Banks Exposures and Sovereign Stress Transmission*

Altavilla Carlo
European Central Bank

Marco Pagano
University of Naples Federico II, CSEF and EIEF

Saverio Simonelli
University of Naples Federico II and CSEF

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Abstract

In the euro debt crisis, bank sovereign exposures amplified the transmission of sovereign stress to the solvency risk of banks and to their lending activity. We estimate the magnitude of this amplification mechanism relying on novel ECB monthly data on sovereign exposures and lending policies of 252 euro-area banks from 2007 to 2015. We find that for the median euro-area periphery bank, a 100-basis-points increase in the domestic sovereign CDS premium translated into an additional increase of 20 basis point in the bank CDS premium, adding to a baseline effect of 47 basis points. Moreover, the drop in the value of domestic sovereign holdings of periphery banks associated with a 1-standard-deviation increase in the 10-year sovereign yield accounted for 9% of the actual drop in total loans, the magnitude of this effect being stronger for undercapitalized banks. No such amplification effects are detected for banks in core countries. Finally, increases in the yield of domestic sovereign debt triggered larger increases in the sovereign exposures of more leveraged periphery banks, in line with the "carry trade" hypothesis.

JEL classification: E44, F3, G01, G21, H63.

Keywords: sovereign exposures, sovereign risk, credit risk, bank lending, euro debt crisis.

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1 Introduction

The 2009-11 sovereign debt crisis in the euro area has dramatically highlighted that the deterioration of sovereign creditworthiness has powerful effects on the credit risk of banks and on their lending activity. There are at least three reasons for this. First, being associated with a drop in entrepreneurial confidence and household wealth, sovereign distress tends to reduce aggregate demand, hence the demand for credit. Second, as the government is the ultimate backstop of distressed domestic banks, doubts about government solvency trigger concerns about the solvency of domestic banks, especially those with weaker balance sheets. Third, insofar as banks themselves hold domestic government bonds, they suffer capital losses when these bonds depreciate due to increased sovereign risk: the resulting drop in banks' equity increases their default risk. This raises their funding costs, and pushes them closer to the required prudential capital ratio, forcing the weakest ones to deleverage. On both accounts – funding costs and deleveraging – banks will reduce lending. The drop in lending is further reinforced if banks react to sovereign stress by increasing their holdings of high-yield public debt, either in search for yield ("carry trades") or due to pressure by their government seeking to place newly issued debt ("moral suasion").

Assessing the relative importance of the third channel, i.e. banks' sovereign exposures, in the overall transmission of sovereign stress to private lending is of paramount importance for policy, because bank prudential regulation can affect the amount of sovereign debt that banks are allowed or induced to hold, as well as its breakdown between domestic and foreign debt. Currently, euro-area prudential regulation gives preferential treatment to sovereign debt compared to loans to firms and households and privately issued securities: debt issued by euro-area sovereigns entails no capital charges for euro-area banks (zero risk weight in the measurement of their risk-weighted assets), in contrast to lending to firms and households, and imposes no quantity constraints on their sovereign debt portfolio. This regulatory treatment would be questionable if banks' sovereign exposures were found to act as an important amplification mechanism in the transmission of sovereign stress to bank risk and lending activity. And it would be even more questionable if banks were found to expand their holdings of risky public debt at times of sovereign stress, crowding out their lending to firms and households even further.

In this paper, we estimate the specific contribution of bank sovereign exposures to the overall transmission of sovereign stress to lending by using a novel, ECB proprietary database that contains monthly data on sovereign exposures and lending policies of 252 euro-area banks from 2007 to 2015. We document that in the euro debt crisis the domestic sovereign exposures of banks have been a key linchpin in the transmission of sovereign stress to bank risk and lending. First, we estimate that for the median bank in the euro-area periphery, a 100-basis-points increase in the domestic sovereign CDS premium translates

into an additional increase of 20 basis point in the bank CDS premium, adding to a baseline effect of 47 basis points; in contrast, no such amplification effect is present for core-country banks. Second, in periphery countries, the drop in value of the domestic sovereign holdings of banks due to a 1-standard-deviation increase in the 10-year sovereign yield, accounts for 9% of the actual drop in total loans during the sample period. Furthermore, the magnitude of the effect associated with sovereign exposures is stronger for undercapitalized banks. Again, no such amplification effect is instead detectable for banks in core countries.

Since these results highlight the importance of bank-level differences in domestic sovereign exposures, it is natural to ask which bank characteristics were responsible for so widely different portfolio choices, and in particular which of them have been associated with "doubling up", namely the tendency to increase distressed government debt holdings in the face of increases in its yield. We find that, in periphery countries, increases in the yield of domestic sovereign debt triggered larger increases in the sovereign exposures of more leveraged banks. The role of leverage appears in line with the "carry trade" hypothesis, in that undercapitalized banks have a greater incentive to engage in search for yield (Acharya and Steffen, 2014, and Battistini, Pagano and Simonelli, 2014).

We are not the first to investigate these issues. Gennaioli, Martin and Rossi (2014a) present a model where sovereign defaults reduce private lending by harming the balance sheets of domestic banks, the more so the larger are banks' government debt holdings, and test these predictions on cross-country evidence, and in a companion paper also on bank-level evidence (Gennaioli, Martin and Rossi, 2014b). Becker and Ivashina (2014) use company-level data on bank borrowing and bond issuance to document that European companies were more likely to substitute loans with bonds when banks in their country owned more domestic sovereign debt and when that debt was risky. Three other recent studies investigate these issues using loan-level data for syndicated lending by European banks. Popov and van Horen (2014) and De Marco (2014) show that after the start of the euro area sovereign debt crisis, banks from core countries with sizeable exposures to periphery sovereign debt reduced their syndicated lending and increased their loan rates more than non-exposed banks. Acharya, Eisert, Eufinger and Hirsch (2015) combine syndicated loan data with company-level data, to investigate the real effects of the loan supply contraction triggered by the sovereign crisis.

The limitation of these studies is that they are based on extremely limited data for sovereign exposures of banks, since so far time-series data for bank-level sovereign exposures have been simply unavailable: Gennaioli, Martin and Rossi (2014b) rely on the total bond holdings of banks, which lump domestic government bonds together with non-domestic bonds held by banks. The other studies cited above rely on sovereign exposures data drawn from the EBA stress tests up to 2011, which refer only to three dates and to a small sample of systemically relevant banks, and measure lending with data for syndicated

loans, which provide about 10% of total euro-area lending and cater mostly to large, established companies.

In contrast, our sovereign exposures and loan data refer to a sample of banks that provide about 70% of total euro-area lending, and its longitudinal and time-series granularity enable us to investigate whether time-varying differences in domestic sovereign exposures affect the transmission of sovereign stress to the credit risk of banks and to their lending policies. Moreover, we can investigate whether the intensity of this transmission depends on bank characteristics, such as their capitalization and their ownership (public or private, domestic or foreign). Finally, we are able to analyze how the domestic sovereign exposures of banks respond to changes in the expected yields on sovereign debt, and thus test the carry trade hypothesis using panel data with a time-series dimension that greatly exceeds the three data points provided by the EBA stress data used in Acharya and Steffen (2015).

The structure of the paper is as follows. In Section 2, we describe the data, present some stylized aggregate facts, and highlight the considerable microeconomic variation present in the data. Section 3 investigates whether banks' domestic sovereign exposures affected the transmission of sovereign stress to bank risk, and Section 4 whether they influenced its impact on bank lending. Section 5 documents the differential response of sovereign exposures to changes in domestic sovereign yields across periphery and core banks, and within each group between undercapitalized and well-capitalized banks, and between public and private banks. Section 6 concludes.

2 Data and stylized facts

This section describes our data and provides some stylized facts about euro-area banks' holdings of domestic sovereign bonds, and their relationship with these banks' lending and credit risk. These stylized facts will be useful not only to understand the correlations present in the data at the aggregate level but also the additional insights that can be gleaned by exploiting the considerable variation present in bank-level data.

2.1 Data sources and descriptive statistics

Our analysis makes use of a unique proprietary dataset of balance sheet items at individual bank level (Individual Balance Sheet Indicators, or IBSI), which is regularly updated by the ECB and is composed of monthly observations on the main balance sheet indicators (both on the asset and liability side) for 252 banks resident in all euro area countries spanning from June 2007 to February 2015. Banks are observed at unconsolidated level: we have information on whether a single cross-sectional unit is a head institution or a (domestic and

foreign) subsidiary. We complement the balance sheet indicators with individual lending interest rates data (at different maturities) drawn from another unique proprietary dataset (Individual MFI Interest Rates or IMIR), also updated by the ECB. Finally, we match our dataset with data on credit default swap (CDS) premia for individual banks from Datastream. We also use country-level data to measure sovereign credit risk: the 10-year sovereign debt yields and 5-year CDS (average-of-the-month) from Datastream, and survey-based yield forecasts at 3- and 12-month horizons from Consensus Economics.

As shown in **Table 1**, the sample contains a total of 252 unconsolidated banks in 18 euro-area countries, the highest coverage being in the largest countries: Germany (65), France (37), Italy (26) and Spain (26). Some of the banks are head institutions (145), the others being domestic or foreign subsidiaries. The table also reports the number of banks directly owned by the government in each country (amounting to about 20% of the total).

[Insert Table 1]

The representativeness of the sample is shown in **Table 2**, which reports the main assets, loans to non-financial corporations and holdings of government bonds by the banks in the dataset as a fraction of the corresponding country's aggregate figure, drawn from the ECB Balance Sheet Indicators (BIS) database. On average, our data cover about 70% of the corresponding country aggregates for the main variables; weighting the country coverage by the respective GDP weights does not change the results.

[Insert Table 2]

Our data are far more representative of the euro-area banking system than those used in previous studies, along several dimensions. First, we have data for the sovereign exposures of 252 banks, to be compared with at most 91 banks in the pre-2014 EBA stress test data. Second, we observe these banks' sovereign exposures (as well as loans and interest rates) for 93 months, to be compared with the 2 or 3 discrete snapshots based on EBA stress test data used in all previous studies of the euro-area debt crisis. Thirdly, as illustrated by **Figure 1**, our bank loan data cover almost 70% of the corresponding country loan aggregates, to be compared with the 10% coverage of the syndicated loan data used by the studies of Popov and van Horen (2014) De Marco (2014) and Acharya, Eisert, Eufinger and Hirsch (2015).

[Insert Figure 1]

Table 3 reports the mean, the median and the standard deviation of bank sovereign exposures, loans to firms, interest rates (Panel A), and bank characteristics (Panel B). The average bank's domestic exposures is 4% of its main assets (i.e., total assets net ofderivatives and real estate), while its exposures to non-domestic sovereign issuers is 1.8% of main assets, highlighting the strong home bias of the sovereign bond portfolio of euro-area banks. Unfortunately, our data do not provide a breakdown of non-domestic exposures by issuer.

On average, lending to non-financial companies amounts to 18% of main assets, with an average interest rate of 3.6%. The typical bank in our sample is quite large, the median bank's main assets amounting to 80 billion euro; but there is considerable cross-sectional variability, as indicated by the large between standard deviation. The median bank's capital/asset ratio is 5.6%, corresponding to a leverage ratio of 18; its deposits and borrowing from the ECB are 64.3% and 4.9% of its liabilities, respectively. But funding structure differs widely across banks, as witnessed by the large standard deviations of the leverage ratio, as well of the ratios of deposits, interbank loans and ECB borrowing to total liabilities. These differences will be seen to be important in the empirical analysis, since both the response of lending to sovereign stress and that of sovereign exposures to sovereign yields will be seen to vary greatly across banks with different leverage and different funding structures.

[Insert Table 3]

2.2 Stylized facts

Figure 2 shows how the median value and the distribution of the domestic sovereign exposures of euro-area banks (in percent of their main assets) changed from July 2007 to February 2015. The median domestic sovereign exposure (the red line in the figure) of domestic banks in periphery countries increased from 3% to 7% over the sample period. The increase was much more pronounced for banks directly controlled by the respective governments (about 12% at the end of the sample period). Foreign banks, instead, appear to have a complete different policy regarding their exposures to sovereign debt issued by the country where they operate: in both periphery and core countries, their median exposure is less than 1% and very stable over the sample period. The increase in domestic sovereign bond holdings is also visible in core countries, although it is more moderate.

[Insert Figure 2]

The rise in banks' domestic sovereign holdings is important for our empirical analysis, since it might reinforce the nexus between banks and home country risk. Some rough evidence about the relationship between this nexus and the time pattern of sovereign exposures already emerges from the aggregate data shown in **Figure 3**. The figure plots the 24-month rolling correlations between sovereign and bank CDS premia (blue line), as a measure of the strength of the bank-government solvency nexus, together with the domestic sovereign exposures as a fraction of total assets (blue line) for the largest four euro area countries. In Italy and Spain the increasing positive correlation between sovereign and bank CDS observed through the sample mirrors the increasing pattern of the exposures. No such co-movement is observed instead for Germany and France.

[Insert Figure 3]

Exploiting bank-level cross-sectional variation, however, one can go beyond these aggregate correlations, and distinguish how the nexus between government and bank solvency differs between high-exposure and low-exposure banks. **Figure 4** shows the relationship between banks' 5-year CDS premia, computed as the average of the CDS of the individual banks, and the respective sovereign 5-year CDS premia, computed as the simple average of the sovereign CDS, for periphery (panel A) and core (panel B) countries in a given month. Within each group of countries, the figure distinguishes between low-exposure banks (graphs on the left) and high-exposure ones (graphs on the right), respectively defined as banks whose domestic sovereign exposure in 2009 was below the 25th percentile or above the 75th percentile of the distribution. The figure shows a significant positive correlation between sovereign and bank solvency risk for both groups of countries and banks. But in periphery countries the correlation between sovereign and bank risk is much stronger for banks that hold more domestic government bonds. Instead, in core countries the intensity of the sovereign-bank nexus does not vary depending on the degree of their sovereign exposure. Even though sovereign risk may influence the riskiness of banks via many channels (for instance because governments are ultimate backstops for banks or due to rating agencies' policies), this is *prima facie* evidence that at least part of its effects travels through the domestic bond holdings of banks.

[Insert Figure 4]

The aggregate data also indicate that in periphery and core countries the sovereign exposures of banks have a very different time-series relationship with bank lending. The top panel of **Figure 5** shows that, for the median bank in periphery countries, loans to non-financial companies (NFCs) are negatively associated with its sovereign exposures: over the sample period, median domestic sovereign exposures increase from 1% to 6% of assets, and lending to firms decreases from 28% to less than 20% of main assets, the largest drop occurring in the second half of 2012. Towards the end of the sample, sovereign holdings appear to stabilize after a drop in December 2013: this may be related to the freezing of the balance sheet situation (in Spain) for the comprehensive assessment to be undertaken by the ECB in the following months. Since late 2014 also lending to firms (as a fraction of the median bank's assets) appear to stabilize, in line with the improvement recorded by aggregate lending statistics for periphery countries: the annual rate of change of loans to non-financial corporations (adjusted for loan sales and securitization) was -0.3% in March 2015, continuing its gradual recovery from a trough of -3.2% in February 2014.

[Insert Figure 5]

The bottom panel shows a completely different picture for core countries: except for the first two years of the sample, the loans-to-asset ratio of the median core-country bank is positively correlated with its domestic sovereign exposures (also scaled by assets), and both

variables have a distinct positive trend. It is also worth noticing that, despite their trend increase, the domestic exposures of core country banks grow far less than those of periphery banks: starting from a similar value of slightly less than 1% in 2009, the median core-country bank increases its domestic sovereign exposure to about 2.7% in early 2015, compared with about 6% for the median periphery bank.

The sharply different correlations between lending and sovereign exposures documented by Figure 5 are not solely driven by country-level macroeconomic variables: they are also present at the microeconomic, individual-bank level. This is apparent in **Figure 6**, where the top panel plots the loan/asset ratios of individual periphery-country banks against their respective sovereign debt/asset ratios, after removing all time-series variation and unobserved heterogeneity from both types of data (the data shown being residuals of regressions of bank-level loan and exposure data on time dummies and bank fixed effects); the bottom panel plots the same data for core-country banks.

[Insert Figure 6]

As shown by the regression lines drawn in the two graphs, the negative correlation between sovereign exposures and loans is still present in the data for individual periphery banks, even after removing all time-series variation and controlling for banks' characteristics, while it is absent for core-country banks. Hence, Figure 6 suggests that the aggregate time-series correlations displayed in Figure 5 should also be present to some extent in panel data regressions exploiting the bank-level relationship between loans and sovereign exposures.

3 Domestic exposures and sovereign risk

In this section we investigate to what extent the domestic sovereign exposures of banks play a specific role in the transmission of risk from the sovereign to domestic banks, over and above the risk transmission that results from the fact that the national government is the ultimate backstop of banks in distress, and that sovereign stress increases country-level risk and therefore makes domestic bank loans riskier.

In order to identify the effect of the sovereign risk on the riskiness of banks, we regress the CDS premium of bank *i* in country *j* in month *t* (CDS_{ijt}) on the current sovereign CDS ($Sov.CDS_{ijt}$) interacted with the banks exposures to domestic sovereign debt in the previous period ($Sov.Exp_{ijt-1}$), while controlling for other risk transmission mechanisms by including the sovereign CDS premium among the explanatory variables:

$$CDS_{ijt} = \alpha_i + \gamma_t + \beta_1 Sov.CDS_{jt} + \beta_2 Sov.Exp_{ijt-1} + \beta_3 Sov.CDS \times Sov.Exp_{ijt-1} + \beta_4 X_{ijt-1} + \beta_5 Y_{jt-1} + \varepsilon_{ijt}, \quad (1)$$

where α_i and γ_t denote the bank and time fixed effects, respectively; X_{ijt-1} denotes bank specific controls that may affect the bank's credit risk, that is, the lagged leverage ratio and the deposit-liability ratio), and Y_{jt-1} indicates country-specific controls, namely the average expected default frequency (EDF) of non-financial corporations (Moody's Analytics), as a measure of bank customers' credit risk in the respective country, and an indicator of the demand for bank loans in the corresponding country obtained from the Bank Lending Survey of the ECB.[1] Our coefficient of interest, β_3, captures the response of the bank riskiness to changes in sovereign risk due to its holding of domestic bond.

The estimates of specification (1) are reported in **Table 4**, first for all the countries in the sample (column 1), and then separately for core-country banks (column 2) and for periphery-country banks (column 3). The estimate of the coefficient β_1 indicates that a 100-basis-points change in the sovereign CDS premium has a 56-basis-points baseline effect on the CDS premium of domestic banks in the overall sample, while the effect traveling through sovereign exposures, captured by the coefficient β_3, is not significantly different from zero. When the regression is estimated separately on the two subsamples, the coefficient β_1 remains unchanged; however, for periphery-country banks the coefficient β_3 becomes statistically significant: for these countries sovereign exposures tend to amplify the effect of sovereign stress on bank credit risk. More precisely, the value of 0.05 means that for the median bank, which has a 5% exposure to sovereign debt, a 100-basis-points increase in the domestic sovereign CDS premium translates into an additional increase of 25 basis point in the bank CDS premium (or 1-standard-deviation increase in sovereign CDS translates into an increase in 26 basis point in the bank CDS). Hence, adding the baseline effect (0.48) and that due to its sovereign exposure (0.25), the overall pass-through from periphery sovereigns to domestic bank CDS premia equals 2/3.

[Insert Table 4]

The previous results may be affected by the potential endogeneity of the sovereign CDS premium: an increase in the risk of systemic banks may lead to deterioration of sovereign's creditworthiness. That the causality between government and bank solvency can go both ways is highlighted by the models by Acharya et al. (2014), Cooper and Nikolov (2013) and Leonello (2014) and is documented empirically for the euro debt crisis by Acharya et al. (2014). To address this issue, we re-estimate model (1) excluding from the sample the

[1] We use the answer to the following question of the BLS: "Over the past three months, how has the demand for loans or credit lines to enterprises changed at your bank, apart from normal seasonal fluctuations?".

systemically important financial banks (SIFI)[2] since the distress of a SIFI is most likely to trigger a government bailout, and therefore hurt public finances. The resulting estimates, reported in **Table 5**, are very close to those shown in Table 4.

Another endogeneity concern arises in connection with banks' sovereign exposures: a drop in a bank's creditworthiness, as measured by its CDS premium, may induce it to change its sovereign exposure. For instance, if domestic government yields are high, a more distressed bank may wish to increase its sovereign exposure more than a sound one, since the first has greater incentive to "bet for resurrection" by engaging in "carry trades" in high-yield securities. To address this concern, in **Table 6** we re-estimate the model replacing lagged exposures with a dummy variable ($High.Exp_{ij09}$) that equals 1 for banks with domestic sovereign exposure above the 75th percentile in 2009, i.e. before the breakout of the sovereign crisis, and zero for banks with domestic sovereign exposure above the 25th. Since this dummy variable is constant over the whole period, the direct effect of exposures is now absorbed by the bank-level fixed effect. Hence we estimate the following specification:

$$CDS_{ijt} = \alpha_i + \gamma_t + \delta_1 Sov.CDS_{jt} + \delta_2 Sov.CDS_{jt} \times High.Exp_{ij09} + \delta_3 X_{ijt-1} + \delta_4 Y_{jt-1} + \varepsilon_{ijt}, \quad (2)$$

where the coefficient δ_2 of the interacted variable captures the differential response of the default risk for banks with a high initial exposure to the change in sovereign risk. For periphery countries (in column 3 of Table 6) this coefficient is positive and statistically significant: an increase of 100 basis points in the sovereign CDS premium is associated with an increase of 45 basis points in the default premium of domestic banks with high initial exposures. Interestingly, in this specification the whole pass-through from sovereign risk to bank risk travels via banks' sovereign exposures, and is significant only for periphery-country banks: for core-country banks, the response to sovereign risk does not depend on their initial exposure (see column 2 of Table 6).

[Table 5 and Table 6]

A further possible problem with the previous estimates is that the CDS market may sometimes misprice sovereign default risk, especially in turbulent times such as the euro-area sovereign crisis, and this may introduce an error-in-variables problem. Therefore, we re-estimate specification (1) replacing the sovereign CDS premium with an alternative measure of sovereign stress, namely the surprise component ($NewsYield$) of the realized yields on domestic sovereign at 10-year maturity, computed as the difference between the realized yield and the consensus prediction made by professional forecasters for the same period 3 or 12 months before. Hence the specification becomes:

[2] The number of SIFI banks is obtained by enlarging the Financial Stability Board (FSB) list of Global Systemically Important Banks (G-SIBs) with other significant banking groups.

$$CDS_{ijt} = \alpha_i + \gamma_t + \phi_1 NewsYield_{jt} + \phi_2 Sov.Exp_{ijt-1} + \phi_3 NewsYield_{jt} \times Sov.Exp_{ijt-1} + \phi_4 X_{ijt-1} + \phi_5 Y_{jt-1} + \varepsilon_{ijt}. \quad (3)$$

This specification is estimated only on data for France, Germany, the Netherlands, Italy and Spain, since government yield predictions by professional forecasters are available only for these five countries. The resulting estimates are presented in **Table 7**.

[Table 7 here]

The coefficient of the interacted variable, ϕ_3, is positive and statistically significant for all countries both for the 3-month yield surprise and the 12-month yield surprise (columns 1 and 2). When specification (3) is estimated separately for the three core countries (France, Germany and the Netherlands) and for the two periphery ones (Italy and Spain), no coefficient is statistically significant for the former (in columns 3 and 4), while for periphery countries the coefficient ϕ_3 equals 3.8 and is significantly different from zero only for the news obtained by using 12-month-ahead forecasts (column 6). Since yields are expressed in percentage point and CDS are expressed in basis points, this coefficient of 3.8 is comparable to the coefficient estimate of 0.05 obtained for the sovereign CDS premium in Table 4: either measure of sovereign stress yields a similar estimate of the impact on bank solvency that can be attributed to domestic sovereign exposures in periphery countries.

4 Sovereign stress and bank lending

We now turn to investigating whether bank sovereign exposures create a specific channel through which sovereign stress transmits to bank lending policies. An increase in sovereign credit risk may induce more exposed banks to reduce the amount of lending, due to the capital losses that they suffer when sovereign bonds depreciate: the resulting drop in banks' equity increases their default risk and pushes them closer to the required prudential capital ratio, forcing the weakest ones to deleverage by reducing their lending. Moreover, an increase in sovereign risk can also have a disproportionate effect on the lending rates charged by the more exposed banks: having suffered greater capital losses, these banks will be charged a greater cost of capital, and will tend to pass at least part of this increase in the form of higher interest rates to their clients.

4.1 Impact on loans

To evaluate the impact of sovereign stress on bank lending we estimate the following model:

$$Loans_{ijt} = \alpha_i + \gamma_t + \varphi_1 Sov.Yield_{jt-2} + \varphi_2 Sov.Exp_{ijt-3} + \varphi_3 Sov.Yield_{jt-2} \times Sov.Exp_{ijt-3} + \varphi_4 X_{ijt-2} + \varphi_5 Y_{jt-2} + \varepsilon_{ijt}. \quad (4)$$

where the dependent variable ($Loans_{ijt}$) is the volume of lending to non-financial corporations, scaled by the bank's main assets, and all other variables are as defined in expression (1).[3] The rationale for lagging the sovereign yield by two months relative to the bank loans in specification (4) is that adjusting the lending policy of banks in response to equity losses or gains presumably takes time.[4] Since the capital losses or gains are realized on a bank's sovereign holdings before the change in yields, domestic sovereign exposures are measured as of three months before the dependent variable. In any event, we perform robustness checks on the lag structure assumed in specification (4), as will be seen below.

Table 8 shows the results for the specification where loans of all maturities are pooled together. In column 1, where the model is estimated by pooling observations for all countries, the interaction term (φ_3) is negative and statistically significant. However, this result stems only from the inclusion of periphery countries in the sample: when the regression is estimated for core countries only, the coefficient is not statistically significant, as shown in column 2. In contrast, it is negative and statistically significant when it is estimated only for periphery countries: as shown in column 3, the domestic sovereign exposures of periphery banks tend to amplify the effect of sovereign stress on loans to NFC.

[Insert Table 8]

To appreciate the economic significance of the estimates in column 3, it should be noticed that they imply that for the median bank in periphery country – with an exposure of 5% – an increase in the sovereign yields of one standard deviation (1.9 percentage points) is associated with a decline of 0.5 percentage points on the loans over assets. Multiplying this

[3] All equations presented in this section also include for Spain a trend with a break in November 2012, to capture the effects of the restructuring and recapitalisation operations undertaken by SAREB on balance sheets. SAREB is the Spanish acronym of the "bad bank" set up by the Spanish government to manage the assets transferred by the four nationalized Spanish financial institutions (BFA-Bankia, Catalunya Banc, NGC Banco-Banco Gallego and Banco de Valencia). Even though it was created on 31 August 2012, this company completed the acquisition of these assets in November 2012.

[4] The results are very robust to different lag structures in the specification.

drop to the sample average of the main assets in periphery countries implies a drop in the outstanding amount of loans of €11 billion, which is about 9% of the realized drop since January 2008.

Another way to assess the economic significance of the effect in the periphery countries is to compute the change in the median bank's loan-to-asset ratio associated with the change in the value of its sovereign holdings. **Figure 7** shows for each periphery country the median value of the component of bank loan-asset ratio predicted within-sample by the interaction term (relying on its estimated coefficient of 0.05 in column 3 of Table 8). The implied drop in loans is very limited until mid-2010, while it becomes more sizeable since the onset of sovereign tensions. In particular, in late 2013 the drop in loans associated with the loss on domestic sovereign exposures equals 2% of bank assets in Portugal. Instead, in Italy and Spain, the amplification effect of the sovereign shock due to banks' exposures reaches its maximum in July 2013, then steadily reverting to the mean.

[Insert Figure 7]

To check whether our results might be partially driven by other characteristics of the banks' balance sheets, besides their domestic sovereign exposures, we re-estimate the previous model including as additional controls the interaction of sovereign yields with the ratio between deposits and total liabilities, and with the leverage ratio (defined as capital and reserves over liabilities) in 2008:

$$\begin{aligned} Loans_{ijt} = {} & \alpha_i + \gamma_t + \theta_1 Sov.Yield_{jt-2} + \theta_2 Sov.Exp_{ijt-3} + \theta_3 Sov.Yield_{jt-2} \times Sov.Exp_{ijt-3} \\ & + \theta_4 Sov.Yield_{jt-2} \times Lev_{ij08} + \theta_5 Sov.Yield_{jt-2} \times Dep_{ijt-3} + \theta_6 Dep_{ijt-3} \\ & + \theta_7 X_{ijt-2} + \theta_8 Y_{jt-2} + \varepsilon_{ijt}. \end{aligned} \quad (5)$$

The interaction with the deposit-liability ratio in specification (5) is meant to capture the ability of banks with better access to liquidity to overcome possible funding pressures associated with higher sovereign yields. The interaction with the leverage ratio, instead, is meant to test whether less capitalized banks are more affected by sovereign shocks, being more likely to be pushed against the capital ratio required by prudential regulation and thus to be forced to deleverage. The leverage ratio is measured at the beginning of the sample to reduce potential endogeneity problems.

The results are shown in

Table 9: upon controlling for these other balance sheet characteristics, the effect of sovereign exposures on the transmission of sovereign stress to loans is virtually unchanged. Moreover, the additional interaction terms are both statistically significant and with the expected signs: the impact of an adverse shock to sovereign yields is smaller for banks with more stable funding structure and better capital ratio.

[Insert

Table 9]

In specifications (4) and (5), bank loans are modelled as responding to sovereign yields, the idea being that a rise in yields is associated with a capital loss in banks exposed to sovereign risk, which in turn triggers a reduction in lending. However, to the extent that the rise in yields is anticipated, banks may be induced to switch from loans to sovereign exposures in their portfolios in advance of the yield rise – as indeed we document in Section

5. This would determine an endogeneity problem, as lending – the dependent variable – and lagged sovereign exposures – one of the explanatory variables – would both respond to the sovereign yield. To address this concern, we re-estimate specification (4) after replacing the yield with its unexpected component, based on survey-based consensus forecasts of the 10-year yield for Germany, France, the Netherlands, Italy and Spain: yield surprises should affect loans only via to the implied unexpected capital loss that they inflict on a bank; as the shock is unanticipated, the bank cannot have modified its sovereign holdings to take advantage of it. The results, which are shown in

Table 10, are consistent with those of the previous tables.

[Insert

Table 10]

4.2 Impact on lending rates

In this subsection we characterize how a second dimension of banks' lending policies, namely their individual bank-level interest rates on new loans to non-financial corporation, reacted to sovereign stress during the crisis, and specifically whether sovereign exposures influenced lending conditions, besides loan volumes. We estimate the following specification:

$$\begin{aligned} Lending.Rate_{ijt} = \alpha_i + \gamma_t + \lambda_1 Sov.Yield_{jt} + \lambda_2 Sov.Exp_{ijt-1} \\ + \lambda_3 Sov.Yield_{jt} \times Sov.Exp_{ijt-1} + \lambda_4 X_{ijt-1} + \lambda_5 Y_{jt-1} + \varepsilon_{ijt}. \end{aligned} \quad (6)$$

The coefficient λ_1 measures the direct "pass-through" effect of sovereign yields on the lending rates of banks: when sovereign yields increase, banks will want to retain only the customers that can pay comparable lending rates, controlling for risk. The coefficient λ_3 instead captures the amplification effect specifically associated with sovereign exposures: the banks that suffer the greatest capital losses due to the increase in sovereign yields will need to charge higher lending rates to make up for the shortfall. Exposure to sovereign risk may also generate a composition effect in banks' loan pool: more exposed banks, being perceived as unsound lenders, may be shunned by their best customers, and be left only with their riskiest ones, to whom they charge comparatively high rates.

Table 11 reports the estimates of specification (6), first for all countries, and then separately for core and periphery ones. In each case, the estimation is performed separately for short and long lending maturities. The coefficient λ_3 of the interaction term is positive (0.015) and statistically significant for all specification with the only exception of interest rates charged on loans up-to-1 year in core countries (column 4). The estimates allow us to compute the implied pass-through due to the banks' sovereign exposure. For instance, considering short-term loans in periphery countries (column 5) our result implies that an increase in yields of 100 basis points is associated with an increase of 8 basis points in lending rates. The "total" pass-through can be obtained by summing this effect associated with the median sovereign exposure to the baseline impact (λ_1) of 11 basis points.

[Insert **Table 11**]

5 Sovereign yields and exposures

The results reported so far highlight the importance of bank-level differences in domestic sovereign exposures for the transmission of sovereign shocks. Hence, it is natural to ask which bank characteristics contributed to generating these differences, and possibly

exacerbated them, also in response to sovereign stress, over the period under examination. In particular, it is interesting to investigate whether the degree of bank undercapitalization (which was already been seen to amplify the impact of sovereign exposures on loans at times of sovereign stress) was associated with the tendency to increase distressed government debt holdings in the face of increases in its yield, i.e. have increased banks' propensity to engage in "carry trades" for periphery country banks. Since we do not observe the breakdown by country of the holdings of non-domestic exposures, we cannot do the same investigation for the core country banks.

It is important to notice that, being the result of banks' portfolio allocation problem, the choice to increase or reduce sovereign exposures must respond to the expected component of the return on government debt, as is the case for the response of bank loans to unexpected capital losses, which arise from the unexpected component of the return on sovereign debt. Hence, the model we estimate is the following:

$$Sov.Exp_{ijt} = \alpha_i + \gamma_t + \mu_1 Exp.Ret_{jt} + \mu_2 Exp.Ret_{jt} \times Lev_{ij08} + \mu_4 X_{ijt} + \varepsilon_{ijt}, \qquad (7)$$

where the dependent variable is the exposures to domestic sovereign bond as ratio of the main assets, and the variable $Exp.Ret_{jt}$ is the expected return on the sovereign debt of country *j*. Leverage (Lev_{ij08}) is measured either by the bank's regulatory capital ratio, namely, Tier-1 capital ratio at the end of 2008, or the book leverage ratio, i.e. the book value of equity scaled by the bank's main assets, using the IBSI data at the end of 2008. Clearly, when Lev_{ij08} is defined as the bank's regulatory capital ratio, the carry-trade hypothesis predicts the coefficient μ_1 to be positive and the coefficient μ_2 to be negative: banks respond to the expected return on domestic sovereign debt by increasing their exposure to it ($\mu_1>0$), but do so less if they have a better capital ratio, since they have less need to engage in carry trades as a way to "bet for resurrection" ($\mu_2<0$). Instead, when Lev_{ij08} is defined as the bank's book leverage ratio, which takes larger values for less capitalized banks, the "carry trade" hypothesis predicts also the interaction coefficient to be positive ($\mu_2>0$).

We use three different proxies to measure the expected return on the sovereign debt, $Exp.Ret_{jt}$. First, assuming mean-reversion in yields, we measure it as the change in yields: when banks observe an increase in the yield on domestic sovereign debt, they expect it to drop in the future, and therefore they expect a positive return on domestic sovereign debt. Second, assuming mean-reversion in sovereign credit risk, we measure it as the change in the CDS premium on the domestic sovereign: when banks observe an increase in this CDS premium, they expect it to drop in the future, and by the same token to make a positive return on domestic sovereign debt. Thirdly, we use a survey-based gauge of the expected return on sovereign debt, measuring it as the difference between the current yield and the

expected yield over the 3 or 12 months ahead: recalling that the price of sovereign debt is inversely related to its yield, the difference between the current yield and the expected yield on the debt of country *j* is positively associated with its expected appreciation.

The results shown in **Table 12**, where the expected return on sovereign debt is measured by the change in its yield and leverage is measured by the bank's regulatory capital ratio, show that in the subsample of periphery countries the coefficient μ_1 is positive and μ_2 is negative, as predicted by the "carry trade" hypothesis, while neither of them is significantly different from zero for core countries. Very similar results are obtained in **Table 13**, where the expected return on sovereign debt is proxied by the change in the sovereign CDS premium.

The estimates reported in **Table 12**, where the expected return on sovereign debt is measured by survey-based data, are slightly different. Here the coefficient μ_1 is positive in core countries (which here include only France, Germany and the Netherlands owing to data constraints), while it is not significant in periphery countries, unlike what found in the two previous tables. However, the sign of the coefficient of the interacted variable is consistent with the findings of the previous two tables, once it is considered that here Lev_{ij08} is defined as the bank's book leverage ratio: here μ_2 is positive, indicating that greater book leverage is associated with larger domestic sovereign exposures. Hence, all three tables agree on the finding that in the periphery countries, when the domestic sovereign debt becomes riskier, the banks less capitalized increase their exposures more relative to the others.

6 Conclusions

In the euro debt crisis, bank sovereign exposures amplified the transmission of sovereign stress to the solvency risk of banks and to their lending activity. We estimate the magnitude of this amplification mechanism relying on novel ECB monthly data on sovereign exposures and lending policies of 252 euro-area banks from 2007 to 2015.

We find that for the median euro-area periphery bank, a 100-basis-points increase in the domestic sovereign CDS premium translated into an additional increase of 20 basis point in the bank CDS premium, adding to a baseline effect of 47 basis points. Moreover, the drop in the value of domestic sovereign holdings of periphery banks associated with a 1-standard-deviation increase in the 10-year sovereign yield accounted for 9% of the actual drop in total loans, the magnitude of this effect being stronger for undercapitalized banks. No such amplification effects are detected for banks in core countries. Finally, increases in the yield of

domestic sovereign debt triggered larger increases in the sovereign exposures of more leveraged periphery banks, in line with the "carry trade" hypothesis.

On the whole, our estimates imply that the sovereign exposures of banks in Ireland, Italy, Portugal and Spain have increased considerably the volatility of loan supply in 2008-15, first exacerbating its drop in 2009-11 and contributing to its recovery since 2013. In spite of the latter, more benign, effect of bank sovereign exposures on credit, currently their potential disruptive effects are even larger than at the peak of the crisis, should there be a revival of tensions on the sovereign debt market of the euro-area periphery. Currently the domestic exposures of euro-area banks are on average 7% of their assets, compared with the 4% of the 2010-11, which makes their potential amplification effects on bank loans proportionately larger. Assuming that the relationships estimated in this paper were to apply in a new crisis, the effect of an increase of sovereign yields in Ireland, Italy, Portugal and Spain of the same magnitude as that experienced in 2010-11 (when they increased by more than 400 basis points) associated with bank domestic sovereign exposures in these countries would amount to a drop in the loan-to-asset ratio of 7 %, almost twice as much as that implied by the sovereign exposures at the inception of the crisis. This highlights the urgency of reforming the preferential treatment that current euro-area prudential regulation gives to the domestic sovereign holdings of banks.

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Table 1: Distribution of the individual bank by country and ownership

For each country, the table reports the number of individual banks and the ownership structure.

	Total	Domestic		Foreign
		Private	Public	
Austria	9	8	0	1
Belgium	10	2	1	7
Cyprus	5	3	1	1
Estonia	4	0	0	4
Finland	7	3	0	4
France	37	30	3	4
Germany	65	25	26	14
Greece	6	6	0	0
Ireland	13	2	3	8
Italy	26	18	1	7
Latvia	5	4	0	1
Luxembourg	11	3	0	8
Malta	4	3	0	1
Netherlands	10	4	3	3
Portugal	6	3	1	2
Slovakia	3	0	0	3
Slovenia	5	1	2	2
Spain	26	16	6	4
Total	**252**	**131**	**47**	**74**

Table 2: Sample representativeness

For each country, the table shows the main assets, loans to NFCs and holdings of government debt securities covered by our individual bank dataset in January 2015 as percentage of the aggregate data for th corresponding as reported in BSI statistics of the ECB.

	Main assets	Loans to the non-financial private sector	Holdings of Government debt securities
Austria	40	38	50
Belgium	72	81	84
Cyprus	73	87	86
Estonia	87	90	74
Finland	85	82	86
France	74	68	87
Germany	64	48	74
Greece	92	91	85
Ireland	38	74	66
Italy	63	59	48
Latvia	61	81	47
Luxembourg	34	69	36
Malta	30	81	77
Netherlands	87	89	91
Portugal	69	70	66
Slovakia	55	57	63
Slovenia	54	50	69
Spain	84	86	86
Average	**64**	**72**	**71**
Weighted Average	**69**	**64**	**73**

Table 3: Descriptive Statistics

The table presents the mean, median and standard deviation of bank sovereign exposures, loans to firms, interest rates (Panel A), and bank characteristics (Panel B). Dom. Gov. Bond is the domestic sovereign debt holdings as proportion of the total assets of banks. Loans to NFC are the bank loans to non-financial corporations as proportion of the total assets of banks. Interest Rate (NFC) is the interest rate applied to loans by non-financial corporations. Leverage is the ratio of bank's total assets to its capital.

Panel A: Domestic Exposures, Loans and Interest Rates

				Std. Dev.	
	N	mean	median	between	within
Dom. Gov. Bond (%)	20543	4	2	5.6	2.6
Non-Dom. Gov. Bond (%)	20432	1.8	0.3	3.1	2.1
Loans to NFC (%)	20609	18.1	16	13.6	4.1
Interest rate (NFC)	15866	3.6	3.3	1.1	1.2

Panel B: Bank Characteristics

				Std. Dev.	
	N	mean	median	between	within
Total Assets (bn)	20653	80	35	118.2	24.3
Leverage ratio	19542	18	14.5	12	5.2
Deposit/liabilities (%)	20538	64.3	67.7	22.3	7
Interbank loans/liabilities (%)	3774	-1	0	34	12.3
Borrowing from ECB/liabilities (%)	3864	4.9	1.4	5.8	4.2

Table 4: Sovereign risk transmission and lagged sovereign exposures: CDS premia

Dependent variable: Bank CDS premium. The periphery countries are Cyprus, Ireland, Italy, Portugal and Spain. The core countries are Austria, Belgium, Finland, France, Germany and Netherland. Banks controls: (lagged) capital-asset ratio; (lagged) deposit-liability ratio. Country controls: Expected Default Frequency (EDF) of NFCs (Moody's Analytics); demand for loans (Bank Lending Survey, ECB). Standard errors in parentheses are clustered at the bank level. Sample: 2007m8-2015m12. * p<0.1, ** p<0.05, *** p<0.01

	(1) all	(2) core	(3) periph
$Sov.CDS5y_t$	0.56***	0.54**	0.48***
	(0.14)	(0.23)	(0.18)
$Sov.Exposures_{t-1}$	3.88	0.26	4.62
	(2.37)	(1.02)	(4.97)
$Sov.CDS5y_t \times Sov.Exposures_{t-1}$	0.03	0.00	0.05**
	(0.02)	(0.00)	(0.02)
Controls	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Adjusted R^2	0.73	0.72	0.7
Banks	108	67	41
Observations	8553	5235	3318

Table 5: Sovereign risk transmission and sovereign exposures: without SIFI

Dependent variable: Bank CDS premium. The sample does not include systemically important financial institutions (SIFI, as defined by he Financial Stability Board). The periphery countries are Cyprus, Ireland, Italy, Portugal and Spain. The core countries are Austria, Belgium, Finland, France, Germany and Netherland. Banks controls: (lagged) capital-asset ratio; (lagged) deposit-liability ratio. Country controls: Expected Default Frequency (EDF) of NFC (Moody's Analytics); demand for loans (Bank Lending Survey, ECB). Standard errors in parentheses are clustered at the bank level. Sample: 2007m8-2015m12. * p<0.1, ** p<0.05, *** p<0.01

	(1)	(2)	(3)
	all	core	periph
$Sov.CDS5y_t$	0.48***	0.50*	0.31*
	(0.15)	(0.27)	(0.16)
$Sov.Exposures_{t-1}$	3.79	0.24	3.65
	(2.4)	(1)	(5.59)
$Sov.CDS5y_t$ x Sov.Exposures	0.03	0.00	0.06**
	(0.02)	(0.00)	(0.02)
Controls	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Adjusted R^2	0.73	0.71	0.71
Banks	99	60	39
Observations	7845	4671	3174

Table 6: Sovereign risk transmission and initial sovereign exposures: CDS premia

Dependent variable: Bank CDS premium. The variable "High Exp." is equal to 1 (0) for the banks whose exposures to domestic sovereign debt in 2009 is above (below) the 75th (25th) percentile. The periphery countries are Cyprus, Ireland, Italy, Portugal and Spain. The core countries are Austria, Belgium, Finland, France, Germany and Netherland. Banks controls: (lagged) capital-asset ratio; (lagged) deposit-liability ratio. Country controls: Expected Default Frequency (EDF) of NFC (Moody's Analytics); demand for loans (Bank Lending Survey, ECB). Standard errors in parentheses are clustered at the bank level. Sample: 2009m1-2015m2. * p<0.1, ** p<0.05, *** p<0.01.

	(1) all	(2) core	(3) periph
$Sov.CDS5y_t$	0.47**	0.11	0.27
	(0.23)	(0.47)	(0.22)
$Sov.CDS5y_t \times HighExp_{09}$	0.22	0.16	0.45**
	(0.22)	(0.3)	(0.19)
Controls	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Adjusted R^2	0.82	0.77	0.72
Banks	50	31	21
Observations	2776	1701	1212

Table 7: Sovereign risk transmission and lagged exposures: innovations in yields

Dependent variable: Bank CDS premium. The variable "3m News yield" (respectively, "12m News yield") is the unexpected realization of the government yield, defined as the difference between the actual and the forecasted yield at time t-3 (t-12). The periphery countries are Italy and Spain. The core countries are France, Germany and Netherland. Banks controls: (lagged) capital-asset ratio; (lagged) deposit-liability ratio. Standard errors in parentheses are clustered at the bank level. Country controls: Expected Default Frequency (EDF) of NFC (Moody's Analytics); demand for loans (Bank Lending Survey, ECB). Sample: 2007m8-2015m2. * p<0.1, ** p<0.05, *** p<0.01.

	all		core		periph	
	(1)	(2)	(3)	(4)	(5)	(6)
$3m.NewsYield_t$	18.00*		20.07		10.39	
	(9.03)		(14.99)		(22.28)	
$12m.NewsYield_t$		11.84		17.55		21.2
		(7.21)		(11.22)		(21.34)
$Sov.Exposures_{t-1}$	6.68**	8.11***	-2.21	-2.62	11.06***	11.76***
	(2.91)	(3.06)	(1.55)	(2.06)	(3.64)	(3.72)
$3m.NewsYield_t$ x $Sov.Exposures_{t-1}$	3.38*		-0.92		3.39	
	(1.71)		(0.99)		(2.44)	
$12m.NewsYield_t$ x $Sov.Exposures_{t-1}$		3.50**		-0.72		3.84**
		(1.37)		(1.68)		(1.76)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.77	0.78	0.72	0.73	0.8	0.82
Banks	74	74	50	50	24	24
Observations	4996	4996	3340	3340	1958	1828

Table 8: Sovereign stress and bank lending: total loans

Dependent variable: Total loans to NFC (% of asset). Countries in column (1) are the core countries, the periphery countries, Slovenia and Slovakia. The core countries are Austria, Belgium, Finland, France, Germany, Netherland. The periphery countries are Ireland, Italy, Portugal and Spain. Banks controls: (lagged) capital-asset ratio; (lagged) deposit-liability ratio. Country controls: Expected Default Frequency (EDF) of NFC (Moody's Analytics); demand for loans (Bank Lending Survey, ECB). Standard errors in parentheses are clustered at the bank level. Sample: 2007m8-2015m2. * p<0.1, ** p<0.05, *** p<0.01

	(1) all	(2) core	(3) periph
$Sov.Yield10y_{t-2}$	-0.24	-0.56	0.13
	(0.17)	(0.8)	(0.2)
$Sov.Exposures_{t-3}$	-0.04	0.11	-0.13
	(0.08)	(0.08)	(0.12)
$Sov.Yield10y_{t-2}$ x $Sov.Exposures_{t-3}$	-0.04**	-0.01	-0.05**
	(0.02)	(0.03)	(0.02)
Controls	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Adjusted R^2	0.93	0.92	0.94
Banks	202	136	58
Observations	16699	11409	4762

Table 9: Sovereign stress and bank lending: controlling for bank characteristics

Dependent variable: Total loans to NFC (% of asset). Countries in column (1) are the core countries, the periphery countries, Slovenia and Slovakia. The core countries are Austria, Belgium, Finland, France, Germany, Netherland. The periphery countries are Ireland, Italy, Portugal and Spain. Country controls: Expected Default Frequency (EDF) of NFC (Moody's Analytics); demand for loans (Bank Lending Survey, ECB). Standard errors in parentheses are clustered at the bank level. Sample: 2009m1-2015m2.
* p<0.1, ** p<0.05, *** p<0.01.

	(1) all	(2) core	(3) periph
$Sov.Yield10y_{t-2}$	0.31	1.9	-0.44
	(0.45)	(1.28)	(0.31)
$Sov.Exposures_{t-3}$	-0.11	0.05	-0.15
	(0.07)	(0.07)	(0.1)
$Sov.Yield10y_{t-2}$ x $Sov.Exposures_{t-3}$	-0.03*	-0.01	-0.04**
	(0.02)	(0.03)	(0.02)
$Sov.Yield10y_{t-2}$ x $Dep/Liability_{t-3}$	0.00	-0.01	0.01*
	(0.01)	(0.01)	(0.01)
$Dep/Liability_{t-3}$	0.01	0.05	-0.1
	(0.04)	(0.05)	(0.07)
$Sov.Yield10y_{t-2}$ x $Leverage_{08}$	-0.02	-0.01	-0.01**
	(0.01)	(0.02)	(0.01)
Time FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Adjusted R^2	0.94	0.93	0.94
Banks	177	120	52
Observations	12782	8698	3724

Table 10: Sovereign stress and bank lending: unexpected change in yields

Dependent variable: Loans to NFC up 1 year (% of asset). The variable "3m News yield" is the unexpected realization of the government yield, defined as the difference between the actual and the forecasted yield at time $t-3$. The periphery countries are Italy and Spain. The core countries are France, Germany and Netherland. Banks controls: (lagged) capital-asset ratio; (lagged) deposit-liability ratio. Country controls: Expected Default Frequency (EDF) of NFC (Moody's Analytics); demand for loans (Bank Lending Survey, ECB). Standard errors in parentheses are clustered at the bank level. Sample: 2007m8-2015m2. * p<0.1, ** p<0.05, *** p<0.01.

	(1)	(2)	(3)
	all	core	periph
$3m.NewsYield_{t-3}$	0.19	-0.16	0.36
	(0.15)	(0.25)	(0.22)
$Sov.Exposures_{t-4}$	-0.08***	-0.03	-0.12**
	(0.03)	(0.02)	(0.06)
$3m.NewsYield_{t-3}$ x $Sov.Exposures_{t-4}$	-0.03**	-0.02	-0.04**
	(0.01)	(0.01)	(0.02)
Controls	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Adjusted R^2	0.92	0.85	0.93
Banks	155	109	46
Observations	12736	9067	3669

Table 11: Sovereign stress and lending rates

Dependent variables: Lending rates to NFCs.). Countries in column (1) are the core countries, the periphery countries, Slovenia and Slovakia. The core countries are Austria, Belgium, Finland, France, Germany, Netherland. The periphery countries are Ireland, Italy, Portugal and Spain. Banks controls: capital-asset ratio; deposit-liability ratio. Country controls: Expected Default Frequency (EDF) of NFC (Moody's Analytics); demand for loans (Bank Lending Survey, ECB). Standard errors in parentheses are clustered at the bank level. Sample: 2007m8-2015m2. * p<0.1, ** p<0.05, *** p<0.01

	all		core		periph	
	(up1y)	(ov.1y)	(up1y)	(ov.1y)	(up1y)	(ov.1y)
$Sov.Yield10y_t$	0.14***	-0.09	0.24***	-0.12	0.10***	-0.09
	(0.03)	(0.07)	(0.06)	(0.09)	(0.04)	(0.1)
$Sov.Exposures_{t-1}$	-0.03***	-0.08***	-0.02	-0.11***	-0.05***	-0.03
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
$Sov.Yield10y_t$ x $Sov.Exposures_{t-1}$	0.01***	0.03***	0.00	0.03***	0.01***	0.02**
	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Country trend	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.81	0.58	0.84	0.61	0.79	0.58
Banks	144	138	92	88	52	50
Observations	11388	6772	7153	4415	4235	2357

Table 12: Sovereign exposures and changes in sovereign yields

Dependent variable: domestic exposures. The variable "t1cer08" is the Tier1 capital ratio at the end of 2008. The periphery countries are Ireland, Italy, Portugal and Spain. The core countries are Austria, Belgium, Estonia, Finland, France, Germany, Netherland, Slovenia, Slovakia. Banks controls: (lagged) deposit-liability ratio. Standard errors in parentheses are clustered at the bank level. Sample: 2009m1-2015m2. * p<0.1, ** p<0.05, *** p<0.01.

	(1)	(2)
	(core)	(periph.)
ΔSov.Yield10y$_t$	-0.66	1.17*
	(1.78)	(0.68)
ΔSov.Yield10y$_t$ x t1cer$_{08}$	-0.11	-0.18*
	(0.29)	(0.11)
Time FE	Yes	Yes
Bank FE	Yes	Yes
Adjusted R^2	0.94	0.76
Banks	48	29
Observations	3376	2016

Table 13: Sovereign exposures and changes in sovereign CDS premia

Dependent variable: domestic exposures. The variable "t1cer08" is the Tier1 capital ratio at the end of 2008. The periphery countries are Ireland, Italy, Portugal and Spain. The core countries are Austria, Belgium, Estonia, Finland, France, Germany, Netherland, Slovenia, Slovakia. Banks controls: (lagged) deposit-liability ratio.
Standard errors in parentheses are clustered at the bank level. Sample: 2009m1-2015m2. * p<0.1, ** p<0.05, *** p<0.01.

	(1)	(2)
	(core)	(periph.)
DSov.CDS5y$_t$	-2.93	0.89**
	(1.92)	(0.39)
DSov.CDS5y$_t$ x t1cer$_{08}$	0.37	-0.15**
	(0.23)	(0.06)
Time FE	Yes	Yes
Bank FE	Yes	Yes
Adjusted R^2	0.95	0.75
Banks	41	33
Observations	2960	2230

Table 14: Sovereign exposures and expected returns on sovereign debt

Dependent variable: Sovereign exposures (as % of main assets). The variable HighLeverage08 is equal to 1 (0) for the banks whose leverage in 2008 is above (below) the median. The periphery countries are Italy and Spain. The core countries are France, Germany and Netherland. Banks controls: (lagged) deposit-liability ratio. Standard errors in parentheses are clustered at the country-month level. Sample: 2009m1-2015m2. * p<0.1, ** p<0.05, *** p<0.01.

	3-month		12-month	
	(core)	(periph.)	(core)	(periph.)
$Exp.Returns_t$	1.54***	0.30	0.63**	0.00
	(0.29)	(0.23)	(0.24)	(0.22)
$Exp.Returns_t$ x $HighLeverage_{08}$	0.10	0.35**	0.09	0.41***
	(0.09)	(0.14)	(0.08)	(0.12)
Time FE	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.64	0.62	0.63	0.62
Banks	97	40	97	40
Observations	8740	3514	8740	3514

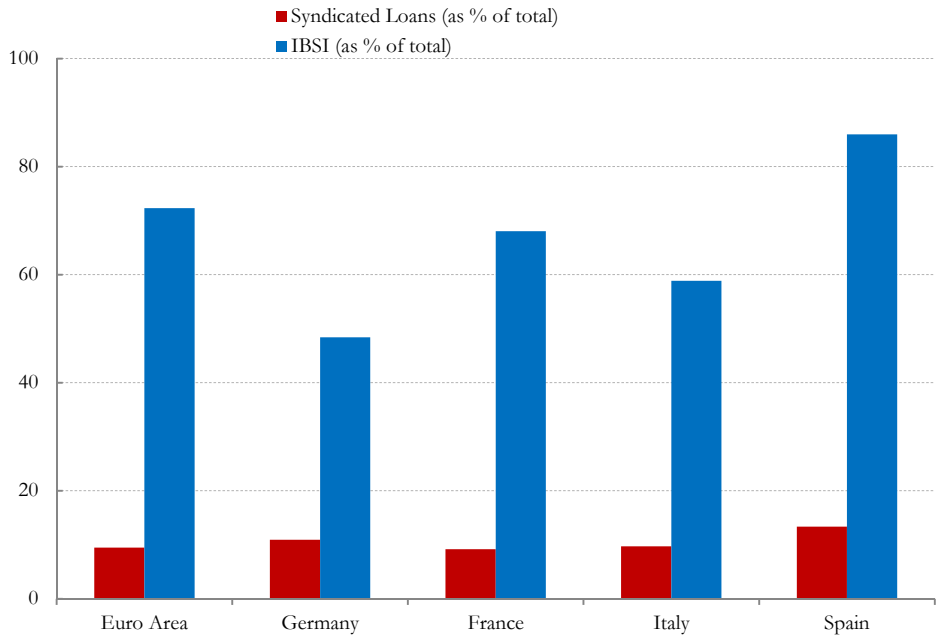


Figure 1: Syndicated loans as percentage of total loans. The figure shows the ratio of syndicated loans to total (BSI) on average over the sample January 2012 – February 2015.

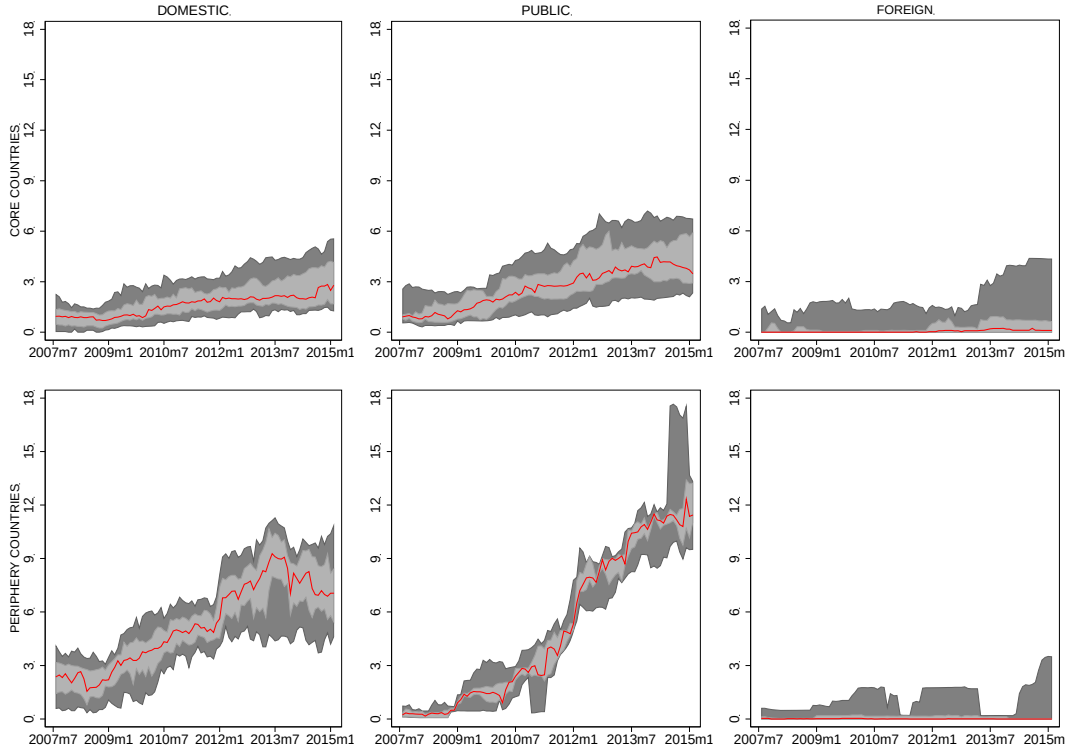
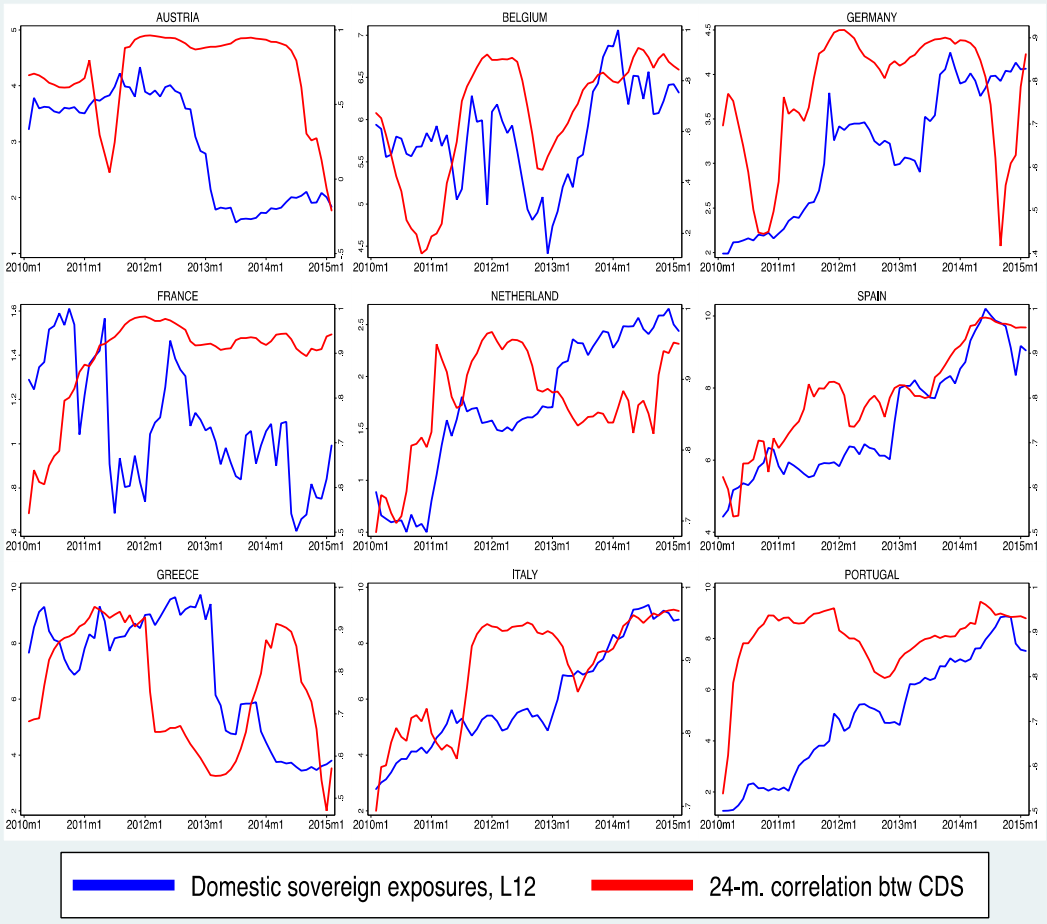
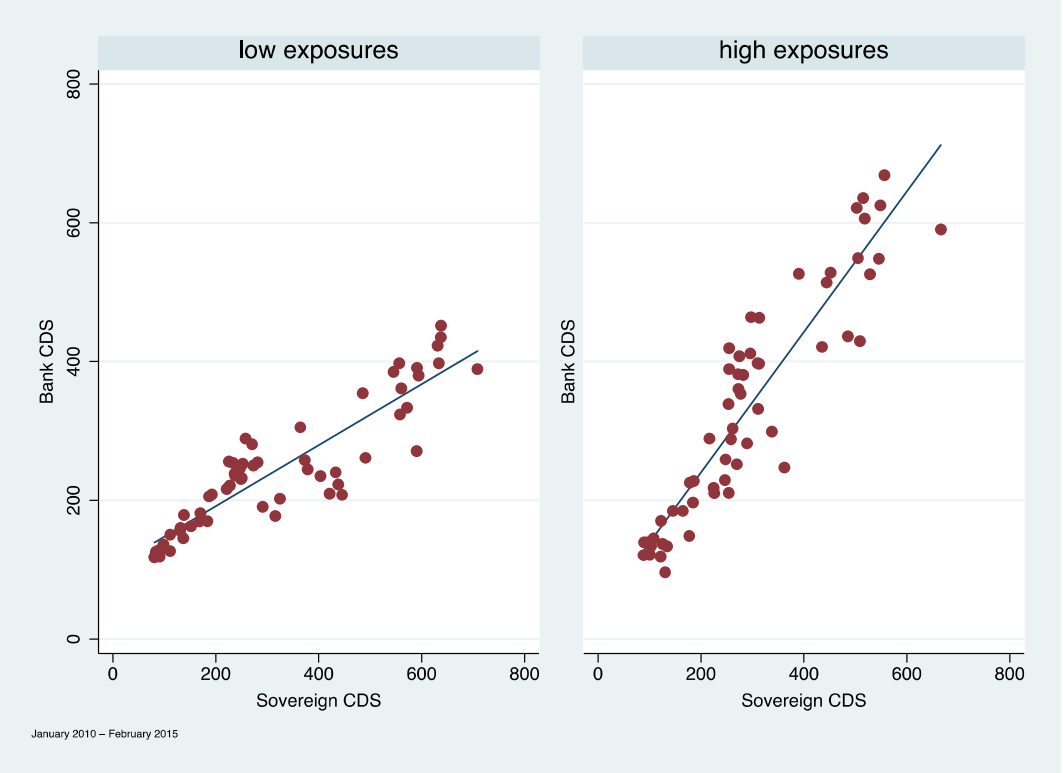


Figure 2: Domestic sovereign holdings, by bank ownership. The dark shaded area is the 25th -75th percentile, the light shaded area is the 40th-60th percentile. The red solid line is the median of the country-area cross-sectional distribution. The core countries are Belgium, France, Germany and Netherland. The periphery countries are Greece, Ireland, Italy, Portugal and Spain. Sample: August 2007 - February 2015.



correlations between sovereign and bank. The blue line is the average domestic sovereign exposures (of domestic banks) as % of average total assets in each country. Sample: August 2007 - February 2015.

Panel A: Periphery-country banks



Panel B: Core-country banks

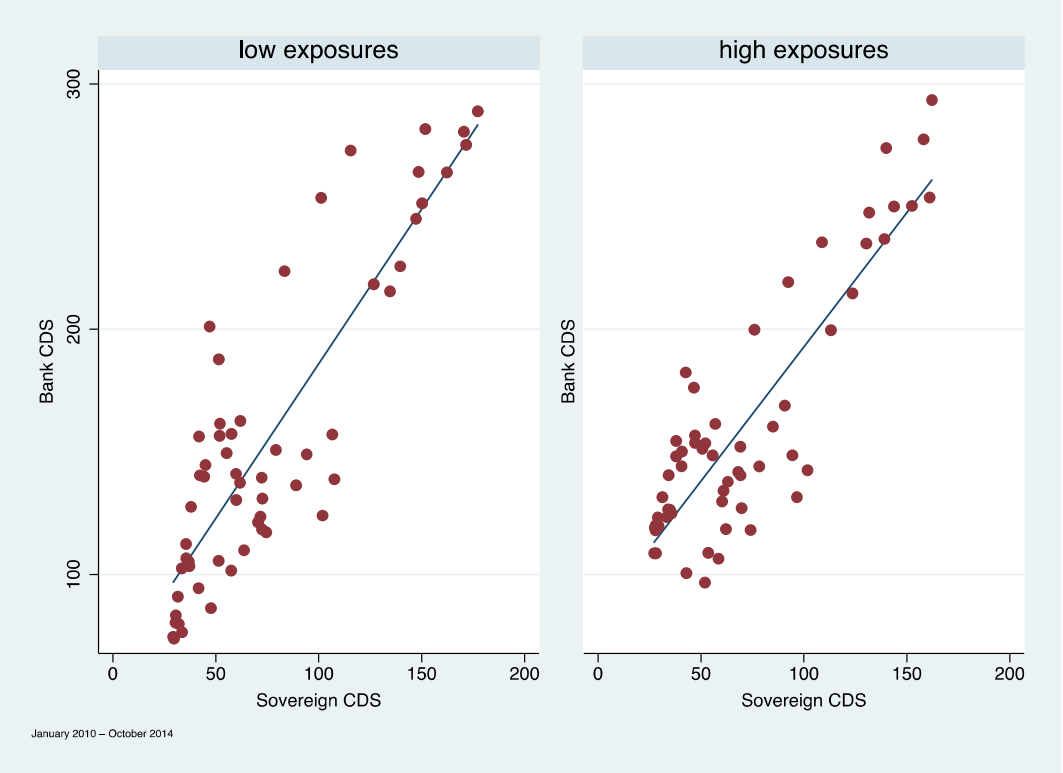
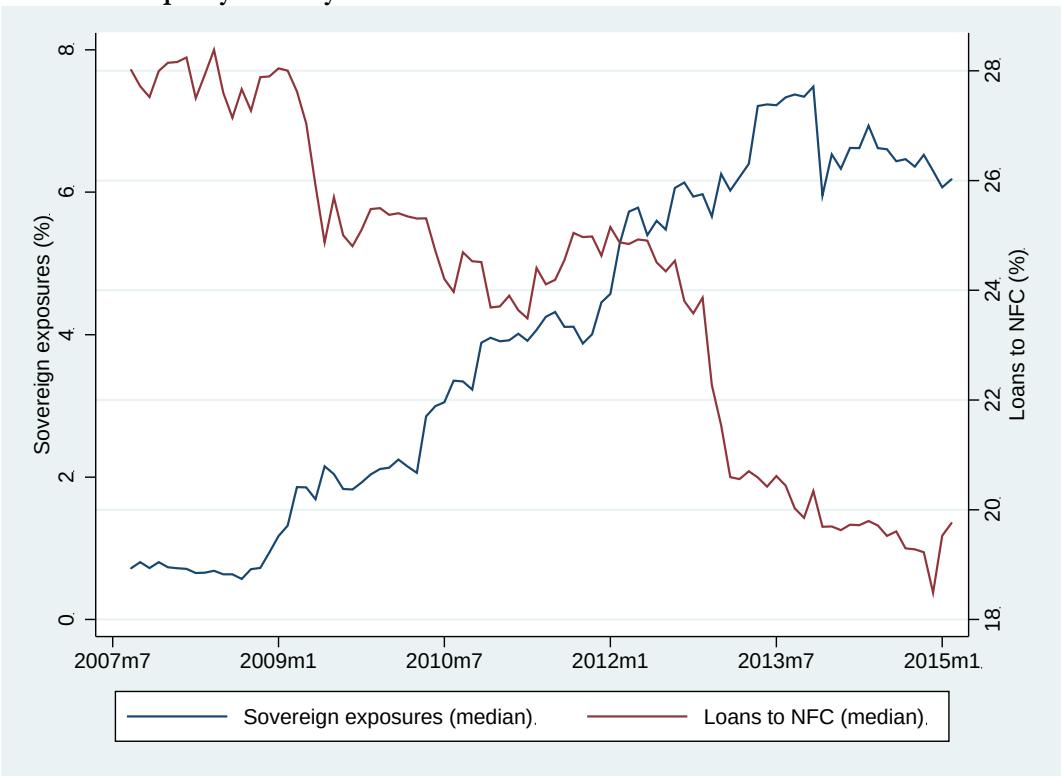


Figure 4: Breakdown by country groups and by size of exposures. Bank CDS is the average CDS premium of individual banks in a given month. Sovereign CDS is the simple average of the sovereign CDS premia for the relevant group of countries in a given month. The periphery countries are Ireland, Italy, Portugal and Spain. The core countries are Austria, France, Germany, and the Netherlands. The group "low exposure" ("high exposure") contains the banks whose 2009 exposure to domestic debt is below (above) the 25 (75) percentile. The sample extends from January 2010 to February 2015.

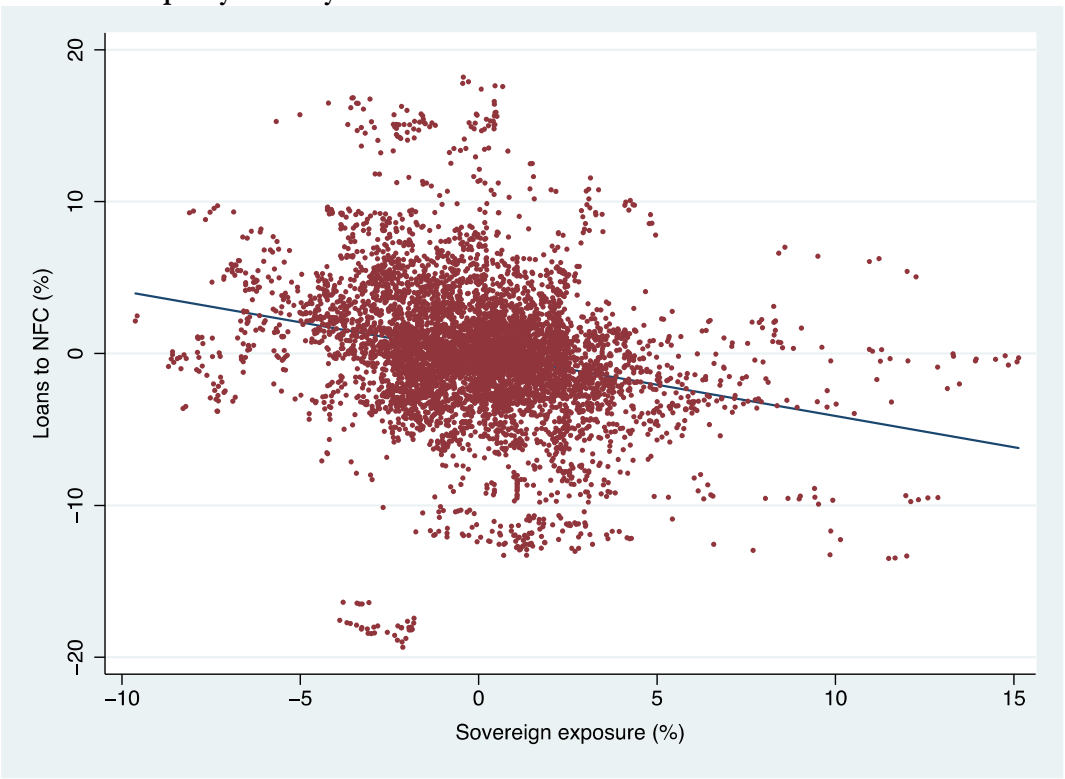
Panel A: Periphery-country banks



Panel B: Core-country banks

Figure 5: Sovereign exposures and lending: median periphery and core banks. Note: The periphery countries are Greece, Ireland, Italy, Portugal and Spain. The core countries are Austria, Belgium, France, Germany, Luxemburg and Netherland. Sample: August 2007 - February 2015.

Panel A: Periphery-country banks



Panel B: Core-country banks

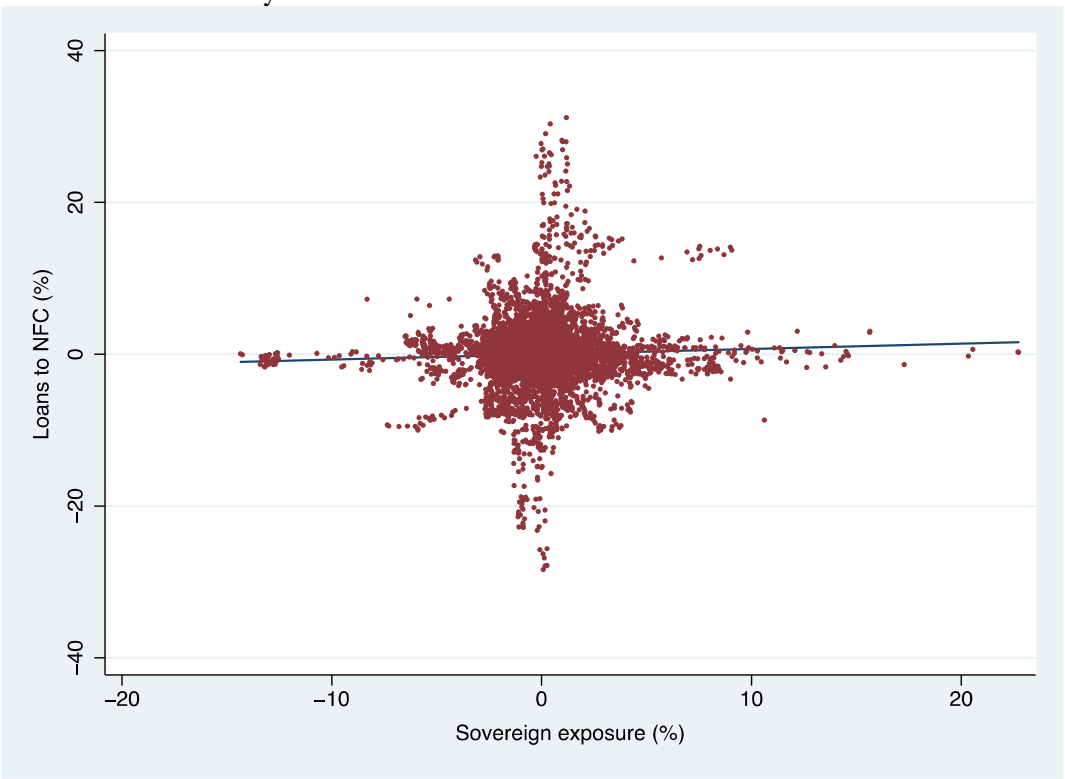


Figure 6: Sovereign exposures and lending: periphery and core bank. Note: Residuals of loan and sovereign exposure regressions on bank fixed effects and time dummies. The periphery countries are Greece, Ireland, Italy, Portugal and Spain. The core countries are Austria, Belgium, France, Germany, Luxemburg and Netherland. Sample: August 2007 - February 2015.

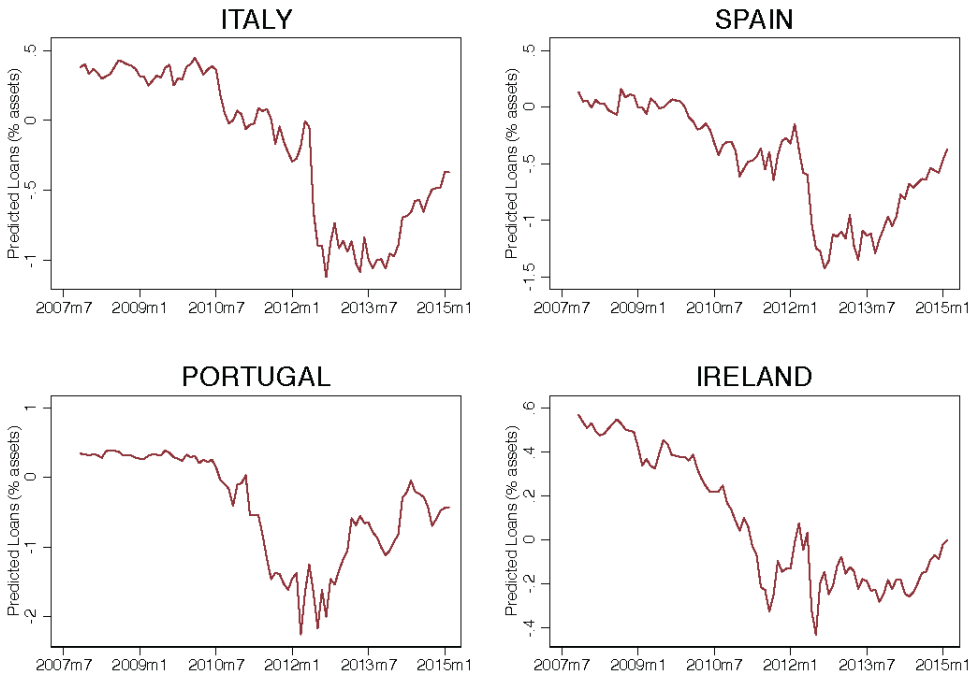


Figure 7: Impact of banks' domestic sovereign exposures on their lending over time. The figure reports for each month the predicted values of loans (as ratio of the actual value) due to banks' balance sheet channel.