower with 124.44 BP but range up to 9,923.82 BP. Using logarithmic CDS levels in panel (b), the relation becomes substantially more linear, indicating that sovereign and bank CDS levels tend to be aligned within countries. However, considering daily changes of logarithmic CDS in panel (c) shows a positive—but plus-shaped—relation, implying that sovereign and bank CDS also change independently

[25] A bank's excess sovereign exposure is calculated as the share that exceeds 25% of its total capital: $ExcessExposure^{Sov}_{i,j,t} = max[Exposure^{Sov}_{i,j,t} - 0.25 \cdot TotalCapital_{i,j,t}; 0]$.

of each other.

[INSERT FIGURE 3 ABOUT HERE]

Table 5 calculates correlations between daily changes in logarithmic sovereign and bank CDS to get a first descriptive indication of the sovereign-bank nexus. Over the full sample, the correlation is 22.43%. In core Europe, it is substantially lower at 14.65% and almost doubles to 40.63% in GIIPS. Applying a median split to banks' unweighted and risk-weighted domestic sovereign exposures, we find lower correlations of 15.30% to 16.41% for weakly exposed banks compared to 33.56% to 35.76% for heavily exposed ones over the full sample, indicating that sovereign exposures strengthen the sovereign-bank nexus and providing descriptive evidence for hypotheses H1a and H2. However, on the core EU and GIIPS sub-samples, this effect is weaker or reversed, providing descriptive evidence for a weakening of the nexus and hypothesis H1b. Likewise, a median split of banks' total capital ratios shows that the correlation is higher for weakly-capitalized banks at 32.24% compared to strongly-capitalized ones at 15.29%. This also tends to hold for the sub-samples, providing descriptive evidence for H3.

[INSERT TABLE 5 ABOUT HERE]

Turning to macroeconomics, the CDS indices of the European sovereign and banking sectors average at 80.54 BP and 185.98 BP with standard deviations of 94.41 BP and 125.47 BP, respectively. The level of the term structure of interest rates measured by the European Overnight Index Average (EONIA) and 12-months European Interbank Offered Rate (EURIBOR) is on average -0.08% and 0.33% with standard deviations of 0.35 PP and 0.65 PP. Its slope is normal at a positive 1.64 PP with a standard deviation of 0.45 PP. As country-specific equity indices are not directly comparable between countries due to different baselines, we use log-returns in the following.

4.2 Regression Analyzes

4.2.1 Sovereign-Bank Nexus Benchmark

We start by estimating the average co-variation between sovereign and bank CDS based on equation 1 to arrive at a benchmark for the sovereign-bank nexus. Model (1) of table 6 yields a positive and highly significant nexus coefficient β^N over the full sample of EU banks. A 1% increase in the domestic sovereign's CDS translates into an 0.0692% increase in bank CDS. Addressing bank-level control variables, the effect of banks' credit ratings is generally not different from zero at conventional levels, potentially due to slowly-changing ratings and their through-the-cycle character. Turning to country-level control variables, CDS behave counter-cyclically as worsening macroeconomic conditions measured by rising CDS indices, a flattening of the term structure of interest rates as well as falling and volatile equity markets are highly significant. Overall, our independent variables explain 19.4% of the variation in bank CDS. Model (2) includes daily time fixed effects as an alternative. Since these capture factors that a constant across banks but different through time, they absorb a huge part of the variation in sovereign CDS. As a result, the nexus effect drops to 0.0189%, but stays significant at the 5% level. The explanatory power of the model more than doubles to 39.8%, confirming that CDS changes are mainly driven by systematic factors. Models (3) to (6) cover the sub-samples and provide evidence that the sovereign-bank nexus is substantially stronger in GIIPS compared to core EU.

[INSERT TABLE 6 ABOUT HERE]

To further investigate systematic effects, we re-estimate equation 1 by years. Figure 4 plots yearly nexus coefficients β^N using direct macroeconomic control variables in panel (a) and daily time fixed effects in panel (b). In a first step, this allows us to replicate and confirm the results of Acharya et al. (2014). They define three sub-periods and report a statistically insignificant coefficient for the pre-bailout period from 01 Jan. 2007 to 25 Sep. 2008, indicating an independence of sovereign and bank CDS. During bank bailouts by domestic sovereigns from 26 Sep. 2008 to 21 Oct. 2008, the effect turns negative and significant at -0.597%, implying a short-term convergence of CDS. After bailouts, the effect remains positive and significant at 0.074% from 22 Oct. 2008 to 30 Apr. 2011, providing evidence for a long-term synchronization of CDS. In a robustness test from May 2011 to Dec. 2012, their effect drops to 0.051%. In our data set, we find statistically insignificant coefficients for 2008 and 2009—potentially due to the short time span of the bailout period—and similar-sized effects between 0.063% to 0.068% in 2010 and 0.0569% to 0.0778% in 2011. The explanatory power of the models is also comparable with an adjusted R^2 between 43.8% and 59.8%, confirming that our data set is not biased or distorted. In a second step, we expand their analyzes from 2012 to 2020. Including direct macroeconomic controls, the effect stays positive and significant. However, with daily time fixed effects it becomes absorbed and thus insignificant. We base this on a calming of the European sovereign debt crisis and sovereign risks becoming less heterogeneous. As our observation period starts with the publication of the first EBA stress test on 15 Jul. 2011, our study suffers from daily time fixed effects absorbing our main variable of interest and we rely on direct macroeconomic control variables instead.

[INSERT FIGURE 4 ABOUT HERE]

4.2.2 Impact of Banks' Sovereign Exposures

Next, we expand our benchmark model step-wise. Table 7 adds an interaction between the domestic sovereign's CDS and banks' domestic sovereign exposures scaled by total assets as specified in equation 2. The coefficient of the interaction term is statistically insignificant over the full sample and the core EU sub-sample, but turns negative and significant at the 5%-level in GIIPS.

[INSERT TABLE 7 ABOUT HERE]

Figure 5 visualizes the marginal effect of a change in the domestic sovereign's CDS on bank CDS at different percentiles of banks' domestic sovereign exposures including 90% confidence intervals. For orientation, the interaction variable ranges from its minimum to maximum and the vertical dashed black lines show its mean as well as 25% and 75% percentiles. The horizontal dashed gray line shows the average co-movement between sovereign and bank CDS at means. Panel (a) covers the full sample, panels (b) and (c) the core EU and GIIPS sub-samples. In GIIPS, the co-variation between sovereign and bank CDS is estimated at 0.1975% at means. It drops to 0.1607% at the 75% percentile of banks' domestic sovereign exposures and increases to 0.2411% at their 25% percentile, indicating that relatively highly exposed banks are less prone to sovereign risk spillovers compared to weakly exposed banks. At first, this is counter-intuitive as it contradicts the idea that sovereign exposures allow for risk transmissions through the asset channel. Empirically, the opposite seems to be the case, potentially because of the close connection between sovereign and broader country risk, offering evidence for hypothesis H1b.

[INSERT FIGURE 5 ABOUT HERE]

Table 8 weights banks' sovereign exposures by hypothetical risk weights as specified in equation 4, leading to the *missing capital* measure proposed by Kirschenmann et al. (2020). However, exchanging banks' unweighted sovereign exposures by risk-weighted ones, respectively their *missing capital*, the results remain unchanged. For the full sample and the core EU sub-samples, the interaction stays insignificant and yields a negative coefficient in GIIPS.

[INSERT TABLE 8 ABOUT HERE]

Figure 5 visualizes analogous marginal effects at different percentiles of banks' risk-weighted domestic sovereign exposures.

[INSERT FIGURE 6 ABOUT HERE]

4.2.3 Isolating the Size and Risk Effects

As the *missing capital* measure of Kirschenmann et al. (2020)—respectively risk-weighted sovereign exposure—forces the effects of the size and riskiness of banks' sovereign exposures through one coefficient, potential opposing effects cannot be observed. Thus, we expand their model using a three-way interaction approach as suggested by Dawson and Richter (2006). To isolate the size and risk components, we disentangle the two-way interaction term including banks' risk-weighted sovereign exposures into a three-way interaction between the domestic sovereign's CDS, the size of banks' sovereign exposures as well as its hypothetical risk weight and include all lower-level interactions as specified in equation 5. Table 9 summarizes the results. Most notably, the three-way interaction term becomes negative and statistically significant at the 1%-level, indicating that the co-variation does vary at different combinations of banks' sovereign exposures and sovereign risk. Moreover, the lower-level two-way interactions also become positive and statistically significant at the 5%-level.

[INSERT TABLE 9 ABOUT HERE]

Holding banks' sovereign exposures constant, figure 7 plots the marginal effect of a change in the domestic sovereign's CDS on bank CDS at different percentiles of the sovereign's hypothetical IRBA-CR weight. At means, a 1% increase in sovereign CDS induces a 0.1288% increase in bank CDS. This effect drops to 0.0922% in relatively low risk countries measured by the 25% percentile of the sovereign's IRBA-CR weight and increases to 0.1754% in high risk countries measured by the 75% percentile. Due to their binary distribution within the EU, sovereign risks hardly vary in core EU and GIIPS and thus lose their explanatory power in the sub-samples.

[INSERT FIGURE 7 ABOUT HERE]

As the effects of banks' sovereign exposures and sovereign risk now depend on two coefficients, their signs cannot be interpreted directly. Thus, we calculate the slopes of the regression function for weakly and highly exposed banks located in low and high risk countries separately, defined by the 25% and 75% percentiles of the respective interaction variable. Figure 8 displays a scatter plot of daily changes in logarithmic sovereign and bank CDS including the resulting four groups of banks. High sovereign risks are depicted by the black and dark gray lines, low risks by the lighter gray lines, with the darker colors representing high sovereign exposures. The steepest slope—and thus strongest co-variation between sovereign and bank CDS—is exhibited by banks with low sovereign exposures located in high risk countries. At the other extreme, the flattest slope—and thus weakest co-variation—is estimated for banks with low sovereign exposures from low risk countries. The other two groups lie in between.

[INSERT FIGURE 8 ABOUT HERE]

Table 10 summarizes these slope estimations and calculates corresponding risk-weighted sovereign exposures as percentage of total assets in brackets. At high sovereign exposure and high sovereign risk—equivalent to a risk-weighted exposure of 6.0858%—a 1% increase in the domestic sovereign's CDS translates into an increase in bank CDS of 0.1548%. This effect is emphasized to 0.2082% at low sovereign exposures and high sovereign risks—equivalent to a risk-weighted exposure of 1.3881%—supporting hypothesis H1b. Empirically, sovereign exposures seem to make banks less prone to macroeconomic crises through the economy channel due to the close connection between sovereign and broader country risk. At high sovereign exposure and low sovereign risk—equivalent to a risk-weighted exposure of 1.1334%—the co-variation is estimated at 0.1202%. It drops to 0.0478% at low sovereign exposures and low sovereign risk—equivalent to a risk-weighted exposure of 0.2585%—supporting hypothesis H1a. We attribute this state-dependent effect of sovereign exposures on the sovereign-bank nexus to risk transmissions from sovereigns to banks through the asset channel in a stable macroeconomic environment. All slope differences are statistically significant at the 1% level. Notably, banks with the highest risk-weighted sovereign exposure do not exhibit the strongest linkage to their sovereign. Moreover, the sovereign-bank nexus can be very different for banks with similar risk weighted sovereign exposures.

[INSERT TABLE 10 ABOUT HERE]

4.2.4 Impact of Banks' Financial Strengths

Our final model assesses the impact of banks' financial strengths on the sovereign-bank nexus by interacting the domestic sovereign's CDS with banks' total capital ratios as specified in equation 6. Table 11 summarizes the results.

[INSERT TABLE 11 ABOUT HERE]

Importantly, the coefficient of the interaction term is negative and significant at the 5%-level, indicating that the co-variation between sovereign and bank CDS is weaker for better capitalized banks. This marginal effect is visualized in figure 9 at different percentiles of banks' total capital ratios. The average co-variation of 0.1301% rises to 0.1375% at the 25% and falls to 0.1245% at the 75% percentile, respectively. Surprisingly, the coefficient turns positive in the GIIPS sub-sample.

[INSERT FIGURE 9 ABOUT HERE]

Figure 10 expands the scatter plot of daily changes in logarithmic sovereign and bank CDS by slope estimations for weakly and strongly capitalized banks by the solid and dashed lines respectively, leading to eight groups of banks. Since the dashed lines always lie above the solid ones, increasing capital buffers weaken the sovereign-bank nexus.

[INSERT FIGURE 10 ABOUT HERE]

These slope estimations as well as corresponding risk-weighted sovereign exposures are again summarized in table 12. Turning from the 25% percentile of banks' total capital ratios to its 75% percentile, the slopes—and thus the co-variation between sovereign and bank CDS—decrease. All slope differences are statistically significant at the 1%-level. In summary, this provides empirical evidence that additional capital buffers stemming from non-zero sovereign risk weights would indeed weaken the sovereign-bank nexus and thus serve as a reasonable starting point for the future regulatory treatment of sovereign debt. However, as the nexus is not strongest for banks with the highest risk-weighted sovereign exposure, the impact of traditional risk-weighting schemes would be limited. Ultimately, the sovereign-bank nexus is mainly driven by sovereign risks and we highlight advantages of sovereign exposures, as these make banks less prone to macroeconomic shocks.

[INSERT TABLE 12 ABOUT HERE]

4.3 Robustness Tests

4.3.1 Wild Cluster Bootstrap

To test the reliability of the coefficients and address potential non-normalities in the data, we rely on the wild cluster bootstrap method proposed by Roodman et al. (2018). Its main idea is to generate a large number of bootstrap samples that mimic the distribution of the population from which the sample is obtained. Then, on each of these bootstrap samples the original statistical test is performed. Finally, the bootstrap p-value is calculated as the proportion of bootstrap statistics that are more extreme than the original test statistic. Table 13 summarizes bootstrapped t- and p-values for our full model using 999 replications to generate bootstrap samples. The individual statistical significance of our coefficients remains unchanged, indicating that estimations are stable. Moreover, the joint significance of our interaction terms is assessed via F-tests, as it is not possible to change one variable while holding all other terms constant. The interaction terms addressing banks' sovereign exposures and sovereign risk, banks' financial strengths as well as the full set of interaction terms are statistically significant at least at the 5%-level.

[INSERT TABLE 13 ABOUT HERE]

4.3.2 Estimastion on a Lower Observation Frequency

As daily data might be noisy and suffer from measurement errors, we re-estimate our full model on a lower observation frequency as in Acharya et al. (2014). Tables 14 and 15 present results based on weekly and monthly observations. Most importantly, the three-way interaction term stays statistically significant and the coefficient signs allow for unchanged conclusions. However, the statistical significance is reduced, potentially due to the lower number of observations.

[INSERT TABLES 14 and 15 ABOUT HERE]

Figure 11 shows scatter plots of changes in logarithmic sovereign and bank CDS on (a) weekly and (b) monthly observations including estimations for low and high values of banks' sovereign exposures, sovereign risk and bank capitalization.

[INSERT FIGURE 12 ABOUT HERE]

4.3.3 Different Measures of Sovereign Risk

Our main measure of sovereign risk are hypothetical risk weights calculated in line with regulatory standards based on the IRBA-CR. To mitigate weaknesses of regulatory risk-weighting schemes, we use the domestic sovereign's issuer credit rating as alternative in table 16. Most importantly, the three-way interaction term between the domestic sovereign' CDS, banks' domestic sovereign exposures and sovereign risk remains statistically significant and the coefficient combination allows for similar conclusions.

[INSERT TABLE 16 ABOUT HERE]

Margin plots of a change in sovereign CDS on bank CDS at different percentiles of the domestic sovereign's issuer credit rating are presented in figure 12.

[INSERT FIGURE 12 ABOUT HERE]

4.3.4 Different Measures of Banks' Financial Strengths

Our main measure of banks' financial strengths is regulatory capital ratios. As alternatives to this balance-sheet-based measure, we use banks' Return on Assets (ROA) as a profitability-based measure in table 17. The coefficient of the interaction term exhibits a negative sign, indicating that the co-variation between sovereign and bank CDS is weaker for more profitable banks. In the core EU sub-sample, it is statistically significant at the 1%-level, in GIIPS and over the full sample, confidence intervals become rather big and significance is lost.

[INSERT TABLE 17 ABOUT HERE]

Margin plots of a change in sovereign CDS on bank CDS at different percentiles of banks' ROA are presented in figure 13.

[INSERT FIGURE 13 ABOUT HERE]

4.3.5 Addressing Potential Endogeneity Concerns

Since sovereign and bank risks are dependent on macroeconomic conditions within a country, our analyzes might suffer from endogeneity. This can lead to a positive relation between sovereign and bank CDS without a direct transmission channel between both. To address this issue further, we follow Acharya et al. (2014) and add banks' share returns as additional explanatory variable in table 18. These should capture changes in macroeconomic conditions and eliminate the effect of sovereign CDS on bank CDS if no direct transmission channel exists. The signs and statistical significance of all interaction terms remains unchanged. Moreover, the effect of banks' share returns is negative and highly significant, indicating that positive share returns induce falling bank CDS.

[INSERT TABLE 18 ABOUT HERE]

5 Conclusion

In this paper, we empirically explore the impact of bank capital regulation on the co-movement between sovereign and bank sector credit risks. We quantify this so-called sovereign-bank nexus following Acharya et al. (2014) using sovereign and bank CDS. As debt issued by members of the EU benefits from privileges in banking regulation—namely no minimum capital requirements, highest liquidity status and no exposure limits regardless of its actual riskiness—European banks might be highly exposed to their domestic sovereign without holding risk-adequate capital buffers. This potentially strengthens the sovereign-bank nexus, which poses a substantial threat to the financial stability of a country. To investigate the impact of regulatory privileges for European sovereign debt on the sovereign-bank nexus, we disentangle the *missing capital* measure proposed by Kirschenmann et al. (2020) into its components and assess their impact step-wise on the co-variation between sovereign and bank CDS using on a three-way interaction approach suggested by Dawson and Richter (2006).

Although regulatory privileges for European sovereign debt have been criticized by academics and policymakers alike, we highlight advantages of sovereign exposures and contribute to the ongoing discussions on the future regulatory treatment of sovereign debt. Based on a sample of large European banks between 2011 and 2020, we confirm that sovereign and bank CDS generally co-vary positively, which is stronger in riskier countries, as already widely known in the literature. We then add to the literature twofold. First, we show that the impact of the size of banks' domestic sovereign exposures is state-dependent. In relatively low risk countries, increasing exposures to the domestic sovereign emphasize the co-variation between sovereign and bank CDS, consistent with a strengthening of the sovereign-bank nexus through an asset channel. In relatively high risk countries, this effect is reversed as increasing exposures mute the co-variation, potentially caused by advantages of sovereign debt that make banks less prone to macroeconomic crises. I.e. sovereign debt is usually privileged in refinancing operations and banks with a higher share of sovereign debt in their balance sheet are less-exposed to the non-financial economy. Second, we provide evidence that the co-variation between sovereign and bank CDS is weakener for financially stronger banks. Combining these insights allows for the joint conclusion that increasing capital buffers stemming from non-zero risk weights on sovereign debt would indeed weaken the sovereign-bank nexus and thus serve as a reasonable starting point for the future regulatory treatment of sovereign debt. However, as the nexus is not strongest for banks with the highest risk-weighted sovereign exposure, capital requirements based on traditional risk-weighting schemes that combine exposure size and exposure risk would be limited, as it is mainly driven by sovereign risks. Fully breaking it would require a more granular approach that focuses on sovereign risks independent of banks' sovereign exposures. This is our main contribution.

E.g. our data set shows that a 1% increase in sovereign risk is estimated to translate into an increase in bank risk of 0.0648% for banks with a relatively low risk-weighted sovereign exposure of 0.2585% of total assets. This nexus is emphasized to 0.1590% for a relatively high risk-weighted sovereign exposure of 6.0858% of total assets. However, for banks with almost identical risk-weighted sovereign exposures of 1.1334% and 1.3881% of total assets, stemming from high exposure size and low sovereign risk and low exposure size and high sovereign risk respectively, the sovereign-bank nexus can be very different. For the former group of banks, the co-variation is estimated at 0.1278%. For the latter one, it almost doubles to 0.2156%. All these groups of banks would experience a weakening of the sovereign-bank nexus through increasing capital buffers.

A shortcoming of our study is the close connection between sovereign and broader country risk, which cannot be avoided by domestic banks. High sovereign risks are almost inevitable connected to nation-wide economic crises. Although we carefully control for macroeconomic fundamentals and follow established studies in context of the sovereign-bank nexus, it could be argued that our measure of sovereign risk also serves as a general macroeconomic indicator and thus our models measure a "corporate-bank" nexus. Regarding this, we provide an outlook for further studies in appendix A.2.

Appendix

A.1 Estimating Sovereign Risk

Our primary measure of sovereign risks are risk weights derived from the IRBA-CR. Basel Committee on Banking Supervision (2005) offers a detailed explanation of the IRBA-CR risk weight function. It builds on a Value at Risk (VaR) framework and calibrates capital requirements to the distance between the VaR at a confidence level of 99.9% and expected losses. Expected losses are viewed as cost component of the banking business managed by risk-adequate pricing and risk provisioning. Thus, under pillar 1, capital is only required for losses beyond expected levels—namely unexpected losses.[26] A key characteristic of the BCBS credit risk model is portfolio invariance, meaning that capital requirements only depend on exposure-specific characteristics and not on the portfolio it is added to. Under the assumption of a well-diversified portfolio, idiosyncratic risks are eliminated and systematic risks affecting all positions are modelled by a single systematic risk factor. In this context, the risk parameter PD, LGD and M are sufficient to determine exposure-specific capital requirements and their sum equals bank-wide capital requirements.

Equation 8 calculates risk weights for country j at time t ($IRBAWeight_{j,t}^{Sov}$) for $0\% < PD_{j,t}^{Sov} < 100\%$ as required in art. 153(1iii) CRR I for institutional, corporate and sovereign exposures.[27] $N(\cdot)$ denotes the cumulative distribution function of a standard normal random variable and $G(\cdot)$ its inverse.

[26] Capital adequacy for expected losses is assessed under pillar 2 in the ICAAP and SREP.

[27] The BCBS risk weight function is identical to the CRR version. However, the former directly calculates capital requirements, while the latter calculates risk weights by adding 12.5 as the reciprocal of the solvability coefficient of 8% postulated in art. 92(1c) CRR I. Moreover it adds a multiplier of 1.06.

$$
\begin{aligned}
IRBAWeight_{j,t}^{Sov} = \big[&LGD_{j,t}^{Sov} \cdot N\big(\frac{1}{\sqrt{1-R_{j,t}^{Sov}}} \cdot G(PD_{j,t}^{Sov}) \\
&+ \sqrt{\frac{R_{j,t}^{Sov}}{1-R_{j,t}^{Sov}}} \cdot G(0.999)\big) - LGD_{j,t}^{Sov} \cdot PD_{j,t}^{Sov}\big] \\
&\cdot \frac{1+(M_{j,t}^{Sov}-2.5)\cdot b_{j,t}^{Sov}}{1-1.5\cdot b_{j,t}^{Sov}} \cdot 12.5 \cdot 1.06.
\end{aligned}
\tag{8}
$$

$R_{j,t}^{Sov}$ is the *asset correlation* with the single systematic risk factor as defined in equation 9. Assuming that high-PD positions are mainly affected by idiosyncratic and low-PD ones by systematic risks, correlations are fixed between 12% and 24% and increase with decreasing PD.

$$
R_{j,t}^{Sov} = 0.12 \cdot \frac{1-e^{-50\cdot PD_{j,t}^{Sov}}}{1-e^{-50}} + 0.24 \cdot \big(1 - \frac{1-e^{-50\cdot PD_{j,t}^{Sov}}}{1-e^{-50}}\big). \tag{9}
$$

$b_{j,t}^{Sov}$ is the *maturity adjustment* as defined in equation 10. Adjustments are standardized on 2.5 years. Capital requirements increase with increasing $M_{j,t}^{Sov}$ and decreasing $PD_{j,t}^{Sov}$, since long-term positions are assumed to be riskier than short-term ones and low-PD positions have more downside potential than high-PD ones.

$$
b_{j,t}^{Sov} = \big(0.11852 - 0.05478 \cdot \ln(PD_{j,t}^{Sov})\big)^2. \tag{10}
$$

As risk parameters, we derive $PD_{j,t}^{Sov}$ from external issuer credit ratings as used by European Banking Authority (2011) in the EBA stress tests. We take ratings from Moody's Investors Service, Standard & Poor's Financial Services and Fitch Ratings and map them according to Bank for International Settlements (2021). In case of split ratings, we choose the second-best rating in line with the approach taken by European Banking Authority (2019) as well as regulatory standards in annex VI, part 3, 1(5-7) CRD I. We set (economic-downturn) $LGD_{j,t}^{Sov}$ to 40% in accordance with the assumptions applied by European Banking Authority (2011). We set $M_{j,t}^{Sov}$ to the standard assumption of 2.5 years required in art. 162(1) CRR I. Table 19 summarizes the results. The left panel maps the ratings of the different agencies. The right panel calibrates risk weights to $PD_{j,t}^{Sov}$, $LGD_{j,t}^{Sov}$ and $M_{j,t}^{Sov}$.

[INSERT TABLE 19 ABOUT HERE]

A.2 Outlook: Corporate-Bank Nexus

Our study highlights advantages of sovereign exposures, as these can reduce the co-variation between sovereign and bank CDS. This is potentially caused by the close connection between sovereign and broader country risk. As outlook to further analyzes, we estimate the co-variation between the economic performance of banks measured by share returns ($ShPrice^{Bank}_{i,j,t}$) and the general economy within a country measured by broad equity indices ($EqIndex^{Level}_{j,t}$). Analogous to the sovereign-bank nexus, this allows to estimate the "corporate-bank nexus" at different percentiles of banks' sovereign exposures and financial strengths. Specifically, we estimate equation 11:

$$
\begin{aligned}
\Delta \ln(ShPrice^{Bank}_{i,j,t}) = {} & \beta^{N} \cdot \Delta \ln(EqIndex^{Level}_{j,t}) \\
& + \beta^{E1} \cdot \Delta \ln(EqIndex^{Level}_{j,t}) \cdot Exposure^{Sov}_{i,j,t} \\
& + \beta^{E2} \cdot Exposure^{Sov}_{i,j,t} \\
& + \beta^{S1} \cdot \Delta \ln(EqIndex^{Level}_{j,t}) \cdot CapitalRatio^{Bank}_{i,j,t} \\
& + \beta^{S2} \cdot CapitalRatio^{Bank}_{i,j,t} \\
& + \beta^{C} \cdot \Delta\theta_{i,j,t} + \zeta_i + \tau_t + \alpha + \epsilon_{i,j,t}.
\end{aligned}
\tag{11}
$$

$\Delta \ln(ShPrice^{Bank}_{i,j,t})$ is the daily change in bank *i's* logarithmic share price. $\Delta \ln(EqIndex^{Level}_{j,t})$ is the corresponding change in an equity index of bank *i's* home country *j*. $Exposure^{Sov}_{i,j,t}$ is bank *i's* exposure to its home country *j* scaled by total assets. $CapitalRatio^{Bank}_{i,j,t}$ is bank *i's* total capital ratio. $\Delta\theta_{i,j,t}$ denotes a set of control variables covering bank *i's* credit rating, Europe-wide CDS indices, the EONIA, EURIBOR, term spread and country-specific equity volatility indices. ζ_i and τ_t are bank and daily time fixed effects. α and $\epsilon_{i,j,t}$ are the constant and residual of the regression model.

Table 20 summarizes the results. Bank share returns and equity indices generally co-vary positively, indicated by a positive coefficient β^{N}. At means, a 1% increase in domestic equity indices induces a 1.4734% increase in bank share returns. Addressing the asset side of banks' balance sheets, this general co-variation becomes weaker for banks with a greater share of exposures to the domestic sovereign, indicated by a negative coefficient of the interaction term β^{E1}. At their 25% percentile, it rises to 1.55479% and falls to 1.4253% at their 75% percentile. Addressing the funding side of banks' balance sheets, this general co-variation becomes weaker for better-capitalized banks, indicated by a negative coefficient of the interaction term β^{S1}. At the 25% percentile of banks' total capital ratios, it rises to 1.5309% and falls to 1.4370% at their 75% percentile. As these results are similar to our sovereign-bank nexus specification, this provides further evidence that sovereign and broader country risks can hardly be disentangled and sovereign CDS serve as macroeconomic indicators.

[INSERT TABLE 20 ABOUT HERE]

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Figures

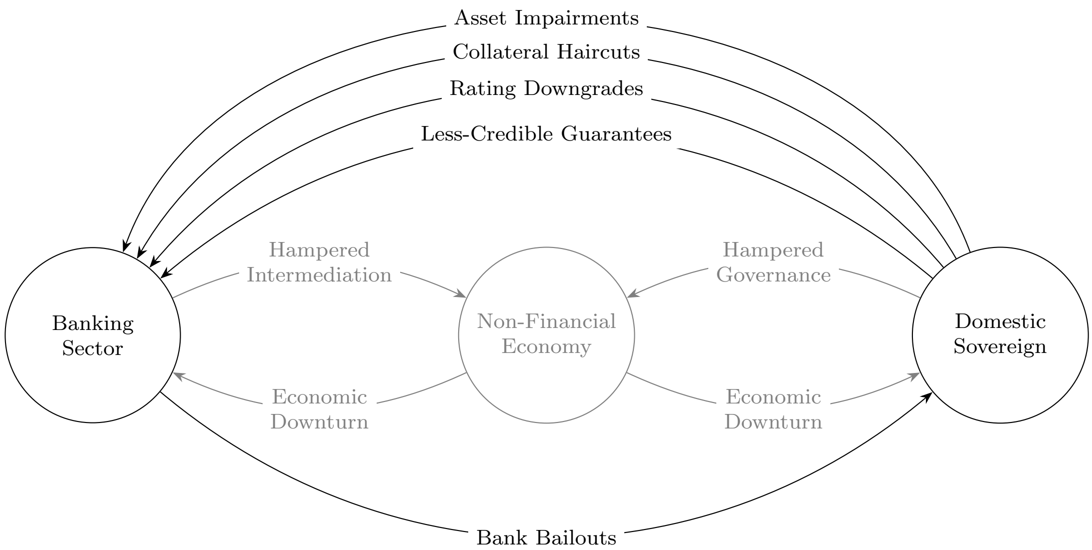


Figure 1. ***Transmission channels between sovereigns and banks.*** *Adjusted from Committee on the Global Financial System (2011). Arrows depict direction of risk transmissions.*

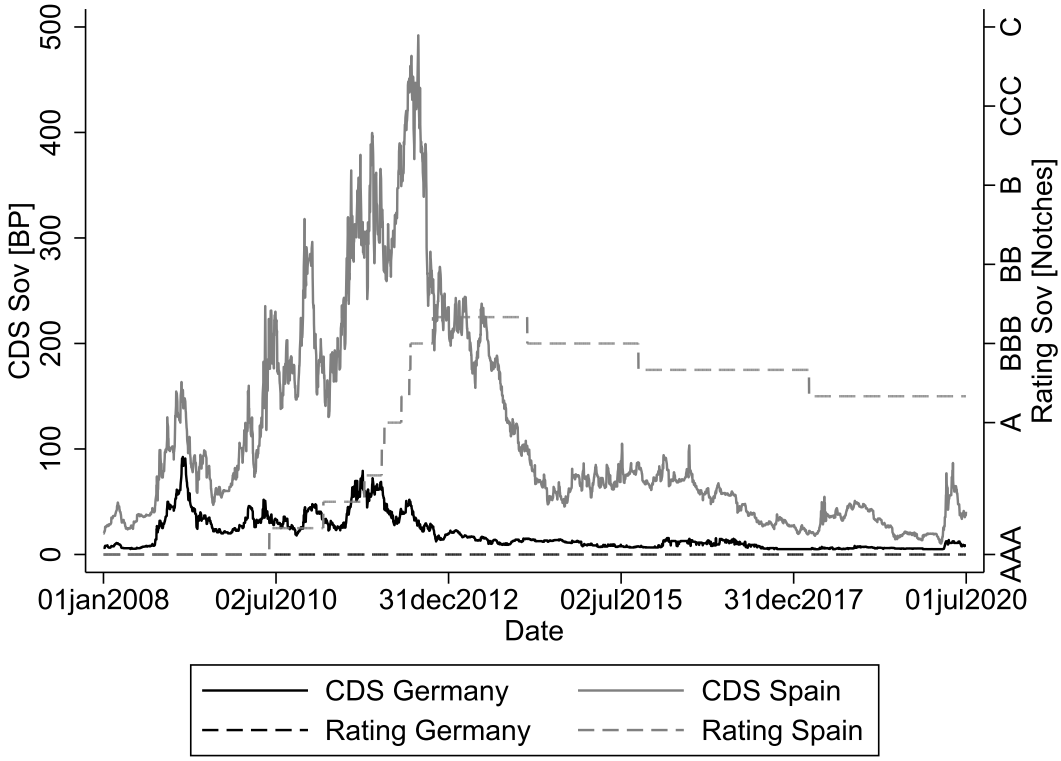
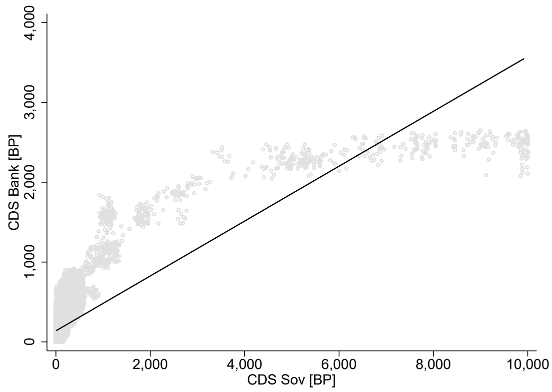
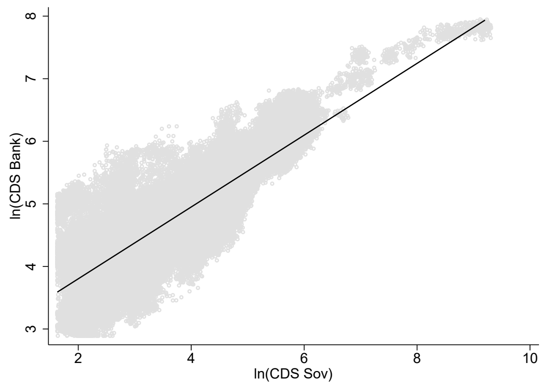


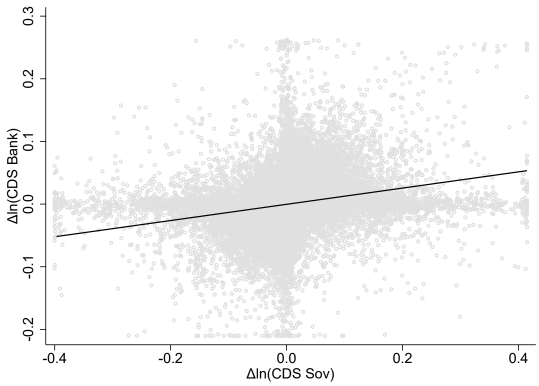
Figure 2. ***Risk comparison between Germany and Spain.*** *Evolution of daily sovereign CDS (left scale) and issuer credit ratings (right scale) between 01 Jan. 2008 and 30 Jun. 2020.*



(a) *CDS levels*

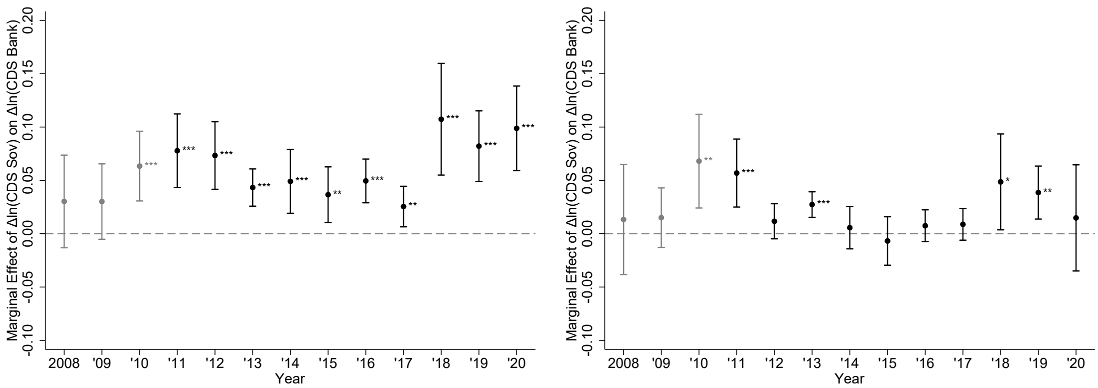


(b) *Logarithmic CDS*



(c) *First differencs of logarithmic CDS*

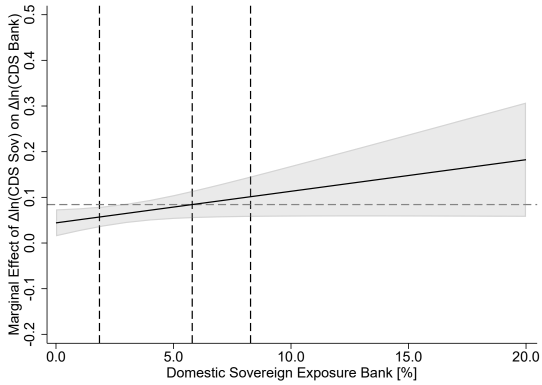
Figure 3. ***Scatter plots of daily average sovereign and bank CDS.*** *Co-movement between bank CDS (vertical axis) and domestic sovereign CDS (horizontal axis) using (a) CDS levels, (b) the natural logarithm of CDS levels and (c) first differences of logarithmic CDS.*



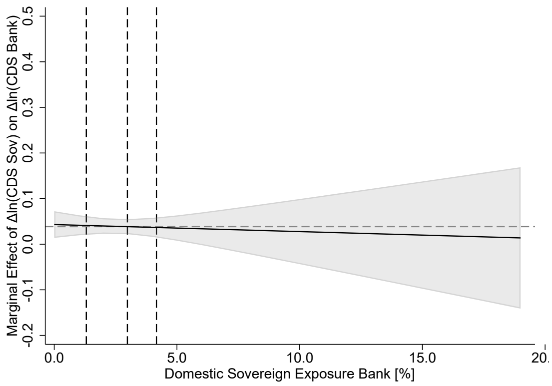
(a) *Direct macroeconomic control variables*

(b) *Daily time fixed effects*

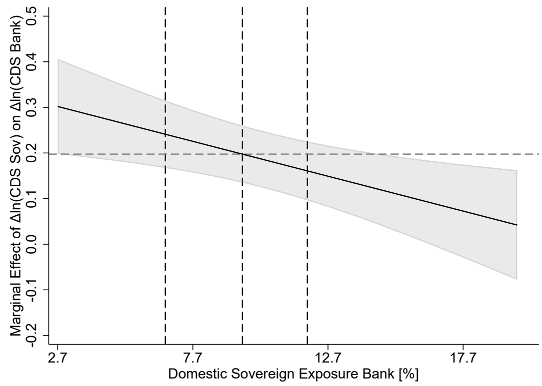
Figure 4. ***Coefficient plots of sovereign and bank CDS by years.*** *Calculations are based on equation 1 including 90% confidence intervals using (a) direct macroeconomic control variables and (b) daily time fixed effects to control for systematic effects. For gray coefficients, no sovereign exposures are available. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.*



(a) *Europe—Full*

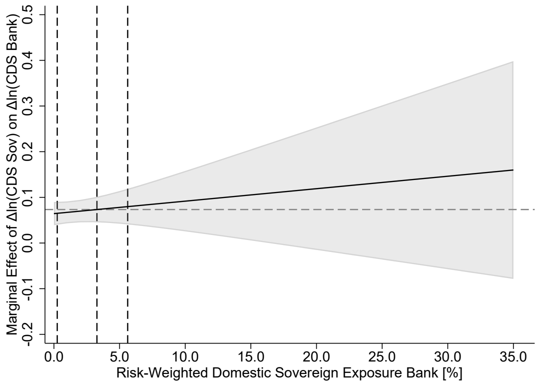


(b) *Europe—Core*

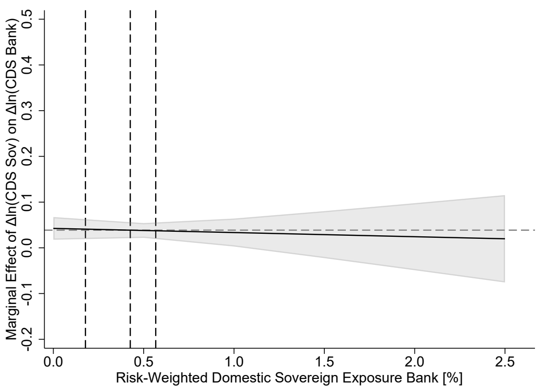


(c) *Europe—GIIPS*

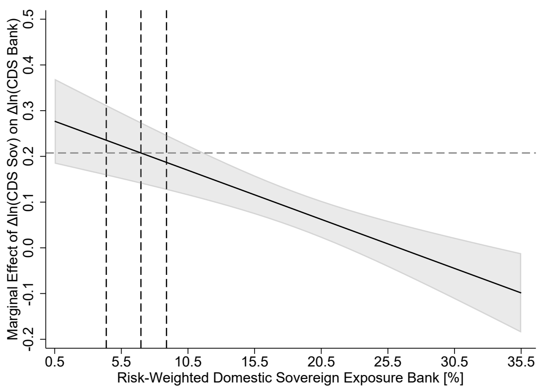
Figure 5. ***Margin plots of banks' domestic sovereign exposures.*** *Marginal effects of sovereign CDS on bank CDS at different percentiles of banks' domestic sovereign exposures scaled by total assets for (a) the full sample of European banks as well as the (b) core and (c) GIIPS sub-samples. Estimations are based on table 7 including 90% confidence intervals. The horizontal dashed gray line shows the average co-movement between sovereign and bank CDS estimated at means. The vertical dashed black lines show the mean as well as 25% and 75% percentiles of banks' domestic sovereign exposures and estimations range from its minimum to maximum.*



(a) *Europe—Full*

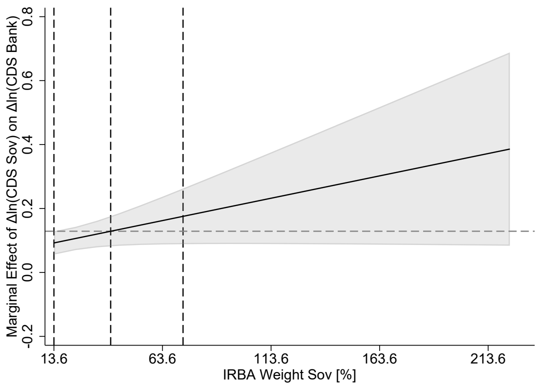


(b) *Europe—Core*

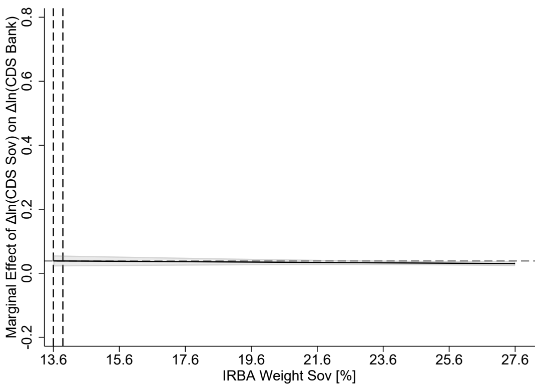


(c) *Europe—GIIPS*

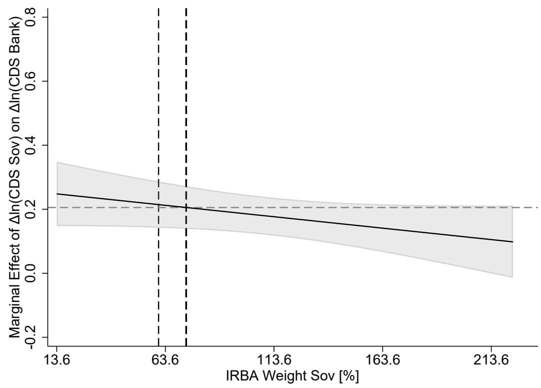
Figure 6. ***Margin plots of banks' risk-weighted domestic sovereign exposures.*** *Marginal effects of sovereign CDS on bank CDS at different percentiles of banks' risk-weighted domestic sovereign exposures scaled by total assets for (a) the full sample of European banks as well as the (b) core and (c) GIIPS sub-samples. Estimations are based on table 7 including 90% confidence intervals. The horizontal dashed gray line shows the average co-movement between sovereign and bank CDS estimated at means. The vertical dashed black lines show the mean as well as 25% and 75% percentiles of banks' risk-weighted domestic sovereign exposures and estimations range from its minimum to maximum.*



(a) *Europe—Full*



(b) *Europe—Core*



(c) *Europe—GIIPS*

Figure 7. ***Margin plots of sovereign risk weights.*** *Marginal effects of sovereign CDS on bank CDS at different percentiles of the domestic sovereign's IRBA-CR weight for (a) the full sample of European banks as well as the (b) core and (c) GIIPS sub-samples. Estimations are based on table 9 including 90% confidence intervals. The horizontal dashed gray line shows the average co-movement between sovereign and bank CDS estimated at means. The vertical dashed black lines show the mean as well as 25% and 75% percentiles of the domestic sovereign's IRBA-CR weight and estimations range from its minimum to maximum.*

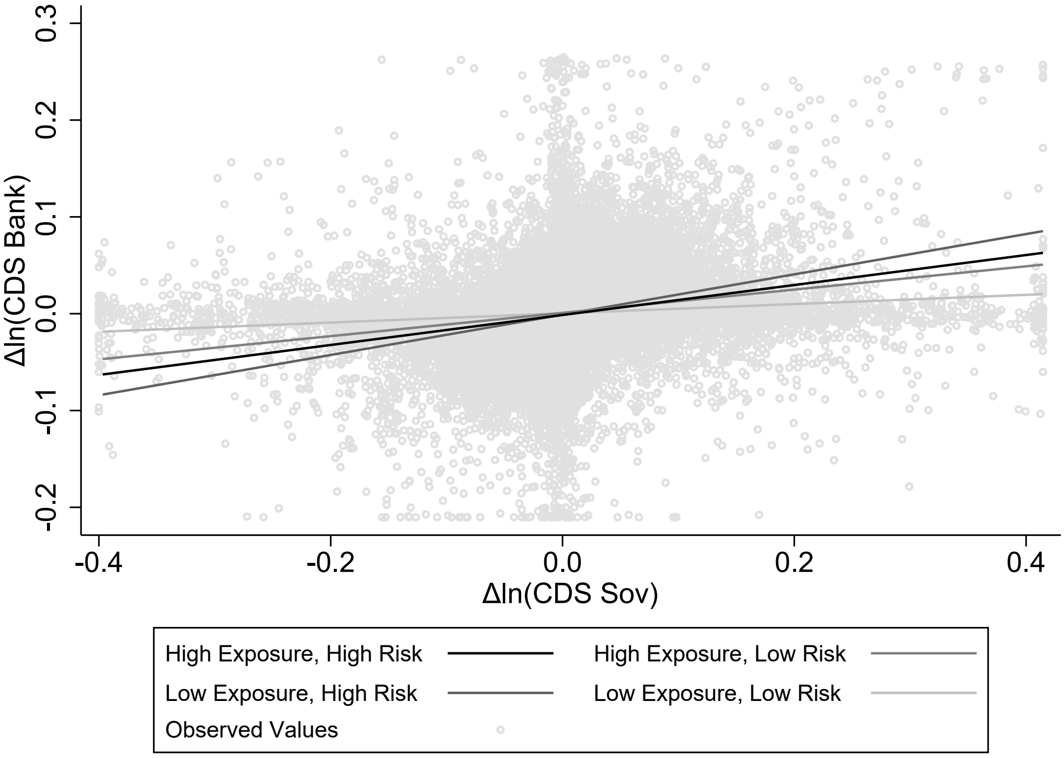
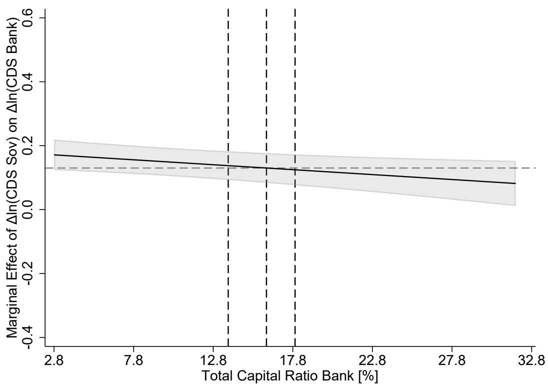
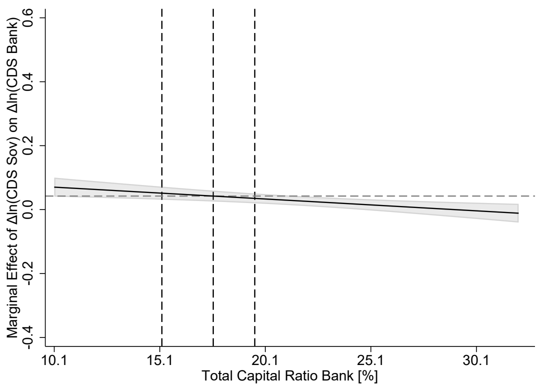


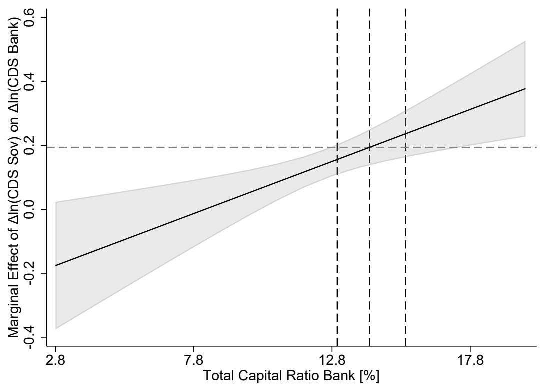
Figure 8. ***Slope estimations for exposure size and sovereign risk.*** *Scatter plot of daily changes in logarithmic sovereign and bank CDS. Estimations are based on table 9 including four subgroups. Banks with (1) a high size of domestic sovereign exposures and high sovereign risk (solid black line), (2) a low size of domestic sovereign exposures and high sovereign risk (solid dark gray line), (3) a high size of domestic sovereign exposures and low sovereign risk (solid gray line) and (4) a low size of domestic sovereign exposures and low sovereign risk (solid light gray line). Low and high values represent the 25% and 75% percentiles of the respective interaction variable.*



(a) *Europe—Full*



(b) *Europe—Core*



(c) *Europe—GIIPS*

Figure 9. ***Margins plots of bank capitalization.*** *Marginal effects of sovereign CDS on bank CDS at different percentiles of banks' total capital ratios for (a) the full sample of European banks as well as the (b) core and (c) GIIPS sub-samples. Estimations are based on table 11 including 90% confidence intervals. The horizontal dashed gray line shows the average co-movement between sovereign and bank CDS estimated at means. The vertical dashed black lines show the mean as well as 25% and 75% percentiles of banks' total capital ratios and estimations range from its minimum to maximum.*

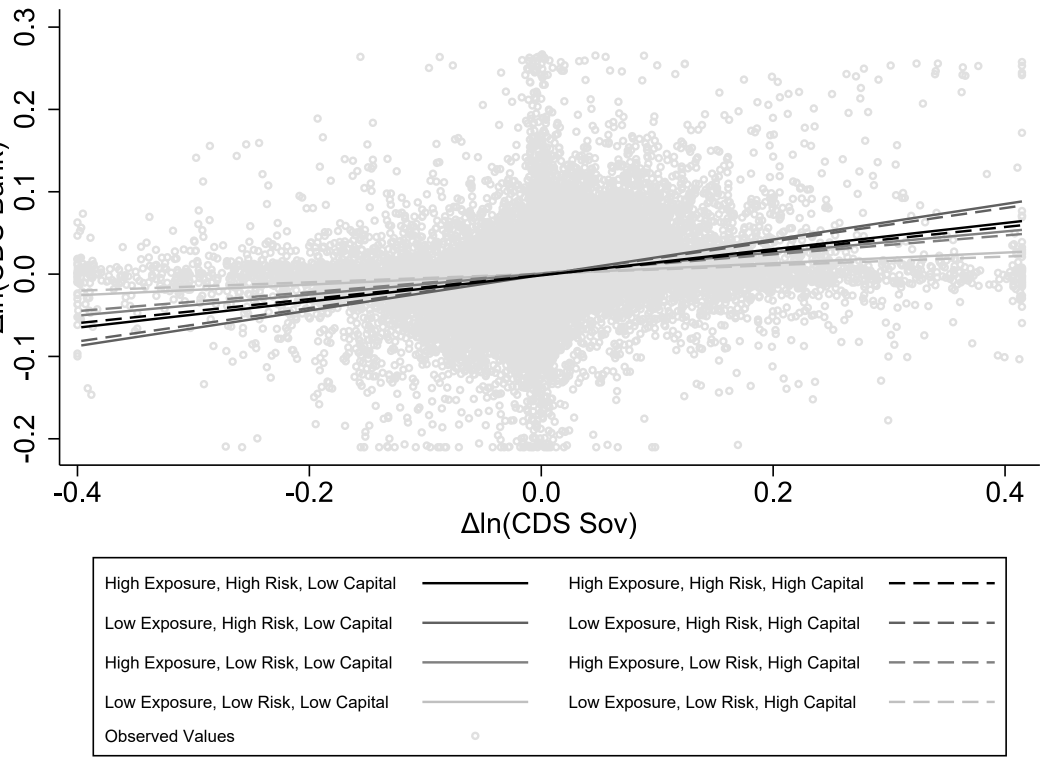
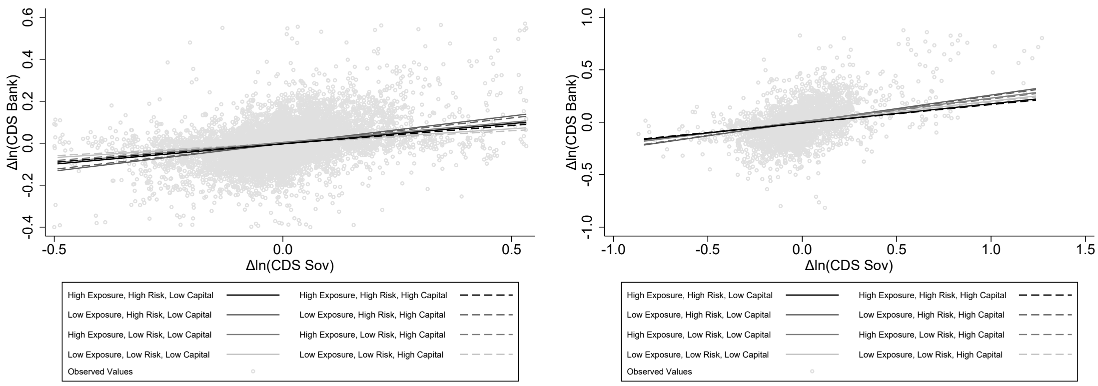


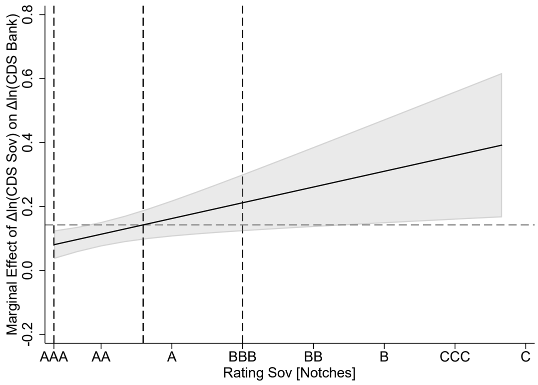
Figure 10. ***Slope estimations for exposure size, sovereign risk and capitalization.*** *Scatter plot of daily changes in logarithmic sovereign and bank CDS. Estimations are based on table 11 including eight subgroups. Banks with low capital and (1) a high size of domestic sovereign exposures and high sovereign risk (solid black line), (2) a low size of domestic sovereign exposures and high sovereign risk (solid dark gray line), (3) a high size of domestic sovereign exposures and low sovereign risk (solid gray line) and (4) a low size of domestic sovereign exposures and low sovereign risk (solid light gray line). Analogous, groups (5) to (8) cover banks with high capital by the dashed lines. Low and high values represent the 25% and 75% percentiles of the respective interaction variable.*



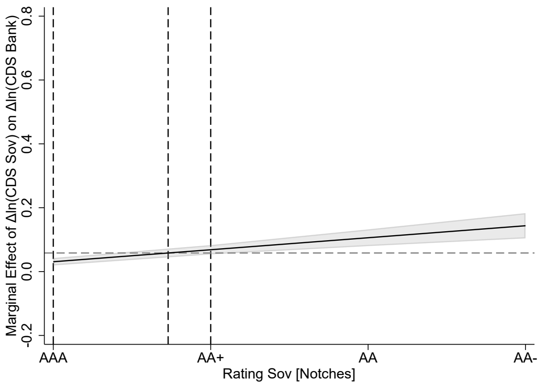
(a) *Weekly observations*

(b) *Monthly observations*

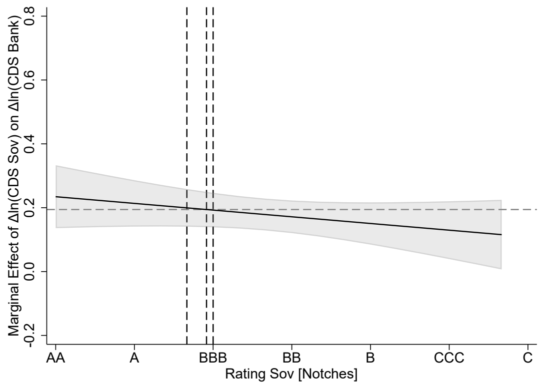
Figure 11. ***Slope estimations at lower observation frequencies.*** *Scatter plots of changes in logarithmic sovereign and bank CDS on (a) weekly and (b) monthly observations. Estimations are based on tables 14 and 15 including eight subgroups. Banks with low capital and (1) a high size of domestic sovereign exposures and high sovereign risk (solid black line), (2) a low size of domestic sovereign exposures and high sovereign risk (solid dark gray line), (3) a high size of domestic sovereign exposures and low sovereign risk (solid gray line) and (4) a low size of domestic sovereign exposures and low sovereign risk (solid light gray line). Analogous, groups (5) to (8) cover banks with high capital by the dashed lines. Low and high values represent the 25% and 75% percentiles of the respective interaction variable.*



(a) *Europe—Full*

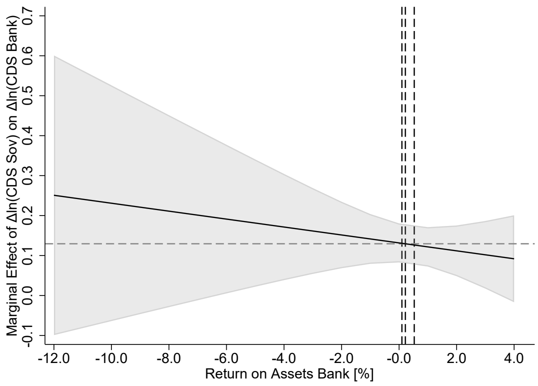


(b) *Europe—Core*

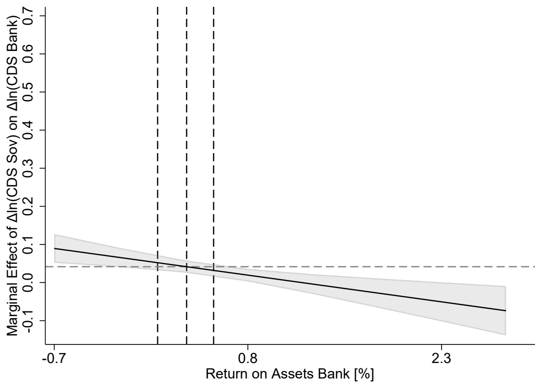


(c) *Europe—GIIPS*

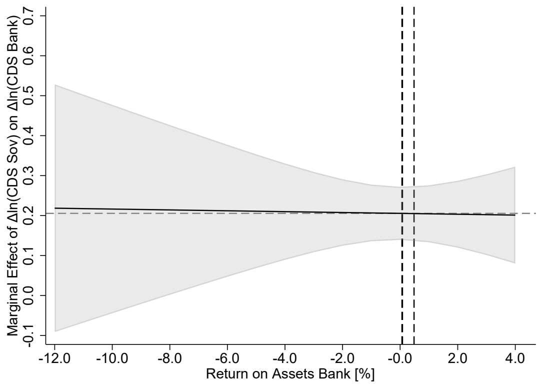
Figure 12. ***Robustness test: Margin plots of sovereign ratings.*** *Marginal effects of sovereign CDS on bank CDS at different percentiles of the domestic sovereign's issuer credit rating for (a) the full sample of European banks as well as the (b) core and (c) GIIPS sub-samples. Estimations are based on table 16 including 90% confidence intervals. The horizontal dashed gray line shows the average co-movement between sovereign and bank CDS estimated at means. The vertical dashed black lines show the mean as well as 25% and 75% percentiles of the domestic sovereign's issuer credit rating and estimations range from its minimum to maximum.*



(a) *Europe—Full*



(b) *Europe—Core*



(c) *Europe—GIIPS*

Figure 13. ***Robustness test: Margin plots of banks' ROA.*** *Marginal effect of sovereign CDS on bank CDS at different percentiles of banks' return on assets for (a) the full sample of European banks as well as the (b) core and (c) GIIPS sub-samples. Estimations are based on table 17 including 90% confidence intervals. The horizontal dashed gray line shows the average co-movement between sovereign and bank CDS estimated at means. The vertical dashed black lines show the mean as well as 25% and 75% percentiles of banks' return on assets and estimations range from its minimum to maximum.*

Tables

Table 1. ***Regulatory requirements for sovereign debt.*** *Differentiation between requirements for credit, liquidity and concentration risks of third-country and privileges for EU sovereign debt. Ratings are mapped to credit quality steps based on art. 136 European Parliament and Council (2013b) and Joint Committee of the European Supervisory Authorities (2014). ECAI stands for External Credit Assessment Institution. HQLA are high quality liquid assets. RSF is the required amount of stable funding.*

	Credit Risks			Liquidity Risks			Concentration Risks
	Banking Book	Trading Book	Leverage Ratio	Liquidity Coverage Ratio		Net Stable Funding Ratio	
ECAI Rating	Risk Weight	Specific Risk Capital Charge	Exposure Measure	HQLA	Haircut	RSF Factor	Large Exposures Limit
AAA to AA-	0.00%	0.00%	Inclusion	Level 1	0.00%	0.00%	$25\% \cdot Capital$
A+ to A-	20.00%	0.25%/1.00%/1.60%	Inclusion	Level 2A	15.00%	15.00%	$25\% \cdot Capital$
BBB+ to BBB-	50.00%	0.25%/1.00%/1.60%	Inclusion	Not eligible	100.00%	50.00%/85.00%	$25\% \cdot Capital$
BB+ to B-	100.00%	8.00%	Inclusion	Not eligible	100.00%	50.00%/85.00%	$25\% \cdot Capital$
CCC+ to D	150.00%	12.00%	Inclusion	Not eligible	100.00%	50.00%/85.00%	$25\% \cdot Capital$
EU Privilege:	0.00%	0.00%	Inclusion	Level 1	0.00%	0.00%	No limit

Table 2. ***EBA investigations.*** *Overview of EBA investigations since the first publication of bank-level sovereign exposures. Reporting date refers to the closing date of the balance sheet. Publication date is the date on which the EBA made the data available to the public. Stress test 2016 covers the same reporting date as transparency exercise 2016 and is thus redundant. In stress test 2018, the EBA did not disclose sovereign exposures. The data is available at European Banking Authority (2020).*

EBA Investigation	Reporting Date(s)			Publication Date
Stress Test 2011	2010-12-31			2011-07-15
Capital Exercise 2011	2011-12-31	and	2012-06-30	2012-10-03
Transparency Exercise 2013	2012-12-31	and	2013-06-30	2013-12-16
Stress Test 2014	2013-12-31			2014-10-26
Transparency Exercise 2015	2014-12-31	and	2015-06-30	2015-11-24
Stress Test 2016	2015-12-31			2016-07-29
Transparency Exercise 2016	2015-12-31	and	2016-06-30	2016-12-02
Transparency Exercise 2017	2016-12-31	and	2017-06-30	2017-11-24
Stress Test 2018	2017-12-31			2018-11-02
Transparency Exercise 2018	2017-12-31	and	2018-06-30	2018-12-14
Transparency Exercise 2019	2018-12-31	and	2019-06-30	2019-11-29
Transparency Exercise 2020	2019-12-31			2020-06-08

Table 3. ***Sample distribution by banks, grouped by countries.*** *The full sample covers 56,612 daily observations for 41 banks from 13 European countries from 15 Jul. 2011 to 30 Jun. 2020.*

	Country	Bank	Obs. N	Obs. (%)
Europe—Core	Austria	BAWAG PSK AG	577	(1.02)
	Austria	Erste Group Bank AG	2,085	(3.68)
	Austria	Raiffeisen Bank International AG	1,882	(3.32)
	Belgium	KBC Groep NV	1,922	(3.40)
	Denmark	Danske Bank AS	1,673	(2.96)
	France	BNP Paribas SA	1,890	(3.34)
	France	Credit Agricole SA	1,893	(3.34)
	France	Societe Generale SA	1,892	(3.34)
	Germany	Commerzbank AG	1,747	(3.09)
	Germany	Deutsche Bank AG	1,753	(3.10)
	Germany	Landesbank Berlin AG	6	(0.01)
	Netherlands	ABN Amro Bank NV	153	(0.27)
	Netherlands	ING Groep NV	1,694	(2.99)
	Sweden	Nordea Bank Abp	1,303	(2.30)
	Sweden	Skandinaviska Enskilda Banken AB	1,653	(2.92)
	Sweden	Svenska Handelsbanken AB	1,689	(2.98)
	Sweden	Swedbank AB	1,669	(2.95)
	UK	Barclays PLC	2,214	(3.91)
	UK	HSBC Holdings PLC	1,439	(2.54)
	UK	Lloyds Banking Group PLC	2,216	(3.91)
	UK	Standard Chartered PLC	637	(1.13)
	Sub-Total	21	31,987	(56.50)
Europe—GIIPS	Greece	Alpha Bank SA	362	(0.64)
	Greece	Eurobank Ergasias SA	151	(0.27)
	Greece	National Bank of Greece SA	153	(0.27)
	Ireland	Bank of Ireland Group PLC	195	(0.34)
	Ireland	Permanent TSB Group Holdings PLC	119	(0.21)
	Italy	Banca Monte dei Paschi di Siena SpA	2,191	(3.87)
	Italy	Banca Popolare di Milano Scarl	568	(1.00)
	Italy	Banco BPM SpA	395	(0.70)
	Italy	Intesa Sanpaolo SpA	2,298	(4.06)
	Italy	Mediobanca SpA	1,458	(2.58)
	Italy	UniCredit SpA	2,306	(4.07)
	Italy	Unione di Banche Italiane SpA	1,571	(2.78)
	Portugal	Banco Comercial Portugues SA	2,078	(3.67)
	Portugal	Espirito Santo Financial Group SA	11	(0.02)
	Spain	Banco Bilbao Vizcaya Argentaria SA	2,292	(4.05)
	Spain	Banco Pastor SA	251	(0.44)
	Spain	Banco Popular Espanol SA	1,751	(3.09)
	Spain	Banco Santander SA	2,180	(3.85)
	Spain	Banco de Sabadell SA	2,292	(4.05)
	Spain	Bankinter SA	2,003	(3.54)
	Sub-Total	20	24,625	(43.50)
Europe—Full		41	56,612	(100.00)

Table 4. ***Descriptive statistics.*** *The full sample covers 56,612 daily observations for 41 banks from 13 European countries between 15 Jul. 2011 and 30 Jun. 2020. Numbers for core European countries and GIIPS are given in brackets.* $CDS^{Sov}_{j,t}$ *and* $CDS^{Bank}_{i,j,t}$ *are five-year sovereign and bank CDS.* $Rating^{Sov}_{j,t}$ *and* $Rating^{Bank}_{i,j,t}$ *are the second-best issuer credit ratings from Moody's, S&P and Fitch converted to integers such that the best rating is equal to 1 and worse ratings are ascending.* $IRBAWeight^{Sov}_{j,t}$ *is the sovereign's hypothetical IRBA-CR risk weight according to equation 8.* $CapitalRatio^{Bank}_{i,j,t}$ *is a bank's total capital ratio.* $ROA^{Bank}_{i,j,t}$ *is a bank's return on assets.* $ShReturn^{Bank}_{i,j,t}$ *is a bank's daily share return.* $TotalAssets^{Bank}_{i,j,t}$ *are a bank's total assets and* $Exposure^{Sov}_{i,j,t}$ *as well as* $RWExposure^{Sov}_{i,j,t}$ *the share of un- and risk-weighted domestic sovereign exposures.* $CDSIndex^{Banks}_{t}$ *and* $CDSIndex^{Sovs}_{t}$ *are Europe-wide banking and sovereign CDS indices.* $EONIA_t$ *is the Euro OverNight Index Average.* $EURIBOR^{12M}_t$ *is the 12-months European Interbank Offered Rate.* $TermSpread^{ISDA}_t$ *is the difference between the 30-year and 1-year ISDA IRS rate.* $\Delta\ln(EqIndex^{Level}_{j,t})$ *and* $\Delta\ln(EqIndex^{Vola}_{j,t})$ *are log-returns on the level and volatility of country-specific equity indices.*

Variable	Mean	Std. Dev.	Min.	P^{25}	P^{50}	P^{75}	Max.
Sovereign Level							
$CDS^{Sov}_{j,t}$ [BP]	124.44	585.15	5.10	15.23	36.17	95.67	9,923.82
(Europe—Core)	*(26.86)*	*(29.86)*	*(5.10)*	*(9.79)*	*(17.61)*	*(30.11)*	*(341.98)*
(Europe—GIIPS)	*(251.20)*	*(870.39)*	*(10.44)*	*(61.66)*	*(97.61)*	*(202.28)*	*(9,923.82)*
$\Delta\ln(CDS^{Sov}_{j,t})$	0.00	0.06	-0.40	-0.01	0.00	0.01	0.41
$Rating^{Sov}_{j,t}$ [Notches]	4.78	3.86	1.00	1.00	3.00	9.00	20.00
(Europe—Core)	*1.73*	*0.88*	*1.00*	*1.00*	*1.00*	*2.00*	*4.00*
(Europe—GIIPS)	*8.75*	*2.34*	*3.00*	*8.00*	*9.00*	*9.00*	*20.00*
$IRBAWeight^{Sov}_{j,t}$ [%]	39.74	36.07	13.61	13.61	13.61	73.08	230.92
(Europe—Core)	*13.90*	*2.02*	*13.61*	*13.61*	*13.61*	*13.61*	*27.94*
(Europe—GIIPS)	*73.31*	*31.48*	*13.61*	*60.49*	*73.08*	*73.08*	*230.92*
Bank Level							
$CDS^{Bank}_{i,j,t}$ [BP]	181.52	248.19	18.01	64.33	116.62	197.57	2,576.79
(Europe—Core)	*(103.82)*	*(74.23)*	*(18.01)*	*(51.20)*	*(77.72)*	*(142.16)*	*(508.40)*
(Europe—GIIPS)	*(282.46)*	*(341.21)*	*(21.10)*	*(108.03)*	*(169.53)*	*(340.34)*	*(2,576.79)*
$\Delta\ln(CDS^{Bank}_{i,j,t})$	0.00	0.03	-0.21	-0.01	0.00	0.01	0.25
$Rating^{Bank}_{i,j,t}$ [Notches]	7.96	3.05	3.00	6.00	8.00	9.00	22.00
(Europe—Core)	*(6.17)*	*(1.47)*	*(3.00)*	*(5.00)*	*(6.00)*	*(7.00)*	*(9.00)*
(Europe—GIIPS)	*(10.29)*	*(2.99)*	*(3.00)*	*(8.00)*	*(10.00)*	*(12.00)*	*(22.00)*
$\Delta Rating^{Bank}_{i,j,t}$ [Notches]	0.00	-3.00	-3.00	0.00	0.00	0.00	7.00
$CapitalRatio^{Bank}_{i,j,t}$ [%]	16.10	3.70	2.76	13.70	15.50	17.90	32.45
(Europe—Core)	*(17.63)*	*(3.87)*	*(10.10)*	*(15.20)*	*(17.24)*	*(19.60)*	*(32.45)*
(Europe—GIIPS)	*(14.12)*	*(2.25)*	*(2.76)*	*(12.95)*	*(14.20)*	*(15.42)*	*(19.84)*
$ROA^{Bank}_{i,j,t}$ [%]	0.20	0.83	-12.02	0.08	0.29	0.51	4.39
$ShPrice^{Bank}_{i,j,t}$ [€]	30.84	148.45	0.09	3.02	8.09	18.60	4,037.25
$\Delta\ln(ShPrice^{Bank}_{i,j,t})$	0.00	0.03	-1.20	-0.01	0.00	0.01	0.36
$ShReturn^{Bank}_{i,j,t}$ [%]	0.02	2.66	-69.83	-1.15	0.00	1.17	43.14
$TotalAssets^{Bank}_{i,j,t}$ [B€]	672.61	614.68	23.60	161.46	463.67	1,150.67	2,422.08
$Exposure^{Sov}_{i,j,t}$ [%]	5.85	4.57	0.05	1.90	4.87	8.33	20.14
(Europe—Core)	*(3.03)*	*(2.49)*	*(0.05)*	*(1.36)*	*(2.06)*	*(4.21)*	*(19.27)*
(Europe—GIIPS)	*(9.51)*	*(4.04)*	*(2.67)*	*(6.65)*	*(8.66)*	*(11.91)*	*(20.14)*
$RWExposure^{Sov}_{i,j,t}$ [%]	3.28	4.30	0.01	0.26	0.82	5.63	35.95
Control Variables							
$CDSIndex^{Banks}_{t}$ [BP]	185.98	125.47	41.12	98.18	132.72	258.00	552.18
$\Delta\ln(CDSIndex^{Banks}_{t})$	0.00	0.06	-0.71	-0.01	0.00	0.01	0.71
$CDSIndex^{Sovs}_{t}$ [BP]	80.54	94.41	12.64	27.04	44.18	83.50	431.70
$\Delta\ln(CDSIndex^{Sovs}_{t})$	0.00	0.06	-0.78	-0.02	0.00	0.01	0.60
$EONIA_t$ [PP]	-0.08	0.35	-0.47	-0.36	-0.14	0.09	1.49
$\Delta EONIA_t$ [PP]	0.00	0.04	-0.49	0.00	0.00	0.00	0.49
$EURIBOR^{12M}_t$ [PP]	0.33	0.65	-0.40	-0.14	0.11	0.55	2.19
$\Delta EURIBOR^{12M}_t$ [PP]	0.00	0.01	-0.08	0.00	0.00	0.00	0.08
$TermSpread^{ISDA}_t$ [PP]	1.64	0.45	0.28	1.41	1.72	1.90	2.50
$\Delta TermSpread^{ISDA}_t$ [PP]	0.00	0.04	-0.23	-0.02	0.00	0.02	0.22
$EqIndex^{Level}_{j,t}$	7,948	6,553	263	2,904	6,648	10,422	25,478
$\Delta\ln(EqIndex^{Level}_{j,t})$	0.00	0.17	-1.90	-0.07	0.00	0.08	1.98
$EqIndex^{Vola}_{j,t}$	21	8	0	15	18	24	96
$\Delta\ln(EqIndex^{Vola}_{j,t})$	0.00	3.16	-227.27	-1.38	-0.07	1.13	115.25

Table 5. ***Correlations between sovereign and bank CDS.*** *Correlation coefficients are calculated on daily changes of logarithmic sovereign and bank CDS ($\Delta \ln(CDS^{Sov}_{j,t})$ and $\Delta \ln(CDS^{Bank}_{i,j,t})$) over the full sample as well as the core EU and GIIPS sub-samples. Moreover, median splits of bank's unweighted ($Exposure^{Sov}_{i,j,t}$) and risk-weighted domestic sovereign exposures ($RWExposure^{Sov}_{i,j,t}$) scaled by total assets as well as their capitalization ($CapitalRatio^{Bank}_{i,j,t}$) is applied. The number of observations is given in brackets.*

	Europe—Full		Europe—Core		Europe—GIIPS	
	Correl.	(Obs.)	Correl.	(Obs.)	Correl.	(Obs.)
Full Sample	22.43%	(56,612)	14.65%	(31,987)	40.63%	(24,625)
$Exposure^{Sov}_{i,j,t}$						
$\leq$ Median	16.41%	(28,364)	14.12%	(16,046)	42.91%	(12,445)
$>$ Median	33.56%	(28,248)	15.84%	(15,941)	37.90%	(12,180)
$RWExposure^{Sov}_{i,j,t}$						
$\leq$ Median	15.30%	(28,312)	14.12%	(16,046)	43.11%	(12,389)
$>$ Median	35.76%	(28,300)	15.84%	(15,941)	37.16%	(12,236)
$CapitalRatio^{Bank}_{i,j,t}$						
$\leq$ Median	32.24%	(28,362)	21.28%	(16,040)	41.50%	(12,328)
$>$ Median	15.29%	(28,250)	9.37%	(15,947)	40.07%	(12,297)

Table 6. ***Sovereign-bank nexus benchmark.*** *Regression results for equation 1.* $\Delta\ln(CDS^{Bank}_{i,j,t})$ *and* $\Delta\ln(CDS^{Sov}_{j,t})$ *denote daily changes in logarithmic bank and sovereign CDS. Control variables cover a bank's credit rating, Europe-wide CDS indices, the EONIA, EURIBOR, term spread and country-specific equity indices. Standard errors (in parentheses) are clustered at the bank level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.*

	$\Delta\ln(CDS^{Bank}_{i,j,t})$					
	Europe—Full		Europe—Core		Europe—GIIPS	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\ln(CDS^{Sov}_{j,t})$	0.0692***	0.0189**	0.0396***	0.0055	0.2006***	0.0732***
	(0.0151)	(0.0071)	(0.0094)	(0.0054)	(0.0363)	(0.0163)
$\Delta Rating^{Bank}_{i,j,t}$	-0.0015	-0.0015	-0.0062**	-0.0029	0.0001	-0.0014
	(0.0014)	(0.0012)	(0.0023)	(0.0018)	(0.0018)	(0.0015)
$\Delta\ln(CDSIndex^{Banks}_{t})$	0.0546***		0.0584***		0.0431***	
	(0.0042)		(0.0062)		(0.0047)	
$\Delta\ln(CDSIndex^{Sovs}_{t})$	0.0501***		0.0521***		0.0322***	
	(0.0045)		(0.0063)		(0.0048)	
$\Delta EONIA_t$	0.0079**		0.0108**		0.0017	
	(0.0029)		(0.0049)		(0.0014)	
$\Delta EURIBOR^{12M}_t$	-0.0329		-0.0545		0.0048	
	(0.0321)		(0.0503)		(0.0285)	
$\Delta TermSpread^{ISDA}_t$	-0.0764***		-0.0882***		-0.0432***	
	(0.0079)		(0.0108)		(0.0083)	
$\Delta\ln(EqIndex^{Level}_{j,t})$	-0.0547***		-0.0593***		-0.0352***	
	(0.0074)		(0.0106)		(0.0066)	
$\Delta\ln(EqIndex^{Vola}_{j,t})$	0.0009***		0.0007***		0.0016***	
	(0.0003)		(0.0002)		(0.0004)	
Entity Fixed Effects	Bank level	Bank level	Bank level	Bank level	Bank level	Bank level
Time Fixed Effects	No	Daily	No	Daily	No	Daily
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	56,612	56,612	31,987	31,987	24,625	24,625
Banks	41	41	21	21	20	20
Adjusted R^2	19.4%	39.8%	18.4%	41.5%	23.7%	41.3%

Table 7. ***Impact of banks' domestic sovereign exposures.*** *Regression results for equation 2.* $\Delta\ln(CDS^{Bank}_{i,j,t})$ *and* $\Delta\ln(CDS^{Sov}_{j,t})$ *denote daily changes in logarithmic bank and sovereign CDS.* $Exposure^{Sov}_{i,j,t}$ *is a bank's domestic sovereign exposure scaled by total assets. Control variables cover a bank's credit rating, Europe-wide CDS indices, the EONIA, EURIBOR, term spread and country-specific equity indices. Standard errors (in parentheses) are clustered at the bank level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.*

	$\Delta\ln(CDS^{Bank}_{i,j,t})$					
	Europe—Full		Europe—Core		Europe—GIIPS	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\ln(CDS^{Sov}_{j,t})$	0.0438**	0.0308**	0.0432**	0.0254**	0.3429***	0.2624***
	(0.0177)	(0.0117)	(0.0172)	(0.0115)	(0.0748)	(0.0556)
$\Delta\ln(CDS^{Sov}_{j,t}) \cdot Exposure^{Sov}_{i,j,t}$	0.0069	-0.0035	-0.0015	-0.0087	-0.0153**	-0.0208***
	(0.0043)	(0.0036)	(0.0054)	(0.0054)	(0.0064)	(0.0064)
$Exposure^{Sov}_{i,j,t}$	-0.0000	-0.0000	-0.0001	-0.0001	0.0000	0.0000
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
$\Delta Rating^{Bank}_{i,j,t}$	-0.0016	-0.0014	-0.0062**	-0.0028	0.0001	-0.0014
	(0.0014)	(0.0012)	(0.0023)	(0.0018)	(0.0019)	(0.0015)
$\Delta\ln(CDSIndex^{Banks}_{t})$	0.0535***		0.0584***		0.0437***	
	(0.0043)		(0.0062)		(0.0047)	
$\Delta\ln(CDSIndex^{Sovs}_{t})$	0.0479***		0.0522***		0.0321***	
	(0.0045)		(0.0061)		(0.0044)	
$\Delta EONIA_t$	0.0074**		0.0107**		0.0024	
	(0.0029)		(0.0049)		(0.0015)	
$\Delta EURIBOR^{12M}_t$	-0.0315		-0.0548		0.0094	
	(0.0323)		(0.0502)		(0.0275)	
$\Delta TermSpread^{ISDA}_t$	-0.0740***		-0.0883***		-0.0436***	
	(0.0079)		(0.0107)		(0.0089)	
$\Delta\ln(EqIndex^{Level}_{j,t})$	-0.0532***		-0.0593***		-0.0355***	
	(0.0076)		(0.0106)		(0.0066)	
$\Delta\ln(EqIndex^{Vola}_{j,t})$	0.0009***		0.0007***		0.0017***	
	(0.0003)		(0.0002)		(0.0004)	
Entity Fixed Effects	Bank level	Bank level	Bank level	Bank level	Bank level	Bank level
Time Fixed Effects	No	Daily	No	Daily	No	Daily
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	56,612	56,612	31,987	31,987	24,625	24,625
Banks	41	41	21	21	20	20
Adjusted R^2	19.6%	39.8%	18.4%	41.6%	24.2%	42.3%

Table 8. ***Impact of banks' risk-weighted domestic sovereign exposures.*** *Regression results for equation 4.* $\Delta\ln(CDS^{Bank}_{i,j,t})$ *and* $\Delta\ln(CDS^{Sov}_{j,t})$ *denote daily changes in logarithmic bank and sovereign CDS.* $RWExposure^{Sov}_{j,t}$ *is a bank's risk-weighted domestic sovereign exposure (IRBA-CR) scaled by total assets. Control variables cover a bank's credit rating, Europe-wide CDS indices, the EONIA, EURIBOR, term spread and country-specific equity indices. Standard errors (in parentheses) are clustered at the bank level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.*

	$\Delta\ln(CDS^{Bank}_{i,j,t})$					
	Europe—Full		Europe—Core		Europe—GIIPS	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\ln(CDS^{Sov}_{j,t})$	0.0644***	0.0232***	0.0426***	0.0209***	0.2824***	0.1684***
	(0.0151)	(0.0071)	(0.0145)	(0.0072)	(0.0550)	(0.0306)
$\Delta\ln(CDS^{Sov}_{j,t}) \cdot RWExposure^{Sov}_{i,j,t}$	0.0027	-0.0027	-0.0091	-0.0473**	-0.0107***	-0.0104***
	(0.0042)	(0.0023)	(0.0263)	(0.0194)	(0.0027)	(0.0031)
$RWExposure^{Sov}_{i,j,t}$	-0.0002***	-0.0000	-0.0003	-0.0001	-0.0002***	-0.0000
	(0.0001)	(0.0001)	(0.0006)	(0.0007)	(0.0000)	(0.0001)
$\Delta Rating^{Bank}_{i,j,t}$	-0.0016	-0.0014	-0.0062**	-0.0028	-0.0000	-0.0015
	(0.0014)	(0.0012)	(0.0023)	(0.0018)	(0.0018)	(0.0015)
$\Delta\ln(CDSIndex^{Banks}_t)$	0.0542***		0.0584***		0.0426***	
	(0.0043)		(0.0062)		(0.0045)	
$\Delta\ln(CDSIndex^{Sovs}_t)$	0.0495***		0.0522***		0.0304***	
	(0.0045)		(0.0061)		(0.0048)	
$\Delta EONIA_t$	0.0076**		0.0107**		0.0035**	
	(0.0029)		(0.0049)		(0.0016)	
$\Delta EURIBOR^{12M}_t$	-0.0299		-0.0545		0.0128	
	(0.0325)		(0.0503)		(0.0296)	
$\Delta TermSpread^{ISDA}_t$	-0.0757***		-0.0882***		-0.0415***	
	(0.0080)		(0.0108)		(0.0086)	
$\Delta\ln(EqIndex^{Level}_{j,t})$	-0.0541***		-0.0593***		-0.0351***	
	(0.0074)		(0.0106)		(0.0065)	
$\Delta\ln(EqIndex^{Vola}_{j,t})$	0.0009***		0.0007***		0.0016***	
	(0.0003)		(0.0002)		(0.0004)	
Entity Fixed Effects	Bank level	Bank level	Bank level	Bank level	Bank level	Bank level
Time Fixed Effects	No	Daily	No	Daily	No	Daily
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	56,612	56,612	31,987	31,987	24,625	24,625
Banks	41	41	21	21	20	20
Adjusted R^2	19.5%	39.8%	18.4%	41.6%	24.5%	41.9%

Table 9. ***Isolating the size and risk effects.*** *Regression results for equation 5. $\Delta \ln(CDS^{Bank}_{i,j,t})$ and $\Delta \ln(CDS^{Sov}_{j,t})$ denote daily changes in logarithmic bank and sovereign CDS. $Exposure^{Sov}_{i,j,t}$ is a bank's domestic sovereign exposure scaled by total assets. $IRBAWeight^{Sov}_{j,t}$ is the sovereign's hypothetical risk weight (IRBA-CR). Control variables cover a bank's credit rating, Europe-wide CDS indices, the EONIA, EURIBOR, term spread and country-specific equity indices. Standard errors (in parentheses) are clustered at the bank level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.*

	$\Delta \ln(CDS^{Bank}_{i,j,t})$					
	Europe—Full		Europe—Core		Europe—GIIPS	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln(CDS^{Sov}_{j,t})$	-0.0189	-0.0092	0.0552	0.1360	0.2965**	0.3084***
	(0.0288)	(0.0225)	(0.0406)	(0.0997)	(0.1099)	(0.0869)
$\Delta \ln(CDS^{Sov}_{j,t}) \cdot Exposure^{Sov}_{i,j,t}$	0.0158**	0.0015	-0.0028	-0.0266	-0.0041	-0.0205**
	(0.0063)	(0.0053)	(0.0125)	(0.0179)	(0.0084)	(0.0097)
$\Delta \ln(CDS^{Sov}_{j,t}) \cdot IRBAWeight^{Sov}_{j,t}$	0.0033**	0.0022*	-0.0009	-0.0081	0.0005	-0.0006
	(0.0014)	(0.0011)	(0.0017)	(0.0070)	(0.0011)	(0.0007)
$\Delta \ln(CDS^{Sov}_{j,t}) \cdot Exposure^{Sov}_{i,j,t} \cdot IRBAWeight^{Sov}_{j,t}$	-0.0003***	-0.0002**	0.0001	0.0013	-0.0001	0.0000
	(0.0001)	(0.0001)	(0.0005)	(0.0010)	(0.0001)	(0.0001)
$Exposure^{Sov}_{i,j,t}$	0.0001	0.0001	-0.0002	-0.0023***	0.0005***	0.0005***
	(0.0001)	(0.0001)	(0.0002)	(0.0003)	(0.0001)	(0.0001)
$IRBAWeight^{Sov}_{j,t}$	-0.0000	0.0000	-0.0000	-0.0011***	0.0000	0.0001***
	(0.0000)	(0.0000)	(0.0001)	(0.0001)	(0.0000)	(0.0000)
$Exposure^{Sov}_{i,j,t} \cdot IRBAWeight^{Sov}_{j,t}$	-0.0000	-0.0000	0.0000	0.0002***	-0.0000***	-0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$\Delta Rating^{Bank}_{i,j,t}$	-0.0017	-0.0014	-0.0062**	-0.0029	-0.0000	-0.0014
	(0.0013)	(0.0013)	(0.0023)	(0.0018)	(0.0018)	(0.0015)
Macroeconomic Control Variables	Yes	No	Yes	No	Yes	No
Entity Fixed Effects	Bank level	Bank level	Bank level	Bank level	Bank level	Bank level
Time Fixed Effects	No	Daily	No	Daily	No	Daily
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	56,612	56,612	31,987	31,987	24,625	24,625
Banks	41	41	21	21	20	20
Adjusted R^2	20.2%	40.0%	18.4%	41.6%	24.6%	42.4%

Table 10. ***Slope estimations for exposure size and sovereign risk.*** *Estimations are based on table 9 for different combinations of banks' sovereign exposures and sovereign risks. Corresponding risk-weighted sovereign exposures as percent of total assets are given in brackets.*

		$IRBAWeight_{j,t}^{Sov}$			
		P^{25}		P^{75}	
		Slope	(RWE)	Slope	(RWE)
$Exposure_{i,j,t}^{Sov}$	P^{25}	0.0478***	(0.2585%)	0.2082***	(1.3881%)
	P^{75}	0.1202***	(1.1334%)	0.1548***	(6.0858%)

Table 11. ***Impact of banks' financial strengths.*** *Regression results for equation 6.* $\Delta\ln(CDS^{Bank}_{i,j,t})$ *and* $\Delta\ln(CDS^{Sov}_{j,t})$ *denote daily changes in logarithmic bank and sovereign CDS.* $Exposure^{Sov}_{i,j,t}$ *is a bank's domestic sovereign exposure scaled by total assets.* $IRBAWeight^{Sov}_{j,t}$ *is the sovereign's hypothetical risk weight (IRBA-CR).* $CapitalRatio^{Bank}_{i,j,t}$ *is a bank's regulatory total capital ratio. Control variables cover a bank's credit rating, Europe-wide CDS indices, the EONIA, EURIBOR, term spread and country-specific equity indices. Standard errors (in parentheses) are clustered at the bank level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.*

	$\Delta\ln(CDS^{Bank}_{i,j,t})$					
	Europe—Full		Europe—Core		Europe—GIIPS	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\ln(CDS^{Sov}_{j,t})$	0.0459	0.015	0.1297**	0.1567	-0.1382	-0.2481
	(0.0527)	(0.0395)	(0.0599)	(0.0999)	(0.1623)	(0.2597)
$\Delta\ln(CDS^{Sov}_{j,t}) \cdot Exposure^{Sov}_{i,j,t}$	0.0141**	0.0009	-0.0068	-0.0262	-0.0086	-0.0219**
	(0.0066)	(0.0056)	(0.0127)	(0.0178)	(0.0099)	(0.0102)
$\Delta\ln(CDS^{Sov}_{j,t}) \cdot IRBAWeight^{Sov}_{j,t}$	0.0031**	0.0021*	-0.0008	-0.0074	0.0002	-0.0006
	(0.0014)	(0.0011)	(0.0016)	(0.0071)	(0.0012)	(0.0006)
$\Delta\ln(CDS^{Sov}_{j,t}) \cdot Exposure^{Sov}_{i,j,t} \cdot IRBAWeight^{Sov}_{j,t}$	-0.0003***	-0.0002**	0.0002	0.0012	-0.0001	0.0000
	(0.0001)	(0.0001)	(0.0005)	(0.0011)	(0.0001)	(0.0001)
$Exposure^{Sov}_{i,j,t}$	0.0001	0.0001	-0.0002	-0.0023***	0.0004***	0.0005***
	(0.0001)	(0.0001)	(0.0002)	(0.0003)	(0.0001)	(0.0001)
$IRBAWeight^{Sov}_{j,t}$	-0.0000	0.0000	-0.0000	-0.0011***	0.0000	0.0000***
	(0.0000)	(0.0000)	(0.0001)	(0.0001)	(0.0000)	(0.0000)
$Exposure^{Sov}_{i,j,t} \cdot IRBAWeight^{Sov}_{j,t}$	-0.0000	-0.0000	0.0000	0.0002***	-0.0000***	-0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$\Delta\ln(CDS^{Sov}_{j,t}) \cdot CapitalRatio^{Bank}_{i,j,t}$	-0.0031**	-0.0012	-0.0037**	-0.0015	0.0326**	0.0390**
	(0.0015)	(0.0012)	(0.0013)	(0.0009)	(0.0115)	(0.0145)
$CapitalRatio^{Bank}_{i,j,t}$	0.0001**	0.0001***	0.0000	0.0001***	0.0003***	0.0003***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0001)
$\Delta Rating^{Bank}_{i,j,t}$	-0.0017	-0.0015	-0.0061**	-0.0029	0.0001	-0.0014
	(0.0014)	(0.0013)	(0.0023)	(0.0018)	(0.0019)	(0.0015)
Macroeconomic Control Variables	Yes	No	Yes	No	Yes	No
Entity Fixed Effects	Bank level	Bank level	Bank level	Bank level	Bank level	Bank level
Time Fixed Effects	No	Daily	No	Daily	No	Daily
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	56,612	56,612	31,987	31,987	24,625	24,625
Banks	41	41	21	21	20	20
Adjusted R^2	20.3%	40.1%	18.5%	41.6%	25.3%	43.1%

Table 12. ***Slope estimations for exposure size, sovereign risk and capitalization.*** *Estimations are based on table 11 for combinations of banks' sovereign exposures and capitalization as well as sovereign risks. Corresponding risk-weighted sovereign exposures as percentage of total assets are given in brackets.*

	Percentile	(RWE)	$CapitalRatio^{Bank}_{i,j,t}$ P^{25}	$CapitalRatio^{Bank}_{i,j,t}$ P^{75}
$Exposure^{Sov}_{i,j,t}$ $IRBAWeight^{Sov}_{j,t}$	P^{25} P^{25}	(0.2585%)	0.0648***	0.0519***
$Exposure^{Sov}_{i,j,t}$ $IRBAWeight^{Sov}_{j,t}$	P^{75} P^{25}	(1.1334%)	0.1278***	0.1149***
$Exposure^{Sov}_{i,j,t}$ $IRBAWeight^{Sov}_{j,t}$	P^{25} P^{75}	(1.3881%)	0.2156***	0.2027***
$Exposure^{Sov}_{i,j,t}$ $IRBAWeight^{Sov}_{j,t}$	P^{75} P^{75}	(6.0858%)	0.1590***	0.1460***

Table 13. ***Robustness test: Wild cluster bootstrap.*** *Bootstrapped t- and F-values for equation 6 following Roodman et al. (2018) to address potential non-normalities in the data. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.*

	$\Delta\ln(CDS^{Bank}_{i,j,t})$					
	Europe—Full		Europe—Core		Europe—GIIPS	
Individual Statistical Significance	t-value	p-value	t-value	p-value	t-value	p-value
$\beta^{N}\cdot\Delta\ln(CDS^{Sov}_{j,t})$	0.8701	0.4074	2.1652	0.6937	-0.8514	0.4284
$\beta^{E1}\cdot\Delta\ln(CDS^{Sov}_{j,t})\cdot Exposure^{Sov}_{i,j,t}$	2.1334	0.0420**	-0.5322	0.8609	-0.8690	0.4685
$\beta^{R1}\cdot\Delta\ln(CDS^{Sov}_{j,t})\cdot IRBAWeight^{Sov}_{j,t}$	2.1798	0.0250**	-0.4895	0.7728	0.1829	0.9239
$\beta^{ER1}\cdot\Delta\ln(CDS^{Sov}_{j,t})\cdot Exposure^{Sov}_{i,j,t}\cdot IRBAWeight^{Sov}_{j,t}$	-2.8164	0.0691*	0.4468	0.8468	-0.9965	0.4274
$\beta^{E2}\cdot Exposure^{Sov}_{i,j,t}$	0.9247	0.3984	-0.8538	0.5435	3.0541	0.0300**
$\beta^{R2}\cdot IRBAWeight^{Sov}_{j,t}$	-1.0615	0.3093	-0.5216	0.6236	0.0897	0.9179
$\beta^{ER2}\cdot Exposure^{Sov}_{i,j,t}\cdot IRBAWeight^{Sov}_{j,t}$	-1.2817	0.2352	0.7444	0.5526	-2.8695	0.0400**
$\beta^{S1}\cdot\Delta\ln(CDS^{Sov}_{j,t})\cdot CapitalRatio^{Bank}_{i,j,t}$	-2.0383	0.0701*	-2.7561	0.0290**	2.8381	0.0701*
$\beta^{S2}\cdot CapitalRatio^{Bank}_{i,j,t}$	2.5047	0.0160**	0.9095	0.4174	3.7951	0.0400**
$\beta^{C1}\cdot\Delta Rating^{Bank}_{i,j,t}$	-1.2301	0.2513	-2.6345	0.0280**	0.0660	0.9489
$\beta^{C2}\cdot\Delta\ln(CDSIndex^{Banks}_{t})$	12.0432	0.0000***	9.3357	0.0000***	9.5859	0.0000***
$\beta^{C3}\cdot\Delta\ln(CDSIndex^{Sovs}_{t})$	10.2552	0.0000***	8.5119	0.0000***	6.4451	0.0010***
$\beta^{C4}\cdot\Delta EONIA_{t}$	2.5136	0.0180**	2.0684	0.0531*	2.4051	0.0320**
$\beta^{C5}\cdot\Delta EURIBOR^{12M}_{t}$	-0.8973	0.3694	-1.0801	0.2863	-0.1329	0.9099
$\beta^{C6}\cdot\Delta TermSpread^{ISDA}_{t}$	-8.8030	0.0000***	-8.0943	0.0000***	-5.4020	0.0000***
$\beta^{C7}\cdot\Delta\ln(EqIndex^{Level}_{j,t})$	-6.9733	0.0000***	-5.5901	0.0000***	-5.2955	0.0010***
$\beta^{C8}\cdot\Delta\ln(EqIndex^{Vola}_{j,t})$	3.7225	0.0000***	3.1658	0.0000***	3.7860	0.0000***
Joint Statistical Significance	F-value	p-value	F-value	p-value	F-value	p-value
$\beta^{N}+\beta^{E1}+\beta^{R1}+\beta^{ER1}+\beta^{E2}+\beta^{R2}+\beta^{ER2}$	10.3500	0.0010***	8.4176	0.0991*	6.7055	0.4344
$\beta^{N}+\beta^{S1}+\beta^{S2}$	7.2453	0.0150**	4.4332	0.2402	6.1535	0.0571*
$\beta^{N}+\beta^{E1}+\beta^{R1}+\beta^{ER1}+\beta^{E2}+\beta^{R2}+\beta^{ER2}+\beta^{S1}+\beta^{S2}$	9.2694	0.0010***	449.8627	0.7648	7.4767	0.3413

Table 14. ***Robustness test: Weekly observations.*** *Regression results for equation 6 using weekly observations.* $\Delta \ln(CDS^{Bank}_{i,j,t})$ *and* $\Delta \ln(CDS^{Sov}_{j,t})$ *denote daily changes in logarithmic bank and sovereign CDS.* $Exposure^{Sov}_{i,j,t}$ *is a bank's domestic sovereign exposure scaled by total assets.* $IRBAWeight^{Sov}_{j,t}$ *is the sovereign's hypothetical risk weight (IRBA-CR).* $CapitalRatio^{Bank}_{i,j,t}$ *is its regulatory total capital ratio. Control variables cover a bank's credit rating, Europe-wide CDS indices, the EONIA, EURIBOR, term spread and country-specific equity indices. Standard errors (in parentheses) are clustered at the bank level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.*

	$\Delta \ln(CDS^{Bank}_{i,j,t})$					
	Europe—Full		Europe—Core		Europe—GIIPS	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln(CDS^{Sov}_{j,t})$	0.1441	0.0827	0.4380***	0.5174***	-0.0404	-0.2571
	(0.0995)	(0.0942)	(0.1458)	(0.1684)	(0.1931)	(0.3260)
$\Delta \ln(CDS^{Sov}_{j,t}) \cdot Exposure^{Sov}_{i,j,t}$	0.0130	0.0006	0.0009	-0.0400	-0.0237*	-0.0340**
	(0.0099)	(0.0095)	(0.0229)	(0.0329)	(0.0133)	(0.0153)
$\Delta \ln(CDS^{Sov}_{j,t}) \cdot IRBAWeight^{Sov}_{j,t}$	0.0027	0.0021	-0.0157**	-0.0282**	-0.0016	-0.0022**
	(0.0018)	(0.0016)	(0.0059)	(0.0133)	(0.0012)	(0.0009)
$\Delta \ln(CDS^{Sov}_{j,t}) \cdot Exposure^{Sov}_{i,j,t} \cdot IRBAWeight^{Sov}_{j,t}$	-0.0003**	-0.0002	-0.0005	0.0018	0.0000	0.0001
	(0.0002)	(0.0001)	(0.0009)	(0.0021)	(0.0001)	(0.0001)
$Exposure^{Sov}_{i,j,t}$	0.0008*	0.0006	0.0051***	-0.0024*	0.0023**	0.0023**
	(0.0005)	(0.0005)	(0.0010)	(0.0012)	(0.0010)	(0.0010)
$IRBAWeight^{Sov}_{j,t}$	-0.0000	0.0001	0.0025***	-0.0011**	0.0001	0.0002*
	(0.0001)	(0.0001)	(0.0003)	(0.0005)	(0.0001)	(0.0001)
$Exposure^{Sov}_{i,j,t} \cdot IRBAWeight^{Sov}_{j,t}$	-0.0000*	-0.0000	-0.0004***	0.0002**	-0.0000**	-0.0000**
	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0000)	(0.0000)
$\Delta \ln(CDS^{Sov}_{j,t}) \cdot CapitalRatio^{Bank}_{i,j,t}$	-0.0042	-0.0029	-0.0062**	-0.0048	0.0465***	0.0613***
	(0.0035)	(0.0035)	(0.0029)	(0.0028)	(0.0129)	(0.0191)
$CapitalRatio^{Bank}_{i,j,t}$	-0.0001	0.0002	-0.0002**	-0.0001	0.0011**	0.0018***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0004)	(0.0006)
$\Delta Rating^{Bank}_{i,j,t}$	0.0123	0.0123	0.0013	0.0101*	0.0163	0.0155
	(0.0098)	(0.0082)	(0.0068)	(0.0052)	(0.0124)	(0.0117)
Macroeconomic Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Entity Fixed Effects	Bank level	Bank level	Bank level	Bank level	Bank level	Bank level
Time Fixed Effects	No	Weekly	No	Weekly	No	Weekly
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,662	12,662	7,472	7,472	5,190	5,190
Banks	41	41	21	21	20	20
Adjusted R^2	36.5%	51.8%	35.7%	56.9%	42.0%	53.0%

Table 15. ***Robustness test: Monthly observations.*** *Regression results for equation 6 using monthly observations.* $\Delta \ln(CDS^{Bank}_{i,j,t})$ *and* $\Delta \ln(CDS^{Sov}_{j,t})$ *denote daily changes in logarithmic bank and sovereign CDS.* $Exposure^{Sov}_{i,j,t}$ *is a bank's domestic sovereign exposure scaled by total assets.* $IRBAWeight^{Sov}_{j,t}$ *is the sovereign's hypothetical risk weight (IRBA-CR).* $CapitalRatio^{Bank}_{i,j,t}$ *is its regulatory total capital ratio. Control variables cover a bank's credit rating, Europe-wide CDS indices, the EONIA, EURIBOR, term spread and country-specific equity indices. Standard errors (in parentheses) are clustered at the bank level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.*

	$\Delta \ln(CDS^{Bank}_{i,j,t})$					
	Europe—Full		Europe—Core		Europe—GIIPS	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln(CDS^{Sov}_{j,t})$	0.2068**	0.1869	1.1905***	0.4832*	0.2306	0.1127
	(0.1014)	(0.1160)	(0.0897)	(0.2654)	(0.2374)	(0.3153)
$\Delta \ln(CDS^{Sov}_{j,t}) \cdot Exposure^{Sov}_{i,j,t}$	0.0062	0.0042	-0.1607***	-0.0423	-0.0192	-0.0190
	(0.0081)	(0.0086)	(0.0269)	(0.0512)	(0.0185)	(0.0193)
$\Delta \ln(CDS^{Sov}_{j,t}) \cdot IRBAWeight^{Sov}_{j,t}$	0.0013	0.0017	-0.0706***	-0.0225	-0.0015	-0.0010
	(0.0014)	(0.0013)	(0.0039)	(0.0211)	(0.0012)	(0.0011)
$\Delta \ln(CDS^{Sov}_{j,t}) \cdot Exposure^{Sov}_{i,j,t} \cdot IRBAWeight^{Sov}_{j,t}$	-0.0002**	-0.0002**	0.0103***	0.0017	-0.0000	-0.0000
	(0.0001)	(0.0001)	(0.0009)	(0.0035)	(0.0001)	(0.0001)
$Exposure^{Sov}_{i,j,t}$	0.0021	0.0029	-0.0008	-0.0219***	0.0056	0.0089*
	(0.0022)	(0.0022)	(0.0044)	(0.0071)	(0.0038)	(0.0044)
$IRBAWeight^{Sov}_{j,t}$	0.0001	0.0005	0.0003	-0.0105***	0.0006	0.0013*
	(0.0003)	(0.0004)	(0.0016)	(0.0029)	(0.0004)	(0.0007)
$Exposure^{Sov}_{i,j,t} \cdot IRBAWeight^{Sov}_{j,t}$	-0.0000	-0.0001	-0.0000	0.0016***	-0.0001	-0.0001**
	(0.0000)	(0.0000)	(0.0002)	(0.0005)	(0.0001)	(0.0001)
$\Delta \ln(CDS^{Sov}_{j,t}) \cdot CapitalRatio^{Bank}_{i,j,t}$	-0.0019	-0.0071	-0.0004	-0.0050	0.0231	0.0219
	(0.0048)	(0.0053)	(0.0048)	(0.0054)	(0.0141)	(0.0178)
$CapitalRatio^{Bank}_{i,j,t}$	-0.0001	0.0008*	-0.0011**	0.0001	0.0059***	0.0064**
	(0.0005)	(0.0005)	(0.0004)	(0.0004)	(0.0015)	(0.0029)
$\Delta Rating^{Bank}_{i,j,t}$	0.0054	-0.0004	0.0097	-0.0065	0.0058	0.0030
	(0.0069)	(0.0049)	(0.0193)	(0.0140)	(0.0072)	(0.0074)
Macroeconomic Control Variables	Yes	No	Yes	No	Yes	No
Entity Fixed Effects	Bank level	Bank level	Bank level	Bank level	Bank level	Bank level
Time Fixed Effects	No	Monthly	No	Monthly	No	Monthly
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,000	3,000	1,758	1,758	1,242	1,242
Banks	40	40	21	21	19	19
Adjusted R^2	47.6%	58.9%	47.8%	63.7%	49.3%	58.8%

Table 16. ***Robustness test: Sovereign ratings.*** *Regression results for equation 6 using the domestic sovereign's issuer credit rating ($Rating^{Sov}_{j,t}$) as different measure of sovereign risk. $\Delta\ln(CDS^{Bank}_{i,j,t})$ and $\Delta\ln(CDS^{Sov}_{j,t})$ denote daily changes in logarithmic bank and sovereign CDS. $Exposure^{Sov}_{i,j,t}$ is a bank's domestic sovereign exposure scaled by total assets. $CapitalRatio^{Bank}_{i,j,t}$ is a bank's regulatory total capital ratio. Control variables cover a bank's credit rating, Europe-wide CDS indices, the EONIA, EURIBOR, term spread and country-specific equity indices. Standard errors (in parentheses) are clustered at the bank level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.*

	$\Delta\ln(CDS^{Bank}_{i,j,t})$					
	Europe—Full		Europe—Core		Europe—GIIPS	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\ln(CDS^{Sov}_{j,t})$	0.1288***	0.0701**	0.0231	0.0017	-0.0843	-0.3042
	(0.0427)	(0.0298)	(0.0274)	(0.0230)	(0.1405)	(0.2473)
$\Delta\ln(CDS^{Sov}_{j,t}) \cdot Exposure^{Sov}_{i,j,t}$	0.0069	-0.0036	0.0048	-0.0004	-0.0149**	-0.0209**
	(0.0047)	(0.0041)	(0.0054)	(0.0043)	(0.0065)	(0.0075)
$\Delta\ln(CDS^{Sov}_{j,t}) \cdot Rating^{Sov}_{j,t}$	0.0000**	0.0000**	0.0022***	0.0014**	-0.0000	-0.0000
	(0.0000)	(0.0000)	(0.0007)	(0.0006)	(0.0000)	(0.0000)
$\Delta\ln(CDS^{Sov}_{j,t}) \cdot Exposure^{Sov}_{i,j,t} \cdot Rating^{Sov}_{j,t}$	-0.0000***	-0.0000***	-0.0004***	-0.0003***	-0.0000	-0.0000
	(0.0000)	(0.0000)	(0.0001)	(0.0001)	(0.0000)	(0.0000)
$Exposure^{Sov}_{i,j,t}$	0.0000	0.0000	-0.0000	-0.0001	-0.0000	-0.0000
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
$Rating^{Sov}_{j,t}$	0.0000	-0.0000	0.0000***	0.0000	0.0000*	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$Exposure^{Sov}_{i,j,t} \cdot Rating^{Sov}_{j,t}$	-0.0000	0.0000**	-0.0000	0.0000	-0.0000*	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$\Delta\ln(CDS^{Sov}_{j,t}) \cdot CapitalRatio^{Bank}_{i,j,t}$	-0.0045***	-0.0021*	-0.0012	-0.0003	0.0305**	0.0396**
	(0.0015)	(0.0012)	(0.0009)	(0.0009)	(0.0113)	(0.0148)
$CapitalRatio^{Bank}_{i,j,t}$	0.0001**	0.0001***	0.0001***	0.0001***	0.0003***	0.0004***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0001)
$\Delta Rating^{Bank}_{i,j,t}$	-0.0016	-0.0015	-0.0070**	-0.0034*	0.0002	-0.0013
	(0.0014)	(0.0012)	(0.0026)	(0.0019)	(0.0019)	(0.0016)
Macroeconomic Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Entity Fixed Effects	Bank level	Bank level	Bank level	Bank level	Bank level	Bank level
Time Fixed Effects	No	Daily	No	Daily	No	Daily
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	56,612	56,612	31,987	31,987	24,625	24,625
Banks	41	41	21	21	20	20
Adjusted R^2	19.9%	39.9%	19.0%	41.8%	25.3%	43.0%

Table 17. ***Robustness test: Banks' ROA.*** *Regression results for equation 6 using a bank's return on assets ($ROA^{Bank}_{i,j,t}$) as different measure of financial strength. $\Delta\ln(CDS^{Bank}_{i,j,t})$ and $\Delta\ln(CDS^{Sov}_{j,t})$ denote daily changes in logarithmic bank and sovereign CDS. $Exposure^{Sov}_{i,j,t}$ is a bank's domestic sovereign exposure scaled by total assets. $IRBAWeight^{Sov}_{j,t}$ is the sovereign's hypothetical risk weight (IRBA-CR). Control variables cover a bank's credit rating, Europe-wide CDS indices, the EONIA, EURIBOR, term spread and country-specific equity indices. Standard errors (in parentheses) are clustered at the bank level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.*

	$\Delta\ln(CDS^{Bank}_{i,j,t})$					
	Europe—Full		Europe—Core		Europe—GIIPS	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\ln(CDS^{Sov}_{j,t})$	-0.0136	-0.0062	0.0562	0.1341	0.2990**	0.3176***
	(0.0289)	(0.0227)	(0.0376)	(0.0987)	(0.1169)	(0.0959)
$\Delta\ln(CDS^{Sov}_{j,t}) \cdot Exposure^{Sov}_{i,j,t}$	0.0148**	0.0010	-0.0057	-0.0272	-0.0044	-0.0216*
	(0.0065)	(0.0055)	(0.0123)	(0.0176)	(0.0098)	(0.0112)
$\Delta\ln(CDS^{Sov}_{j,t}) \cdot IRBAWeight^{Sov}_{j,t}$	0.0034**	0.0022*	0.0008	-0.0071	0.0005	-0.0006
	(0.0015)	(0.0011)	(0.0015)	(0.0069)	(0.0012)	(0.0007)
$\Delta\ln(CDS^{Sov}_{j,t}) \cdot Exposure^{Sov}_{i,j,t} \cdot IRBAWeight^{Sov}_{j,t}$	-0.0003***	-0.0002**	0.0002	0.0013	-0.0001	0.0000
	(0.0001)	(0.0001)	(0.0005)	(0.0010)	(0.0001)	(0.0001)
$Exposure^{Sov}_{i,j,t}$	0.0001	0.0001	-0.0002	-0.0023***	0.0004**	0.0005***
	(0.0001)	(0.0001)	(0.0002)	(0.0003)	(0.0002)	(0.0001)
$IRBAWeight^{Sov}_{j,t}$	-0.0000	0.0000	-0.0001	-0.0011***	0.0000	0.0000***
	(0.0000)	(0.0000)	(0.0001)	(0.0001)	(0.0000)	(0.0000)
$Exposure^{Sov}_{i,j,t} \cdot IRBAWeight^{Sov}_{j,t}$	-0.0000	-0.0000	0.0000	0.0002***	-0.0000**	-0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$\Delta\ln(CDS^{Sov}_{j,t}) \cdot ROA^{Bank}_{i,j,t}$	-0.0099	-0.0060	-0.0467***	-0.0259*	-0.0011	-0.0043
	(0.0165)	(0.0096)	(0.0162)	(0.0139)	(0.0146)	(0.0084)
$ROA^{Bank}_{i,j,t}$	-0.0001	-0.0002	0.0002	0.0005	-0.0001	-0.0001
	(0.0001)	(0.0001)	(0.0006)	(0.0006)	(0.0002)	(0.0001)
$\Delta Rating^{Bank}_{i,j,t}$	-0.0017	-0.0014	-0.0061**	-0.0028	0.0000	-0.0014
	(0.0013)	(0.0013)	(0.0023)	(0.0018)	(0.0018)	(0.0015)
Macroeconomic Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Entity Fixed Effects	Bank level	Bank level	Bank level	Bank level	Bank level	Bank level
Time Fixed Effects	No	Daily	No	Daily	No	Daily
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	56,612	56,612	31,987	31,987	24,625	24,625
Banks	41	41	21	21	20	20
Adjusted R^2	20.2%	40.0%	18.5%	41.6%	24.6%	42.4%

Table 18. ***Robustness test: Endogeneity.*** *Regression results for equation 6 including a bank's share return ($ShReturn^{Bank}_{i,j,t}$) as additional control variable. $\Delta\ln(CDS^{Bank}_{i,j,t})$ and $\Delta\ln(CDS^{Sov}_{j,t})$ denote daily changes in logarithmic bank and sovereign CDS. $Exposure^{Sov}_{i,j,t}$ is a bank's domestic sovereign exposure scaled by total assets. $IRBAWeight^{Sov}_{j,t}$ is the sovereign's hypothetical risk weight (IRBA-CR). $CapitalRatio^{Bank}_{i,j,t}$ is a bank's regulatory total capital ratio. Control variables cover a bank's credit rating, Europe-wide CDS indices, the EONIA, EURIBOR, term spread and country-specific equity indices. Standard errors (in parentheses) are clustered at the bank level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.*

	$\Delta\ln(CDS^{Bank}_{i,j,t})$					
	Europe—Full		Europe—Core		Europe—GIIPS	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\ln(CDS^{Sov}_{j,t})$	0.0436	0.0144	0.1175*	0.1585	-0.1311	-0.2437
	(0.0515)	(0.0389)	(0.0574)	(0.0989)	(0.1619)	(0.2559)
$\Delta\ln(CDS^{Sov}_{j,t})\cdot Exposure^{Sov}_{i,j,t}$	0.0139**	0.0008	-0.0080	-0.0273	-0.0088	-0.0220**
	(0.0065)	(0.0055)	(0.0131)	(0.0178)	(0.0098)	(0.0101)
$\Delta\ln(CDS^{Sov}_{j,t})\cdot IRBAWeight^{Sov}_{j,t}$	0.0031**	0.0021*	-0.0004	-0.0076	0.0002	-0.0006
	(0.0014)	(0.0011)	(0.0016)	(0.0071)	(0.0012)	(0.0006)
$\Delta\ln(CDS^{Sov}_{j,t})\cdot Exposure^{Sov}_{i,j,t}\cdot IRBAWeight^{Sov}_{j,t}$	-0.0003***	-0.0002**	0.0002	0.0013	-0.0001	0.0000
	(0.0001)	(0.0001)	(0.0005)	(0.0010)	(0.0001)	(0.0001)
$Exposure^{Sov}_{i,j,t}$	0.0001	0.0001	-0.0001	-0.0022***	0.0003**	0.0004***
	(0.0001)	(0.0001)	(0.0002)	(0.0003)	(0.0001)	(0.0001)
$IRBAWeight^{Sov}_{j,t}$	-0.0000	0.0000	0.0000	-0.0011***	-0.0000	0.0000***
	(0.0000)	(0.0000)	(0.0001)	(0.0001)	(0.0000)	(0.0000)
$Exposure^{Sov}_{i,j,t}\cdot IRBAWeight^{Sov}_{j,t}$	-0.0000	-0.0000	-0.0000	0.0002***	-0.0000**	-0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$\Delta\ln(CDS^{Sov}_{j,t})\cdot CapitalRatio^{Bank}_{i,j,t}$	-0.0030**	-0.0011	-0.0034**	-0.0015	0.0322**	0.0388**
	(0.0015)	(0.0012)	(0.0012)	(0.0009)	(0.0115)	(0.0143)
$CapitalRatio^{Bank}_{i,j,t}$	0.0001**	0.0001***	0.0000	0.0001***	0.0003***	0.0003***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0001)
$ShReturn^{Bank}_{i,j,t}$	-0.0014***	-0.0009***	-0.0026***	-0.0013***	-0.0007***	-0.0006***
	(0.0003)	(0.0002)	(0.0004)	(0.0003)	(0.0002)	(0.0001)
$\Delta Rating^{Bank}_{i,j,t}$	-0.0020	-0.0019	-0.0069**	-0.0035*	-0.0000	-0.0016
	(0.0013)	(0.0012)	(0.0024)	(0.0018)	(0.0019)	(0.0015)
Macroeconomic Control Variables	Yes	No	Yes	No	Yes	No
Entity Fixed Effects	Bank level	Bank level	Bank level	Bank level	Bank level	Bank level
Time Fixed Effects	No	Daily	No	Daily	No	Daily
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	56,612	56,612	31,987	31,987	24,625	24,625
Banks	41	41	21	21	20	20
Adjusted R^2	20.8%	40.3%	20.0%	41.9%	25.4%	43.2%

Table 19. ***Quantification of credit risks of European sovereign debt.*** *Hypothetical risk weights for sovereign exposures in the IRBA-CR based on equation 8. Moody's ratings are mapped to to S&P and Fitch ratings according to Bank for International Settlements (2021). PD is derived from external issuer credit ratings and LGD is set to 40% as specified by European Banking Authority (2011). M is set to the standard assumption of 2.5 years as defined in art. 162(1) CRR I.*

	Mapping of Ratings			Internal Ratings-Based Approach			
	Group	Moody's	S&P/Fitch	PD	LGD	M [Years]	Risk Weight
Investment Grade	1	Aaa	AAA	0.03%	40.00%	2.5	13.61%
	2	Aa1	AA+	0.03%	40.00%	2.5	13.61%
	3	Aa2	AA	0.03%	40.00%	2.5	13.61%
	4	Aa3	AA-	0.10%	40.00%	2.5	27.94%
	5	A1	A+	0.18%	40.00%	2.5	39.04%
	6	A2	A	0.26%	40.00%	2.5	47.58%
	7	A3	A-	0.29%	40.00%	2.5	50.36%
	8	Baa1	BBB+	0.42%	40.00%	2.5	60.49%
	9	Baa2	BBB	0.64%	40.00%	2.5	73.08%
	10	Baa3	BBB-	1.17%	40.00%	2.5	91.86%
Speculative Grade	11	Ba1	BB+	2.17%	40.00%	2.5	110.71%
	12	Ba2	BB	2.67%	40.00%	2.5	117.19%
	13	Ba3	BB-	3.56%	40.00%	2.5	127.04%
	14	B1	B+	5.78%	40.00%	2.5	148.41%
	15	B2	B	9.71%	40.00%	2.5	179.96%
	16	B3	B-	12.22%	40.00%	2.5	195.45%
	17	Caa1	CCC+	36.15%	40.00%	2.5	230.92%
	18	Caa2	CCC	36.15%	40.00%	2.5	230.92%
	19	Caa3	CCC-	36.15%	40.00%	2.5	230.92%
	20	Ca	CC	36.15%	40.00%	2.5	230.92%
	21/22	C	C/D	36.15%	40.00%	2.5	230.92%

Table 20. ***Corporate-bank nexus.*** *Regression results for equation 11.* $\Delta\ln(ShPrice^{Bank}_{i,j,t})$ *and* $\Delta\ln(EqIndex^{Level}_{j,t})$ *denote daily changes in a bank's logarithmic share price and a domestic equity index.* $Exposure^{Sov}_{i,j,t}$ *is a bank's domestic sovereign exposure scaled by total assets.* $CapitalRatio^{Bank}_{i,j,t}$ *is its total capital ratio. Control variables cover a bank's credit rating, CDS indices, EONIA, EURIBOR, term spread and country-specific equity volatility indices. Standard errors (in parentheses) are clustered at the bank level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.*

	$\Delta\ln(ShPrice^{Bank}_{i,j,t})$					
	Europe—Full		Europe—Core		Europe—GIIPS	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\ln(EqIndex^{Level}_{j,t})$	1.9489***	2.0079***	2.0289***	1.6230***	1.3037***	1.6212***
	(0.2480)	(0.3093)	(0.1426)	(0.2058)	(0.3499)	(0.2268)
$\Delta\ln(EqIndex^{Level}_{j,t})\cdot Exposure^{Sov}_{i,j,t}$	-0.0191	-0.0257	-0.0595***	-0.0587***	-0.0103	-0.0136*
	(0.0185)	(0.0176)	(0.0126)	(0.0135)	(0.0091)	(0.0075)
$Exposure^{Sov}_{i,j,t}$	-0.0000	-0.0000	0.0000	0.0000	-0.0001**	-0.0001
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$\Delta\ln(EqIndex^{Level}_{j,t})\cdot CapitalRatio^{Bank}_{i,j,t}$	-0.0218**	-0.0186	-0.0306***	-0.0236**	0.0335*	0.0207
	(0.0106)	(0.0121)	(0.0076)	(0.0104)	(0.0186)	(0.0145)
$CapitalRatio^{Bank}_{i,j,t}$	-0.0000*	-0.0000	-0.0001***	-0.0000**	0.0000	0.0002**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0001)
$\Delta Rating^{Bank}_{i,j,t}$	-0.0001	-0.0001	-0.0019	-0.0023	-0.0004	0.0002
	(0.0015)	(0.0014)	(0.0021)	(0.0017)	(0.0016)	(0.0015)
$\Delta\ln(CDSIndex^{Banks}_{t})$	-0.0036**		-0.0066***		0.0002	
	(0.0015)		(0.0016)		(0.0014)	
$\Delta\ln(CDSIndex^{Sovs}_{t})$	-0.0035**		-0.0064***		-0.0017	
	(0.0015)		(0.0020)		(0.0018)	
$\Delta EONIA_t$	-0.0038**		-0.0009		-0.0056**	
	(0.0016)		(0.0023)		(0.0026)	
$\Delta EURIBOR^{12M}_t$	0.0518**		0.1015***		-0.0146	
	(0.0199)		(0.0140)		(0.0306)	
$\Delta TermSpread^{ISDA}_t$	0.0229***		0.0373***		0.0090*	
	(0.0047)		(0.0048)		(0.0046)	
$\Delta\ln(EqIndex^{Vola}_{j,t})$	0.0004**		-0.0000		0.0015***	
	(0.0002)		(0.0001)		(0.0002)	
Entity Fixed Effects	Bank level	Bank level	Bank level	Bank level	Bank level	Bank level
Time Fixed Effects	No	Daily	No	Daily	No	Daily
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	77,895	77,895	44,358	44,358	33,537	33,537
Banks	41	41	21	21	20	20
Adjusted R^2	51.3%	57.5%	52.5%	63.9%	53.0%	58.0%