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SOVEREIGN-BANK NEXUS: RISK TRANSFERS AND CAUSALITY

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Abstract

Whilst banks are exposed to sovereign risk, sovereigns are exposed to bank risk. This Work Project investigates the linkage between both, i.e., the sovereign-bank nexus. Focusing on a sample of 11 European countries during 2014-2020, evidence supporting a positive response of banks' home country sovereign debt holdings to increases in sovereign bond spreads and decreases in profitability is presented. It is also shown that banks' solvency over this period was connected to their home country sovereign bond spreads. Lastly, adding a sample of 40 banks, it is confirmed that the sovereign-bank linkage was still in place during the 2017-2020 period.

Keywords: sovereign-bank nexus, banking union, GIIPS, home bias

1 Introduction

A major enhancer of the European sovereign debt crisis (2010-2012) was the tight connection between national governments and the banking sector, the so-called sovereign-bank nexus. Supported by this linkage, sovereigns and banks reciprocally weakened each other causing the ongoing financial crisis to escalate into a sovereign debt crisis. In particular, banks' home country sovereign debt rising exposures played a key role in exacerbating the mutual enfeeblement. Figure A1 shows the increasing banks' domestic sovereign debt exposures of Greece, Italy, Ireland, Portugal and Spain (GIIPS) from 2008 to 2012. On the one hand, in parallel with the financial crisis, governments were called to support their national financial systems, overburdening public finances in several countries. On the other hand, the considerable amount of domestic sovereign debt in banks' balance sheets passed on the weaknesses of the public finances, amplifying the fragilities of the banking system while concerns about the solvency of European banks were growing. Furthermore, the vulnerabilities were exacerbated by the rise of the funding costs for both sovereigns and banks as well as for non-financial corporations. In particular, yield spreads to the German bond of the GIIPS remarkably widened, portraying the doubts regarding debt repayment. Figure A2 shows the upward movement of the sovereign bond yields for the GIIPS in comparison to the German bond yield during the peak of the crisis. These issues did not remain inside borders and the spillover effects and contagion are nowadays still part of the agenda of policy makers.

Since the outbreak of the last European crisis, stabilizing the financial system and reinstalling credibility became a priority. The European Union (EU) responded by creating a banking unit, the European Banking Union, which currently has two established pillars - the single supervisory mechanism (SSM) and the single resolution mechanism (SRM). The completion of the banking union is dependent on a third pillar, the European deposit insurance scheme (EDIS). Considering the concerns related to the heterogeneity across national banking

sectors, in particular, due to risk asymmetries inherent to the exposure of national banking sectors to their own national sovereigns, this third step has not been taken (Véron, 2017). The single rulebook ensures a consistent application of the EU banking rules. Considering that supervision, resolution and funding were aligned at the European level, the emergence of the European Banking Union was a key step towards a truthful Economic and Monetary Union. Nonetheless, banks and sovereigns are still linked through their holdings of sovereign debt and the domestic economy, which compromises the progress in reducing the sovereign-bank nexus.

The current prudential treatment of sovereign debt does not directly address the home bias of banks' debt portfolios or incentivize banks to diversify their sovereign exposures. Instead, under the Capital Requirements Regulation (EU) 575/2013 of 26 June 2013 (CRR), there is a strong incentive for a skewed asset allocation considering that EU sovereign debt exposures are allowed to be zero-risk weighted, regardless of their inherent risk, and are not subject to the large exposures limit of 25% of Tier 1 capital. As a consequence, potential adverse shocks might leave the banks in a vulnerable position. For instance, banks might find themselves undercapitalized as adequate capital buffers are not held to ensure that an additional layer of capital is available to be drawdown when losses on their portfolios are incurred. Therefore, banks are encouraged by the prevailing regulatory framework to hold sovereign debt issued by any EU Member State, since preference towards it facilitates the compliance with the capital requirements. In addition, with respect to the liquidity standards, no limits or haircuts are applied to domestic sovereign exposures that are eligible as high-quality liquid assets. Despite the general consensus that the high concentration of sovereign exposures poses risks for banks (European Parliament, 2019), close to zero progress has been made with respect to prudential treatment. One of the reasons includes the scarcity of sovereign default events that, if fully covered from a prudential point of view, could entail extremely high capital requirements and negatively impact banks' balance sheets and the sovereign debt market (Enria *et al.*, 2016).

The recent outbreak of COVID-19 exposed the tightening of the sovereign-bank nexus. Banks increased their home country sovereign debt exposures, and in addition, debt from the GIIPS became more appealing. Concurrently, governments were implementing fiscal programs and the issuance of debt securities increased. Rating agencies, shortly after, started taking action on banks and sovereigns considering the rising credit risks (Reuters, 2020). Nonetheless, a preliminary assessment of the impact of COVID-19 on the EU banking sector, published by the European Banking Authority (EBA), indicates that banks entered this crisis in a stronger position in comparison to the Global Financial Crisis in 2008-2009 (EBA, 2020a). Furthermore, according to (Enria, 2020) the stronger levels of capital and liquidity allowed banks to not deepen and spread the shock. In comparison to the previous crisis, there was also a faster reaction and banks continued to lend to costumers.

Considering the aim of the Banking Union to break the sovereign-bank vicious circle (European Commission, 2012), this Work Project will assess whether the nexus between sovereigns and banks has been in fact weakened. The main findings are the following. Focusing on a sample of 11 countries between 2014 and 2020, empirical evidence supporting the increase in domestic sovereign debt holdings as a response to decreasing profitability and increasing sovereign bond spreads is presented. It is also shown that banks' solvency was connected to their home country sovereign bond spreads. Lastly, including a sample of 40 banks, it is confirmed that the link between sovereigns' and banks' credit risk was still in place during the 2017-2020 period.

This Work Project is organized as follows. In section 2, an overview of the literature is presented and this work is placed in the context of the relevant work. Section 3 introduces the empirical methodology, addresses the data sources and reveals the empirical findings followed by the discussion of the results. Section 4 offers some concluding remarks.

2 Literature review

Dell'Ariccia *et al.* (2018) identify three interacting channels responsible for the link between banks and sovereigns. Direct links from sovereigns to banks include the excessive sovereign debt exposures and, from banks to sovereigns, the government guarantees and potential backstops (safety nets). An indirect link arises from the domestic economy. Acharya *et al.* (2013) find empirical evidence that supports the feedback loop using credit default swaps (CDS) spreads for the period 2007-2011 even after controlling for aggregate and bank-level determinants of credit spreads. More evidence of risk transferring from the financial sector to the sovereign led by bailouts is presented by Stanga (2011), who estimates a vector autoregressive model (VAR) with sign restrictions over the period of 2007 to 2011, finding evidence of the interlinkage between banking and government risks. Alter and Schüler (2012) employ a cross-country analysis for the periods before and during/after government bailouts employing a bivariate vector error correction (VEC) and VAR framework. In addition, they conduct tests on Granger-causality, use impulse responses to access the interconnections of the CDS spreads series and present more evidence on the private-to-public risk transfer effect. Alter and Beyer (2013) identity and quantify spillover effects using a VAR with exogenous variables (VARX) and generalized impulse response functions (IRF) to determine spillover indices. Based on that econometric framework they find an increasing interdependence between banks and sovereigns from 2009 to 2012.

In particular, the sizable expansion of banks' sovereign exposures was at the core of the sovereign debt crisis in 2010-2012 and, especially, the bias towards domestic debt. Acharya and Steffen (2014) find evidence for an increase in the home bias of GIIPS banks between 2007 and 2013. The incentives have been extensively debated in the literature. The skewness towards domestic sovereign debt has been mainly explained by "moral suasion", the pressure of governments on banks to hold a greater amount of sovereign bonds when under strain, specially

via direct government ownership and government influence. Becker and Ivashina (2018) present results for the 2007-2013 period consistent with sovereign governments inducing banks to take on sovereign debt, while showing a contraction on corporate loan supply during periods that are prone to be associated with financial repression. Ongena *et al*. (2019) find evidence for a higher increase of sovereign debt holdings on domestic banks from fiscally distressed countries when the government had larger refinancing necessities. An additional explanation attributed to the increase in sovereign home bias is the "risk-shifting" hypothesis. According to Andreeva and Vlassopoulos (2016), for higher sovereign CDS spreads, banks whose creditworthiness is positively correlated with that of the domestic sovereign, exhibit larger exposures to their governments' bonds. These findings support the risk-shifting hypothesis, where the risk is mainly borne by the creditors whilst shareholders get the high risk premium at the expense of precautionary measures that would strengthen the capital buffers. Moreover, Acharya and Steffen (2014) argue that banks with higher short-term leverage levels, as well as undercapitalized banks and with more risk-weighted assets, are more prone to use low risk-weight GIIPS government bonds as a source of high risk premia with short-term unsecured funding to earn the carry spread, whilst complying with the regulatory capital requirements. Precisely due to the low bank capital, undercapitalized banks act as buyers of last resort for the domestic sovereign, since in case of default banks are protected by limited liability and in good states home sovereign debt provides a high payoff (Crosignani, 2020).

This Work Project is primarily related to the literature on the link between sovereign risk and bank risk, and banks' biased sovereign debt purchases towards domestic sovereign debt.

The first part of this analysis is associated with the research on the risk-shifting theory (Crosignani, 2020; Acharya and Steffen, 2014; Horváth *et al*., 2015), analyzing whether riskier and more vulnerable banks have stronger incentives to shift their asset allocation into riskier government debt. This theory is checked, particularly focusing on the home bias, by creating

two subsamples, GIIPS banks versus non-GIIPS banks, and the engagement on "carry trades" (Acharya and Steffen, 2014) is also taken into account.

This analysis also relates to the literature on regulatory and accounting treatment of sovereign exposures (Enria *et al*., 2016). In particular, the relationship between domestic banks' capital position and the changes in the sovereign bond yields was investigated. The effect of the home bias on the capital position of domestic banks, considering that increases in sovereign risk might affect banks through their holdings of domestic debt, was also assessed. These were checked by analyzing the link between banks' capital and the changes in the sovereign bond yield spreads. This analysis is in line with the argument that excessive concentration of domestic debt leaves banks in a vulnerable position during periods of stress as well as with the discussions regarding the prudential framework with respect to sovereign exposures (BCBS, 2017; ESRB, 2015).

The last part of the Work Project is directly connected to the literature that use CDS spreads as a measure of sovereign and bank risk in order to assess the risk transfer between banks and sovereigns (Acharya *et al*., 2013; Alter and Beyer, 2013; Alter and Schüler, 2012). In the context of the substantial amount of existing literature addressing the interconnection and risk contagion between banks and sovereigns during the period of the sovereign debt crisis, this analysis aims to extend the timespan of the previous investigations. The econometric methodology followed is based on the two-step estimation technique proposed by Engle and Granger (1987) which also concerns the possibility of cointegration, therefore not neglecting useful information such as the long-run relationship between series.

In order to assess whether the European Banking Union has weakened the sovereign-bank nexus, it is important to visualize the building steps towards this project and the current stance. Section 6.1 in the Appendix provides a brief overview of the topic.

3 Empirical Analysis

This section investigates whether: 1) the profitability and solvency position of the European banking sector as well as home country sovereign bond yield spreads play a role on the changes of domestic sovereign debt holdings; 2) there is a link between sovereign risk and banks' solvency, and 3) there still is a feedback loop between the credit risk of sovereigns and the banking system.

The empirical analysis is divided in the aforementioned three parts and includes a sample of 11 countries with a particular focus on two subsamples: the peripheral countries – Greece, Ireland, Italy, Portugal and Spain (GIIPS) – and, in opposition, six additional countries – Austria, Belgium, France, Germany and the Netherlands along with Finland (non-GIIPS). Due to the data constraints, both the first and second part of the analysis only include the period starting at the end of 2014. In contrast, the last part benefits from the data availability which allowed for the exploitation of three different periods between 2009 and 2020.

3.1 Main risks and vulnerabilities of the EU banking sector

The first section, in view of the risk-shifting theory, analyses whether riskier and more vulnerable banks prefer riskier government debt. According to this argument, by shifting their asset allocation to high-risk assets and linking their risk to the sovereign risk, banks bet on their own survival considering the limited liability in case of default and the otherwise potential benefits for shareholders (Crosignani, 2020; Acharya and Steffen, 2014). This theory cannot fully explain the preference towards domestic sovereign exposures since riskier and more vulnerable banks should also shift their sovereign allocation towards assets from other riskier countries. Nonetheless, the following investigation is focused on the risk-shifting behavior with respect to the home bias, in order to assess whether the prominent preference towards domestic government exposures from riskier banks located in crisis countries was still material after the sovereign debt crisis and the developments regarding the Banking Union. In combination, the

possibility of engagement in "carry trades" through the purchase of high yield sovereign bonds financed by short-term debt is also taken into account (Acharya and Steffen, 2014). The two subsamples distinguish the banks from the GIIPS, perceived as the potential weak banks situated in crisis countries, from non-GIIPS banks.

3.1.1 Data

A dataset was constructed from Q4 2014 to Q2 2020, totaling 23 quarterly observations (i.e., T = 23) for 11 countries. The data collection process relied on three sources: (1) the supervisory and prudential statistics available on the Statistical Data Warehouse; (2) the International Monetary Fund's (IMF) dataset that tracks the global demand for advanced economy sovereign debt and, (3) Refinitiv Eikon. Mainly due to data availability the data were considered on an aggregated basis. With respect to the sovereign debt exposures, it was possible to collect for the domestic banks the domestic debt holdings as well as the proportion of domestic debt, which covers both loans and securities, out of the total debt held, which covers currency and deposits, loans and securities (Arslanalp and Tsud, 2012). Considering that banks do not exclusively have exposures to governments through securities and since the analysis also included loans, it allowed to not underestimate the true level of sovereign debt exposures. Additionally, spreads of each sovereign 10-year bond yield over the German 10-year bond yield were used. The maturity-matched German bond yield is used as a proxy for the risk-free yield considering the size of the German bond market in Europe and the consequent limited liquidity premium. The advantage of using a spread is that it isolates the risk relative to the usual higher quality German yield. The dataset was perfectly balanced

Tables A1 and A2 present summary statistics on the two bank risk indicators – common equity tier 1 ratio (CET1 ratio) and return-on-equity (ROE) - as well as on sovereign bond yield spreads and sovereign debt exposures. During the period ranging from Q4 2014 to Q2 2020, non-GIIPS banks had the highest averages of CET1 ratio and ROE. Additionally, on average,

the domestic government debt corresponds to 18.4% (16.5%) of total government debt held by non-GIIPS (GIIPS) banks. With respect to the average of sovereign debt holdings, the figures for both groups of countries are not far apart from each other.

Figures A3.1 and A4.1 show that between Q4 2014 and Q2 2020, GIIPS and non-GIIPS banks have kept their levels of sovereign debt holdings fairly stable with the exception of German banks that showed a prominent negative trend. However, it is also noticeable that all countries included in the sample have increased their sovereign debt holdings during 2020, suggesting this action as a response to the impact of COVID-19. With respect to the GIIPS, it is also observable that Italian and Spanish banks show the highest levels, whilst for the non-GIIPS, German banks hold the greatest amount. Moreover, it is clear from Figures A3.2 and A4.2 that an increase during 2020 occurred in several domestic sectors when it comes to the share of domestic debt in the total debt held, in particular for the GIIPS and France.

A further analysis of the sovereign bond yield spreads is presented in the next subsection.

3.1.2 Methodology

In this section, the effect of the solvency position and profitability of the banking sector as well as the influence of the sovereign bond yield spreads on the home bias were investigated. Those connections were exploited by regressing both the home bias measure and the domestic sovereign debt holdings on two risk indicators – CET1 ratio and ROE - as well as on the domestic sovereign bond yield spreads. The home bias indicator corresponded to the proportion of domestic government debt in the total government debt held, which reflects the domestic banks' preference towards domestic debt over foreign debt.

Considering the structure of the dataset, a panel data regression that includes country fixed effects was implemented in order to control for the discrepancies across the 11 countries, i.e. the individual heterogeneity within the sample. Accordingly, the estimates could not be biased as a consequence of omitted time-invariant variables. In addition, other sources of endogeneity

might have risen due to simultaneity. For instances, sovereign debt exposures could be expected to increase bank profitability. Nonetheless, the tests of endogeneity overruled that suspicion. Moreover, considering that the panel unit root tests confirmed that the series were difference-stationary, the data were first-differenced. In order to overcome cross-sectional heteroscedasticity and serial correlation, clustered standard errors within countries were used in the estimation. Two lags of each variable were included.

Accordingly, regressions of the following form were estimated:

$$\Delta log(H_{c,t}) = \sum_{i=0}^{2} \beta_i \Delta CET1\ ratio_{c,t-i} + \sum_{i=0}^{2} \delta_i \Delta ROE_{c,t-i} + \sum_{i=0}^{2} \gamma_i \Delta Spread_{c,t-i} + \\ + u_c + \varepsilon_{c,t} \quad (1)$$

$$\Delta HB_{c,t} = \sum_{i=0}^{2} \vartheta_i \Delta CET1\ ratio_{c,t-i} + \sum_{i=0}^{2} \pi_i \Delta ROE_{c,t-i} + \sum_{i=0}^{2} \theta_i \Delta Spread_{c,t-i} + \\ + u_c + \varepsilon_{c,t} \quad (2)$$

where $\Delta log(H_{c,t})$ represents the quarterly change in the natural logarithm of domestic sovereign debt holdings for the domestic banks of country c at time t and $\Delta HB_{c,t}$ is the quarterly change in the share of domestic government debt out of total government debt held by the domestic banks of country c at time t. Additionally, $\Delta CET1\ ratio_{c,t}$ and $\Delta ROE_{c,t}$ are the quarterly changes in the common equity tier 1 ratio and in return-on-equity, respectively, aggregated for the banking sector of country c at time t and, $\Delta Spread_{c,t}$, the quarterly changes in the spread of the 10-year sovereign bond yield for country c at time t over the German 10-year bond yield. Lastly, u_c and $\varepsilon_{c,t}$ are the country-specific fixed effects and the error term, respectively. Table 1 presents the estimation. Table A3 provides complementary information.

Table 1: Relationship between the main risks and vulnerabilities of the EU banking sector and the domestic sovereign debt holdings

	Δ Home Bias (%)		Δ log(Holdings)	
	GIIPS	Non-GIIPS	GIIPS	Non-GIIPS
Δ CET1 ratio (%)				
L0	0.1295	-0.1340	0.0191	-0.0048
L1	0.0644	-0.2001	0.0089	-0.0172 **
L2	0.0240	0.1606	-0.0029	0.0097
Δ ROE (%)				
L0	-0.0675	0.0170	-0.0078 *	-0.0016
L1	-0.0628 *	0.0296 *	-0.0054 ***	-0.0001
L2	-0.0258 **	0.0140	-0.0031 **	0.0007
Δ Spread				
L0	0.1286	0.7389	0.0102 *	0.0478
L1	0.1257 **	0.0119	0.0165 ***	0.0641 *
L2	-0.1288	0.0496	-0.0119	0.0344
R-squared	14.75%	15.91%	22.25%	28.98%

3.1.3 Discussion of the results

The results suggest that, on average, during the Q4 2014 to Q2 2020 period, GIIPS banks responded to increases in their sovereign bond yield spreads and decreases in the ROE with increases in the proportion of domestic government debt out of total government debt held. The results for the domestic sovereign debt holdings are in agreement and even more prominent. During the same period, non-GIIPS banks with past decreases in the CET1 ratio increased their domestic sovereign debt holdings. The coefficient relative to past variations of the sovereign bond yield spreads was also statistically significant and positive. Nonetheless, the results for the non-GIIPS were not as consistent.

Overall, these findings indicate that the response to changes in banks' risks and domestic sovereign bond yield spread variations is not equal for both groups of countries. In particular, the results relative to the GIIPS support the view that riskier banks might show excess risk taking and seek for the high-yield debt, increasing even further the concentration of home country sovereign debt. Moreover, the GIIPS findings are also in line with the "carry trade" hypothesis (Acharya and Steffen, 2014). However, Crosignani (2020) and Acharya and Steffen

(2014) find that undercapitalized banks tend to hold more domestic sovereign bonds and are more likely to invest in carry trades, respectively, whereas in this case, decreases in profitability are the main incentive for riskier banks. This shift from the levels of capital to the levels of profitability is particularly relevant considering that European banks are facing significant profitability challenges whilst presenting solid capital positions (EBA 2020b), which was not the case in the earlier periods of the mentioned studies. As regards the COVID-19 crisis, the persistence of a skewed asset allocation or even the intensification of the home bias, might translate into the reemergence of the sovereign-bank feedback loop, in particular, in the countries where the exposure levels are already elevated. In a scenario of sovereign distress, the widening spreads could cause losses and impact banks' capital adequacy. The recent increase in sovereign debt holdings might be a consequence of the absorbing role of banks, as they tend to take up a significant share of the government debt issued, as well as a result of the liquidity management. The expected prolonged low interest rate environment as well as the lower economic activity might pose a strain on banks in terms of profitability and solvency. Further challenges to banks' profitability are expected to be presented with the asset quality deterioration and credit losses.

3.2 Sovereign debt securities spreads and banks' solvency

The second part of the analysis examined the relationship between domestic banks' capital position and the changes in the sovereign bond yields. Widening spreads have an impact on banks' stability through different channels. Besides the impact on profitability and the damage on banks' balance sheets, adverse market valuations penalize the value of the collateral used for funding and increase the funding costs (BIS, 2011). In addition, banks and sovereigns are also ultimately linked through indirect channels, such as the domestic economy (Dell'Ariccia *et al.*, 2018).

With respect to the direct impact through the domestic sovereign bond holdings, the extent of the effect is dependent on banks' accounting strategies, namely, if sovereign exposures are carried on the balance sheet at fair value (fair value through other comprehensive income and fair value through profit or loss) or at amortized cost. In the latter, interest revenue still appears on the income statement, but variations in the market value do not have any effect. Losses are, nonetheless, recorded in the case of impairments. Moreover, since movements in market prices are not reflected in the banks' balance sheet and taken into account for capital adequacy purposes, regulatory capital is not set aside to absorb losses.

Figure A5 illustrates the valuation methods used for sovereign exposures according to the EBA Spring 2020 Transparency Exercise (EBA, 2020c). A significant part of the exposures is classified at amortized cost, being that the prominent classification among most of the countries in the sample. Only Greece and Ireland present less than 50% of their domestic sovereign exposures at amortized cost. In the context of the sovereign debt crisis, a temporary sovereign capital buffer designed to reflect the current market valuations of sovereign exposures was introduced (EBA, 2011). Nonetheless, this was a temporary requirement and, currently, the sovereign risk is not part of the regulatory framework. As a response to the COVID-19 pandemic, prudential filters for sovereign debt securities held at fair value through other comprehensive income were temporarily reintroduced (European Council, 2020), which diminishes the impact of market valuations on capital ratios.

3.2.1 Data

The analysis is based on a dataset comprising the 11 countries, which includes the tier 1 ratio and additional indicators for the domestic banks of each country, as well as the spread of each 10-year sovereign bond yield over the German 10-year bond yield. The tier 1 ratio and the additional indicators were collected from the Statistical Data Warehouse, whilst the sovereign

bond yields were retrieved from Refinitiv Eikon. The dataset was created for the period from Q4 2014 to Q2 2020, totaling 23 quarterly observations (i.e., T = 23).

Tables A4 and A5 present summary statistics on the balanced panel data. Between Q4 2014 to Q2 2020, the GIIPS showed the highest average of sovereign spreads whilst non-GIIPS had the greatest average of tier 1 ratios, reaching 16.4% (versus 14.5%) and confirming that, on average, banks from non-GIIPS countries were better capitalized.

Figures A6 and A7 show the evolution of the average tier 1 ratio and the sovereign yield spread for each country between Q4 2014 and Q2 2020. As regards the aggregated tier 1 ratio, Spanish banks showed the lowest average of 12.97%. For the last data point included in the sample, Spanish banks registered once again the smallest value (13.90%). Regarding the bond yield spreads, despite the significant decrease, Greece displays the highest spread over the German bond yield consistently throughout this period, being the only exception relative to Italy as of Q2 2020. With the outbreak of the COVID-19 pandemic, the bond yield spread increased for every country included in the sample, being the highest increase of 65.8 bps posted by Portugal and followed by Spain (48.3 bps), Greece (45.6 bps) and Italy (37.7 bps).

3.2.2 Methodology

Considering the different contexts that might lead to changes in sovereign bond yield spreads, the potential impact on banks' solvency might stem from different sources. The analysis started with the confirmation of the link between banks' solvency and changes in sovereign bond yield spreads. Some of the potential channels were subsequentially addressed.

Starting with the first part of the analysis, the tests for panel unit roots suggested that both series, of tier 1 ratios and sovereign bond yield spreads were difference-stationary. For that reason, the variables included consisted of first differences. Despite the low frequency data and the reduced historical availability, the analysis benefited from a strongly balanced dataset. Another empirical concern was endogeneity, considering the possible two-way relationship

between banks' tier 1 capital ratio and sovereign bond yield spreads. In order to address this concern, a panel vector autoregression (VAR) model was used. By using the panel VAR methodology all variables are treated as endogenous and, simultaneously, the unobserved individual heterogeneity between countries is allowed (Love and Zicchino, 2006). Thus, it was possible to examine the relationship between the tier 1 ratios and the sovereign bond yield spreads while allowing for country-specific unobserved heterogeneity. Another important step when constructing a VAR model is the choice of the appropriate lag length. Based on the Bayesian information criterion (BIC), the Akaike information criterion (AIC) and the Hannan and Quinn information criterion, one lag was chosen.

Accordingly, the analysis relied on the following estimation:

$$\mathbf{Y}_{c,t} = \mathbf{Y}_{c,t-1}\mathbf{A}_1 + \mathbf{u}_c + \mathbf{e}_{c,t} \quad (3)$$

where $\mathbf{Y}_{c,t}$ is a (1×2) vector of the dependent variables - $\Delta Tier\ 1\ ratio_{c,t}$, the quarterly changes in the aggregated tier 1 ratio for country c at time t, and $\Delta Spread_{c,t}$, the quarterly changes in the spread of the 10-year bond yield for country c at time t over the German 10-year bond yield. Additionally, $\mathbf{u}_c$ and $\mathbf{e}_{c,t}$ are (1×2) vectors of dependent variable-specific panel fixed effects and idiosyncratic errors, respectively. Finally, $\mathbf{A}_1$ is a (2×2) matrix with the parameters to be estimated. Table 2 presents the results. Table A6 provides additional information.

Table 2: Relationship between the tier 1 ratio and sovereign spreads

	GIIPS	Non-GIIIPS
Δ Tier 1 ratio (%)		
Δ Spread		
L1	-0.2185 ***	-0.6138 **
Δ Spread		
Δ Tier 1 ratio		
L1	-0.2502 **	0.0135 *
Hansen's J statistic	3.15E-33	8.35E-32

In the second part, the potential channels that might have an impact on banks' solvency and, in particular, if the effect through the domestic sovereign bond holdings is significant upon

changes in sovereign bond yield spreads are analyzed. The choice of the variables was based on the fact that variations in the sovereign bond yield spreads might not only lead to portfolio gains or losses but are also often associated with increases and decreases in credit risk and have an impact on funding costs. A weighted average of CDS spreads for each country was used as a proxy for banks' funding costs (further details are provided in the next section).

The tests for panel unit roots suggested that the data were difference-stationary and therefore, the series were first-differenced. Considering the heterogeneity in the different banking sectors and the exposure to fluctuations in macroeconomic fundamentals, panel data regressions that include country fixed effects were used. In order to control for cross-sectional heteroscedasticity and serial correlation, clustered standard errors within countries were used in the estimations.

Firstly, the following OLS regressions were estimated:

$$\Delta y_{c,t} = \beta_i \Delta Spread_{c,t} + u_c + \varepsilon_{c,t} \quad (4)$$

where $\Delta y_{c,t}$ represents the quarterly change in one of the following variables for the domestic banks of country c at time t: *RWA ratio*, the risk-weighted assets over total assets; *Provisions ratio*, the provisions over total assets; *FV ratio*, the gains and losses on financial assets and liabilities at fair value through profit and loss over total assets; *Trading ratio*, the gains and losses on financial assets held for trading and liabilities over total assets, and; *log(CDS)*, the natural logarithm of the weighted average of banks' CDS spreads, aggregated for the banking sector of country c at time t. Lastly, u_c and $\varepsilon_{c,t}$ are the country-specific fixed effects and the error term, respectively. Table A7 reports the results.

Additionally, the following panel regression was estimated:

$$\Delta Tier1\ ratio_{c,t} = \beta_1 \Delta RWA\ ratio_{c,t} + \beta_2 \Delta Provisions\ ratio_{c,t} + \beta_3 \Delta log\ (CDS)_{c,t} + \\ + \beta_4 \Delta FV\ ratio_{c,t} + \beta_5 \Delta Trading\ ratio_{c,t} + u_c + \varepsilon_{c,t} \quad (5)$$

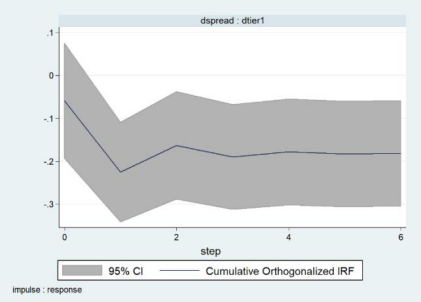
Table A8 presents the results.

3.2.3 Discussion of the results

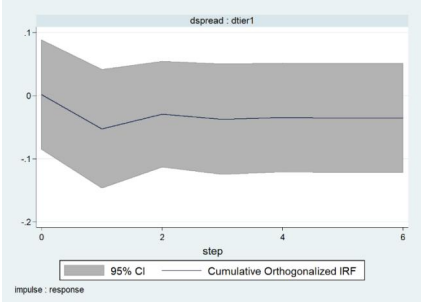
As reported in Table 2, for both groups of countries, evidence of the connectedness between sovereign spread movements and changes in the domestic banks' tier 1 ratio was found. Furthermore, the Δ*Spread* coefficient for the non-GIIPS countries was in absolute terms almost three times greater than the one for the GIIPS. On average, during the period spanning from Q4 2014 to Q2 2020, a 100 basis points increase in the *Spread* translated into a 0.61 percentage points decrease in the non-GIIPS banks' *Tier 1 ratio*. By performing the Granger causality test, it was confirmed that past values of the sovereign bond yield spreads were useful to predict the values of the tier 1 ratio, conditional on past values of the tier 1 ratio (Table A9). Additionally, with respect to the GIIPS, the results also suggest that concerns about the solvency of the banks might lead to higher spreads of the home country sovereign bonds. The impulse–response functions (IRFs) were also calculated. Considering that first differences were used, cumulative IRFs were computed. Figure 1 illustrates the *Tier 1 ratio* response to a spread shock and Table A10 presents the results. The IRFs suggest that the *Tier 1 ratio* from the GIIPS suffers a more prominent impact after a shock in *Spread.*

Figure 1: Impulse response functions

a) GIIPS



b) Non-GIIPS



The second part of the analysis indicates that, for both groups of countries, on average, the increases in Δ*Spread* had a positive statistically significant impact on Δ*FV ratio* during the period between Q4 2014 and Q2 2020. However, with respect to the Δ*Tier 1 ratio,* the

coefficients on the $\Delta FV\ ratio$ were not statistically significant. The same was found with respect to the $\Delta Trading\ ratio$ in the case of non-GIIPS countries. Additionally, the results suggest that both the GIIPS and non-GIIPS banks' funding costs are impacted by the changes in risk premia and that, in turn, banks' solvency is also slightly affected.

Overall, from Q4 2014 to Q2 2020, domestic banks' solvency and sovereign bond spreads were connected, which is in agreement with the multidimensional channels responsible for the two-way feedback between banks and sovereigns discussed by Dell'Ariccia *et al*. (2018). Nonetheless, it was also noticeable that banks' vulnerability to higher concentrations of sovereign debt securities has been limited. One of the explanations stems from the accounting treatment of the sovereign exposures, considering that a large share is subject to amortized cost accounting (e.g. ECB, 2020; IMF, 2020).

3.3 The Sovereign-Bank Feedback Loop

To end the analysis, the direction and magnitude of the risk transmission between the banking sector and sovereigns was assessed. The core of the methodology relied on a bivariate panel VECM, allowing for endogeneity while capturing the causal relationship between two sets of variables over time. With respect to the bank and sovereign risk indicators, CDS spreads were used since these are a common measure of bank and sovereign risk among the relevant literature. Moreover, not only CDSs are actively traded and therefore, highly liquid but also, considering the sample period, are reasonably available.

3.3.1 Data

As aforementioned, CDS spreads were the proxy used to measure the sovereign risk of the 11 countries, as well as the bank risk for a sample of 40 banks established in the same 11 countries. In particular, 5-year senior unsecured CDS quotes retrieved from Bloomberg (Stanga, 2011; Alter and Schüler, 2012; Alter and Beyer, 2013). With respect to the bank risk, the sample of 40 banks was selected based on the EBA Spring 2020 transparency exercise, an

approach inspired by the one used by Acharya and Steffen (2014). Table A11 shows the list of the banks included in the sample. Only the banks that did not have 5-year senior unsecured CDS quotes available throughout the whole duration were dropped. A weighted average was computed for each country with the weights based on the banks' total assets as of end-2019. The analysis was narrowed to three periods. The first period spanned from the beginning of 2009 to the end of 2012, covering the peak of the sovereign debt crisis. The second started immediately after and lasted until 2016, addressing the awakening from the crisis and the efforts to make the financial system more stable and resilient. The last one began in 2017 and lasted until the third quarter of 2020, including the impact of all the reforms implemented after the financial crisis and subsequent amendments, but also the primary shock of the COVID-19 pandemic. Weekly data were used (Stanga, 2011).

Tables A12 and A13 present summary statistics on sovereign CDS and bank CDS for GIIPS and non-GIIPS, respectively, for the three periods considered. It is noticeable that for both groups, the average sovereign CDS spread as well as the average bank CDS spread have substantially decreased throughout these periods. Additionally, and as expected, both averages are consistently higher for the GIIPS.

Figures A9.1 and A9.2 and Figures A10.1 and A10.2 display the movement of weekly sovereign CDS and weekly weighted average bank CDS for GIIPS and non-GIIPS, respectively, during 2020. Regarding the banking sector, the highest impact of the COVID-19 pandemic was felt by the Portuguese and Italian banks. Whereas for sovereigns, the highest impact was noted in Greece and Italy. Even though the shock was also noticeable for the non-GIIPS, the overall effect was less pronounced.

3.3.2 Methodology

The panel unit root diagnostics confirmed that both series were difference-stationary. However, if the variables were cointegrated, not taking into account cointegration would lead

to a misspecified model. Considering the relation between bank and sovereign CDSs and its dynamic link, it was also important to account for endogeneity. Accordingly, a similar approach to the two-step estimation technique proposed by Engle and Granger (1987) was adopted.

Firstly, the following model was estimated in order to obtain the residuals:

$$Bank\ CDS_{c,t} = \beta Sovereign\ CDS_{c,t} + u_c + \varepsilon_{c,t} \quad (6)$$

where $Bank\ CDS_{c,t}$ is the weekly weighted average of the bank CDS spreads of country c at time t and $Sovereign\ CDS_{c,t}$ is the weekly sovereign CDS spread of country c at time t. Additionally, u_c and $\varepsilon_{c,t}$ are the country fixed effects and the idiosyncratic error term, respectively. The standard errors were clustered at the country-level to allow for correlation of errors terms within countries.

The residuals were obtained, and it was assumed that the lagged form contains information about the long-term relationship between bank CDS spreads and sovereign CDS spreads. These lagged residuals were defined as the error correction term (*ECT*) and included in the estimation of a panel VECM with the first differences of both variables, *Bank CDS* and *Sovereign CDS*. The lag length was set to two based on the Bayesian information criterion (BIC), the Akaike information criterion (AIC) and the Hannan and Quinn information criterion.

Specifically, the following model was estimated:

$$\mathbf{Y}_{c,t} = \sum_{i=1}^{2} \mathbf{Y}_{c,t-i}\mathbf{A}_i + \mathbf{H}_c\mathbf{ECT}_{c,t-1} + \mathbf{u}_c + \mathbf{e}_{c,t} \quad (7)$$

where $\mathbf{Y}_{c,t}$ is a (1×2) vector of the dependent variables, $\Delta log(Bank\ CDS_{c,t})$, aggregated for country c at time t, and $\Delta log(Sovereign\ CDS_{c,t})$, for country c at time t. $\mathbf{ECT}_{c,t-1}$ is a (1×2) vector of the residuals obtained from the previous regression. Additionally, $\mathbf{u}_c$ and $\mathbf{e}_{c,t}$ are (1×2) vectors of dependent variable-specific panel fixed effects and idiosyncratic errors, respectively. Finally, $\mathbf{A}_i$ and $\mathbf{H}_c$ are (2×2) matrices with the parameters to be estimated.

The estimation was repeated for the three periods and for both groups of countries. Table 3 presents the results. Table A14 provides complementary information.

Table 3: The Sovereign-Bank Feedback Loop

	GIIPS			Non-GIIPS		
	2009-2012	2013-2016	2017-2020	2009-2012	2013-2016	2017-2020
Δ Log(Sovereign CDS)						
Δ Log(Bank CDS)						
L1	-0.2528 ***	-0.0134	-0.0190	-0.1188 ***	0.1641 ***	0.1072 *
L2	-0.0216	0.0638 *	0.0080	0.1199 ***	0.0432 ***	0.0603 **
Δ Log(Bank CDS)						
Δ Log(Sovereign CDS)						
L1	0.1243 ***	0.0321	0.1146 *	0.0835 ***	0.0010	-0.0246
L2	0.0731 *	-0.0505	0.1207 ***	-0.0103	-0.0039	0.1249 ***
Hansen's J statistic	1.08E-31	9.42E-32	9.19E-32	3.63E-31	2.56E-31	6.55E-32

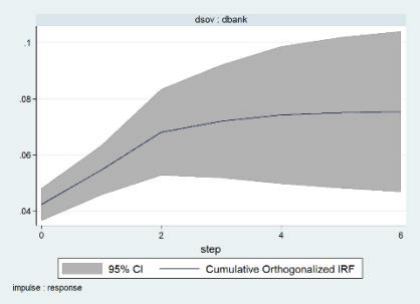
3.3.3 Discussion of the results

As expected, evidence of the sovereign-bank feedback loop during the first period, in fact, for both groups of countries, was found. With respect to the second period, between 2013 and 2016, more evidence of the feedback loop in the non-GIIPS countries, which is not similarly observed in the GIIPS, is presented. Finally, over the last period, which spanned from 2017 to Q3 2020, the results suggest that the link was still in place. More specifically, for both groups of countries, on average, a past 10% increase in the *Sovereign CDS* spread leads to an approximate 1.2% increase in the *Bank CDS* spread.

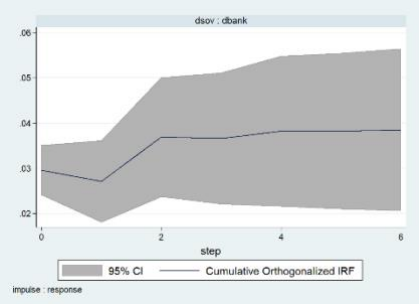
From a Granger causality perspective, the tests revealed that past values of the *Bank CDS* spreads were useful to predict the values of the *Sovereign CDS* spreads, conditional on past values of the *Sovereign CDS* spreads, for both groups of countries during the first two periods. With respect to the reverse causal relationship, the null hypothesis that *Sovereign CDS* spreads do not Granger-cause *Bank CDS* spreads was rejected at the 1% confidence level in all periods for the GIIPS. Regarding the non-GIIPS, the same null hypotheses was not rejected only between 2013 and 2016. Table A15 provides the results. The cumulative IRFs were also estimated and are presented on Figure A11 as well as in Table A16. Figure 2 shows that in the most recent period, the *Bank CDS* spreads from the GIIPS observed the biggest impact after a shock in *Sovereign CDS* spreads and it is also the impact that lasted the longest.

Figure 2: Impulse response functions

a) GIIPS



b) Non-GIIPS



Previous studies regarding the sovereign-bank loop are generally focused on the sovereign debt crisis period and are all in agreement on the existence of some type of connection between sovereigns and banks during that period (Stanga, 2011; Alter and Schuler, 2012; Alter and Beyer, 2013; Acharya *et al.*, 2013). This work is in line with prior research and with more recent studies that find that the doom loop weakened around the time of the introduction of the Banking Union (Covi and Eydam, 2020). Nonetheless, the results suggest that the connectedness between the credit risk of sovereigns and the banking sector is still present and in both groups of countries. This interdependence might pose a stronger threat with the negative impact of the COVID-19 pandemic. In particular, the fiscal measures to support the economies and the rising sovereign debt holdings pose a concern as banks take up a notorious stake of the government debt issued. Not only that, but also indirect effects such as banks' exposure to the domestic economy might intensify the linkage.

4 Conclusion

Considering that banks and sovereigns are prominently intertwined, the vulnerabilities in one sector intensify the transmission of the tension to the other sector, creating an adverse feedback loop. In the past, the linkage between both has given rise to pressure regarding the financial system's stability.

In light of banks' tendency to keep large concentrations of their home country sovereign debt on their balance sheets, this work investigated how banks responded, in more recent years,

to capital and profitability deteriorations as well as to increases in sovereign bond yield spreads. This biased allocation was particularly heightened during the sovereign debt crisis and very debated in combination with the following topics: moral suasion, moral hazard and risk-shifting, and the engagement in carry trades. The results suggest that, on average, during the Q4 2014 to Q2 2020 period, GIIPS banks responded to increases in their home country sovereign bond yield spreads and decreases in profitability with increases in the domestic sovereign debt holdings. These findings support the view that less profitable banks might show excess risk taking and seek for high-yield debt, increasing even further the concentration of home country sovereign debt. That riskier behavior is not disincentivized by the prudential regulation that still does not address the home bias issue in order to reduce the exposure to sovereign risk. For instance, regardless of the risk, zero risk-weights are still assigned to EU sovereign bonds and no large exposure limits are imposed.

Secondly, it is also shown that during the same period, banks' solvency was connected to their home country sovereign bond yield spreads. However, it was also noticeable that banks' vulnerability to higher concentrations of sovereign debt securities has been limited. One of the main explanations stems from the accounting treatment of the sovereign exposures, considering that a large share is subject to amortized cost accounting. Moreover, considering that prudential filters for sovereign bond exposures were temporarily introduced as a response to the COVID-19 pandemic, it has also become clear that diminishing the impact of the volatility of market valuations on capital adequacy is a major concern. Nonetheless, in turn, that could be translated in an encouragement to increase the exposure to high-yield sovereign debt, also considering the accessible central bank funding, reinforcing the sovereign-bank nexus.

Lastly, using CDS data, it was found that a sovereign-bank linkage is still in place both in the GIIPS and non-GIIPS countries. In particular, it was revealed that, with respect to the 2017 to Q3 2020 period, Granger causality is only significant in one of the directions, from the

sovereign to the banking sector. The analysis of the impulse response functions indicated that the impact of a sovereign shock has significant lingering effects on the banks' creditworthiness, in particular in the GIIPS.

Overall, the results suggest that the sovereign-bank nexus could potentially be reinforced. Considering the economic challenges brought by COVID-19 and the unavoidable impact on the European banking sector, along with the increasing sovereign exposures, the concerns about the nexus that have been reemerging should be addressed. In particular, the significant rise of sovereign indebtedness resulting from the fiscal measures aimed at supporting the economy is one of the channels that can potentially lead to the resurgence of the sovereign-bank nexus. However, a precipitated removal of the fiscal support could compromise the economic recovery. Nonetheless, despite the massive shock of COVID-19, both the impact on CDS and sovereign debt spreads remained modest when compared to the sovereign debt crisis. That limited effect might be a result of the improved resilience and strength of the European banking sector and the confidence on the European institutions commitment to contain the disruption. In order to diminish the risk of intertwined crisis, the efforts to provide a coordinated response instead of keeping it at a national level are imperative. Considering banks' capacity to absorb the losses and maintain their capital adequacy, it is concluded that the Banking Union has passed the first significant test suddenly dictated by the outbreak of COVID-19.

With respect to future research, this work could be extended to a broader set of countries and include the COVID-19 crisis period. Considering the limitations regarding data availability, next steps would involve the incorporation of individual banking data.

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6 Appendix

6.1 Context

The call for the Banking Union materialized with the financial crisis of 2008 and the following sovereign debt crisis which uncovered the close link between the vulnerabilities of sovereigns and the weaknesses of the banking sector. Considering the interdependence between EU countries as well as the possibility of spillover effects and contagion, the necessity of a more integrated banking system became a priority. In 2012, the European Commission developed "A Roadmap towards a Banking Union" which advocated a more integrated financial framework (European Commission, 2012). The first pillar of the Banking Union - the Single Supervisory Mechanism (SSM) - became fully operational in 2014. Since then, the ECB is responsible for the direct supervision of significant institutions (SIs) while the national competent authorities (NCAs) supervise, in close cooperation with the ECB, the less significant institutions (LSIs). The second pillar of the Banking Union - the Single Resolution Mechanism (SRM) – became fully operational in 2016. The SRM aims to guarantee an orderly resolution of failing banks while minimizing costs for taxpayers and to the real economy. The SRM ensures that bank failures are managed efficiently through a Single Resolution Board (SRB) and a Single Resolution Fund (SRF). In addition, the Single Rulebook provides a set of EU laws consistently applied across the Euro Area and in other participating countries. This package comprises rules on capital requirements, recovery and resolution processes and national deposit guarantee schemes. At the moment, although the first two pillars of the Banking Union are fully operational – the SSM and the SRM - a third pillar which envisages a common system for deposit protection is still missing owing to meaningful discrepancies between the Member States. In 2015, the establishment of a European Deposit Insurance Scheme (EDIS) was proposed by the European Commission as the third pillar of the Banking Union (European Commission, 2015). The home bias is one of the blockages since some

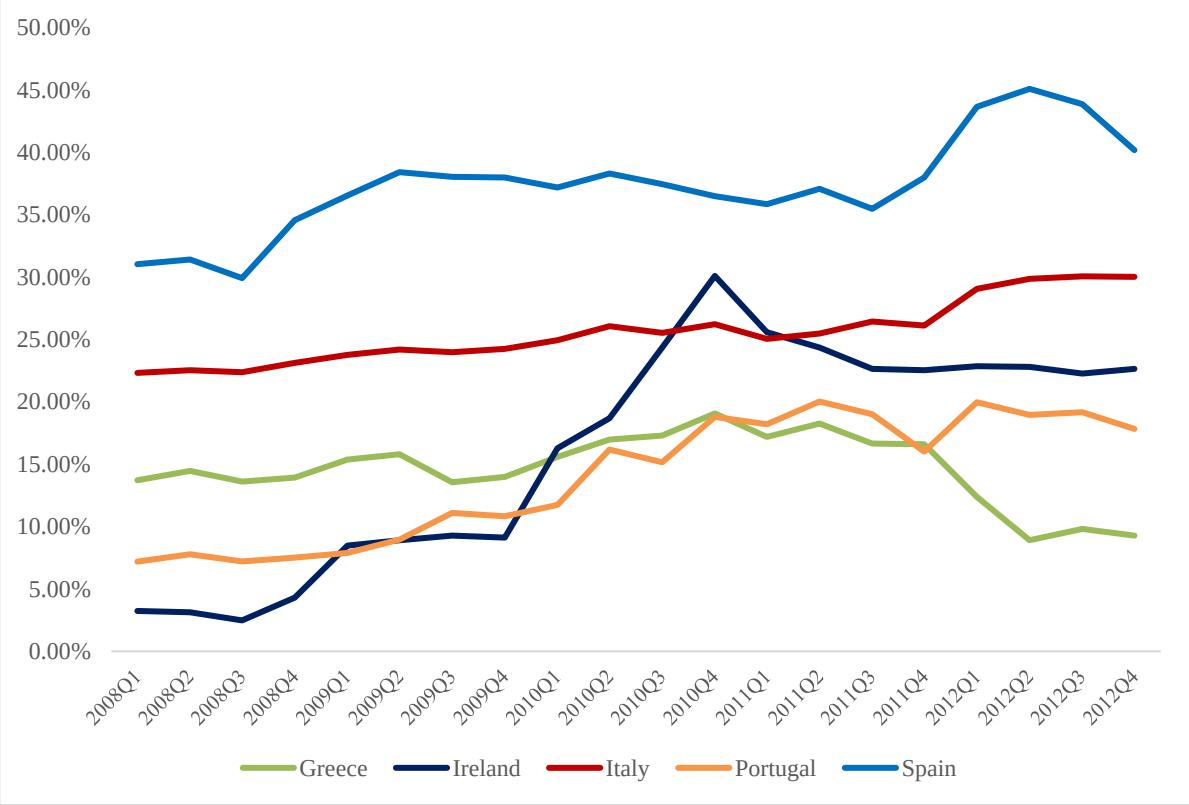
countries fear that deposits protected by EDIS would be used by domestic banks, under moral suasion from their respective home countries, to fund the purchase of large quantities of government debt (Véron, 2017). The fact that deposits are not yet homogeneously protected at the European level leaves the Banking Union project incomplete. Not only does it remain unfinished but its aim of breaking the sovereign-bank nexus has not been achieved. In particular, the home bias problem is still supporting the prominent link between banks and sovereigns since banks still show a strong preference towards domestic sovereign exposures.

Besides highlighting the necessity of strengthening the cooperation of monetary, fiscal and supervisory authorities, the financial crisis also revealed banks' weak capacity to absorb losses, the inadequacy of the capital requirements, the poor liquidity and risk management and the insufficient governance (European Commission, 2013). Therefore, these issues and adequate supervisory thresholds became part of the agenda as well. Accordingly, the Basel III was agreed in 2010 in order to address the precedent shortcomings of Basel II and, two legal acts – the Capital Requirements Directive 2013/36/EU (CRD IV) and the Capital Requirements Regulation 575/2013 (CRR) - entered into force in 2014. In 2019, CRD V and CRR II, which finetuned and continued to implement Basel III by making key amendments, were introduced. The package will be generally applied starting as of mid-2021.

Regardless of how effective the implementation of the SSM and the SRM was, there are still sovereign-bank linkages in place. The ongoing discussions regarding possible solutions to diminish the nexus and strengthen the Banking Union include the EDIS and sovereign exposure concentration charges (Véron, 2017). The latter would address the home bias problem by modifying the CRR.

6.2 Figures

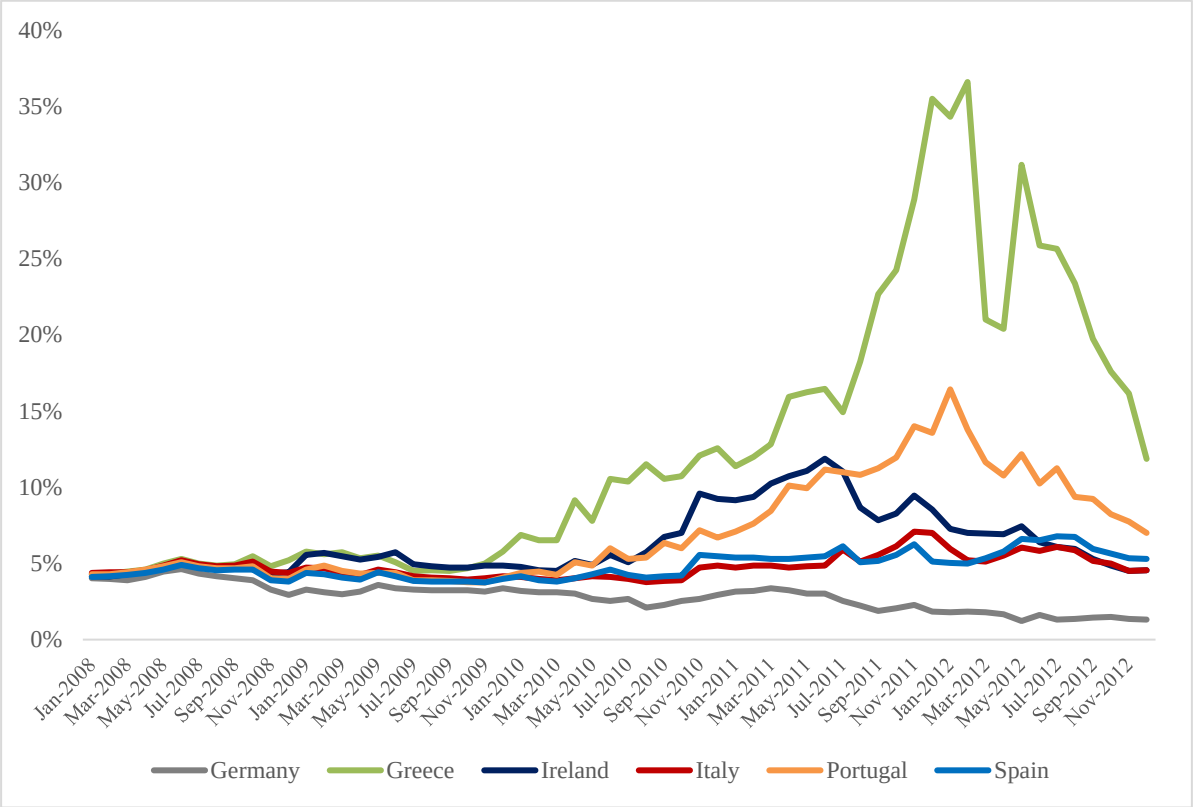
Figure A1: Share of domestic debt out of the total debt held (quarterly)



Note: Figure A1 plots the general government gross debt held by domestic banks as a percentage of the total debt in the period from Q1 2008 to Q4 2012 for the GIIPS. The domestic debt covers both loans and securities and the total debt held covers currency and deposits, loans and securities.

Source: IMF dataset that tracks the global demand for advanced economy sovereign debt.

Figure A2: 10-year government benchmark bond yields (monthly)



Note: Figure A2 plots the monthly 10-year government benchmark bond yields for the GIIPS as well as for Germany in the period from January 2008 to December 2012.

Source: Refinitiv Eikon.

Figure A3.1: Holdings of general government debt (quarterly)

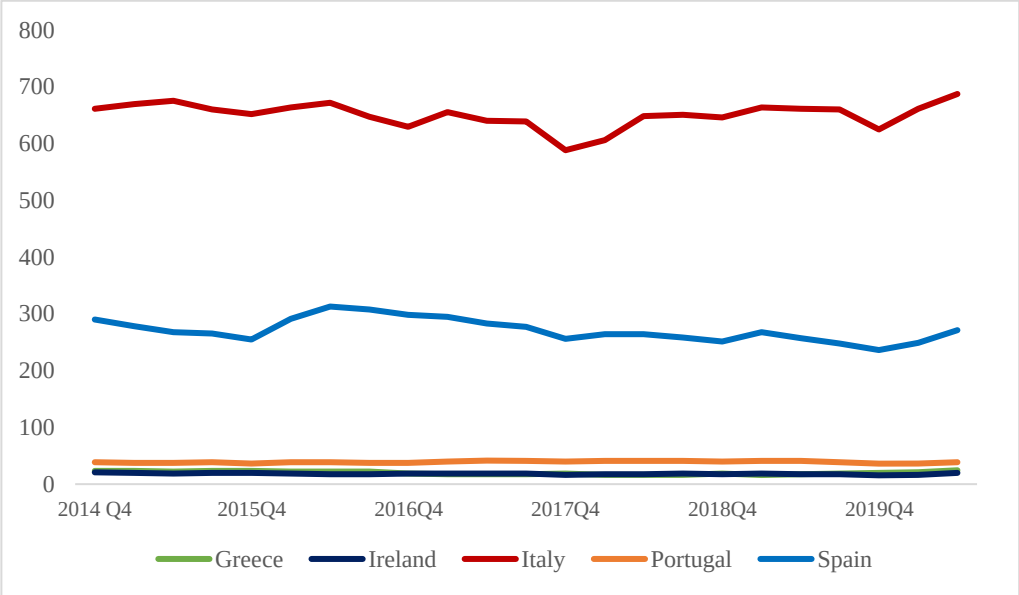
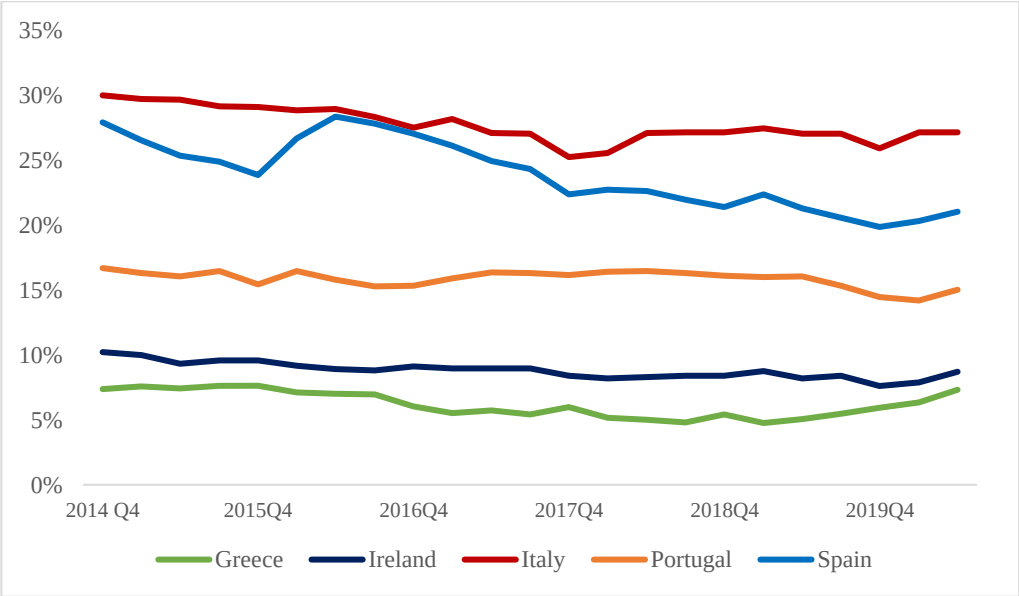


Figure A3.2: Share of domestic debt out of the total debt held (quarterly)



Note: Figure A3.1 plots the general government gross debt held by domestic banks in the period from Q2 2014 to Q2 2020 for the GIIPS, in billions of euros. Figure A3.2 plots the holdings of general government gross debt as a percentage of the total debt held by domestic banks during the same period for the GIIPS. The domestic debt covers both loans and securities and the total debt held covers currency and deposits, loans and securities.

Source: IMF dataset that tracks the global demand for advanced economy sovereign debt.

Figure A4.1: Holdings of general government debt (quarterly)

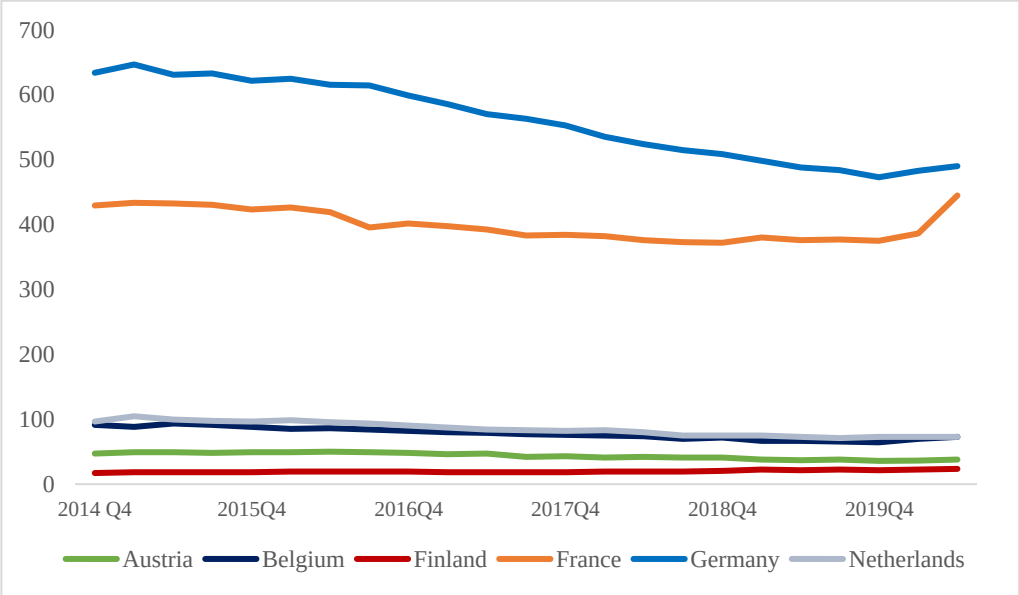
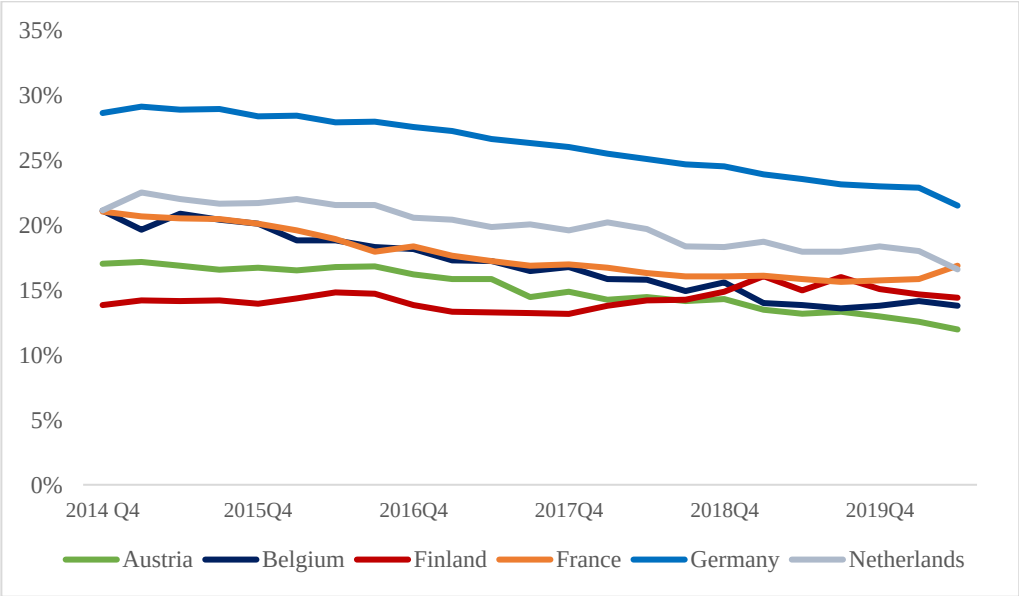


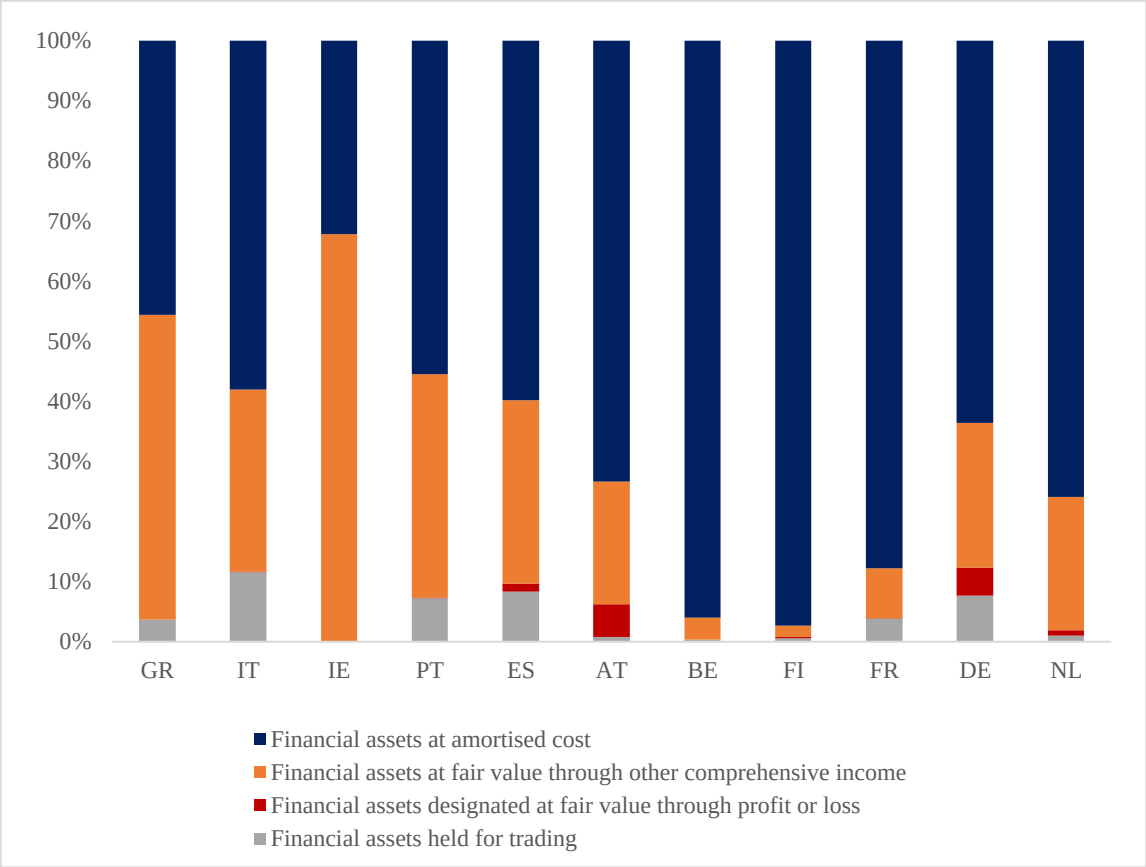
Figure A4.2: Share of domestic debt out of the total debt held (quarterly)



Note: Figure A4.1 plots the general government gross debt held by domestic banks in the period from Q2 2014 to Q2 2020 for the GIIPS, in billions of euros. Figure A4.2 plots the holdings of general government gross debt as a percentage of the total debt held by domestic banks during the same period for the non-GIIPS. The domestic debt covers both loans and securities and the total debt held covers currency and deposits, loans and securities.

Source: IMF dataset that tracks the global demand for advanced economy sovereign debt.

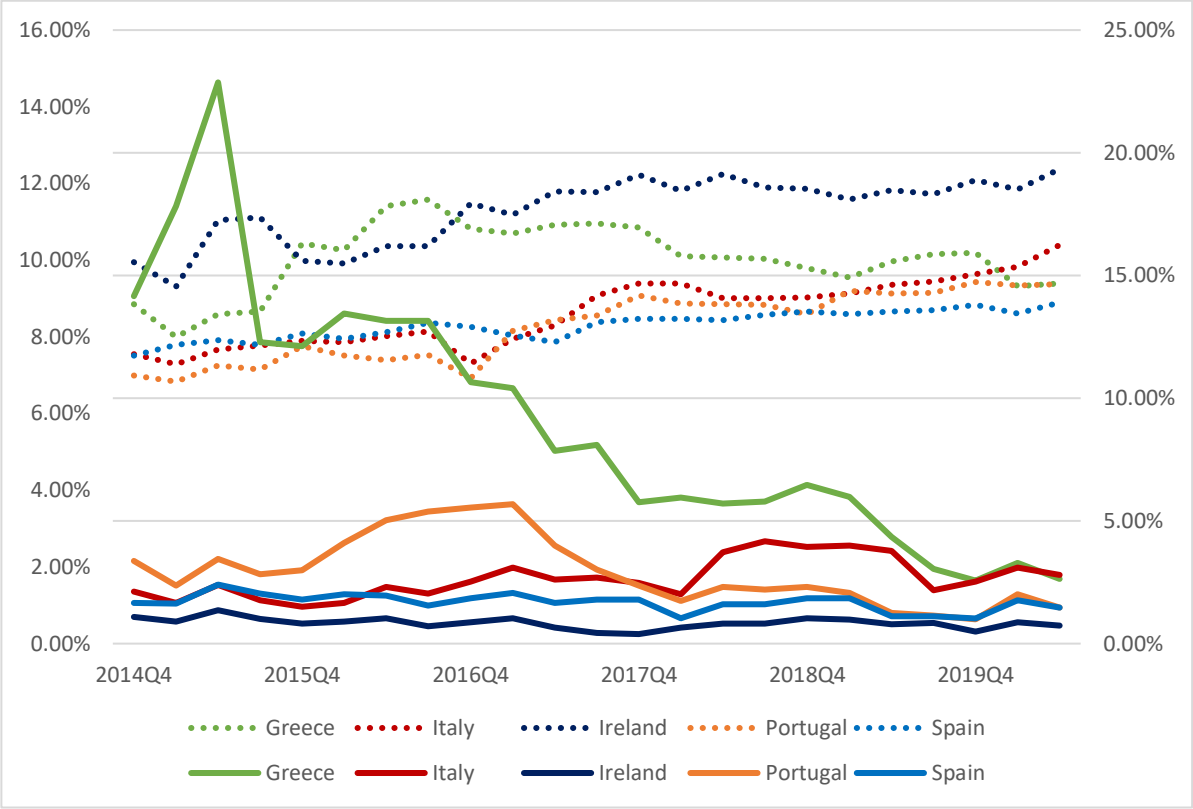
Figure A5: Accounting classification for domestic sovereign exposures



Note: Figure A5 plots the percentage of direct domestic sovereign exposures, on balance sheet, according to the accounting classification used, for Greece, Italy, Ireland, Portugal, Spain, Austra, Belgium, Finland, France, Germany and Netherlands. The measure used is the total gross carrying amount of non-derivative finantial assets (net of short positions). The sovereign exposures have a reference date of December 2019.

Source: EBA Spring Transparency Test 2020.

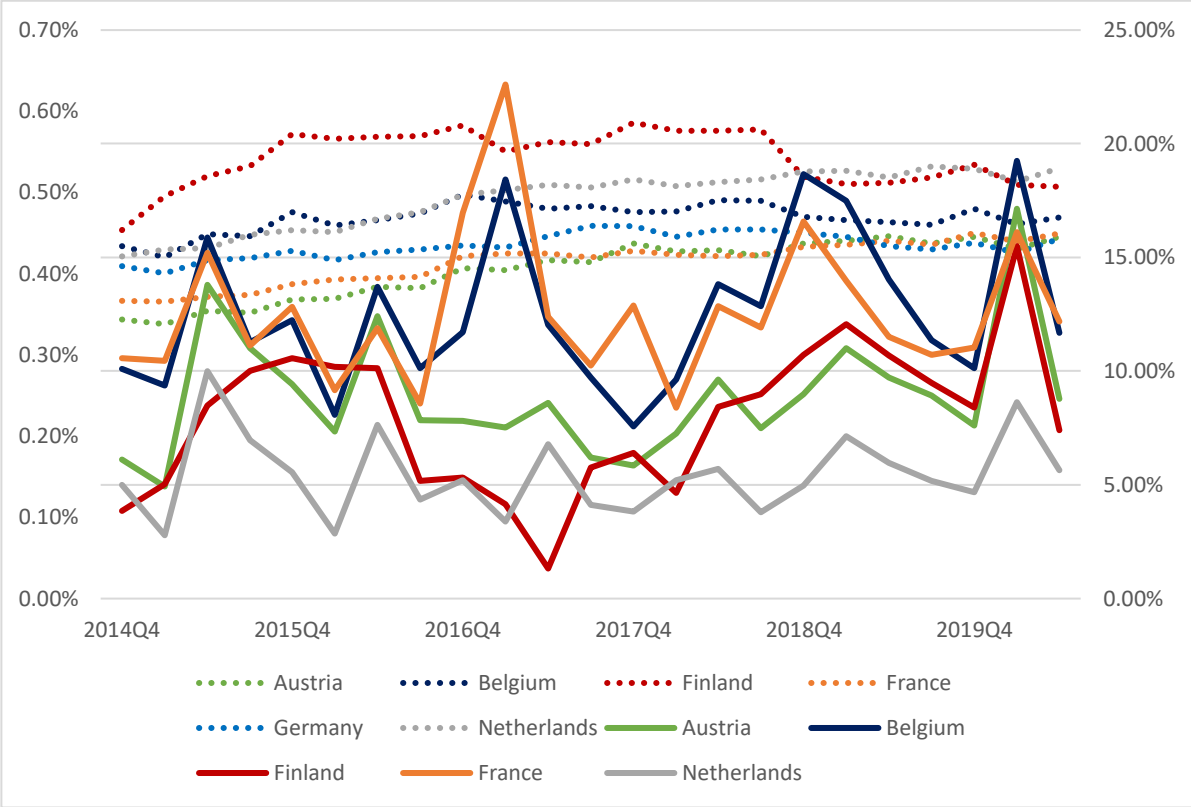
Figure A6: Sovereign bond yield spread and Tier 1 ratio (quarterly)



Note: Figure A6 plots the spread of the sovereign 10-year bond yields over the German 10-year bond yield (LHS, solid lines) and the aggregated tier 1 ratio (RHS, dot lines) for the GIIPS in the period from Q4 2014 to Q2 2020.

Source: ECB Statistical Data Warehouse and Refinitiv Eikon.

Figure A7: Sovereign bond yield spread and tier 1 ratio (quarterly)

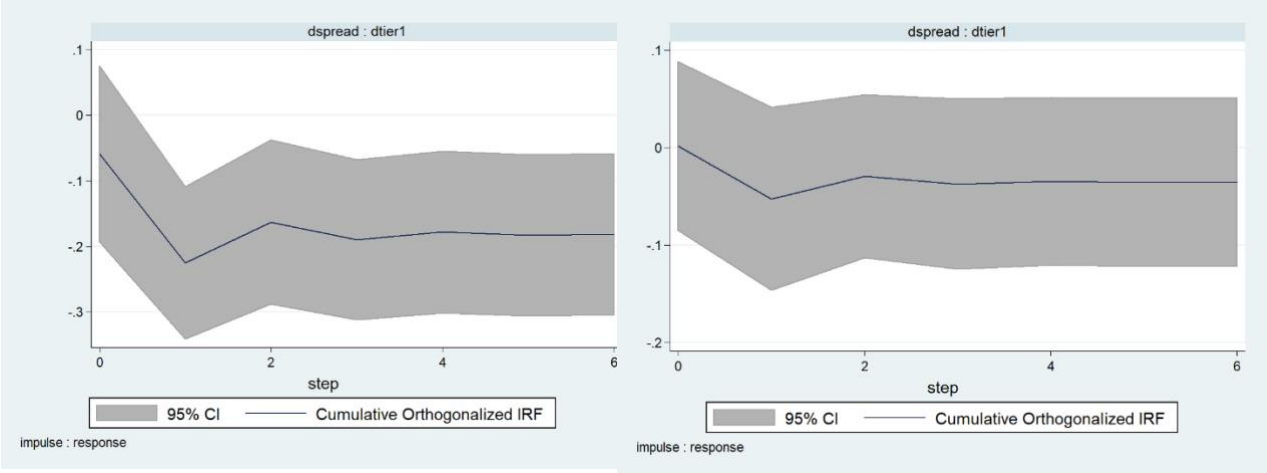


Notes: Figure A7 plots the spread of the sovereign 10-year bond yields over the German 10-year bond yield (LHS, solid lines) and the aggregated tier 1 ratio (RHS, dot lines) for the non-GIIPS in the period from Q4 2014 to Q2 2020.

Source: ECB Statistical Data Warehouse and Refinitiv Eikon.

Figure A8: Impulse response functions

GIIPS	Non-GIIPS
(1)	(2)



Note: Figure A8 plots the impulse reaction functions (IRF) in the period from Q4 2014 to Q2 2020. Column (1) shows the cumulative IRF for the GIIPS and column (2) the cumulative IRF for the non-GIIPS countries. The IRF confidence intervals are computed using 200 Monte Carlo draws from the distribution of the panel VAR model with clustered errors at country level. The impulse variable corresponds to $\Delta Spread$, which is the quarterly change in the spread of sovereign 10-year bond yields over the German 10-year bond yield, and the response variable denotes $\Delta Tier1$, which represents the quarterly change of the consolidated tier 1 ratio.

Figure A9.1: Sovereign CDS (weekly)

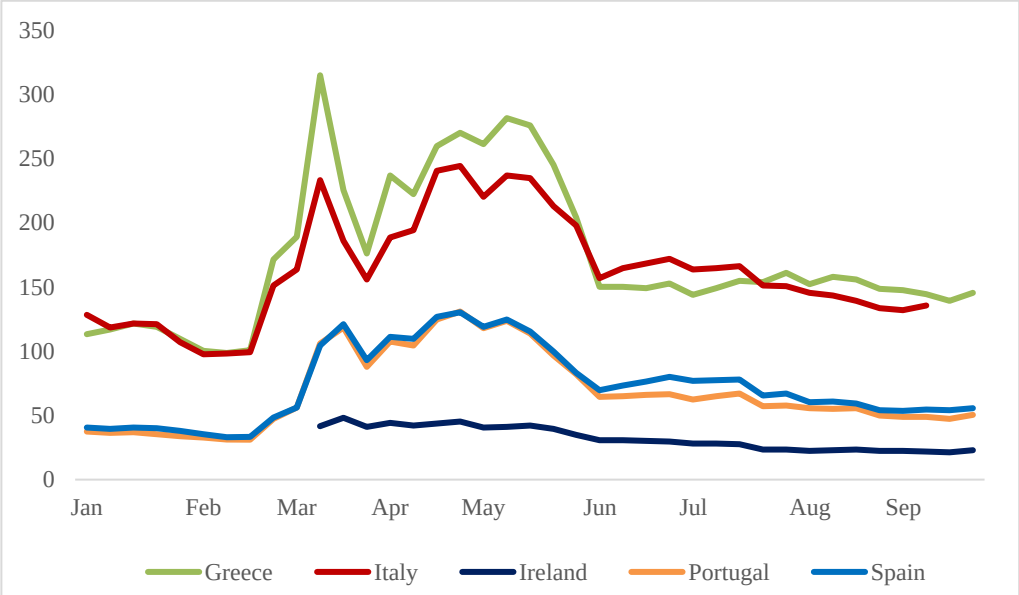
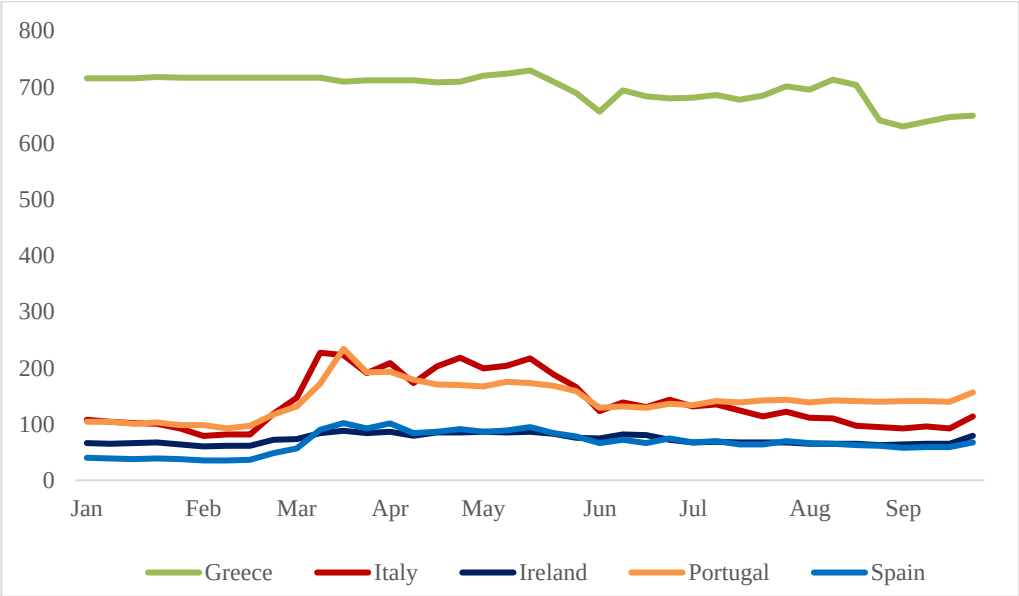


Figure A9.2: Weighted average bank CDS (weekly)



Note: Figure A9.1 plots the weekly 5-year senior unsecured sovereign CDS spreads in basis points since the start of 2020 until the third quarter of 2020 for the GIIPS. Figure A9.2 plots the weekly weighted average of 5-year senior unsecured bank CDS spreads in basis points since the beginning of 2020 until the end of the third quarter of 2020 for the GIIPS. The selection of the banks was based on the Spring 2020 EBA transparency exercise. Table A11 shows the list of the banks included. The weighted average was computed for each country with the weights based on the banks' total assets as of end-2019.

Source: Bloomberg.

Figure A10.1: Sovereign CDS (weekly)

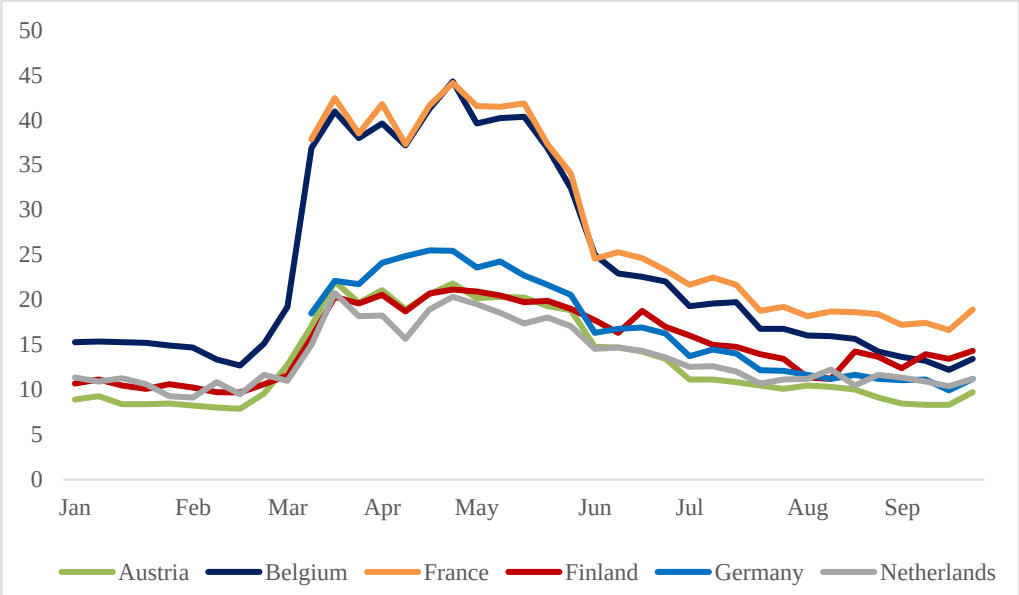
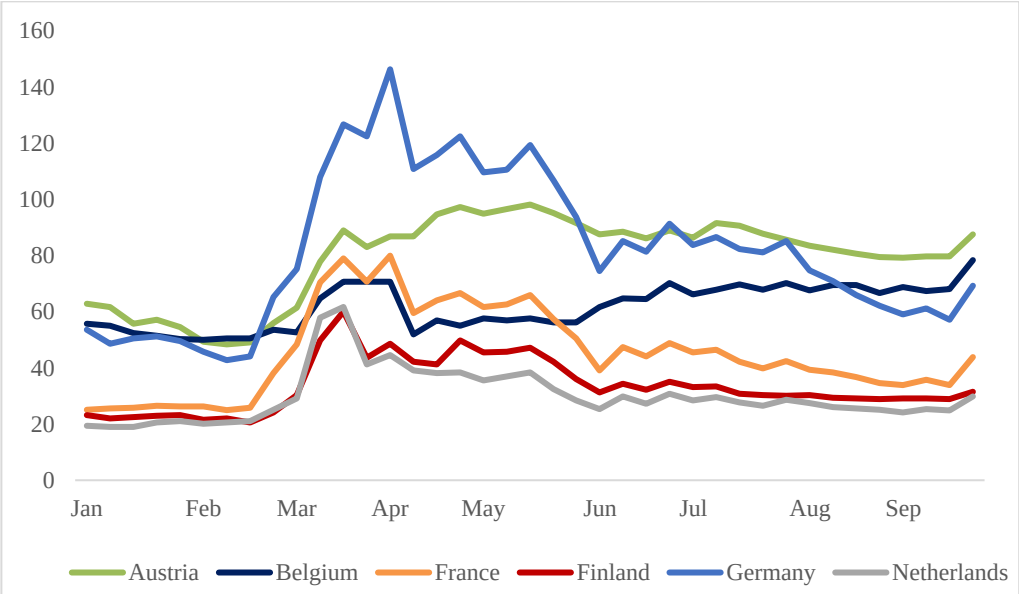


Figure A10.2: Weighted average bank CDS (weekly)

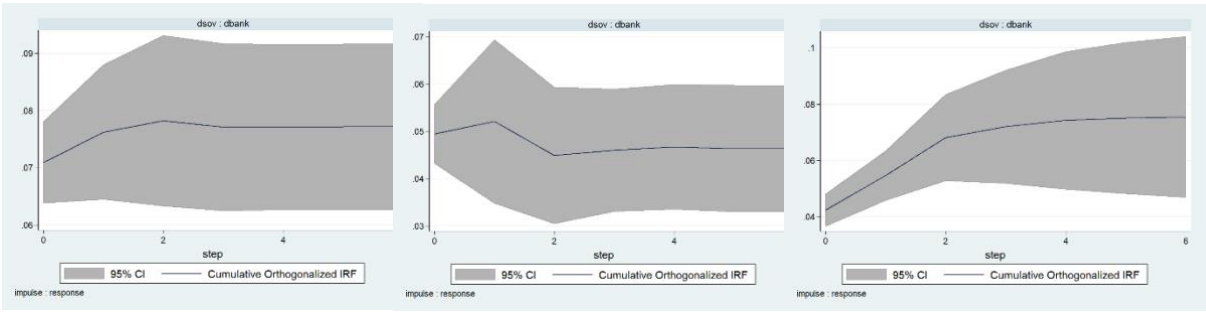


Note: Figure A10.1 plots the weekly 5-year senior unsecured sovereign CDS spreads in basis points since the start of 2020 until the third quarter of 2020 for the non-GIIPS countries. Figure A10.2 plots the weekly weighted average of 5-year senior unsecured bank CDS spreads in basis points since the beginning of 2020 until the end of the third quarter of 2020 for the non-GIIPS countries. The selection of the banks was based on the Spring 2020 EBA transparency exercise. Table 11 shows the list of the banks included. The weighted average was computed for each country with the weights based on the banks' total assets as of end-2019.

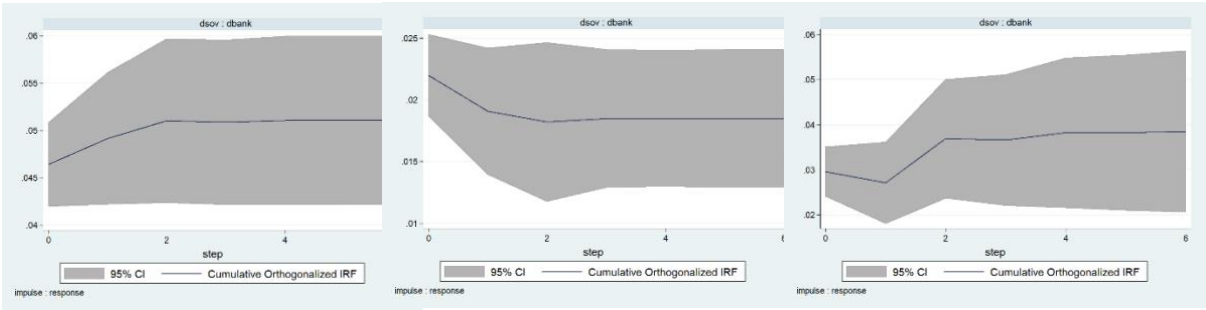
Source: Bloomberg

Figure A11: Impulse response functions

Panel A: GIIPS		
2009-2012	2013-2016	2017-2020
(1)	(2)	(3)



Panel B: Non-GIIPS		
2009-2012	2013-2016	2017-2020
(4)	(5)	(6)



Note: Figure A11 plots the impulse reaction functions (IRF). Panel 1 shows the cumulative IRF for the GIIPS and Panel B the cumulative IRF for the non-GIIPS countries. Columns (1) and (4), (2) and (5), and (3) and (6) present the results for three periods, 2009-2012, 2013-2016 and 2017- Q3 2020, respectively. The IRF confidence intervals are computed using 200 Monte Carlo draws from the distribution of the panel VAR model with robust errors. The impulse variable corresponds to $\Delta Log(Sovereign\ CDS)$, which is the weekly logarithmic change in sovereign CDS and the response variable denotes $\Delta Log(Bank\ CDS)$, which represents the weekly logarithmic change in bank CDS.

6.3 Tables

Table A1: Summary Statistics

		Panel A: GIIPS				
		Mean	Std. Dev.	Min	Max	Observations
Home Bias (%)	overall	16.52%	8.49%	4.76%	30.02%	N = 115
	between		9.31%	6.21%	27.74%	n = 5
	within		1.44%	12.45%	20.95%	T = 23
Holdings	overall	199.885	246.153	15.544	687.439	N = 115
	between		273.607	18.365	650.514	n = 5
	within		13.324	137.713	241.176	T = 23
CET1 (%)	overall	13.97%	2.16%	10.67%	18.38%	N = 115
	between		2.07%	12.27%	16.73%	n = 5
	within		1.12%	10.78%	16.40%	T = 23
ROE (%)	overall	1.20%	5.41%	-24.23%	8.27%	N = 115
	between		3.64%	-4.41%	4.17%	n = 5
	within		4.31%	-18.62%	7.76%	T = 23
Spread	overall	2.19	2.42	0.25	14.64	N = 115
	between		2.07	0.53	5.78	n = 5
	within		1.55	-1.94	11.05	T = 23
Δ Home Bias (%)	overall	0.12%	0.69%	-2.82%	1.98%	N = 110
	between		0.12%	0.00%	0.31%	n = 5
	within		0.68%	-3.01%	1.81%	T = 22
Δ Holdings	overall	0.0003	0.0568	-0.1544	0.1441	N = 110
	between		0.0023	-0.0018	0.0030	n = 5
	within		0.0567	-0.1566	0.1418	T = 22
Δ CET1 (%)	overall	0.09%	0.69%	-2.16%	2.82%	N = 110
	between		0.06%	0.04%	0.17%	n = 5
	within		0.69%	-2.16%	2.88%	T = 22
Δ ROE (%)	overall	-0.07%	4.71%	-21.48%	24.57%	N = 110
	between		0.42%	-0.58%	0.33%	n = 5
	within		4.70%	-21.88%	24.17%	T = 22
Δ Spread	overall	-0.08	0.87	-6.77	3.22	N = 110
	between		0.15	-0.34	0.02	n = 5
	within		0.86	-6.51	3.48	T = 22

Note: This table includes summary statistics on bank indicators, government debt holdings and sovereign bond yield spreads, with respect to the GIIPS, in the period from Q4 2014 to Q2 2020.

Source: ECB Statistical Data Warehouse, IMF dataset that tracks the global demand for advanced economy sovereign debt and Refinitiv Eikon.

Table A2: Summary Statistics

		Panel A: Non-GIIPS				
		Mean	Std. Dev.	Min	Max	Observations
Home Bias (%)	overall	18.35%	4.34%	11.97%	29.15%	N = 138
	between		4.29%	14.33%	26.10%	n = 6
	within		1.85%	13.77%	22.54%	T = 23
Holdings	overall	197.92	208.59	17.14	646.97	N = 138
	between		225.80	19.80	560.73	n = 6
	within		26.67	110.31	284.16	T = 23
CET1 (%)	overall	15.40%	1.86%	11.74%	20.28%	N = 138
	between		1.72%	13.61%	18.47%	n = 6
	within		0.99%	12.85%	17.22%	T = 23
ROE (%)	overall	4.28%	2.91%	-1.95%	12.25%	N = 138
	between		1.53%	1.50%	6.04%	n = 6
	within		2.55%	-2.04%	10.48%	T = 23
Spread	overall	0.22	0.14	0.00	0.63	N = 138
	between		0.13	0.00	0.35	n = 6
	within		0.07	0.04	0.50	T = 23
Δ Home Bias (%)	overall	0.21%	0.53%	-1.40%	1.58%	N = 132
	between		0.13%	-0.03%	0.33%	n = 6
	within		0.52%	-1.40%	1.46%	T = 22
Δ Holdings	overall	0.0049	0.0325	-0.1400	0.0947	N = 132
	between		0.0108	-0.0144	0.0124	n = 6
	within		0.0309	-0.1335	0.0890	T = 22
Δ CET1 (%)	overall	0.09%	0.49%	-2.90%	1.50%	N = 132
	between		0.05%	0.04%	0.15%	n = 6
	within		0.49%	-2.85%	1.55%	T = 22
Δ ROE (%)	overall	-0.14%	3.52%	-10.40%	4.06%	N = 132
	between		0.19%	-0.37%	0.14%	n = 6
	within		3.52%	-10.17%	4.24%	T = 22
Δ Spread	overall	0.00	0.10	-0.29	0.27	N = 132
	between		0.00	0.00	0.00	n = 6
	within		0.10	-0.29	0.27	T = 22

Note: This table includes summary statistics on bank indicators, government debt holdings and sovereign bond yield spreads, with respect to the non-GIIPS, in the period from Q4 2014 to Q2 2020.

Source: ECB Statistical Data Warehouse, IMF dataset that tracks the global demand for advanced economy sovereign debt and Refinitiv Eikon.

Table A3: Relationship between the main risks and vulnerabilities of the EU banking sector and the domestic sovereign debt holdings

	Δ Home Bias (%)		Δ log(Holdings)	
	GIIPS	Non-GIIPS	GIIPS	Non-GIIPS
	(1)	(2)	(3)	(4)
Δ CET1 ratio (%)				
L0	0.1295	-0.1340	0.0191	-0.0048
L1	0.0644	-0.2001	0.0089	-0.0172 **
L2	0.0240	0.1606	-0.0029	0.0097
Δ ROE (%)				
L0	-0.0675	0.0170	-0.0078 *	-0.0016
L1	-0.0628 *	0.0296 *	-0.0054 ***	-0.0001
L2	-0.0258 **	0.0140	-0.0031 **	0.0007
Δ Spread				
L0	0.1286	0.7389	0.0102 *	0.0478
L1	0.1257 **	0.0119	0.0165 ***	0.0641 *
L2	-0.1288	0.0496	-0.0119	0.0344
Observations	100	120	100	120
Countries	5	6	5	6
R-squared	14.75%	15.91%	22.25%	28.98%

Note: This table shows the effect of the changes of two bank risk indicators and sovereign bond spread variations on the changes in the home bias measure and in the domestic sovereign debt holdings, in the period from Q4 2014 to Q2 2020. Columns (1) and (3) presents the results for the GIIPS domestic banks and columns (2) and (4) presents for the non-GIIPS. The first dependent variable, *Home Bias*, represents the share of domestic government debt holdings out of total government debt holdings for the domestic banks from each country. The second dependent variable, *Holdings*, represents the domestic government debt holdings for the domestic banks from each country in billions of Euros. The set of independent variables includes: the Common Equity Tier 1 ratio (*CET1*), the return on equity ratio (*ROE*) and the spread of sovereign 10-year bond yields over the German 10-year bond yield (*Spread*). L0, L1 and L2 represent the contemporaneous value, the first lag and the second lag, respectively, of the explanatory variables included in the model. The regressions include country fixed effects. Standard errors are clustered at country level. ***, **, and * indicates statistical significance at the 1%, 5%, and 10% level, respectively.

Source: ECB Statistical Data Warehouse, IMF dataset that tracks the global demand for advanced economy sovereign debt and Refinitiv Eikon.

Table A4: Summary Statistics

		Mean	Std. Dev.	Min	Max	Observations	
Spread	overall	2.19	2.42	0.25	14.64	N =	115
	between		2.07	0.53	5.78	n =	5
	within		1.55	-1.94	11.05	T =	23
Tier1 ratio (%)	overall	14.5%	2.2%	10.7%	19.3%	N =	115
	between		2.1%	12.9%	17.6%	n =	5
	within		1.3%	11.4%	17.3%	T =	23
RWA ratio (%)	overall	53.4%	8.8%	39.5%	73.1%	N =	115
	between		9.2%	45.3%	66.6%	n =	5
	within		2.9%	45.9%	59.9%	T =	23
Provisions ratio (%)	overall	0.8%	0.3%	0.3%	1.3%	N =	115
	between		0.2%	0.4%	1.0%	n =	5
	within		0.2%	0.5%	1.5%	T =	23
Fair Value ratio (%)	overall	0.0%	0.0%	-0.1%	0.1%	N =	115
	between		0.0%	0.0%	0.0%	n =	5
	within		0.0%	-0.1%	0.1%	T =	23
Trading ratio (%)	overall	0.0%	0.1%	-0.1%	0.1%	N =	115
	between		0.0%	0.0%	0.0%	n =	5
	within		0.0%	-0.1%	0.1%	T =	23
CDS	overall	379.49	536.89	41.18	3399.63	N =	115
	between		496.64	91.68	1255.64	n =	5
	within		298.66	-196.91	2523.48	T =	23
Δ Spread	overall	-0.08	0.87	-6.77	3.22	N =	110
	between		0.15	-0.34	0.02	n =	5
	within		0.86	-6.51	3.48	T =	22
Δ Tier1 ratio (%)	overall	0.14%	0.71%	-1.77%	2.77%	N =	110
	between		0.07%	0.04%	0.20%	n =	5
	within		0.70%	-1.80%	2.87%	T =	22
Δ RWA ratio (%)	overall	-0.24%	1.06%	-4.14%	3.35%	N =	110
	between		0.26%	-0.44%	0.16%	n =	5
	within		1.04%	-4.53%	2.96%	T =	22
Δ Provisions ratio (%)	overall	-0.01%	0.13%	-0.88%	0.34%	N =	110
	between		0.01%	-0.03%	0.00%	n =	5
	within		0.13%	-0.86%	0.36%	T =	22
Δ Fair Value ratio (%)	overall	0.00%	0.03%	-0.08%	0.20%	N =	110
	between		0.00%	0.00%	0.01%	n =	5
	within		0.03%	-0.09%	0.19%	T =	22
Δ Trading ratio (%)	overall	0.00%	0.05%	-0.19%	0.09%	N =	110
	between		0.00%	0.00%	0.01%	n =	5
	within		0.05%	-0.19%	0.09%	T =	22
Δ log(CDS)	overall	-2.06	302.35	-1629.60	1827.57	N =	110
	between		3.10	-6.12	1.19	n =	5
	within		302.34	-1631.24	1825.93	T =	22

Note: This table includes summary statistics on bank consolidated data as well as on spreads of sovereign 10-year bond yields over the German 10-year bond yield, in the period from Q4 2014 to Q2 2020, for the GIIPS.

Source: ECB Statistical Data Warehouse, Bloomberg and Refinitiv Eikon.

Table A5: Summary Statistics

		Mean	Std. Dev.	Min	Max	Observations	
Spread	overall	0.22	0.14	0.00	0.63	N =	138
	between		0.13	0.00	0.35	n =	6
	within		0.07	0.04	0.50	T =	23
Tier1 ratio (%)	overall	16.41%	1.99%	12.07%	20.93%	N =	138
	between		1.85%	14.49%	19.35%	n =	6
	within		1.03%	13.27%	17.99%	T =	23
RWA ratio (%)	overall	36.00%	6.55%	28.92%	50.70%	N =	138
	between		7.01%	30.21%	49.01%	n =	6
	within		1.32%	32.51%	39.50%	T =	23
Provisions ratio (%)	overall	0.47%	0.36%	0.00%	1.08%	N =	138
	between		0.38%	0.07%	0.97%	n =	6
	within		0.06%	0.34%	0.61%	T =	23
Fair Value ratio (%)	overall	0.01%	0.09%	-0.37%	0.35%	N =	138
	between		0.01%	-0.01%	0.02%	n =	6
	within		0.08%	-0.35%	0.36%	T =	23
Trading ratio (%)	overall	0.05%	0.09%	-0.29%	0.43%	N =	138
	between		0.05%	-0.01%	0.14%	n =	6
	within		0.08%	-0.38%	0.34%	T =	23
CDS	overall	71.97	36.19	19.48	221.39	N =	138
	between		25.15	48.63	114.16	n =	6
	within		27.91	12.63	179.20	T =	23
Δ Spread	overall	0.00	0.10	-0.29	0.27	N =	132
	between		0.00	0.00	0.00	n =	6
	within		0.10	-0.29	0.27	T =	22
Δ Tier1 ratio (%)	overall	0.11%	0.47%	-2.07%	1.48%	N =	132
	between		0.05%	0.05%	0.18%	n =	6
	within		0.47%	-2.04%	1.51%	T =	22
Δ RWA ratio (%)	overall	-0.09%	1.04%	-4.10%	2.22%	N =	132
	between		0.14%	-0.29%	0.07%	n =	6
	within		1.03%	-3.89%	2.36%	T =	22
Δ Provisions ratio (%)	overall	0.00%	0.04%	-0.11%	0.20%	N =	132
	between		0.01%	-0.01%	0.01%	n =	6
	within		0.04%	-0.12%	0.19%	T =	22
Δ Fair Value ratio (%)	overall	0.00%	0.10%	-0.34%	0.71%	N =	132
	between		0.00%	0.00%	0.01%	n =	6
	within		0.10%	-0.35%	0.71%	T =	22
Δ Trading ratio (%)	overall	-0.01%	0.10%	-0.72%	0.29%	N =	132
	between		0.00%	-0.01%	0.00%	n =	6
	within		0.10%	-0.71%	0.28%	T =	22
Δ log(CDS)	overall	-1.32	19.04	-51.89	70.67	N =	132
	between		1.70	-4.50	0.21	n =	6
	within		18.98	-52.05	73.84	T =	22

Note: This table includes summary statistics on bank consolidated data as well as on spreads of sovereign 10-year bond yields over the German 10-year bond yield, in the period from Q4 2014 to Q2 2020, for the non-GIIPS countries.

Source: ECB Statistical Data Warehouse, Bloomberg and Refinitiv Eikon.

Table A6: Relationship between the tier 1 ratio and sovereign spreads

	GIIPS (1)	Non-GIIIPS (2)
Δ Tier 1 ratio		
Δ Tier 1 ratio L1	-0.2062 ***	-0.0785
Δ Spread L1	-0.2185 ***	-0.6138 **
Δ Spread		
Δ Tier 1 ratio L1	-0.2502 **	0.0135 *
Δ Spread L1	-0.1761 ***	-0.3502 ***
Observations	100	120
Countries	5	6
Hansen's J statistic	3.15E-33	8.35E-32

Note: This table shows the results of panel autoregressions, whose dependent variables denotes the aggregated tier 1 ratio and the sovereign spread, in the period from Q4 2014 to Q2 2020. Column (1) presents the results for the GIIPS countries and column (2) shows the results for the non-GIIPS countries. Δ*Tier1* is the quarterly change of the consolidated tier 1 ratio and Δ*Spread* is the quarterly change in the spread of sovereign 10-year bond yields over the German 10-year bond yield. L1 represents the first lag of the dependent variables included in the model. Standard errors are clustered at country level. ***, **, and * indicates statistical significance at the 1%, 5%, and 10% level, respectively.

Table A7: Relationship between bank indicators and sovereign spreads

	Δ RWA ratio	Δ Provisions ratio	Δ Fair Value ratio	Δ Trading ratio	Δ log(CDS)
	(1)	(2)	(3)	(4)	(5)
Panel A: GIIPS					
Δ Spread					
L0	0.0443	-0.0072	0.0076 **	-0.0010	-135.1591 **
L1	-	-	-	-	187.1378 ***
Observations	110	110	110	110	105
Countries	5	5	5	5	5
R-Squared	4.86%	0.01	4.96%	0.50%	56.42%
Panel B: Non-GIIPS					
Δ Spread					
L0	0.6685	0.0080	0.2606 *	-0.1832 *	63.1688 **
L1	-	-	-	-	17.4404
Observations	132	132	132	132	126
Countries	6	6	6	6	6
R-Squared	1.98%	2.75%	7.09%	3.48%	9.45%

Note: This table shows the effect of the changes in sovereign spreads on the changes in bank indicators in the period from Q4 2014 to Q2 2020. Column (1) presents the results for the GIIPS and column (2) shows the results for the non-GIIPS countries. The dependent variables are the following: Δ*RWA ratio*, the quarterly changes in risk-weighted assets over total assets; Δ*Provisions ratio*, the quarterly changes in provisions over total assets, Δ*Fair Value ratio*, the quarterly changes in gains and losses on financial assets and liabilities at fair value through profit and loss over total assets; Δ*Trading ratio*, the quarterly changes in gains and losses on financial assets held for trading and liabilities over total assets; and Δ*log(CDS)*, the quarterly changes in logarithm of bank CDS. For the latter, it was computed the quarterly weighted average of 5-year senior unsecured bank CDS spreads in basis points. The selection of the banks was based on the Spring 2020 EBA transparency exercise. Table A11 shows the list of the banks included. The weighted average was computed for each country with the weights based on the banks' total assets as of end-2019. The independent variable, Δ*Spread*, is the quarterly change in the spread of sovereign 10-year bond yields over the German 10-year bond yield. L0 and L1 represent the contemporaneous value and first lag, respectively, of the explanatory variable included in the model. The regressions include country fixed effects. Standard errors are clustered at country level. ***, **, and * indicates statistical significance at the 1%, 5%, and 10% level, respectively.

Table A8: Relationship between the tier 1 ratio and bank indicators

	GIIPS	Non-GIIIPS
	(1)	(2)
Δ Tier 1 ratio		
Δ RWA ratio	-0.1221 *	0.0417
Δ Provisions ratio	-1.5677 **	0.1235
Δ Fair Value ratio	-3.2639	0.7884
Δ Trading ratio	1.7462 **	1.0750
Δ log(CDS)	-0.0007 ***	-0.0033 *
Observations	110	132
Countries	5	6
R-Squared	28.27%	7.42%

Note: This table shows the effect of the changes in bank indicators on the changes in the tier 1 ratio in the period from 2014 Q4 to 2020 Q2. Column (1) presents the results for the GIIPS countries and column (2) shows the results for the non-GIIPS countries. The dependent variable, Δ*Tier1,* corresponds to the quarterly change of consolidated tier 1 ratio. The set of independent variables include: Δ *RWA ratio*, the quarterly changes in risk-weighted assets over total assets; Δ *Provisions ratio*, the quarterly changes in provisions over total assets, Δ *Fair Value ratio*, the quarterly changes in gains and losses on financial assets and liabilities at fair value through profit and loss over total assets; Δ *Trading ratio*, the quarterly changes in gains and losses on financial assets held for trading and liabilities over total assets; and Δ *log(CDS)*, the quarterly changes in log bank CDS. For the latter, it was computed the quarterly weighted average of 5-year senior unsecured bank CDS spreads in basis points. The selection of the banks was based on the Spring 2020 EBA transparency exercise. Table A11 shows the list of the banks included. The weighted average was computed for each country with the weights based on the banks' total assets as of end-2019. The regressions include country fixed effects. Standard errors are clustered at country level. ***, **, and * indicates statistical significance at the 1%, 5%, and 10% level, respectively.

Table A9: Granger Causality

	GIIPS (1)	Non-GIIIPS (2)
Δ Tier 1 ratio does not Granger-cause Δ Spread	Yes **	Yes *
Δ Spread does not Granger-cause Δ Tier 1 ratio	Yes ***	Yes **

Note: This table shows the results of the Granger causality test based on the regressions included in Table A6. Column (1) reports the results for the GIIPS and column (2) for the non-GIIPS countries. *Yes* implies that according to the panel VAR Granger causality Wald test, variable X Granger-causes variable Y. *No* means that according to the panel VAR Granger causality Wald test, variable X does not Granger-cause variable Y.

Table A10: Impulse response functions (IRF)

	GIIPS	Non-GIIIPS
	(1)	(2)
Panel A: Impulse Δ Spread, Response Δ Tier 1		
Forecast Horizon		
0	-0.0590	0.0019
1	-0.2250	-0.0523
2	-0.1626	-0.0291
3	-0.1895	-0.0371
4	-0.1781	-0.0345
5	-0.1830	-0.0354
6	-0.1809	-0.0351
Panel B: Impulse Δ Tier 1, Response Δ Spread		
Forecast Horizon		
0	0.0000	0.0000
1	-0.1660	0.0061
2	-0.1025	0.0035
3	-0.1298	0.0044
4	-0.1182	0.0041
5	-0.1232	0.0042
6	-0.1211	0.0042

Note: This table presents the impulse reaction functions (IRF) in the period from Q4 2014 to Q2 2020. Panel 1 shows the cumulative IRF when the impulse variable corresponds to Δ*Spread*, which is the quarterly change in the spread of sovereign 10-year bond yields over the German 10-year bond yield, and the response variable denotes Δ*Tier1*, which represents the quarterly change of the consolidated tier 1 ratio. Panel 2 shows the opposite. Column (1) presents the IRF for the GIIPS countries and column (2) shows the IRF for the non-GIIPS countries. The IRF confidence intervals are computed using 200 Monte Carlo draws from the distribution of the panel VAR model with clustered errors at country level.

Table A11: List of banks

	Country	Bank
1	AT	Erste Group Bank AG
2	AT	Raiffeisen Bank International AG
3	AT	Bawag
4	BE	KBC Groep
5	FI	Nordea Bank Abp
6	FR	BNP Paribas
7	FR	Groupe Crédit Agricole
8	FR	RCI Banque
9	FR	Société générale
10	FR	Groupe BPCE
11	DE	COMMERZBANK Aktiengesellschaft
12	DE	Deutsche Bank AG
13	DE	Hamburg Commercial Bank AG
14	DE	Landesbank Hessen-Thüringen Girozentrale
15	DE	Bayerische Landesbank
16	DE	DZ BANK
17	DE	Landesbank Baden-Wurttemberg
18	DE	Norddeutsche Landesbank
19	NE	Coöperatieve Rabobank U.A.
20	NE	ING Groep N,V,
21	NE	ABN AMRO Bank
22	NE	de Volksbank
23	GR	Alpha Bank, S.A.
24	GR	Piraeus Bank, S.A.
25	GR	Eurobank Ergasias
26	GR	National Bank of Greece
27	IT	Banca Monte dei Paschi di Siena S.p.A.
28	IT	Banco BPM S.p.A.
29	IT	Intesa Sanpaolo S.p.A.
30	IT	Mediobanca – Banca di Credito Finanziario S.p.A.
31	IT	UniCredit S.p.A.
32	IT	Unione di Banche Italiane S.p.A.
33	IE	AIB Group plc
34	PT	Banco Comercial Português, S.A.
35	PT	Caixa Geral de Depósitos, S.A.
36	ES	Banco Bilbao Vizcaya Argentaria, S.A.
37	ES	Banco Santander, S.A.
38	ES	Banco de Sabadell, S.A.
39	ES	Bankinter, S.A.
40	ES	CaixaBank, S.A.

Note: This table is a list of the banks included in the Spring 2020 EBA transparency exercise that have 5-year senior unsecured CDS quotes available as of September 2020. The list also includes the country of residence of each bank.

Table A12: Summary Statistics

		Mean	Std. Dev.	Min	Max	Observations
Panel A: 2009 – 2012						
Sovereign CDS	overall	953.72	2445.81	46.00	25422.81	N = 1037
	between		1350.93	244.27	3369.48	n = 5
	within		2129.06	-2311.72	23007.05	T-bar = 207.4
Bank CDS	overall	523.18	521.97	60.72	3099.28	N = 861
	between		375.50	233.42	1115.57	n = 5
	within		391.44	-439.99	2506.89	T-bar = 172.2
Δ Log(Sovereign CDS)	overall	0.68%	12.30%	-58.94%	58.02%	N = 1031
	between		0.82%	-0.10%	2.06%	n = 5
	within		12.28%	-60.32%	56.64%	T-bar = 206.2
Δ Log(Bank CDS)	overall	0.64%	12.04%	-50.65%	80.44%	N = 842
	between		0.29%	0.44%	1.10%	n = 5
	within		12.03%	-50.93%	79.97%	T-bar = 168.4
Panel B: 2013 - 2016						
		Mean	Std. Dev.	Min	Max	Observations
Sovereign CDS	overall	381.31	633.17	39.27	7891.44	N = 1001
	between		509.07	85.37	1286.01	n = 5
	within		443.56	-504.42	6986.74	T-bar = 200.2
Bank CDS	overall	470.14	620.99	66.30	5782.88	N = 1029
	between		463.99	151.31	1274.89	n = 5
	within		459.27	-505.28	4978.13	T-bar = 205.8
Δ Log(Sovereign CDS)	overall	-0.34%	10.26%	-81.70%	146.26%	N = 989
	between		0.27%	-0.72%	-0.12%	n = 5
	within		10.26%	-81.92%	146.04%	T-bar = 197.8
Δ Log(Bank CDS)	overall	0.06%	9.86%	-94.20%	85.50%	N = 1008
	between		0.45%	-0.35%	0.77%	n = 5
	within		9.86%	-94.09%	85.62%	T-bar = 201.6
Panel C: 2017 - 2020						
		Mean	Std. Dev.	Min	Max	Observations
Sovereign CDS (bp)	overall	170.76	180.37	19.99	1094.17	N = 783
	between		142.13	40.04	393.20	n = 5
	within		122.51	-123.86	871.72	T-bar = 156.6
Bank CDS (bp)	overall	286.07	369.09	33.69	2050.96	N = 975
	between		371.28	67.75	943.81	n = 5
	within		160.74	-28.31	1393.21	T-bar= 195
Δ Log(Sovereign CDS)	overall	-0.64%	9.04%	-33.50%	63.67%	N = 767
	between		0.97%	-2.32%	0.20%	n = 5
	within		9.02%	-33.11%	63.93%	T-bar = 153.4
Δ Log(Bank CDS)	overall	-0.36%	7.90%	-84.93%	45.18%	N = 970
	between		0.23%	-0.77%	-0.20%	n = 5
	within		7.90%	-84.98%	45.11%	T-bar = 194

Note: This table includes summary statistics on bank and sovereign credit default swaps (CDS) with respect to the GIIPS countries for three reference periods (2009-2012, 2013-2016 and 2017- Q3 2020). *Bank CDS* is the weighted average bank CDS in basis points, *Sovereign CDS* is sovereign CDS also basis points, Δ *Log(Bank CDS)* is the weekly logarithm change in bank CDS and Δ *Log(Sovereign CDS)* is the weekly logarithm change in sovereign CDS.

Source: Bloomberg.

Table A13: Summary Statistics

		Panel A: 2009 – 2012				
		Mean	Std. Dev.	Min	Max	Observations
Sovereign CDS	overall	84.66	60.80	16.94	405.85	N = 1254
	between		38.17	43.45	144.42	n = 6
	within		49.82	-28.26	346.09	T-bar = 209
Bank CDS	overall	163.38	81.66	50.38	490.00	N = 1201
	between		49.87	102.45	232.32	n = 6
	within		67.31	31.06	422.81	T-bar = 200.2
Δ Log(Sovereign CDS)	overall	-0.15%	11.25%	-52.78%	42.78%	N = 1248
	between		0.28%	-0.52%	0.25%	n = 6
	within		11.24%	-52.97%	43.14%	T-bar = 208
Δ Log(Bank CDS)	overall	-0.05%	8.67%	-35.59%	48.62%	N = 1194
	between		0.21%	-0.29%	0.30%	n = 6
	within		8.67%	-35.94%	48.28%	T-bar = 199
		Panel B: 2013 - 2016				
		Mean	Std. Dev.	Min	Max	Observations
Sovereign CDS	overall	33.40	14.61	12.43	88.01	N = 1248
	between		11.15	21.38	47.47	n = 6
	within		10.48	12.44	74.76	T-bar = 208
Bank CDS	overall	95.82	40.19	36.01	255.73	N = 1254
	between		32.06	64.19	157.40	n = 6
	within		27.54	41.59	201.55	T-bar = 209
Δ Log(Sovereign CDS)	overall	-0.23%	6.44%	-32.15%	41.98%	N = 1236
	between		0.13%	-0.37%	-0.01%	n = 6
	within		6.44%	-32.22%	42.05%	T-bar = 206
Δ Log(Bank CDS)	overall	-0.19%	6.95%	-26.66%	30.20%	N = 1248
	between		0.21%	-0.57%	-0.01%	n = 6
	within		6.94%	-26.84%	30.02%	T-bar = 208
		Panel C: 2017 – 2020 Q3				
		Mean	Std. Dev.	Min	Max	Observations
Sovereign CDS	overall	17.51	7.79	7.88	69.41	N = 1010
	between		5.35	14.25	27.05	n = 6
	within		6.39	6.69	59.87	T-bar = 168.3
Bank CDS	overall	57.68	25.00	18.98	146.26	N = 1170
	between		21.07	33.74	79.63	n = 6
	within		15.96	20.78	124.31	T-bar = 195
Δ Log(Sovereign CDS)	overall	-0.57%	7.12%	-50.86%	65.34%	N = 996
	between		0.33%	-1.11%	-0.27%	n = 6
	within		7.11%	-50.48%	65.23%	T-bar = 166
Δ Log(Bank CDS)	overall	-0.21%	9.02%	-45.37%	94.92%	N = 1164
	between		0.21%	-0.40%	0.16%	n = 6
	within		9.02%	-45.20%	94.55%	T-bar = 194

Note: This table includes summary statistics on bank and sovereign credit default swaps (CDS) with respect to the non-GIIPS for three reference periods (2009-2012, 2013-2016 and 2017- Q3 2020). *Bank CDS* is the weighted average bank CDS in basis points, *Sovereign CDS* is sovereign CDS also basis points, Δ *Log(Bank CDS)* is the weekly logarithm change in bank CDS and Δ *Log(Sovereign CDS)* is the weekly logarithm change in sovereign CDS.

Source: Bloomberg.

Table A14: The Sovereign-Bank Feedback Loop

	GIIPS			Non-GIIPS		
	2009-2012	2013-2016	2017-2020	2009-2012	2013-2016	2017-2020
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Log(Sovereign CDS)						
Δ Log(Sovereign CDS)						
L1	0.0700 ***	-0.2407 **	0.1635 ***	0.0232	-0.1581 ***	-0.0098
L2	0.0427	-0.1580 ***	0.1159 ***	-0.0638 ***	-0.0633 *	0.1223 ***
Δ Log(Bank CDS)						
L1	-0.2528 ***	-0.0134	-0.0190	-0.1188 ***	0.1641 ***	0.1072 *
L2	-0.0216	0.0638 *	0.0080	0.1199 ***	0.0432 ***	0.0603 **
ECT (t-1)	8.41E-06 **	-3.15E-05 ***	-6.49E-06	-3.89E-04 ***	9.67E-05	6.69E-06
Δ Log(Bank CDS)						
Δ Log(Sovereign CDS)						
L1	0.1243 ***	0.0321	0.1146 *	0.0835 ***	0.0010	-0.0246
L2	0.0731 *	-0.0505	0.1207 ***	-0.0103	-0.0039	0.1249 ***
Δ Log(Bank CDS)						
L1	-0.1450 ***	-0.0135	0.0484	-0.1352 ***	-0.1350 **	-0.0261
L2	-0.0744	-0.0232	0.0097	0.0773 ***	-0.0458	0.0371
ECT (t-1)	-1.25E-05 ***	-2.63E-05 ***	-5.68E-05 ***	-4.04E-04 ***	-2.17E-04 ***	-8.21E-04 ***
Observations	793	899	738	1174	1206	966
Countries	5	5	5	6	6	6
Hansen's J statistic	1.08E-31	9.42E-32	9.19E-32	3.63E-31	2.56E-31	6.55E-32

Note: This table shows the results of panel autoregressions, whose dependent variables denotes the sovereign credit risk and the bank credit risk, during three periods - 2009-2012, 2013-2016 and 2017- Q3 2020. Columns (1), (2) and (3) present the results for the GIIPS countries and columns (4), (5) and (6) show the results for the non-GIIPS countries. Δ*Log(Bank CDS)* is the weekly logarithm change in bank CDS and Δ*Log(Sovereign CDS)* is the weekly logarithm change in sovereign CDS. The regressions also include the lagged error correction term (*ECT*). L1 and L2 represent the first and second lags, respectively, of the dependent variables included in the model. Standard errors are clustered at country level. ***, **, and * indicates statistical significance at the 1%, 5%, and 10% level, respectively.

Source: Bloomberg

Table A15: Granger Causality

Panel A: GIIPS			
	2009-2012	2013-2016	2017-2020 Q3
	(1)	(2)	(3)
Δ Log(Sovereign CDS) does not Granger-cause Δ Log(Bank CDS)	Yes ***	Yes ***	Yes ***
Δ Log(Bank CDS) does not Granger-cause Δ Log(Sovereign CDS)	Yes ***	Yes ***	No
Panel B: Non-GIIPS			
	2009-2012	2013-2016	2017-2020 Q3
	(1)	(2)	(3)
Δ Log(Sovereign CDS) does not Granger-cause Δ Log(Bank CDS)	Yes ***	No	Yes **
Δ Log(Bank CDS) does not Granger-cause Δ Log(Sovereign CDS)	Yes ***	Yes ***	No

Note: This table shows the results of the Granger causality test based on the regressions included in Table 14. Panel A reports the results for the GIIPS and Panel B for the non-GIIPS countries. Columns (1), (2) and (3) present the results for three periods, 2009-2012, 2013-2016 and 2017- Q3 2020, respectively. *Yes* implies that according to the panel VAR Granger causality Wald test, variable X Granger-causes variable Y. *No* means that according to the panel VAR Granger causality Wald test, variable X does not Granger-cause variable Y.

Table A16: Impulse response functions (IRF)

	GIIPS			Non-GIIIPS		
	2009-2012	2013-2016	2017-2020	2009-2012	2013-2016	2017-2020
	(1)	(2)	(3)	(4)	(5)	(6)
Impulse: Δ Log(Sovereign CDS), Response: Δ Log(Bank CDS)						
Forecast Horizon						
0	0.0709	0.0494	0.0424	0.0464	0.0220	0.0296
1	0.0762	0.0521	0.0547	0.0491	0.0191	0.0271
2	0.0782	0.0449	0.0681	0.0510	0.0182	0.0369
3	0.0771	0.0460	0.0720	0.0508	0.0185	0.0366
4	0.0771	0.0467	0.0743	0.0511	0.0185	0.0382
5	0.0772	0.0463	0.0751	0.0510	0.0185	0.0383
6	0.0772	0.0463	0.0755	0.0510	0.0185	0.0385
Impulse: Δ Log(Bank CDS), Response: Δ Log(Sovereign CDS)						
Forecast Horizon						
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	-0.0225	-0.0011	-0.0013	-0.0082	0.0107	0.0089
2	-0.0227	0.0045	-0.0010	0.0010	0.0104	0.0135
3	-0.0215	0.0033	-0.0011	-0.0001	0.0091	0.0148
4	-0.0213	0.0025	-0.0011	0.0001	0.0093	0.0156
5	-0.0214	0.0029	-0.0011	0.0000	0.0094	0.0158
6	-0.0215	0.0029	-0.0011	0.0001	0.0093	0.0160

Note: This table presents the impulse reaction functions (IRF) during three periods - 2009-2012, 2013-2016 and 2017- Q3 2020. Panel 1 shows the cumulative IRF when the impulse variable corresponds to Δ*Log(Sovereign CDS)*, which is the weekly logarithm change in sovereign CDS and the response variable denotes Δ*Log(Bank CDS)*, which represents the weekly logarithm change in bank CDS. Panel 2 shows the opposite. Columns (1), (2) and (3) present the results for the GIIPS countries and columns (4), (5) and (6) show the results for the non-GIIPS countries. The IRF confidence intervals are computed using 200 Monte Carlo draws from the distribution of the panel VAR model with robust errors.