Bank Exposures and Sovereign Stress Transmission

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Abstract

Using novel monthly data for 226 euro-area banks from 2007 to 2015, we investigate the causes and effects of banks' sovereign exposures during and after the euro crisis. First, in the vulnerable countries, the publicly owned, recently bailed out and less strongly capitalized banks reacted to sovereign stress by increasing their domestic sovereign holdings more than other banks, suggesting that their choices were affected both by moral suasion and by yield-seeking. Second, their exposures significantly amplified the transmission of risk from the sovereign and its impact on lending. And this amplification of the impact on lending cannot be ascribed to spurious correlation or reverse causality.

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

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

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1 Introduction

The euro-area sovereign debt crisis dramatically spotlighted the nexus between governments and banks and its powerful effects on lending and economic activity: in Greece, Ireland, Italy, Portugal and Spain (the "vulnerable countries" of the euro area), the indicators of government and bank default risk (such as CDS premia and credit ratings) spiked together after the Greek bailout in 2010 and then subsided together in 2012 as the ECB committed to buy distressed sovereign debt if necessary. This paper shows that banks' holdings of domestic sovereign debt played a key role in the nexus both during and after the crisis. We use novel monthly data on sovereign exposures, loans and lending rates for 226 euro-area banks from 2007 to 2015. This panel dataset provides much more information about the cross-sectional and temporal variations in bank sovereign exposures than the European Banking Authority stress test data, used in most earlier studies. We establish three sets of results.

First, in the vulnerable euro-area countries, domestic publicly-owned and recently bailed-out banks reacted to sovereign stress by increasing their holdings of domestic public debt significantly more than other banks: the closer connection with government is likely to explain these banks' greater propensity to support public issuance in times of stress, consistently with the "moral suasion" hypothesis proposed by Uhlig (2013).[1] Moreover, in those same countries, the banks with low regulatory capital increased their holdings of distressed public debt more than the others, which is consistent with the thesis that they followed a "carry trade" strategy to bet on resurrection, as suggested by Acharya and Steffen (2015) and Crosignani (2015). We provide evidence that the behavior of euro-area banks during the crisis was to some extent consistent with both hypotheses, whereas previous studies focused on either one or the other – "moral suasion" being documented by De Marco and Machiavelli (2014), Becker and Ivashina (2014), and Ongena, Popov and Van Horen (2015), and "carry trades" by Acharya and Steffen (2015), Acharya, Eisert, Eufinger and Hirsch (2015) and Buch, Koetter and Ohls (2015). Horváth, Huizinga and Ioannidou (2015) test both hypotheses, but in separate regressions, so that from their estimates it is

[1] Uhlig shows that fiscally vulnerable governments have an incentive to allow domestic banks to hold home risky bonds, in order to borrow more cheaply, while non-vulnerable governments will impose tighter regulation. Battistini, Pagano and Simonelli (2014) argue that sovereign stress heightens this incentive, generating a positive relationship between sovereign yields and banks' holdings of domestic debt, and refer to this prediction as the "moral suasion" hypothesis, a label also used in subsequent work.

unclear whether both would have explanatory power in a nested specification.

Second, we show that in the vulnerable countries, the banks more exposed to the sovereign featured larger increases in solvency risk, sharper reductions in loans and more pronounced rises in lending rates than the less exposed banks. In other words, banks' exposure to domestic sovereign risk via government bond holdings acted as an amplification mechanism in the transmission of stress to the banking system. When sovereign bonds depreciated due to heightened sovereign risk, banks suffered an equity loss, which increased default risk and hence their funding costs, forcing the most highly exposed to deleverage. We estimate this amplification effect by exploiting the heterogeneous response of banks with different sovereign exposures, while allowing for a baseline effect of sovereign stress on bank risk unrelated to their exposures, due, say, to falling confidence in the government as backstop for banks. The amplification effect associated with sovereign exposures is sizeable: in the vulnerable countries, a 100-basis-point increase in the domestic sovereign CDS premium translates into a rise of 31.5 basis points in the CDS premium of the bank with median exposure, while a 1-standard-deviation drop in the price of government bonds reduces the loan growth of the median domestic head bank by 1.4 percentage points, which is 20% of the standard deviation of loan growth. We also find that bank lending reacts primarily to the unexpected component of sovereign stress, i.e. to news that a sovereign default is more likely, as in the model proposed by Bocola (2016).

Third, our estimation determines the direction of causality between sovereign exposures and bank lending. This is an important issue, as both are policy variables for banks – loans being affected not only by banks' credit standards but also by firms' demand. Hence, in principle causality could run from banks' loans to their sovereign holdings rather than the other way: sovereign distress may reduce loan demand by sapping entrepreneurial confidence, and may impair corporate creditworthiness, for instance for firms catering to the public sector. These drops in the amount or quality of loan demand may hit some banks more severely than others, and the worst-affected banks may end up substituting sovereign debt for corporate loans on the asset side. We address this issue with three pieces of evidence. First, banks' losses on their sovereign debt holdings were not systematically correlated with riskier loan portfolios, i.e. with non-performing borrowers. Second, the foreign subsidiaries of vulnerable-country banks cut back on lending in non-vulnerable countries in response to losses on their head banks' domestic sovereign portfolios, and these cuts were as large as those

made by their head banks in lending at home, despite the resilience of loan demand in the more stable countries. Finally, our lending regressions instrument banks' losses or gains on sovereign exposures with their degree of public ownership and previous bailouts, both interacted with sovereign debt repricing: we effectively use a variant of our exposure regressions (those based on the "moral suasion" hypothesis) as the first stage of the bank lending regressions. The resulting IV estimates confirm the results obtained with OLS estimation, supporting the thesis that sovereign exposures amplify the effect of sovereign stress on lending, rather than responding to it.

On the whole, we find that the domestic sovereign exposures of banks in the vulnerable countries accentuated both the impact of sovereign stress until mid-2012 and its abatement subsequently. In this way, they significantly exacerbated the volatility of bank risk and lending in the euro-area periphery from 2008 to 2015 period. This evidence accords with the sovereign-debt feedback loop models of Acharya et al. (2014), Brunnermeier et al. (2016), Cooper and Nikolov (2013), Farhi and Tirole (2014) and Leonello (2014), which show that sovereign exposures create the potential for inefficient equilibria: if banks are highly exposed to the domestic sovereign, pessimistic beliefs about government solvency that lead to sovereign debt repricing will inflict large losses on banks and trigger bailouts; these in turn increase the likelihood of government default, validating the initial pessimism. In these models, the larger the banks' sovereign exposures, the more extensive the region where these inefficient equilibria can arise.

In conclusion, for the prudential regulation of banks it is of paramount importance to determine the contribution of sovereign exposures to the transmission of sovereign stress to banks' risk and lending decisions. Currently, euro-area prudential regulation gives preferential treatment to sovereign debt compared to loans to firms and households: unlike the latter, debt issued by euro-area sovereigns entails no capital charge (it is zero risk-weighted in measuring risk of assets) and is not subject to any portfolio concentration limit. Our evidence indicates that this preferential regulatory treatment is questionable, since banks in the vulnerable countries expanded their holdings of risky public debt at times of sovereign stress, and these exposures amplified the transmission of sovereign stress to bank risk and lending. And these effects may be even larger going forward: in the first quarter of 2015, banks' domestic sovereign exposure in the vulnerable countries averaged 7% of assets, compared with 4% in 2010-11. Hence, should there be a resurgence of sovereign stress comparable

to that experienced in 2010-11, the amplification effects on bank lending predicted by our estimates would be proportionately greater.

Several recent studies have investigated the government-bank nexus in the context of sovereign crises. Gennaioli, Martin and Rossi (2014a) present a model in which sovereign defaults reduce private lending by undermining the balance sheets of domestic banks, the more so the greater their holdings of government debt, and test these predictions on cross-country evidence; in a companion paper (Gennaioli, Martin and Rossi, 2014b) they also test them on also on bank-level data. Becker and Ivashina (2014) use company data on bank borrowing and bond issuance to show that European companies were more likely to replace bank loans with bond issues when banks in their country held more domestic sovereign debt and when that debt was risky. De Marco (2014) and Popov and van Horen (2014) show that the euro-area banks that turned out to have larger sovereign exposures in the EBA stress tests participated less than less exposed banks in the syndicated loan market, and raised their lending rates more sharply.[2] Acharya, Eisert, Eufinger and Hirsch (2015) combine syndicated loan data with company data, to investigate the real effects of the loan contraction triggered by the sovereign crisis.

Due to problems of data availability, these studies could not exploit cross-sectional and time-series variation in banks' sovereign exposures to the same extent as the present paper. 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 three studies use data on sovereign exposures drawn from the EBA stress tests up to 2011, which refer only to three dates and to a small sample of systemically important banks, and they measure bank lending with data on syndicated loans, which account for just 10% of total euro-area lending and cater mostly to large, established corporations. By contrast, our data on sovereign exposures and loans refer to a sample of banks that provide about 70% of total euro-area lending, and their granularity allow investigation both of the determinants of sovereign exposures and of their effects on bank risk and lending.

The structure of the paper is as follows. Section 2 describes the data, illustrating the variation in bank-level exposures and presenting some stylized facts. Section 3 analyzes the determinants of banks' domestic sovereign exposures. Section 4 exam-

[2]De Marco (2014) documents this finding also using yearly balance-sheet data on bank loans, besides syndicated loan data.

ines whether these exposures affected risk transmission from the sovereign to banks, and Section 5 whether they influenced the impact on bank lending and loan rates. Section 6 concludes.

2 Data and Stylized Facts

This section describes our data and sets out some stylized facts about euro-area banks' holdings of domestic sovereign bonds and their relationship with bank lending. These not only help to gauge the correlations in the data at aggregate level but also point to the additional insights that can be gleaned from bank-level data.

Our analysis is based on a unique, proprietary data set of balance sheet items at bank level (Individual Balance Sheet Items, or IBSI), which is regularly updated by the ECB. We use monthly observations on the main balance-sheet indicators (assets and liabilities) from June 2007 to February 2015. The sample contains a total of 226 unconsolidated banks in 18 euro-area countries (Table 1), the highest coverage being in the largest countries: Germany (60), France (32), Italy (24) and Spain (23). The banks are observed at unconsolidated level: 119 group head banks, 49 domestic subsidiaries, and 59 foreign subsidiaries (some affiliated to UK or Danish groups).[3] For all these banks, balance-sheet variables are supplemented by bank-level lending rate data drawn from another ECB proprietary data set (Individual MFI Interest Rates, or IMIR), measured as the average rate on new loans granted to non-financial corporations in a given month, weighted by the corresponding new business volumes.

[Insert Table 1]

These data are merged with data on bank shareownership from Bankscope and hand-collected data about bailout dates from the EU Commission state aid database. For the subset of banks with traded credit default swaps (CDS), we take monthly CDS premia from Datastream. The data include monthly observations of the benchmark 10-year and 5-year sovereign yields, survey-based consensus yield forecasts at

[3] Our analysis is based on the IBSI data realease of 15 April 2015, which contained data for 252 banks. Of these, we removed 26 banks featuring one or more of the following: (i) less than 12 months of observations were available for loans and exposures; (ii) loans equal to zero for the entire sample (with at most sparse spikes); (iii) frequent and extreme jumps in exposures or loans. Of the removed banks, 2 are Finnish, 5 French, 5 German, 2 Irish, 2 Italian, 5 Latvian, 1 is from Luxembourg, 1 Slovenian, and 3 are Spanish.

3-month and 12-month horizons, and 5-year CDS (monthly averages). Yields and CDS premia for euro-area countries are drawn from Datastream; survey-based forecasts are from Consensus Economics and are available only for France, Germany, Italy, the Netherlands and Spain. For details on data definitions and sources, see the Appendix. We apply the following screens to deal with outliers: we remove data for loans and/or exposures in periods where these are continuously zero with rare spikes (which occurs for 5 banks), data for CDS premia if these are constant for more than three months (3 banks), loan interest rates if their values are missing for more than 50% of the observations for a given bank (7 banks), and all negative values of domestic sovereign holdings, equity, main assets and lending.

The representativeness of the sample is shown in Table 2, which reports main assets (defined as total assets less derivatives), loans to non-financial corporations and holdings of government bonds for the banks in our data set as a fraction of the national aggregate, drawn from the ECB Balance Sheet Items (BSI) database. On average, for the main variables our data cover about 70% of the corresponding country aggregate. The bottom row of the table shows that weighting country coverage by GDP 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, our sample has data for the sovereign exposures of 226 banks, compared with at most 91 banks in the pre-2014 EBA stress test data, and for 93 months, compared with the 2 or 3 snapshots of the EBA stress tests. Second, as illustrated by Table 2, our bank loan data cover almost 70% of the corresponding national lending aggregates, compared with the 10% coverage of the syndicated loan data used by Popov and van Horen (2014) De Marco (2014) and Acharya, Eisert, Eufinger and Hirsch (2015).

Descriptive statistics for the main variables are shown in Panel A of Table 3, and for bank characteristics in Panel B. As in the subsequent analysis, the statistics are computed separately for two groups of countries: "vulnerable" (Cyprus, Greece, Ireland, Italy, Portugal, Slovenia and Spain) and "non-vulnerable" (Austria, Belgium, Estonia, Finland, France, Germany, Luxembourg, Malta, the Netherlands, and Slovakia). We define as "vulnerable" – i.e. subject to high sovereign stress – countries

whose 10-year sovereign yield exceeded 6% (or, equivalently, 4 points above the German yield) for at least one quarter in our sample period.

[Insert Table 3]

Table 3 reveals that banks in these two groups of countries behaved quite differently in several respects. First, their domestic sovereign exposures (the ratio of government debt holdings to main assets) are greater in vulnerable countries (4.9%) than in non-vulnerable ones (3.8%), while the opposite applies to non-domestic euro-area exposures (1% versus 2.2%).[4] Hence, in vulnerable countries the sovereign debt portfolios of banks are more "home-biased" than in non-vulnerable countries. (Unfortunately, we cannot measure the diversification of sovereign debt portfolios more precisely, because our data do not break non-domestic exposures down by sovereign issuer.) Second, banks accumulated domestic sovereign debt twice as fast in vulnerable as in non-vulnerable countries (2% versus 1% on a quarterly basis). Third, in vulnerable countries loans to firms are a larger fraction of bank assets than in non-vulnerable countries but grow less, and corporate lending rates are higher.

However, in both groups of countries there is considerable dispersion in the sovereign exposures of banks, as well as in the growth of bank sovereign holdings and corporate lending. Sovereign exposures feature substantial variation both over time and cross-sectionally: in the vulnerable countries, their within and between standard deviations are 3.09 and 3.83 respectively, compared with a mean of 4.9 percent; in the non-vulnerable countries, 1.85 and 6.42, with a mean of 3.8 percent. The growth rate of domestic sovereign holdings is more volatile, and its within standard deviation is four times higher than the between: 19.45 versus 5.16 in vulnerable countries and 22.48 versus 5.41 in non-vulnerable ones. Both values are very large compared to the respective means of -0.4 and 0.2. Both between-bank and within-bank variation in these variables is central to our empirical strategy.

Panel B shows that the characteristics of the average bank in the two groups of countries are similar: quite large, highly leveraged (more so in the non-vulnerable

[4]Banks' sovereign holdings are partly at market prices and partly at book values. They are marked to market if the bank classes them in its "trading book" (i.e., either "available for sale" or "held for trading"). They are at book values if the bank classes them in its "banking book" (i.e., "held to maturity"). Our data do not contain the breakdown between these two components. In the 45 euro-area banks present in the EBA stress test data, trading-book sovereigns account for 59% of the total for banks in vulnerable and 48% in non-vulnerable countries.

countries), yet with high regulatory capital ratios (9.4% in the vulnerable and 9.9% in the non-vulnerable countries), and mainly reliant on deposit funding (about 2/3 in both sets of countries). Also, government intervention in the banks of the two groups is similar, with average public stakes of 24% and 23% respectively (public ownership being defined as shareholding of local or national government and of publicly controlled institutions); and the frequency of observations referring to bailed-out banks is 10% for both sets of countries (the bailout being a dummy equal to 1 during and after a bailout, and 0 otherwise).

Figures 1, 2 and 3 add a dramatic time dimension to two of the stylized facts that emerge from Table 3, namely the rapid growth of banks' domestic sovereign exposures and the sharp decline in the loan-to-asset ratio in vulnerable countries, in striking contrast with the experience of non-vulnerable countries. Figure 1 shows that the different pattern of sovereign exposures between the two groups of countries is driven by the exposures of the head banks: the median domestic subsidiary in the vulnerable countries and the median foreign subsidiary in both groups have virtually no sovereign exposures, reflecting the fact that a banking group's securities portfolio is typically managed by the head bank.[5]

[Insert Figure 1]

Figure 2 shows the pattern of median domestic sovereign exposures and loan-asset ratios for vulnerable countries from July 2007 to February 2015; Figure 3, for non-vulnerable countries. Besides confirming that domestic sovereign exposures increased much more sharply in the former, the figures illustrate the completely different dynamics of the median bank's loan-to-asset ratio. Figure 2 shows that in the vulnerable countries, loans to non-financial corporations are correlated negatively with sovereign exposures: over the sample period, the median bank's domestic exposure increases from 1% to 6% of assets, while its corporate lending falls from 28% under 20% of main assets, the sharpest drop coming in the second half of 2012. In late 2014 the loan-asset ratio begins to stabilize, in line with the improvement in aggregate lending in the vulnerable countries. Figure 3 shows a completely different picture for the non-vulnerable countries: except for the first two years of the sample, the loan-asset ratio

[5] We are grateful to Rony Hamaui (Head of Financial Institutions of Banca Intesa) for pointing out this fact to us, based on his experience.

of the median bank is positively correlated with its domestic sovereign exposures, and both variables have a distinct positive trend.

[Insert Figures 2 and 3]

Of course, these different correlations between sovereign exposures and bank lending at the time-series, aggregate level cannot, as such, establish causation: in principle, the negative correlation in vulnerable countries could reflect either the "crowding out" of private lending by sovereign debt in banks' balance sheets or diminished demand for loans leading banks to substitute them with sovereign debt. However, as we shall see, bank-level data can reveal the direction of causality, as we can exploit heterogeneity among banks in the response to sovereign stress both of sovereign exposures (Section 3) and of corporate loans (Section 5).

3 Determinants of Banks' Sovereign Exposures

The descriptive evidence set out above highlights the cross-sectional and time-series variation in banks' domestic sovereign exposures. Some of this variation is accounted for by three characteristics of the banks: fraction of public shareownership, government-bailout history, and regulatory capital ratio. This section documents that these three characteristics correlate not only with differences in sovereign exposure, but also with the way banks vary such exposure when faced with domestic sovereign stress: public ownership, previous occurrence of a bailout and low capitalization are associated with a greater tendency to increase holdings of distressed government debt in the face of price declines.

As observed in Section 1, according to the "moral suasion" hypothesis publicly owned banks should be more willing than private ones to surrender to government influence and purchase domestic debt at moments of sovereign stress, and foreign banks should be less willing than domestic ones. By the same token, recently bailed-out banks should be more sensitive to government pressure, as their management is typically government-appointed and keenly aware that survival hinged on a public capital infusion. According to the "carry trade" hypothesis, poorly capitalized banks should purchase more high-yield government debt, owing to their incentive to bet on resurrection. Hence, heterogeneity across banks helps to distinguish between the two

hypotheses, which in the aggregate data are observationally equivalent (see Battistini et al., 2014). In this section we show that each of these hypotheses accounts for some of the variation of bank sovereign exposures in vulnerable countries. Before turning to regression analysis, let us examine some graphic evidence to explore how changes in domestic sovereign exposures correlate with bank characteristics.

Figure 4 shows banks' domestic sovereign exposure according to the type of ownership: the lines labeled "public" and "private" respectively plot the average exposure of banks above and below the average fraction of public ownership of shares in the relevant country in 2008. In the left panel, which refers to the vulnerable countries, the two series are very similar until late 2011, but afterwards the banks with more public ownership increase their domestic sovereign exposures at a much faster pace than the other group, the difference between them growing from nil in 2011 to over 6 percentage points in 2015. The right panel shows a qualitatively similar pattern in the non-vulnerable countries as well, but with a much smaller difference of 1-2 percentage points.

[Insert Figure 4]

Figure 5 shows that in the vulnerable countries, banks that benefited from a bailout purchased substantially more domestic government debt in the month before and the year after it. The line plotted in the two panels is the difference between the average domestic sovereign exposure of the bailed-out and the other banks, measured in the same month and group of countries, over a 2-year window centered on the bailout date (month 0). In the vulnerable countries, the exposure of the bailed-out banks rises on average 3 percentage points above that of the control group over the 12 subsequent months. No such pattern is detectable in the non-vulnerable countries.

[Insert Figure 5]

Figure 6 explores whether banks with different regulatory capital ratios (Tier-1 capital scaled by risk-weighted assets, or $T1/RWA$) changed their domestic sovereign exposures differently. The left panel refers to vulnerable countries, the right panel to non-vulnerable ones. The figure is based on the subsample of banks for which $T1/RWA$ data are available in the SNL database: between 30 and 40 banks in each group, depending on month. In each panel, the lines labeled "high $T1/RWA$" and

"low $T1/RWA$" refer to the average domestic sovereign exposure of banks with above-median and below-median $T1/RWA$. After the 2010 Greek bail-out, the vulnerable-country banks with low capital ratios increased their sovereign exposures more than their better-capitalized counterparts. Some difference, albeit smaller, is also observable in the non-vulnerable countries.

[Insert Figure 6]

Taken together, the three figures suggest that in vulnerable countries banks with higher public ownership and less regulatory capital increased their sovereign holdings more than other banks at times of sovereign stress, and recently bailed-out banks bought more stressed domestic debt than other banks. That is, this graphic evidence already suggests that both the "moral suasion" and the "carry trade" hypotheses have explanatory power.

To test these two hypotheses with regression analysis, we proceed in two steps. Since the SNL data on $T1/RWA$ – needed to test the carry trade hypothesis – are only available for a small subsample of banks, we first use the full sample to test the moral suasion hypothesis only. Next, we restrict the estimation to the subsample for which we have SNL data and test both hypotheses on this smaller sample.

In Table 4, we estimate the following specification:

$$\begin{aligned} \frac{\Delta H_{ijt}}{H_{ijt-1}} &= \alpha_{jt} + \gamma_i + \phi_1 Public_{ijt} \times \frac{\Delta P_{jt}}{P_{jt-1}} + \phi_2 Public_{ijt} \\ &\quad + \phi_3 Bailout_{ijt} + \phi_4 F_{ij} \times \frac{\Delta P_{jt}}{P_{jt-1}} + \theta X_{ijt-1} + \eta_{ijt}, \end{aligned} \tag{1}$$

where the dependent variable is the quarterly percentage change in domestic sovereign holdings H_{ijt} of bank i in country j and quarter t. (Holdings H_{ijt} of debt issued by country j's government differ from exposure, which is defined as the ratio of holdings to main assets, i.e. H_{ijt}/A_{ijt}.) In equation (1), $Public_{it}$ is the time-varying fraction of the bank's shares owned directly or indirectly by local or national government or publicly controlled institutions (*Fondazioni* in Italy, *Fundaciones* and *Cajas* in Spain, and *Sparkasse* and *Landesbank* in Germany); $\Delta P_{jt}/P_{jt-1}$ is the percentage change in the price of sovereign j's debt in the previous quarter (computed as the product of the change in the relevant 10-year yield from $t-1$ to t by the corresponding duration as in De Marco (2015)); $Bailout_{ijt}$ equals 1 from the quarter in which bank i was

bailed out (unless acquired by another bank in the two subsequent quarters), and 0 otherwise; F_{ij} equals 1 if bank i is the subsidiary of a foreign bank operating in country j and 0 if it is a domestic head bank or subsidiary. The specification also includes bank fixed effects γ_i to control for unobserved heterogeneity at bank level and time-country effects α_{jt} to control for country-level factors that may affect bank purchases of sovereign debt, including government debt repricing: the latter enters the specification only via its differential effect on banks with different characteristics. Finally, we include the (lagged) deposit-liability ratio X_{ijt-1} as a further bank-level control. In estimating specification (1), errors are clustered at the bank level, and the quarterly growth rates of sovereign holdings are trimmed at $\pm 100\%$ to avoid outliers.

At times of sovereign stress, the price of domestic public debt prices falls; that is, the variable $\Delta P_{jt}/P_{jt-1}$ is negative. The moral suasion hypothesis is that in those times public banks should buy more domestic debt than private ones, and foreign subsidiaries less than domestic banks, so that the coefficients of the interaction effects should be respectively negative and positive: $\phi_1 < 0$ and $\phi_4 > 0$. The hypothesis does not necessarily imply a positive direct effect of public ownership, ϕ_2: public banks are supposed to be more pliant at times of sovereign stress, not to increase their public debt holdings more than other banks at all times. Instead, the moral suasion hypothesis requires bailed-out banks to buy more sovereign debt during and after the salvage, compared with other banks in the same country and quarter: $\phi_4 > 0$. The specification (1) merges elements from the models of "moral suasion" estimated by De Marco and Macchiavelli (2014), Acharya et al. (2015), Horváth et al. (2015) and Ongena et al. (2015): the first three studies estimate regressions of sovereign exposures on indicators of political control and government support using EBA stress test data; the third focuses on measures of foreign ownership using IBSI data for vulnerable countries.[6]

The estimates in Table 4 show that for vulnerable countries the coefficient ϕ_1 of the interaction between public ownership and sovereign debt repricing is negative and significant, while the coefficient of the bailout variable ϕ_3 is positive and significant, as expected. The estimate of ϕ_1 implies that, in response to a 1% decrease in domestic sovereign debt prices, a fully state-owned bank ($Public_{ijt} = 1$) increases its

[6]The specification used by Ongena et al. (2015) also relies on a different variable to gauge sovereign stress, namely a measure of abnormally large domestic sovereign issuance ("high needs"), which may induce the government to pressure domestic banks to underwrite larger amounts of its debt.

domestic sovereign holdings by 0.4% more than a fully private bank ($Public_{ijt} = 0$); the estimate of ϕ_2 instead implies that bailed-out banks increase their public debt holdings by 5.8% more than other banks. The interaction between foreign ownership and sovereign debt repricing is positive but barely significant: this probably reflects the fact that – as Figure 1 shows – banks typically keep the sovereign exposures of their foreign subsidiaries very close to zero, with modest variation around that minimal level. By contrast, none of the coefficients is significantly different from zero in the non-vulnerable countries. As sovereign stress was experienced only in the vulnerable countries, the results support the moral suasion hypothesis. They also broadly agree with the findings of De Marco and Macchiavelli (2014), Horváth et al. (2015) and by Ongena et al. (2015), but not with those of Acharya et al. (2015), who obtain no evidence of moral suasion.

In Table 5, we expand specification (1) to test the carry trade hypothesis as well:

$$\begin{aligned}\frac{\Delta H_{ijt}}{H_{ijt-1}} = \alpha_{jt} + \gamma_i + \delta_1 \frac{T1}{RWA_{ijt-1}} \times \frac{\Delta P_{jt}}{P_{jt-1}} + \delta_2 \frac{T1}{RWA_{ijt-1}} + \phi_1 Public_{ijt} \\ + \phi_2 Public_{ijt} \times \frac{\Delta P_{jt}}{P_{jt-1}} + \phi_3 Bailout_{ijt} + \theta X_{ijt-1} + \eta_{ijt}.\end{aligned} \tag{2}$$

On this hypothesis, weakly capitalized banks (low $T1/RWA_{ijt-1}$) increase their sovereign holdings more than better capitalized ones when government debt becomes cheaper ($\Delta P_{jt}/P_{jt-1} < 0$), and resell it more aggressively if and when prices recover ($\Delta P_{jt}/P_{jt-1} > 0$) to realize their profits. Hence, the coefficient of the interaction between $T1/RWA_{ijt-1}$ and $\Delta P_{jt}/P_{jt-1}$ should be positive: $\delta_1 > 0$.

It is worth noticing that the "carry trade" hypothesis does not imply that poorly capitalized banks invariably purchase more domestic public debt (i.e., δ_2 need not be positive): if the price of domestic sovereign debt is stable while that of distressed foreign sovereign debt declines, a bank wishing to engage in a carry trade will bet on foreign sovereign debt, and divest domestic debt. In other words, the hypothesis predicts an increasing home bias in sovereign debt portfolios only for banks in the vulnerable countries, not in non-vulnerable ones: during the crisis, a yield-seeking German bank would not have invested in German but in Italian or Spanish public debt. But since our data only provide a breakdown between domestic and foreign euro-area sovereign debt holdings, they allow us to test the carry trade hypothesis only for vulnerable countries: for the banks in non-vulnerable countries, such testing would require the complete breakdown of their foreign debt portfolio (as in the studies

of Buch et al. (2015) on German banks and Peydrò, Polo and Sette (2016) on Italian banks). This is why we estimate specification (2) only for vulnerable countries, where our data allow meaningful estimation of the carry-trade coefficient δ_1.

Specification (2) also includes the variables that capture moral suasion, except for the interaction between foreign ownership and sovereign debt repricing, since we have no data on the regulatory capital of foreign subsidiaries. The sample includes only the bank-quarter observations for which the SNL database supplies regulatory capital data. The panel is unbalanced, since there are data gaps even for some of the 41 banks included in the sample.

The estimates of specification (2) are shown in Table 5. The first two columns are for the carry-trade variables only (all domestic banks in column 1, head banks only in column 2, since sovereign debt is held mostly by the group head). The estimate of δ_1 is positive and significant in both columns. To appreciate its economic relevance consider that column 2 estimates that a 1% decrease in the price of domestic sovereign debt is associated with an increase in sovereign holdings of about 1% for the median bank (which has a regulatory capital ratio of 10%). Column 3 shows the estimates for the complete specification (2), comprising both the carry trade and the moral suasion terms, but only for group head banks. Both hypotheses are seen to have some explanatory power: the carry-trade coefficient δ_1 remains virtually the same as in column 2, and the coefficient ϕ_3 of the bailout variable remains positive and significant, and close in magnitude to the estimate given in column 3 of Table 4. The only substantial difference from Table 4 is in the estimate of ϕ_2, i.e. the coefficient of the interaction between public ownership and sovereign debt repricing, which is no longer significant. But all in all, even controlling for carry trade there is some evidence in support of the moral suasion hypothesis also in this small subsample.

[Insert Table 5]

To sum up the evidence to this point, the descriptive statistics in Section 2 show great heterogeneity in banks' sovereign exposure and its changes over time; this section shows that sovereign stress tends to increase this heterogeneity, eliciting different responses from banks with different characteristics. Next, we investigate whether such heterogeneity is associated with differing responses of banks' solvency risk (Section 4) and lending policies (Section 5).

4 Sovereign Stress and Bank Default Risk

In this section we investigate whether the domestic sovereign exposures of euro-area banks amplified the transmission of risk from governments to banks through an "exposure channel". As noted in the introduction, the thesis is that as sovereign stress inflicted greater losses on the banks that held more domestic sovereign debt, it undermined their creditworthiness more severely. In principle, sovereign stress may be transmitted to banks even if they hold no domestic sovereign debt, since it saps the credibility of the implicit bailout guarantee provided by the government; it may also impact directly on the solvency of domestic firms, and hence on their creditor banks. So sovereign stress may also be transmitted to banks via a "direct channel", quite apart from their exposure to government debt. But this baseline effect will be amplified for banks that are heavily exposed. Our analysis focuses precisely on this amplification effect of sovereign exposures. That is, we seek to estimate the strength of the "exposure channel".

Figures 7 and 8 offer graphical evidence, showing how the nexus between government and bank default risk differs between high-exposure and low-exposure banks. Figure 7 plots monthly observations of the average 5-year CDS premium of banks against the corresponding sovereign premium in vulnerable countries, distinguishing between low-exposure and high-exposure banks, defined respectively as those whose domestic sovereign exposure in 2009 was in the bottom or the top quartile of the distribution. Figure 8 does the same for non-vulnerable countries.

[Insert Figures 7 and 8]

In both figures bank default risk appears to be positively correlated with sovereign risk for both groups of banks. But in the vulnerable countries, the correlation is much stronger for high-exposure than for low-exposure banks, whereas in non-vulnerable countries the intensity of the sovereign-bank nexus does not vary with exposure. Even though sovereign risk may influence bank default risk via many channels (for instance because government is the ultimate backstop for banks or by reason of rating agencies' policies), this is *prima facie* evidence that at least part of the effect comes by way of banks' government bond holdings.

4.1 Bank Risk Regressions

In testing the "exposure channel" by panel regressions, we allow the response of foreign banks' solvency risk to their host country's sovereign risk to differ from that of domestic banks. This is because foreign banks may face different prudential regulations and supervision, or enjoy different implicit bailout guarantees from their governments. Moreover, as subsidiaries their exposure to the sovereign risk of the host country is determined mainly by the portfolio of their foreign group head bank: the subsidiary's exposure to host-country sovereign risk is likely to be underestimated, as is suggested by the minuscule exposures of foreign subsidiaries (Figure 1).

To capture the exposure channel, we regress quarterly changes of the five-year CDS premium of bank i in country j and quarter t (ΔCDS^B_{ijt}) on quarterly changes of the domestic sovereign CDS (ΔCDS^S_{jt}) interacted with the domestic sovereign exposure of bank i (Exp_{ijt}), defined as the average ratio of sovereign debt holdings to assets in quarter t, and allowing this interaction to differ between domestic and foreign banks in each country j (respectively identified by the D_{ij} and F_{ij} dummy variables):

$$\Delta CDS^B_{ijt} = \alpha_{jt} + \gamma_i + \left[(\beta_1 + \beta_2 \Delta CDS^S_{jt}) D_{ij} + (\beta_3 + \beta_4 \Delta CDS^S_{jt}) F_{ij}\right] Exp_{ijt} + \boldsymbol{\theta}' \mathbf{X}_{ijt} + \epsilon_{ijt}. \tag{3}$$

The coefficient β_2 of the interaction variable $\Delta CDS^S_{jt} \times Exp_{ijt} \times D_{ij}$ measures the amplification associated with the exposure of domestic banks to the home-country sovereign, β_4 that associated with foreign banks' exposure to that same host-country sovereign. The country-time fixed effects α_{jt} capture all country-specific macroeconomic factors affecting bank credit risk, including the default risk of the domestic sovereign (such as ΔCDS^S_{jt}): hence, they control for the "direct channel" component of the sovereign-bank nexus. Moreover, the bank fixed effects γ_i control for time-invariant bank characteristics. Finally, the bank-level variables $\mathbf{X}_{ijt}$, namely leverage ratio and deposit-liability ratio, control for time-varying bank default risk.

The estimates of specification (3) are shown in Table 6, separately for 44 banks in 5 vulnerable countries (columns 1 and 2) and 61 banks in 6 non-vulnerable countries (columns 3 and 4), first omitting and then including the bank-level controls $\mathbf{X}_{ijt}$. In all regressions, errors are clustered at bank level. The sample is dictated by the availability of CDS data; moreover, it does not include observations of stale CDS prices (i.e., observations with no change in CDS prices) and CDS prices of Greek

and Cypriot banks, on account of the extreme volatility and low liquidity of their markets.

[Insert Table 6]

The estimated coefficient β_2 indicates that the amplification associated with the sovereign exposures of domestic banks is positive and statistically significant in the vulnerable countries, but not for foreign banks, β_4 being small and not significantly different from zero. Conversely, in the non-vulnerable countries there is no amplification for either domestic or foreign banks. Since the median bank in vulnerable countries has a 4.5% exposure to domestic sovereign debt, the 6.98 estimate of β_2 in columns 1 and 2 implies that a 100-basis-point increase in the domestic sovereign CDS premium translates into an increase of 31.4 basis points in the CDS premium of the median domestic bank ($6.98 \times 0.045 = 0.314$). This increase in the predicted CDS premium for banks comes on top of the baseline change associated with the change in the sovereign CDS premium, which is controlled for by the country-time effect included in the regression.

4.2 Endogeneity

In principle, the estimate of coefficient β_2 may be biased if there is reverse causality running from bank default risk to either sovereign exposures or the relevant sovereign default risk.

The first problem may arise if the banks with larger exposures have loan portfolios that are more sensitive to sovereign stress, for instance they may lend disproportionately to state-owned corporations or to companies highly dependent on public procurement contracts. If this is the case, sovereign stress would hit these banks harder not because of larger sovereign exposures, but because of a sharper increase in non-performing loans (NPL). This cross-sectional pattern could be expected if the banks whose clients became riskier in the crisis came to regard the risk-return profile of public debt as more attractive, and therefore increased their sovereign exposures. In other words, such a pattern may reflect reverse causality from NPLs – hence banks' CDS premia – to sovereign exposures.

One way to address this reverse causality concern is to lag banks' sovereign exposures in equation (3). If exposures are lagged by one to four quarters, the results

shown in Table 6 are unaffected. A more direct method is to verify whether at times of sovereign stress the NPL rate tends to rise more at the banks with larger sovereign exposures. Hence, we estimate a regression whose dependent variable is the ratio of impaired loans to gross loans, based on SNL data for 35 banks in vulnerable countries and 43 banks in non-vulnerable ones. The specification is otherwise the same as in (3). The estimates, shown in Table 7, indicate that the coefficient of the variable $\Delta CDS^S_{jt} \times Exp_{ijt} \times D_{ij}$ is not significantly different from zero in the vulnerable as well as the non-vulnerable countries: in times of sovereign stress, the fraction of impaired loans does not tend to increase more in banks with larger domestic sovereign exposures, so that the estimates of β_2 in Table 6 reflect the increased riskiness of banks' sovereign holdings, not that of their loan portfolios.

[Insert Table 7]

Another possible problem with the estimates in Table 6 is that the CDS market may misprice sovereign risk, especially in turbulent times like that of the euro-area crisis, introducing an error-in-variables problem. Therefore, we re-estimate specification (1) replacing the change in the sovereign CDS premium ΔCDS^S_{jt} with an alternative measure of sovereign stress, namely the surprise component of the change in the yield of domestic 10-year sovereign debt, computed as the percentage difference between the realized yield and the consensus prediction of professional forecasters three months earlier, $(Y_{jt} - Y^E_{jt})/Y_{jt-1}$. This new specification is estimated using only data for France, Germany, the Netherlands, Italy and Spain, the only countries for which such forecasts are available. Due to the limited number of observations, this specification is estimated by pooling the observations for foreign and domestic banks. The resulting estimates are presented in Table 8.

[Insert Table 8]

The coefficient of the new interacted variable is again positive and statistically significant for the vulnerable countries, i.e., for banks in Italy and Spain (columns 1 and 2), but not for banks in France, Germany and the Netherlands (columns 3 and 4). Since the median domestic Italian or Spanish bank in this sample had a 5.5% exposure to domestic sovereign debt, the coefficient of 9.62 obtained in column 2 implies that an unexpected 100-basis-point rise in the sovereign yield in Italy or Spain

translated into a 53-basis-point increase in the CDS premium of the median bank of those countries ($9.62 \times 0.055 = 0.529$). This estimate is comparable to that given in Table 6, if a bit higher. That is, whether sovereign stress is measured by changes in CDS premia or unanticipated yield changes, the estimate of the amplification of the bank-sovereign nexus attributable to domestic sovereign exposures is similar.

Finally, another problem could be reverse causality from bank-level CDS (ΔCDS^B_{ijt}) to sovereign CDS premia (ΔCDS^S_{jt}). This possibility is actually inherent in the feedback loop: bank distress may feed back to sovereign risk, due to the increased risk of bailouts. This should drive the estimate of the coefficient β_2 above the value that it would take if stress transmission ran solely from sovereign to banks. Indeed in the model of the "diabolic loop" by Brunnermeier et al. (2016), large domestic sovereign exposures reinforce not only the transmission of stress from the sovereign to domestic banks but also the feedback from banks to sovereign. In this model, the solvency risks of banks and sovereigns are determined simultaneously in equilibrium, and the magnitude of banks' sovereign exposures expands the parameter region where "sunspots" could trigger both bank bailouts and government insolvency. Hence, what is economically relevant is the extent to which banks' sovereign exposures strengthen the correlation between government and bank solvency, irrespective of the direction of stress transmission. This is precisely what the coefficient β_2 measures in specification (3).

5 Sovereign Stress, Bank Lending and Loan Rates

We now investigate whether sovereign exposures amplify the impact of sovereign stress on bank lending policies. An increase in sovereign risk may induce the more highly exposed banks to reduce lending, owing to the capital losses from the repricing of their sovereign holdings. The resulting loss of equity increases banks' default risk and pushes them closer to the minimum prudential capital ratio, forcing the weakest to deleverage. An increase in sovereign risk may also raise the funding costs of the more exposed banks disproportionately. These banks have less collateral to pledge to their creditors given capital losses, which also forces them to contract lending. And they tend to face higher funding rates and haircuts, which they may try to pass on to customers via higher lending rates. Conversely, of course, one would expect symmetric effects when banks' sovereign holdings appreciate, as they did in

the vulnerable countries in 2012-13: in that case, the capital gains on sovereign holdings should amplify the expansion of lending and the decrease in loan rates.

5.1 Bank Lending Regressions

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

$$\frac{\Delta L_{ijt}}{L_{ijt}} = \alpha_{jt}+\gamma_i+\left[\left(\beta_1+\beta_2\frac{\Delta P_{jt-1}}{P_{jt-2}}\right)D_{ij}+\left(\beta_3+\beta_4\frac{\Delta P_{jt-1}}{P_{jt-2}}\right)F_{ij}\right]Exp_{ijt-1}+\boldsymbol{\theta}'\mathbf{X}_{ijt-1}+\nu_{ijt}, \tag{4}$$

where the dependent variable $\Delta L_{ijt}/L_{ijt}$ is the quarterly growth of the loans granted by bank i to non-financial corporations in country j and quarter t, and $\Delta P_{jt-1}/P_{jt-2}$ is the percentage change in the price of sovereign j's debt in the previous quarter. The reason for lagging the price change in (3) is to allow for a gradual response of lending to capital gains or losses on the sovereign portfolio (although similar estimates are obtained using the contemporaneous price change). The price P_{jt} of the sovereign debt of country j is alternatively the price of 10-year and of 5-year government bonds, computed as the product of the change in the relevant yield from $t-1$ to t and the corresponding duration, as in De Marco (2015). As in the credit risk regression in (3), in specification (4) too the loans of domestic and foreign banks are allowed to respond differently to sovereign exposures and capital gains or losses. The bank-level controls $\mathbf{X}_{ijt-1}$ in (4) are the lagged leverage ratio and deposit-liability ratio, and their interactions with the sovereign debt repricing $\Delta P_{jt-1}/P_{jt-2}$, to control for the differential effect that such repricing may have on banks differing in solvency risk. In estimating specification (4), errors are clustered at the bank level, and the quarterly growth rates of loans are trimmed at $\pm 100\%$ to eliminate outliers.[7]

Table 9 shows the estimates of specification (4) for the vulnerable countries. In

[7] In the estimation of this specification, we also take into account two breaks in the time series of loans of four Spanish banks (BFA-Bankia, Catalunya Banc, NGC Banco-Banco Gallego and Banco de Valencia), in November 2012 and January 2013. These breaks are due to restructuring and recapitalization by SAREB, the "bad bank" set up by the government to manage the assets transferred by these four banks. To remove the breaks, we regress the loans for these banks on dummy variables corresponding to the two breaks and replace the actual values with the residuals obtained from this regression. We use the same approach to deal with a break for the Slovenian bank Nova Kreditna Banka Maribor in December 2013, when it transferred its bad loans to the Slovenian bad bank.

panel A, columns 1 to 3 show the estimates obtained when sovereign debt repricing is computed from the yields of 10-year benchmark bonds; columns 4 to 6 relate to 5-year yields. In each case, we start from a specification where domestic and foreign banks are constrained to have the same coefficients (columns 1 and 4), then expand that specification with bank-level controls (columns 2 and 5), and finally estimate a specification where domestic and foreign banks are allowed to have different coefficients and bank-level controls are included.

In all these specifications, the estimate of β_2 is positive and significantly different from zero, indicating that in the vulnerable countries the domestic banks more highly exposed to the sovereign responded to declines in sovereign debt prices by cutting their lending more sharply than the less exposed; and conversely they expanded their lending more in response to a rise in sovereign debt prices. In contrast, the estimate of β_4 is small and not significantly different from zero, implying that foreign banks with different exposures to their host country's debt did not respond differently to its repricing, probably because typically the subsidiaries of foreign banks operating in vulnerable countries had very little exposure to the host country sovereign debt (see Figure 1).

[Insert Table 9]

As in vulnerable countries both domestic and foreign subsidiaries hold little sovereign debt (Figure 1), the sovereign portfolio of domestic banking groups is likely to be concentrated at the group head. In this case lending should react only to the value of sovereign debt holdings of the head bank. Panel B of Table 9 in quires into this in two different ways. First, column 1 estimates a specification similar to (4) using only data for heads of domestic groups, with sovereign repricing based on 10-year yields; column 3 repeats the estimation using 5-year yields. In both cases, the estimate of the interaction coefficient β_2 using only data for head banks is considerably higher than that obtained in Panel A using all banks. The coefficient is rises from 1.40 to 2.48 using 10-year debt repricing, and from 0.97 to 1.96 using 5-year debt repricing, and the explanatory power of the regression increases slightly even though the number of observations is reduced by 42%. Next, in columns 2 and 4 of Panel B, instead of dropping subsidiaries from the sample, we re-estimate the regression by imputing to domestic subsidiaries the sovereign exposures of their respective head banks, since subsidiaries' lending decisions may be affected by the capital gains or losses on the

securities held by their head banks. Again the estimate of β_2 exceeds that obtained in Panel A: 2.08 using 10-year debt repricing, and 1.96 using 5-year debt repricing. This suggests that the amplification effect is indeed associated with the sovereign exposures of the head bank.

The economic relevance of the estimates in Table 9 is considerable: they imply that in the vulnerable countries a 1-standard-deviation drop in the price of 10-year government bonds (-17%) reduces the loan growth of the median domestic bank by 0.7 percentage points and that of the median domestic head bank by 1.4 percentage points . These account respectively for 9.7% and 20% of the standard deviation of loan growth (12.7% and 12.2%). Comparable figures are obtained for the effect of the repricing of 5-year government bonds: in that case the amplification effect accounts for 10.1% of the standard deviation of the loan growth of domestic banks and for 23.3% of that of domestic head banks.[8]

Another way to assess the economic significance of this amplification mechanism, is to compute the loan growth associated with the change in the value of banks' sovereign holdings in the sample period. Figure 9 plots the cumulated component (dashed line) of the loan growth rate predicted by the interaction term (relying on the estimated coefficient of 2.45, reported in column 1 of Table 9, Panel B), averaged across the banks operating in vulnerable countries. The figure also plots actual average loans (solid line) as a benchmark to gauge how far the interaction of bank exposures and sovereign stress helps explain the actual dynamics of lending. The interaction effect is virtually nil until mid-2010, goes negative and increasingly large after the Greek bailout in that year (marked by the first vertical line), and then turns positive and rising after Draghi's "whatever-it-takes" speech in 2012 (the second vertical line): hence, the interaction effect due to sovereign exposures considerably amplified the fluctuations in loan growth during most of the crisis and post-crisis period.

[8] The effect of a 1-standard-deviation rise in the price of 10-year bonds on domestic bank lending is obtained by multiplying its standard deviation (0.17) by the estimate of β_2 in column 3 of Panel A of Table 7 (1.46) and by the median domestic bank's sovereign exposure (0.05), i.e., $0.17 \times 1.46 \times 0.05 = 0.012$. Similarly, for domestic head banks we multiply the estimate of β_2 in column 1 of Panel B of Table 7 (2.48) by the median domestic head bank's exposure (5.8%), i.e., $0.17 \times 2.48 \times 0.058 = 0.024$. The calculation can be repeated for 5-year bonds taking into account that the standard deviation of their price changes is 0.25, and using the estimates of β_2 in column 6 of Panel A (1.03) for all domestic banks and in column 3 of Panel B (1.96) for domestic head banks.

[Insert Figure 9]

In Table 10 the specifications of Table 9 are re-estimated for the non-vulnerable countries: the amplification coefficient β_2 is not significantly different from zero for domestic banks, whereas it is positive and significant for foreign banks (columns 3 and 6 of Panel A); this also explains why it is weakly significant when domestic and foreign banks are pooled (columns 4 and 5 of Panel A). Hence the lending of foreign subsidiaries responds to capital gains or losses on their holdings of their host government's debt. Since these foreign banks include subsidiaries of head banks located in the vulnerable countries, the loans of vulnerable-country banks are presumably sensitive to the valuation of their sovereign debt holdings, whether issued by their home or by their host government – possibly because they are more severely equity-constrained than the banks of the non-vulnerable countries.

[Insert Table 10]

5.1.1 Endogeneity

The estimates in Tables 9 and 10 might be biased and inconsistent due to endogeneity problems. That is, at times of sovereign stress firms may curtail their investments, and thus loan demand, which could engender spurious correlation or reverse causality. Spurious correlation can occur if banks with larger sovereign exposures happen to have customers whose business is more sensitive to sovereign stress, so that when sovereign debt prices fall sharply these banks suffer a larger drop in loan demand of their (solvent) customers. Reverse causality may occur if the banks that face a larger shortfall in loan demand (due to the composition of their customer base) substitute sovereign debt for loan assets: in this case, causality would run from change in corporate loan demand to banks' sovereign debt holdings.

To address the issue of spurious correlation, we investigate how lending by foreign subsidiaries of vulnerable-country banks operating in non-vulnerable countries responds to the repricing of the sovereign portfolio of their head bank. The idea is that the repricing of sovereign debt in the vulnerable countries was external to the credit markets of the non-vulnerable countries, it can be viewed as an exogenous shock to loan supply in the latter, along the lines of Peek and Rosengreen (2000), Klein, Peek and Rosengren (2002) and Puri, Rocholl and Steffen (2011). The do-

mestic sovereign exposures of head banks in vulnerable countries should amplify the magnitude of this shock: for example, the loans granted by Italian banks operating in Germany should respond to the devaluation of Italian sovereign debt to an extent that depends on the amount of Italian sovereign debt owned by their head bank in Italy. This change in lending should not be affected by spurious correlation, as loan demand in Germany should not respond to sovereign stress in Italy.

Hence, we estimate the following specification:

$$\frac{\Delta L_{ijt}}{L_{ijt}} = \alpha_{jt} + \gamma_i + \left(\beta_1 + \beta_2 \frac{\Delta P_{ht-1}}{P_{ht-2}}\right) Exp.Head_{ijt-1} + \boldsymbol{\theta}' \mathbf{X}_{ijt-1} + \nu_{ijt}, \qquad (5)$$

where the dependent variable is the growth rate of loans by bank i to non-financial corporations in non-vulnerable country j. The index h denotes the bank's "home" country: bank i may be either a domestic country-j bank (in which case $h = j$) or the foreign subsidiary of a bank based in vulnerable country h (in which case $h \neq j$). The sample comprises subsidiaries of banks based in Italy and Spain that operate in Austria, Belgium, Germany, Luxembourg, and Slovakia, as well as domestic banks based in these countries. $\Delta P_{ht-1}/P_{ht-1}$ measures the repricing of the sovereign debt of the home country $h \neq j$ in quarter $t-1$. $Exp.Head_{iht}$ is the indirect exposure of subsidiary i operating in country j to the sovereign risk of its *home* country $h \neq j$, and is set to zero if bank i is a domestic bank of country j, i.e. if $h = j$. The bank-level controls $\mathbf{X}_{ijt-1}$ are Exp_{ijt-1} and $\Delta P_{jt-1}/P_{jt-2} \times Exp_{ijt-1}$, where Exp_{ijt-1} is the direct exposure of bank i (whether domestic or the subsidiary of a foreign bank) operating in country j to the sovereign debt of country j in quarter $t-1$: these variables control for the effect of exposure to the *host* country's sovereign risk and the effect of its repricing on bank i's lending.

The results for this specification are shown in Table 11, where columns 1-2 are based on repricing of 10-year debt and columns 3-4 on 5-year debt, either without or with bank-level controls. In all cases, the estimate of the amplification coefficient β_2 is positive, significant and comparable to that estimated in Panel B of Table 9 for the loan growth of the head banks: when repricing refers to 10-year debt, β_2 is estimated to be 3.26 for "lending abroad" by vulnerable-country subsidiaries in Table 11, and 2.48 for "lending at home" by the corresponding head banks in Table 9; the estimates are even closer for 5-year debt, β_2 being 1.71 for "lending abroad" by subsidiaries in Table 11, and 1.96 for "lending at home" by head banks in Table 9.

[Insert Table 11]

Hence, the response of loans granted abroad by subsidiaries of vulnerable-country banks to the repricing of the home country debt held by their head banks in very similar to the response of the domestic loans of those head banks themselves. This suggests that the amplification coefficients estimated in Table 9 do capture a shift in bank loan supply and not a shift in firms' loan demand.

A second endogeneity concern is that lending itself may affect the size of lagged sovereign exposures, generating reverse causality: if sovereign stress affects lending differently across banks, it may induce them to vary their sovereign exposures differentially – increasing them more in banks that suffer a greater loan shortfall, less in the others. This concern should be attenuated by the fact that in our specification the sovereign exposure of bank i is measured one quarter before its loan growth. But in principle banks could change their sovereign holdings in anticipation of future changes in loan growth. In this case, rather than measuring the impact on lending of losses or gains on sovereign holdings, the estimates might be capturing the impact on sovereign exposures of expected changes in lending.

To address this potential reverse causality, recall the evidence in Section 3 that publicly-owned banks increase their domestic sovereign holdings more than privately-owned banks in response to sovereign stress, and that bailouts are followed by increases in domestic sovereign holdings. Hence, in our specification these two variables – public ownership and occurrence of a bank bailout, both interacted with sovereign repricing – can be used as instruments of the interaction term $Exp_{ijt-1} \times \Delta P_{jt-1}/P_{jt-2}$. For them to be a valid instrument, our assumed exclusion restriction is that the lending of publicly-owned and of previously bailed-out banks' loan supply does not react differently to sovereign stress than that of other banks, unless they have different domestic sovereign exposures. In other words, their exposure is the only factor determining their differential response to sovereign stress. This exclusion restriction is consistent with the evidence in Table 11 that differences in loan growth reflect the repricing of different sovereign exposures rather than differing sensitivity to sovereign stress of the demand for loans.

Table 12 shows the instrumental variable estimates of specification (4), restricted to domestic banks (i.e., setting $D_{ij} = 1$ and $F_{ij} = 0$), as obviously there are no domestic bailouts of foreign banks. As mentioned, the instruments of the interac-

tion between exposures and sovereign repricing are $Public_{ijt-1} \times \Delta P_{jt-1}/P_{jt-2}$ and $Bailout_{ijt-1} \times \Delta P_{jt-1}/P_{jt-2}$. For the vulnerable countries the estimate of β_2 is still positive and significant: indeed it increases in value compared to its OLS counterpart, while for non-vulnerable countries it is still not significantly different from zero.

[Insert Table 12]

In short, neither spurious correlation nor reverse causality is a serious problem for the estimates shown in previous tables. Admittedly, this still does not preclude potential reverse causality from banks' loans to sovereign debt repricing: if sovereign stress triggers a contraction in lending, the resulting slowdown in economic activity should trigger a drop in tax revenue, which may in turn reinforce sovereign stress – what Brunnermeier et al. (2016) label the "real diabolic loop". However, this loop requires a considerable amount of time to make itself felt: it is unlikely that the slowdown in lending growth could feed back onto sovereign debt repricing in the *previous* quarter. Furthermore, even if such macroeconomic feedback did exacerbate sovereign stress, it would also aggravate corporate loan curtailment by the more exposed banks.

5.1.2 Unexpected sovereign repricing

The foregoing estimates show that in the vulnerable countries bank loans dropped in response to the depreciation of sovereign debt and rose in response to its appreciation, in proportion to the relevant bank's exposure. Insofar as the price changes are anticipated, however, banks will switch in advance from corporate loans to sovereign debt assets; that is, they can be expected to buy sovereign debt when its price is unusually low – an effect that is indeed documented in Section 3. In this case the estimate of β_2 would conflate the impact of the appreciation of given sovereign exposures and that of the concomitant response of exposures to the expected appreciation. In order to study the first of these two effects by itself, the previous specification is re-estimated replacing sovereign debt repricing with its unexpected component.

As noted in Section 4, we have data on survey-based consensus forecasts of 10-year yields (Y^E_{jt}) for Germany, France, the Netherlands, Italy and Spain, so for these five countries we can compute time series of "yield surprises", $(Y_{jt} - Y^E_{jt})/Y_{jt-1}$. Since these surprises cannot be transformed into unexpected price changes owing to the

non-linearity of the price-yield relationship, in Table 13 we estimate a variant of specification (4) in which the change in the price of sovereign debt $\Delta P_{jt-1}/P_{jt-2}$ is replaced by yield surprises. The interaction between domestic yield surprises $(Y_{jt} - Y_{jt}^{E})/Y_{jt-1}$ and a bank's domestic exposure Exp_{ijt} measures the bank's capital loss from the unexpected repricing of its domestic sovereign holdings. Notice that as the repricing is unanticipated, the bank cannot have modified its sovereign holdings to take advantage of it. To take into account that banks may adjust their lending policy to such an unexpected capital loss with a delay, in the regression this interaction variable is lagged by one quarter with respect to the bank's loan growth, as with the analogous interaction variables in previous specifications.

[Insert Table 13]

The estimates in the first three columns of Table 13 refer to vulnerable countries. In columns 1 and 2, domestic and foreign banks are pooled: the two specifications differ by the absence or presence of bank-level controls, which are the (lagged) capital-asset ratio, the lagged deposit-liability ratio, and their interactions with sovereign yield surprises. In column 3, as in the previous tables, the estimates are allowed to differ between domestic and foreign banks. Columns 4-6 show the estimates of the same specifications for banks operating in non-vulnerable countries. On the whole, the results confirm those of the previous tables, based on the realized repricing of domestic sovereign debt: the estimated coefficient of the interaction term is negative (as expected) and significant for the vulnerable but not for the non-vulnerable countries. Further, it is considerably larger and more precisely estimated for domestic banks than for foreign ones operating in vulnerable countries. The main difference with respect to the previous results is that in any case the coefficient estimate is non-negligible and significantly different from zero at the 10 percent level also for foreign banks operating in vulnerable countries: despite their limited exposure to their host countries' sovereign risk, these banks too appear to have reacted to unexpected losses and gains on their holdings of local sovereign debt.

5.2 Lending Rate Regressions

This subsection considers another dimension of banks' lending policies, namely the interest rates charged on new loans to non-financial corporations: as with lending,

the question is not whether sovereign stress (and its subsequent abatement) affected the interest rates but whether the response was amplified by sovereign exposures. The hypothesis is that the banks hit by greater losses during the sovereign crisis were faced with higher funding costs (due to reduced creditworthiness) and tried to pass them onto borrowers via higher lending rates, and conversely when sovereign stress abated after 2012. To this purpose, we estimate the following specification:

$$\Delta R_{ijt} = \alpha_{jt} + \gamma_i + \left(\beta_1 + \beta_2 \frac{\Delta P_{jt}}{P_{jt-1}}\right) \times Exp_{ijt-1} + \boldsymbol{\theta}' \mathbf{X}_{ijt-1} + u_{ijt}, \tag{6}$$

where ΔR_{ijt} is the change in the average rate charged by bank i in country j on new loans granted to non-financial corporations in quarter t, the rate R_{ijt} being the average of loan rates for different maturities and loan sizes, weighted by their respective new business volumes. The coefficient β_2 measures the amplification effect associated with sovereign exposures; it is expected to be negative, as a decline in government bond prices ($\Delta P_{jt}/P_{jt-1} < 0$) induces the banks with larger exposures Exp_{ijt-1} to increase their loan rates ($\Delta R_{ijt} > 0$) more than other banks, to offset their higher funding costs.

Tables 14 and 15 report the estimates of specification (6), respectively for vulnerable and non-vulnerable countries. In each table, the repricing refers to the 10-year benchmark bond yield in the first two columns, and the 5-year yield in the last two. Columns 1 and 4 show the OLS estimates without bank-level controls, columns 2 and 5 those with bank-level controls. As expected, the OLS estimates of coefficient β_2 are negative and significant for the vulnerable countries but not for non-vulnerable ones.

[Insert Tables 14 and 15]

However, these estimates too may be affected by reverse causality: insofar as sovereign stress lowered average loan quality, it may have led banks to charge higher rates while reducing their loan exposure and at the same time increasing sovereign debt holdings. As for bank lending, we address this concern by IV estimation: columns 3 and 6 of Tables 14 and 15 show the IV estimates obtained using $Bailout_{it} \times \Delta P_{jt}/P_{jt-1}$ as instrument for $Exp_{ijt-1} \times \Delta P_{jt}/P_{jt-1}$. However, unlike the results on loans in Table 12, the IV estimate of the amplification coefficient β_2 is much lower than the OLS estimate and not significantly different from zero, even though the coefficient of the

instrument is strongly significant in the first-stage regression. Hence, in contrast to our findings for lending regressions in Table 12, we cannot be sure of the direction of causality between banks' lending rates and sovereign exposures in the presence of sovereign stress.

6 Conclusions

Exploiting the substantial cross-sectional and time-series variation in individual banks' domestic sovereign exposures, this paper jointly addresses three questions that various recent studies of the euro-area crisis have attacked separately. First, did banks with different characteristics change their public debt holdings differently in response to sovereign stress, and then to its abatement after 2012? Second, were larger sovereign exposures associated with more forceful transmission of sovereign stress to bank risk and lending policies? Third, can we interpret this association as causal, i.e. as an amplification effect *due* to banks' sovereign exposures?

Our findings answer all three questions affirmatively. First, in the vulnerable euro-area countries studied here, publicly owned and less strongly capitalized banks reacted to sovereign stress by increasing their holdings of domestic governments bonds more than other banks, which suggests that portfolio choices were influenced both by government moral suasion and by the search for yield. Second, banks' domestic sovereign exposures in the vulnerable countries were indeed associated with a statistically significant and economically relevant amplification of sovereign risk transmission and of its impact on lending. Third, this amplification effect cannot be ascribed to spurious correlation or reverse causality.

The importance of these findings for banking regulation can hardly be overstated, considering that euro-area prudential regulation currently gives strong preferential treatment to sovereign debt over bank loans, treating it as risk-free for purposes of capital charges and imposing no concentration limit on holdings. To make matters worse, in the vulnerable euro-area countries, banks' domestic sovereign exposures are considerably larger now than in 2010-12, so that a future resurgence of sovereign stress would trigger proportionately larger effects on bank lending.

Appendix

Variable	Symbol	Definition	Source	Units
Ownership	$Public_{ij}$	Fraction of bank equity held in country j and quarter t by local or national government or by publicly controlled institutions (Fondazioni in Italy, Fundaciones and Cajas in Spain, and Sparkasse and Landesbank in Germany).	Bankscope and authors' calculations	
Sovereign debt repricing	$\Delta P_{jt}/P_{jt-1}$	Percentage change of debt prices in country j and quarter t, based on 10- or 5-year debt prices.	Datastream and authors' calculations	
Foreign subsidiary	F_{ij}	Dummy variable equal to 1 if bank i in country j is a foreign subsidiary and 0 otherwise.	ECB	
Bailout	$Bailout_{ijt}$	Dummy variable equal to 1 starting in the quarter t in which bank i in country j was bailed out (unless acquired in the two subsequent quarters), and 0 before t..	EU Commission - State Aid Database	
Sovereign holding growth rate	Sov. Holding Growth	Percentage growth rate of banks' sovereign holdings in quarter t.	IBSI-ECB and authors' calculations	
Tier-1 common equity over risk-weighted assets	$T1/RWA_{ijt-1}$	Ratio between Tier-1 common equity and risk-weighted assets of bank i in country j and quarter $t-1$	SNL	
Sovereign CDS (first difference)	ΔCDS^S_{jt}	Change of the 5-year sovereign CDS premium in country j and quarter t.	Datastream	%
Bank CDS (first differences)	Bank CDS	Change of banks' 5-year CDS premia in quarter t (defined as the difference between the end-of-period value in quarter t and that in period $t-1$).	Datastream	%
Domestic sovereign exposures	Exp_{ijt}	Ratio between domestic sovereign debt holdings and the main assets (total assets minus derivatives) of bank i in country j and quarter $t-1$	IBSI-ECB	
Domestic	D_{ij}	Dummy variable equal to 1 if bank i in country j is domestic and 0 otherwise.	ECB	
10-year government yield	Y_{jt}	10-year benchmark government bond yield in country j and quarter t	Datastream	
10-year government yield forecast	Y^E_{jt}	Consensus estimate of the 10-year government yield of country j for quarter t made by professional forecasters at the end of quarter $t-1$.	Consensus Economics	
Surprise in sovereign yield	$(Y_{jt} - Y^E_{jt})/Y_{jt-1}$	Unexpected percentage change (with respect to consensus forecast) in the domestic sovereign yield of country j in quarter t.	Authors' calculations	%
Bank lending growth		Percentage growth rate of loans granted by bank i in country j to non-financial companies in quarter t.	IBSI-ECB and authors' calculations	%

Continued on next page

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Variable	Symbol	Definition	Source	Units
Domestic sovereign exposure of head banks	$Exp.Head_{iht}$	Indirect exposure of subsidiary i operating in country j to the sovereign risk of its home country $h \neq j$, arising from the sovereign holdings of the head bank of subsidiary i. Set to zero if bank i is a domestic bank of country j, i.e. if $h = j$.	IBSI-ECB and authors' calculations	
Bank-level loan interest rate (first differences)	ΔR_{ijt}	Change in the interest rate charged on new loans by bank i to non-financial coroporations in country j and quarter t.	IMIR-ECB and authors' calculations	%
Bank loan-asset ratio		Bank loans to non-financial corporations as a fraction of the corresponding bank's total assets.	IBSI - ECB	
Deposit-liabilities ratio		Ratio of bank's deposits to its total liabilities.	IBSI - ECB	

References

Acharya, V., I. Drechsler, and P. Schnabl (2014), "A Pyrrhic victory? Bank Bailouts and Sovereign Credit Risk," *Journal of Finance* 69, 2689-2739.

Acharya, V., T. Eisert, C. Eufinger, and C. Hirsch (2015), "Real Effects of the Sovereign Debt Crises in Europe: Evidence from Syndicated Loans," unpublished.

Acharya, V. and S. Steffen (2015), "The Greatest Carry Trade Ever? Understanding Eurozone Bank Risks," *Journal of Financial Economics* 115, 215-236.

Battistini, N., M. Pagano, and S. Simonelli (2014), "Systemic Risk, Sovereign Yields and Bank Exposures in the Euro Crisis," *Economic Policy* 29, 205-241.

Becker, B., and V. Ivashina (2014), "Financial Repression in the European Sovereign Debt Crisis," Swedish House of Finance Research Paper No. 14-13.

Bocola, L. (2016), "The Pass-Through of Sovereign Risk," *Journal of Political Economy*, forthcoming.

Buch, C. M., M. Koetter, and J. Ohls (2015), "Banks and Sovereign Risk: A Granular View," IWH Discussion Papers No. 12, September.

Cooper R. and K. Nikolov, (2013) "Government Debt and Banking Fragility: The Spreading of Strategic Uncertainty," NBER Working Papers 19278.

Crosignani, M. (2015), "Why Are Banks Not Recapitalized During Crises?," unpublished.

De Marco, F. (2014), "Bank Lending and the Sovereign Debt Crisis," Boston College working paper.

De Marco, F. and M. Macchiavelli (2014), "The Political Origin of Home Bias: the Case of Europe," unpublished.

Fahri, E. and J. Tirole (2014), "Deadly Embrace: Sovereign and Financial Balance Sheets Doom Loops," Harvard University, unpublished.

Gennaioli, N., A. Martin, and S. Rossi (2014a), "Sovereign Default, Domestic Banks, and Financial Institutions," *Journal of Finance*, 69(2), 819-866.

Gennaioli, N., A. Martin, and S. Rossi (2014b), "Banks, Government Bonds, and Default: What do the Data Say?," unpublished.

Horváth, B., H. Huizinga, and V. Ioannidou (2015), "Determinants and Valuation Effects of the Home Bias in European Banks' Sovereign Debt Portfolios," CEPR Working Paper No.10661.

Klein, M., J. Peek, and E. Rosengren (2002), "Troubled Banks, Impaired Foreign Direct Investment: The Role of Relative Access to Credit," *American Economic Review*, 92(3), 664–682.

Leonello A. (2014) "Government Guarantees and the Two-Way Feedback between Banking and Sovereign Debt Crises", unpublished.

Ongena, S., A. Popov, and N. van Horen (2015), "The Invisible Hand of the Government: Moral Suasion during the European Sovereign Debt Crisis," unpublished.

Peek, J., and E. S. Rosengren (2000), "Collateral Damage: Effects of the Japanese Bank Crisis on Real Activity in the United States," *American Economic Review*, 90(1), 30–45.

Puri, M., J. Rocholl and S. Steffen (2011), "Global Retail Lending in the Aftermath of the US Financial Crisis: Distinguishing between Supply and Demand Effects," *Journal of Financial Economics*, 100(3), 556–578.

Peydró, J.-L., A. Polo, and E. Sette (2016), "The Risk-Taking Channel of Monetary Policy: Security and Credit Registers Evidence," unpublished.

Popov, A., and N. Van Horen (2013), "The Impact of Sovereign Debt Exposure on Bank Lending: Evidence from the European Debt Crisis," DNB Working Paper No. 382.

Uhlig, H. (2013), "Sovereign Default Risk and Banks in a Monetary Union," *German Economic Review*, 15(1), 23–41.

Table 1: Distribution of the Banks by Country and Ownership

For each country, the table reports the total number of individual banks and their breakdown according to the country in which they operate and domestic or foreign ownership.

	Total	Domestic banks		Foreign banks
		Head banks	Subsidiaries	
Austria	9	6	2	1
Belgium	10	3	0	7
Cyprus	5	4	0	1
Estonia	4	1	0	3
Finland	5	3	0	2
France	32	8	20	4
Germany	60	39	13	8
Greece	6	4	2	0
Ireland	11	3	1	7
Italy	24	15	4	5
Luxembourg	10	3	0	7
Malta	4	3	0	1
Netherlands	10	7	0	3
Portugal	6	4	0	2
Slovakia	3	0	0	3
Slovenia	4	2	0	2
Spain	23	14	6	3
Total	226	119	48	59

Table 2: Sample Representativeness

For each country, the table shows the aggregate values of main assets, loans to non-financial corporations (NFCs) and holdings of government debt in our dataset in January 2015 as percentages of the same variables in the aggregate data reported in the BSI statistics of the ECB.

Ratio of IBSI Aggregates to BSI Totals (%)

	Main Assets	Loans to Non-Financial Corporations	Bank Holdings of Sovereign Debt
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
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 banks' monthly sovereign exposures, loans to firms, CDS premia and interest rates (Panel A), and characteristics (Panel B). The vulnerable countries are Cyprus, Greece, Ireland, Italy, Portugal, Slovenia and Spain; the non-vulnerable countries are Austria, Belgium, Estonia, Finland, France, Germany, Luxembourg, Malta, the Netherlands, and Slovakia. Domestic Sovereign Exposures are domestic sovereign debt as a fraction of the corresponding bank's main assets. Bank Lending is the bank loans to non-financial corporations as a fraction of the corresponding banks' main assets. Bank Lending Growth and Sovereign Holdings Growth are the quarterly growth rates (in percent) of bank loans to non-financial companies and of their sovereign holdings. Interest Rate is the interest rate charged on loans to non-financial corporations. Leverage Ratio is the ratio of banks' total assets to their equity capital. T1/RWA is the ratio of Tier-1 common equity to risk-weighted assets. Public is the fraction of banks' shares owned by local or national government or publicly controlled institutions (*Fondazioni* in Italy, *Fundaciones* and *Cajas* in Spain, and *Sparkasse* and *Landesbank* in Germany). Bailout equals 1 starting in the quarter in which a bank was bailed out (unless acquired in the two subsequent quarters), and 0 before that date.

Panel A. Domestic Exposures, Bank Lending and Interest Rates (%)

	Vulnerable Countries			Non-vulnerable Countries		
	Mean	Median	St. Dev.	Mean	Median	St. Dev.
Dom. Sov. Exposures (%)	4.9	4.0	4.9	3.8	1.7	6.6
Non-Dom. Sov. Exposures (%)	1.0	0.0	3.5	2.2	0.6	3.8
Bank Lending to Firms (%)	25.3	25.3	14.0	15.7	13.1	12.6
Bank CDS (%)	3.7	2.1	4.3	1.4	1.2	1.0
Interest Rate (%)	4.3	4.1	1.6	3.2	2.8	1.4
Bank Lending Growth (%)	-0.4	-0.3	12.5	0.2	0.3	10.8
Sov. Holdings Growth (%)	1.9	0.0	23.1	1.0	0.0	20.1

Panel B. Bank Characteristics

	Vulnerable Countries			Non-vulnerable Countries		
	Mean	Median	St. Dev.	Mean	Median	St. Dev.
Assets (billion euro)	72.1	41.0	93.2	89.0	35.5	137.5
Leverage Ratio	22.1	10.3	116.0	29.0	17.4	172.8
T1/RWA (%)	9.4	9.3	2.7	10.1	9.9	3.4
Deposit/Liabilities (%)	66.7	68.9	16.9	64.3	67.7	24.8
Public	24.3	0.0	38.4	22.9	0.0	40.7
Bailout	0.1	0.0	0.3	0.1	0.0	0.2

Table 4: Determinants of Sovereign Holdings: Moral Suasion

The dependent variable is the growth rate of banks' domestic sovereign holdings in quarter t (defined as the percentage difference between the end-of-period values in quarter t and quarter $t-1$). The vulnerable countries are Greece, Ireland, Italy, Portugal, Slovenia and Spain. The non-vulnerable countries are Austria, Belgium, Finland, France, Germany, Malta and the Netherlands. $\Delta P_{jt}/P_{jt-1}$ is sovereign debt repricing, defined as the percentage change of debt prices in country j and quarter t, based on 10-year benchmark yields. $Public_{ijt}$ Public is the fraction of banks' shares owned by local or national government or publicly controlled institutions (*Fondazioni* in Italy, *Fundaciones* and *Cajas* in Spain, and *Sparkasse* and *Landesbank* in Germany). $Bailout_{ijt}$ equals 1 starting in the quarter t in which bank i in country j was bailed out (unless acquired in the two subsequent quarters), and 0 before quarter t. F_{ij} equals 1 if bank i in country j is a foreign subsidiary and 0 otherwise. All the regressions include the bank-level (lagged) deposit-liability ratio as a further control. The sample ranges from 2008:Q1 to 2014:Q4. Standard errors are clustered at the bank level and are shown in parentheses: $^{***}p<0.01,^{**}p<0.05,^{*}p<0.01$.

	Vulnerable Countries			Non-vulnerable Countries		
	(1)	(2)	(3)	(4)	(5)	(6)
$Public_{it} \times \frac{\Delta P_{jt}}{P_{jt-1}}$	−0.39***	−0.32**	−0.37**	-0.04	-0.06	-0.05
	(0.15)	(0.14)	(0.15)	(0.04)	(0.05)	(0.05)
$Public_{it}$	5.09	4.42	4.41	6.01	5.96	11.19
	(5.18)	(5.05)	(6.23)	(4.17)	(4.14)	(6.86)
$F_{ij} \times \frac{\Delta P_{jt}}{P_{jt-1}}$		0.18*			-0.04	
		(0.11)			(0.05)	
$Bailout_{ijt}$			5.85**			-8.87
			(2.50)			(5.91)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time × Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Only Domestic	No	No	Yes	Yes	Yes	No
Adjusted R^2	0.10	0.10	0.14	0.05	0.05	0.07
Banks	74	74	55	143	143	104
Observations	1892	1892	1401	3706	3706	2719

Table 5: Determinants of Sovereign Holdings in Vulnerable Countries: Moral Suasion and Carry Trade

The dependent variable is the growth rate of banks' domestic sovereign holdings in quarter t (defined as the percentage difference between the end-of-period values in quarter t and quarter $t-1$). The vulnerable countries are Cyprus, Greece, Ireland, Italy, Portugal, Slovenia and Spain. $\Delta P_{jt}/P_{jt-1}$ is sovereign debt repricing, defined as the percentage change of government bond prices in country j and quarter t, based on 10-year benchmark yields. $T1/RWA_{ijt-1}$ is the ratio of Tier-1 common equity to risk-weighted assets of bank i in country j and quarter $t-1$. $Public_{ijt}$ is the fraction of banks' shares owned by local or national government or publicly controlled institutions (*Fondazioni* in Italy, *Fundaciones* and *Cajas* in Spain, and *Sparkasse* and *Landesbank* in Germany). $Bailout_{ijt}$ equals 1 starting in the quarter t in which bank i in country j was bailed out (unless acquired in the two subsequent quarters), and 0 before quarter t. F_{ij} equals 1 if bank i in country j is a foreign subsidiary and 0 otherwise. All the regressions include the bank-level (lagged) deposit-liability ratio as a further control. The sample ranges from 2008:Q1 to 2014:Q4. Standard errors are clustered at the bank level and are shown in parentheses: $^{***}p<0.01$,$^{**}p<0.05$,$^{*}p<0.01$.

	Vulnerable Countries		
	(1)	(2)	(3)
$T1/RWA_{ijt-1} \times \frac{\Delta P_{jt}}{P_{jt-1}}$	6.44**	9.70***	9.46***
	(2.95)	(2.94)	(2.87)
$T1/RWA_{ijt-1}$	−101.97	−179.67*	−180.32*
	(85.87)	(93.04)	(92.59)
$Public_{ijt} \times \frac{\Delta P_{jt}}{P_{jt-1}}$			0.08
			(0.24)
$Public_{ijt}$			6.14
			(5.67)
$Bailout_{ijt}$			4.93**
			(2.33)
Bank FE	Yes	Yes	Yes
Time × Country FE	Yes	Yes	Yes
Only Head	No	Yes	Yes
Adjusted R^2	0.14	0.17	0.16
Banks	41	31	31
Observations	686	523	523

Table 6: Sovereign Risk Transmission to Banks: CDS Premia

The dependent variable is the change in banks' 5-year CDS premia in quarter t (defined as the difference between the end-of-period values in quarter t and quarter $t-1$). The vulnerable countries are Ireland, Italy, Portugal, Slovenia and Spain. The non-vulnerable countries are Austria, Belgium, Finland, France, Germany and the Netherlands. ΔCDS^S_{jt} is the change in the 5-year sovereign CDS premium in country j and quarter t. Exp_{ijt} is the average domestic sovereign exposure of bank i in country j and quarter t, defined as the ratio of sovereign debt holdings to main assets. D_{ij} equals 1 if bank i in country j is domestic and 0 otherwise, and $F_{ij}= 1 - D_{ij}$. The controls are the bank-level (lagged) capital-asset ratio and the lagged deposit-liability ratio. The sample ranges from 2008:Q1 to 2014:Q4. Standard errors are clustered at the bank level and are shown in parentheses: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.01$.

	Vulnerable Countries		Non-vulnerable Countries	
	(1)	(2)	(3)	(4)
$D_{ij}\times\Delta CDS^S_{jt}\times Exp_{ijt}$	7.01***	6.98***	−3.02	−2.84
	(1.33)	(1.32)	(2.80)	(2.74)
$F_{ij}\times\Delta CDS^S_{jt}\times Exp_{ijt}$	−0.86	−0.91	−0.51	−0.51
	(0.82)	(0.83)	(0.63)	(0.63)
$D_{ij}\times Exp_{ijt}$	−67.86	−93.11	−3.08	−18.79
	(84.96)	(92.62)	(89.33)	(88.67)
$F_{ij}\times Exp_{ijt}$	15.21	16.80	−29.43	−49.46
	(110.18)	(94.72)	(28.77)	(33.99)
Controls	No	Yes	No	Yes
Bank FE	Yes	Yes	Yes	Yes
Time × Country FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.61	0.61	0.58	0.58
Banks	44	44	61	61
Observations	1142	1112	1601	1569

Table 7: Banks' Non-Performing Loans and Sovereign Exposures

The dependent variable is the ratio of non-performing loans to total loans of bank i in country j and quarter t. The vulnerable countries are Ireland, Italy and Spain. The non-vulnerable countries are Austria, Belgium, Finland, France, Germany, and the Netherlands. ΔCDS^S_{jt} is the change in the 5-year sovereign CDS in quarter t, Exp_{ijt} is the average domestic sovereign exposure of bank i in country j and quarter t, defined as the ratio of sovereign debt holdings to main assets, D_{ij} equals 1 if bank i in country j is domestic and 0 otherwise, and $F_{ij}= 1 - D_{ij}$. The controls are the bank-level (lagged) capital-asset ratio and the lagged deposit-liability ratio. The sample ranges from 2008:Q1 to 2014:Q4. Standard errors are clustered at the bank level and are shown in parentheses: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.01$.

	Vulnerable Countries		Non-vulnerable Countries	
	(1)	(2)	(3)	(4)
$D_{ij}\times\Delta CDS^S_{jt}\times Exp_{ijt}$	−0.00	−0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
$F_{ij}\times\Delta CDS^S_{jt}\times Exp_{ijt}$	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
$D_{ij}\times Exp_{ijt}$	0.20**	0.19**	0.15	0.15
	(0.09)	(0.09)	(0.23)	(0.23)
$F_{ij}\times Exp_{ijt}$	−0.01	0.06	0.07	0.06
	(0.09)	(0.10)	(0.07)	(0.07)
Controls	No	Yes	No	Yes
Bank FE	Yes	Yes	Yes	Yes
Time × Country FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.84	0.85	0.86	0.86
Banks	35	35	43	43
Observations	378	374	519	498

Table 8: Sovereign Risk Transmission to Banks: Yield Surprises

The dependent variable is the change of banks' 5-year CDS premia in quarter t (defined as the difference between the end-of-period values in quarter t and quarter $t-1$). The vulnerable countries are Italy and Spain. The non-vulnerable countries are France, Germany and the Netherlands. Y_{jt} is the 10-year government bond yield of country j in quarter t, and Y_{jt}^{E} is the consensus estimate of the same yield made at the end of quarter $t-1$, so that $(Y_{jt}-Y_{jt}^{E})/Y_{jt-1}$ is the unexpected percentage change ("surprise") in the domestic sovereign yield in quarter t. Exp_{ijt} is the average domestic sovereign exposure of bank i in country j and quarter t, defined as the ratio of sovereign debt holdings to main assets. The controls are the bank-level (lagged) capital-asset ratio and the lagged deposit-liability ratio. The sample ranges from from 2008:Q1 to 2014:Q4. Standard errors are clustered at the bank level and are shown in parentheses: $^{***}p<0.01,^{**}p<0.05,^{*}p<0.01$.

	Vulnerable Countries		Non-vulnerable Countries	
	(1)	(2)	(3)	(4)
$\frac{Y_{jt}-Y_{jt}^{E}}{Y_{jt-1}}\times Exp_{ijt}$	9.68**	9.62**	−1.24	−1.42
	(4.37)	(4.36)	(3.36)	(3.37)
Exp_{ijt}	−113.83	−119.54	−13.09	−35.51
	(84.92)	(86.36)	(128.52)	(128.08)
Controls	No	Yes	No	Yes
Bank FE	Yes	Yes	Yes	Yes
Time × Country FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.61	0.61	0.53	0.52
Banks	26	26	46	46
Observations	680	672	1201	1169

Table 9: Lending and Sovereign Exposures in Vulnerable Countries

The dependent variable is the growth rate of loans by bank i to non-financial companies in quarter t in vulnerable country j (Greece, Ireland, Italy, Portugal and Spain). $\Delta P_{jt-1}/P_{jt-2}$ is sovereign debt repricing, defined as the percentage change of government bond prices in country j and quarter $t-1$, based on 10-year yields in columns 1-3 of Panel A and columns 1-2 of Panel B, and on 5-year yields in columns 4-6 of Panel A and columns 3-4 of Panel B. Exp_{ijt-1} is the domestic sovereign exposure of bank i in country j and quarter $t-1$. $Exp.Head_{iht-1}$ is the indirect exposure of the head bank of subsidiary i operating in country j to the sovereign risk of its home country $h \neq j$, and is set to zero if bank i is a domestic bank of country j, i.e. if $h = j$. D_{ij} equals 1 if bank i in country j is domestic and 0 otherwise, and $F_{ij}= 1 - D_{ij}$. The controls are the bank-level (lagged) capital-asset ratio and the lagged deposit-liability ratio, and their interactions with sovereign debt repricing. The sample ranges from 2008:Q1 to 2014:Q4. Standard errors are clustered at the bank level and are shown in parentheses: $^{***}p < 0.01$,$^{**}p < 0.05$,$^{*}p < 0.01$.

Panel A: Domestic and foreign banks

	10-Year Debt Repricing			5-Year Debt Repricing		
	(1)	(2)	(3)	(4)	(5)	(6)
$\frac{\Delta P_{jt-1}}{P_{jt-2}} \times Exp_{ijt-1}$	1.38***	1.39***		0.97**	0.97**	
	(0.52)	(0.52)		(0.43)	(0.44)	
$D_{ij} \times \frac{\Delta P_{jt}}{P_{jt-1}} \times Exp_{ijt-1}$			1.45***			1.03**
			(0.52)			(0.46)
$F_{ij} \times \frac{\Delta P_{jt}}{P_{jt-1}} \times Exp_{ijt-1}$			−0.50			−0.20
			(0.80)			(0.54)
Exp_{ijt-1}	10.49	12.08		4.28	6.11	
	(13.68)	(13.87)		(14.64)	(14.49)	
$D_{ij} \times Exp_{ijt-1}$			19.36			12.61
			(14.96)			(17.14)
$F_{ij} \times Exp_{ijt-1}$			−41.52			−41.39
			(28.09)			(26.58)
Controls	No	Yes	Yes	No	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time × Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.08	0.08	0.08	0.08	0.09	0.09
Banks	74	74	74	68	68	68
Observations	1921	1897	1897	1756	1732	1732

Table 9 (continued): Lending and Sovereign Exposures in Vulnerable Countries

Panel B: Domestic banks, using only head banks or imputing their exposures to subsidiaries

	10-Year Debt Repricing		5-Year Debt Repricing	
	(1)	(2)	(3)	(4)
$\frac{\Delta P_{jt-1}}{P_{jt-2}} \times Exp_{ijt-1}$	2.45**		1.96**	
	(0.98)		(0.91)	
Exp_{ijt-1}	16.35		5.07	
	(16.84)		(16.99)	
$\frac{\Delta P_{jt}}{P_{jt-1}} \times Exp.Head_{ijt-1}$		2.05**		1.96**
		(0.79)		(0.78)
$Exp.Head_{ijt-1}$		25.12		12.81
		(17.51)		(16.91)
Controls	Yes	Yes	Yes	Yes
Subsidiary	No	Yes	No	Yes
Bank FE	Yes	Yes	Yes	Yes
Time × Country FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.09	0.11	0.10	0.13
Banks	42	53	38	47
Observations	1115	1345	1004	1187

Table 10: Lending and Sovereign Exposures in Non-Vulnerable Countries
The dependent variable is the growth rate of loans by bank i to non-financial companies in quarter t in non-vulnerable country j (Austria, Belgium, Estonia, Finland, France, Germany, Luxembourg, Malta, the Netherlands and Slovakia). $\Delta P_{jt-1}/P_{jt-2}$ is sovereign debt repricing, defined as the percentage change of government bond prices in country j and quarter $t-1$, based on 10-year yields in columns 1-3 of Panel A and columns 1-2 of Panel B, and on 5-year yields in columns 4-6 of Panel A and columns 3-4 of Panel B. Exp_{ijt-1} is the domestic sovereign exposure of bank i in country j and quarter $t-1$. $Exp.Head_{iht-1}$ is the indirect exposure of the head bank of subsidiary i operating in country j to the sovereign risk of its home country $h \neq j$, and is set to zero if bank i is a domestic bank of country j, i.e. if $h = j$. D_{ij} equals 1 if bank i in country j is domestic and 0 otherwise, and $F_{ij}= 1 - D_{ij}$. The controls are the bank-level (lagged) capital-asset ratio and the lagged deposit-liability ratio, and their interactions with sovereign debt repricing. The sample ranges from 2008:Q1 to 2014:Q4. Standard errors are clustered at the bank level and are shown in parentheses: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.01$.

Panel A: Domestic and Foreign Banks

	10-Year Debt Repricing			5-Year Debt Repricing		
	(1)	(2)	(3)	(4)	(5)	(6)
$\frac{\Delta P_{jt-1}}{P_{jt-2}} \times Exp_{ijt-1}$	0.32	0.34		0.30*	0.29*	
	(0.37)	(0.34)		(0.18)	(0.17)	
$D_{ij} \times \frac{\Delta P_{jt}}{P_{jt-1}} \times Exp_{ijt-1}$			0.02			0.06
			(0.57)			(0.27)
$F_{ij} \times \frac{\Delta P_{jt}}{P_{jt-1}} \times Exp_{ijt-1}$			0.55**			0.43***
			(0.24)			(0.10)
Exp_{ijt-1}	−9.91	−13.49		−14.08	−17.48	
	(13.43)	(13.33)		(14.27)	(14.14)	
$D_{ij} \times Exp_{ijt-1}$			−10.50			−12.12
			(14.09)			(14.48)
$F_{ij} \times Exp_{ijt-1}$			−17.94			−24.27
			(29.07)			(29.33)
Controls	No	Yes	Yes	No	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time × Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.06	0.07	0.07	0.07	0.08	0.08
Banks	147	146	146	143	142	142
Observations	3923	3888	3888	3859	3826	3826

Table 10 (continued): Lending and Sovereign Exposures in Non-Vulnerable Countries

Panel B: Domestic Banks, Using Only Head Banks or Imputing Their Exposures to Subsidiaries

	10-Year Debt Repricing		5-Year Debt Repricing	
	(1)	(2)	(3)	(4)
$\frac{\Delta P_{jt-1}}{P_{jt-2}} \times Exp_{ijt-1}$	0.96		0.46	
	(0.87)		(0.40)	
Exp_{ijt-1}	−23.81		−26.70	
	(16.52)		(17.84)	
$\frac{\Delta P_{jt}}{P_{jt-1}} \times Exp.Head_{ijt-1}$		0.75		0.38
		(0.80)		(0.38)
$Exp.Head_{ijt-1}$		−21.66		−24.23
		(14.98)		(16.27)
Controls	Yes	Yes	Yes	Yes
Subsidiary	Yes	No	Yes	No
Bank FE	Yes	Yes	Yes	Yes
Time × Country FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.14	0.10	0.15	0.10
Banks	73	104	72	103
Observations	1992	2771	1976	2755

Table 11: Lending by Vulnerable-Country Subsidiaries Operating in Non-Vulnerable Countries

The dependent variable is the growth rate of loans to non-financial companies issued by bank i based in country h (the "home" country) operating in non-vulnerable country j. Bank i may be either a domestic country-j bank (in which case $j = h$) or the subsidiary of a bank based in vulnerable country h (in which case $j \neq h$). The vulnerable countries are Italy and Spain; the non-vulnerable countries are Austria, Belgium, Germany, Luxembourg, and Slovakia. $\Delta P_{ht-1}/P_{ht-1}$ measures the repricing of sovereign debt of the home country $h \neq j$ in quarter $t-1$, based on 10-year yields in columns 1-2, and on 5-year yields in columns 3-4. $Exp.Head_{iht}$ is the indirect exposure of the head bank of subsidiary i operating in country j to the sovereign risk of its home country $h \neq j$, and is set to zero if bank i is a domestic bank of country j, i.e. if $h = j$. The bank-level controls are Exp_{ijt-1} and $\Delta P_{jt-1}/P_{jt-2} \times Exp_{ijt-1}$ where Exp_{ijt-1} is the exposure of bank i (whether domestic or a subsidiary of a foreign bank) operating in country j to the sovereign debt of host country j in quarter $t-1$. The sample ranges from 2008:Q1 to 2014:Q4. Standard errors are clustered at the bank level and are shown in parentheses: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.01$.

	10-Year Debt Repricing		5-Year Debt Repricing	
	(1)	(2)	(3)	(4)
$\frac{\Delta P_{ht-1}}{P_{ht-2}} \times Exp.Head_{iht-1}$	3.26**	3.34**	1.71**	1.76**
	(1.32)	(1.36)	(0.70)	(0.72)
$Exp.Head_{iht-1}$	−72.28	−74.25	−70.84	−72.88
	(49.72)	(50.55)	(47.42)	(48.19)
Controls	No	Yes	No	Yes
Bank FE	Yes	Yes	Yes	Yes
Time × Country FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.07	0.07	0.07	0.07
Banks	82	82	82	82
Observations	2278	2278	2278	2278

Table 12: Lending and Sovereign Exposures of Domestic Banks in Vulnerable Countries: IV Estimates

The dependent variable is the growth rate of loans by banks to non-financial companies in quarter t in vulnerable countries (Greece, Ireland, Italy, Portugal and Spain). $\Delta P^{10}_{jt-1}/P^{10}_{jt-2}$ and $\Delta P^{5}_{jt-1}/P^{5}_{jt-2}$ measure the percentage change of government bond prices in country j and quarter $t-1$, respectively for 10-year and 5-year debt. Exp_{ijt-1} is the domestic sovereign exposure of domestic bank i in country j and quarter $t-1$, defined as the ratio of sovereign debt holdings to main assets. The controls are the bank-level (lagged) capital-asset ratio and the lagged deposit-liability ratio, and their interactions with sovereign debt repricing. All regressions in this table are estimated by IV, using $Bailout_{ijt-1} \times \Delta P_{jt-1}/P_{jt-2}$ as instrument for $Exp_{ijt-1} \times \Delta P_{jt-1}/P_{jt-2}$. $Bailout_{ijt}$ equals 1 starting in the quarter t in which bank i in country j was bailed out (unless acquired in the two subsequent quarters), and 0 before quarter t. The sample ranges from 2008:Q1 to 2014:Q4. Standard errors are clustered at the bank level and are shown in parentheses: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.01$.

	Vulnerable Countries		Non-vulnerable Countries	
	(1)	(2)	(3)	(4)
$Exp_{ijt-1} \times \frac{\Delta P^{10}_{jt-1}}{P^{10}_{jt-1}}$	3.56**		−0.93	
	(1.41)		(2.47)	
$Exp_{ijt-1} \times \frac{\Delta P^{5}_{jt-1}}{P^{5}_{jt-1}}$		3.32*		0.84
		(1.86)		(0.81)
Exp_{ijt-1}	4.92	−27.53	−2.76	−26.93
	(20.27)	(38.74)	(21.33)	(20.25)
Banks	54	48	108	107
First Stage F-Test	34	63	3	4
Observations	1396	1238	2920	2902

Table 13. Lending, Sovereign Exposures and Yield Surprises

The dependent variable is the growth rate of loans by bank i to non-financial companies in country j and quarter t. The vulnerable countries are Italy and Spain. The non-vulnerable countries are France, Germany and the Netherlands. $(Y_{jt} - Y^E_{jt})/Y_{jt-1}$ is the unexpected percentage change ("surprise") in the domestic 10-year benchmark sovereign yield in quarter t, computed as the average of the three monthly surprises in quarter t. Exp_{ijt} is the domestic sovereign exposure of bank i in country j and quarter t, defined as the ratio of sovereign debt holdings to main assets. D_{ij} equals 1 if bank i in country j is domestic and 0 otherwise, and $F_{ij} = 1 - D_{ij}$. The controls are the bank-level (lagged) capital-asset ratio and the lagged deposit-liability ratio, and their interactions with sovereign yield surprises. The sample ranges from 2008:Q1 to 2014:Q4. Standard errors are clustered at the bank level and are shown in parentheses: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.01$.

	Vulnerable Countries			Non-vulnerable Countries		
	(1)	(2)	(3)	(4)	(5)	(6)
$\frac{Y_{jt-1}-Y^E_{jt-1}}{Y_{jt-2}} \times Exp_{ijt-1}$	−1.85**	−1.83**		−0.22	−0.11	
	(0.75)	(0.77)		(0.42)	(0.35)	
$D_{ij} \times \frac{Y_{jt-1}-Y^E_{jt-1}}{Y_{jt-2}} \times Exp_{ijt-1}$			−1.89**			0.04
			(0.88)			(0.36)
$F_{ij} \times \frac{Y_{jt-1}-Y^E_{jt-1}}{Y_{jt-2}} \times Exp_{ijt-1}$			−1.07*			−1.58
			(0.62)			(1.37)
Exp_{ijt-1}	−2.09	−0.51		−15.79	−19.99*	
	(14.03)	(13.85)		(12.92)	(11.90)	
$D_{ij} \times Exp_{ijt-1}$			3.42			−21.37*
			(17.60)			(12.38)
$F_{ij} \times Exp_{ijt-1}$			−28.62			17.00
			(26.09)			(29.35)
Controls	No	Yes	Yes	No	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time × Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.10	0.10	0.10	0.09	0.10	0.10
Banks	47	47	47	102	101	101
Observations	1195	1190	1190	2742	2709	2709

Table 14: Lending Rates and Sovereign Exposures in Vulnerable Countries

The dependent variable is the change in the average interest rate charged on new loans by bank i to non-financial corporations in country j and quarter t. The vulnerable countries are Ireland, Italy, Portugal, Spain and Slovenia. $\Delta P_{jt}/P_{jt-1}$ is sovereign debt repricing, defined as the percentage change of government bond prices in country j and quarter t, based on 10-year yields in columns 1-3 and on 5-year yields in columns 4-6. Exp_{ijt-1} is the domestic sovereign exposure of bank i in country j and quarter $t-1$, defined as the ratio of sovereign debt holdings to main assets. The controls are the bank-level (lagged) capital-asset ratio and the lagged deposit-liability ratio. The estimation method is OLS in columns 1, 2, 4 and 5 and IV in columns 3 and 6, using $Bailout_{it} \times \Delta P_{jt}/P_{jt-1}$ as instrument for $Exp_{ijt-1} \times \Delta P_{jt}/P_{jt-1}$. $Bailout_{ijt}$ equals 1 starting in the quarter t in which bank i in country j was bailed out (unless acquired in the two subsequent quarters), and 0 before quarter t. The sample ranges from 2008:Q1 to 2014:Q4. Standard errors are clustered at the bank level and are shown in parentheses: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.01$.

	10-Year Debt Repricing			5-Year Debt Repricing		
	(1)	(2)	(3)	(4)	(5)	(6)
$\frac{\Delta P_{jt}}{P_{jt-1}} \times Exp_{ijt-1}$	−0.06***	−0.06***	−0.01	−0.03***	−0.03***	−0.01
	(0.02)	(0.02)	(0.06)	(0.01)	(0.01)	(0.03)
Exp_{ijt-1}	0.80**	0.79**	0.24	0.67*	0.66*	0.36
	(0.35)	(0.35)	(0.76)	(0.36)	(0.35)	(0.64)
Controls	No	Yes	No	No	Yes	No
Bank FE	Yes	Yes	No	Yes	Yes	No
Time × Country FE	Yes	Yes	No	Yes	Yes	No
Adjusted R^2	0.47	0.46	−0.15	0.47	0.46	−0.15
Banks	55	55	55	55	55	55
First-stage F-Test			59			86
Observations	1482	1474	1482	1482	1474	1482

Table 15: Lending Rates and Sovereign Exposures in Non-Vulnerable Countries

The dependent variable is the change in the average interest rate charged on new loans by bank i to non-financial companies in country j and quarter t. The non-vulnerable countries are Austria, Belgium, Estonia, Finland, Germany, Luxembourg, Malta, the Netherlands and Slovakia. $\Delta P_{jt}/P_{jt-1}$ is sovereign debt repricing, defined as the percentage change of government bond prices in country j and quarter t, based on 10-year yields in columns 1-3 and on 5-year yields in columns 4-6. Exp_{ijt-1} is the domestic sovereign exposure of bank i in country j and quarter $t-1$, defined as the ratio of sovereign debt holdings to main assets. The controls are the bank-level (lagged) capital-asset ratio and the lagged deposit-liability ratio. The estimation method is OLS in columns 1, 2, 4 and 5 and IV in columns 3 and 6, using $Bailout_{it} \times \Delta P_{jt}/P_{jt-1}$ as instrument for $Exp_{ijt-1} \times \Delta P_{jt}/P_{jt-1}$. $Bailout_{ijt}$ equals 1 starting in the quarter t in which bank i in country j was bailed out (unless acquired in the two subsequent quarters), and 0 before quarter t. The sample ranges from 2008:Q1 to 2014:Q4. Standard errors are clustered at the bank level and are shown in parentheses: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.01$.

	10-Year Debt Repricing			5-Year Debt Repricing		
	(1)	(2)	(3)	(4)	(5)	(6)
$\frac{\Delta P_{jt}}{P_{jt-1}} \times Exp_{ijt-1}$	−0.01	−0.01	−0.08	−0.01	−0.01	−0.06
	(0.01)	(0.01)	(0.09)	(0.01)	(0.01)	(0.04)
Exp_{ijt-1}	−0.03	−0.12	0.78	0.08	−0.02	
	(0.38)	(0.38)	(1.08)	(0.36)	(0.36)	
Controls	No	Yes	No	No	Yes	No
Bank FE	Yes	Yes	No	Yes	Yes	No
Time × Country FE	Yes	Yes	No	Yes	Yes	No
Adjusted R^2	0.39	0.39	−0.15	0.39	0.39	−0.14
Banks	105	105	105	101	101	101
First stage F-Test			4			4
Observations	2672	2670	2672	2612	2612	2612

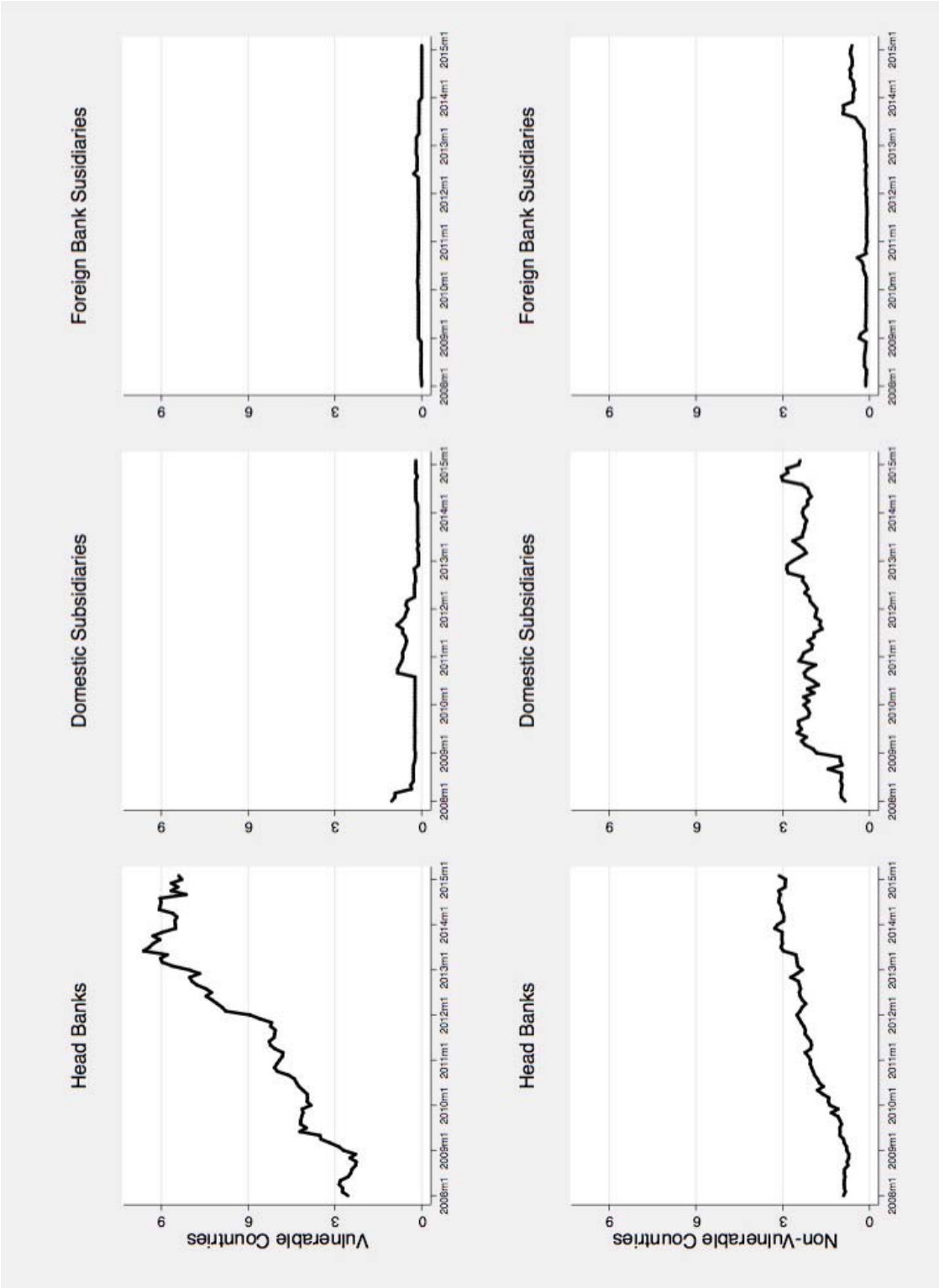

Figure 1: Median domestic sovereign exposure of head banks, domestic and foreign subsidiaries, monthly values. Domestic sovereign exposure is the ratio of domestic sovereign debt holdings to main assets (total assets less derivatives).

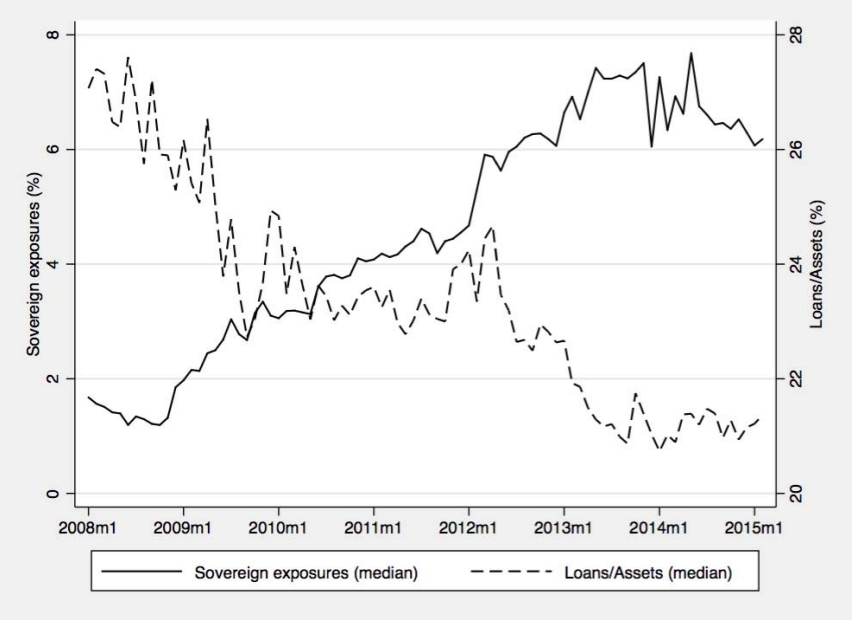

Figure 2: Domestic sovereign exposure and loan-asset ratio of the median bank in vulnerable countries, monthly values. Domestic sovereign exposure is the ratio of domestic sovereign holdings to main assets; the loan-asset ratio is lending to non-financial corporations divided by main assets.

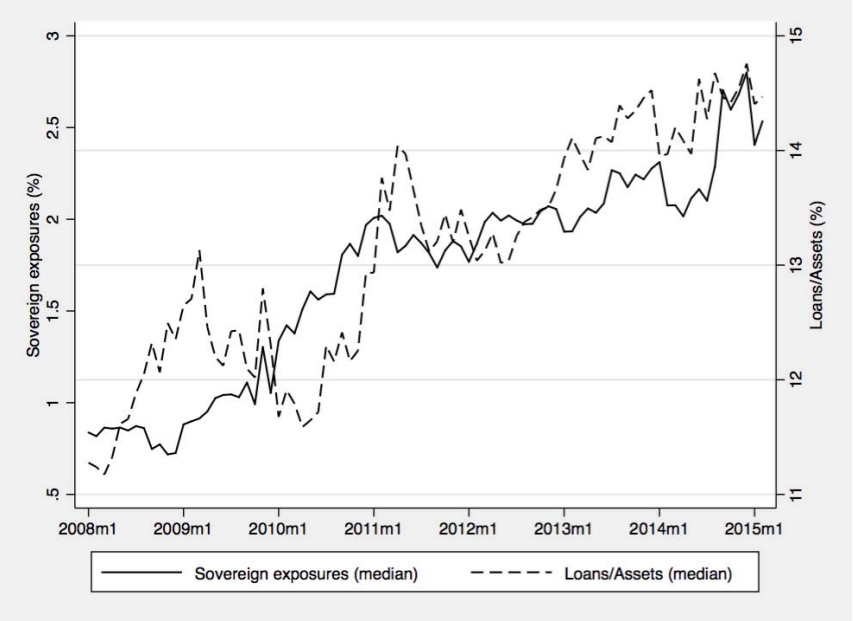

Figure 3: Domestic sovereign exposure and loan-asset ratio of the median bank in vulnerable countries, monthly values. Domestic sovereign exposure is the ratio of domestic sovereign holdings to main assets; the loan-asset ratio is lending to non-financial corporations divided by main assets.

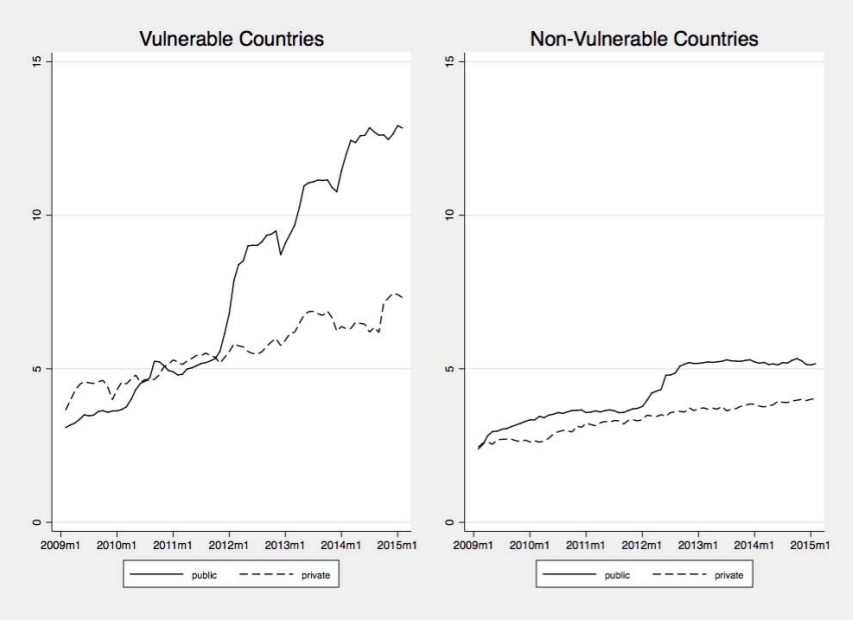

Figure 4: Domestic sovereign exposure and bank ownership, in vulnerable and non-vulnerable countries, monthly values. The lines labeled "public" and "private" respectively plot the average exposure of banks above and below the average fraction of public ownership in the relevant country in 2008.

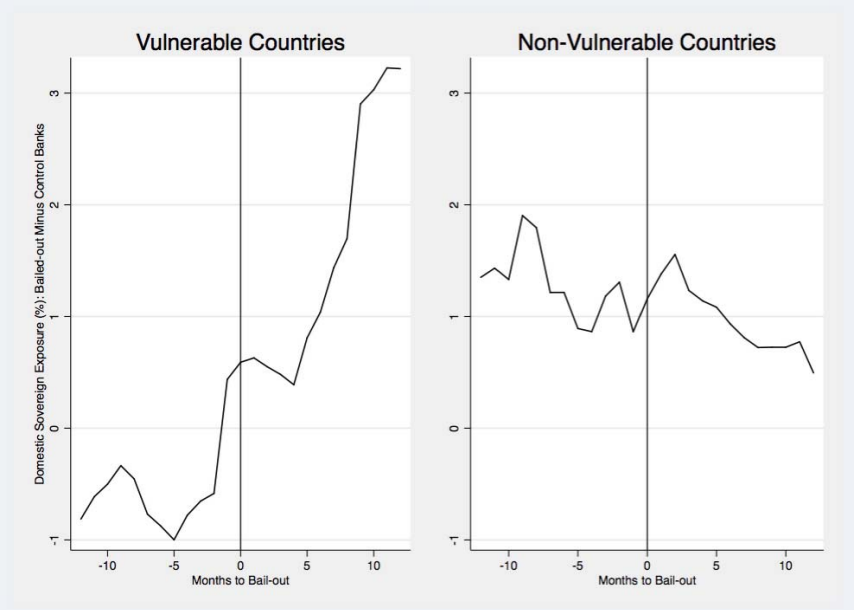

Figure 5: Difference between the average domestic sovereign exposure of bailed-out and control banks, in vulnerable and non-vulnerable countries. Control banks are those that are not bailed out. The difference refers to values observed in the same month and the same group of countries. Month 0 is the bailout date.

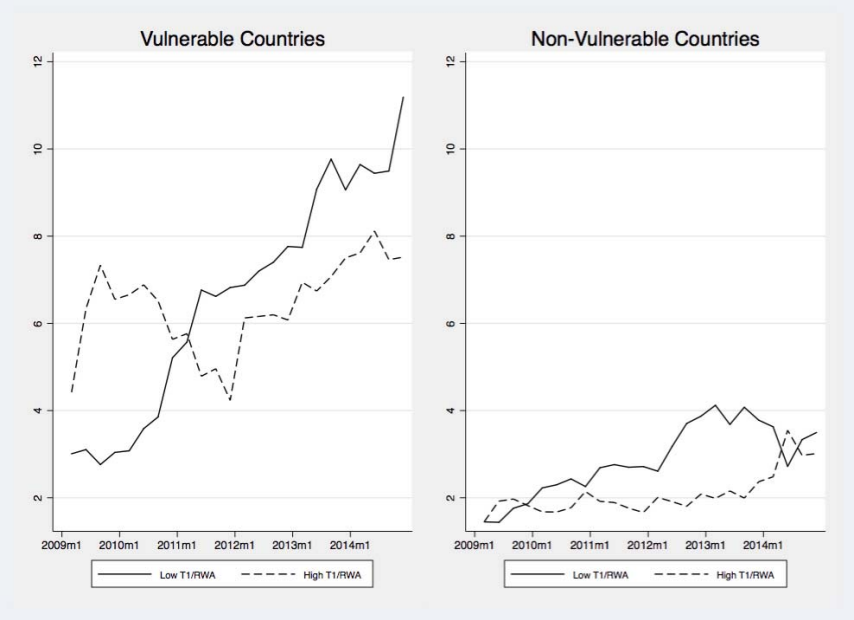

Figure 6: Domestic sovereign exposure and bank regulatory capital in vulnerable and non-vulnerable countries, monthly values. The lines labeled "highT1/RWA" and "lowT1/RWA" refer respectively to the average exposure of banks with above- and below-median ratios of Tier 1 capital to risk-weighted assets.

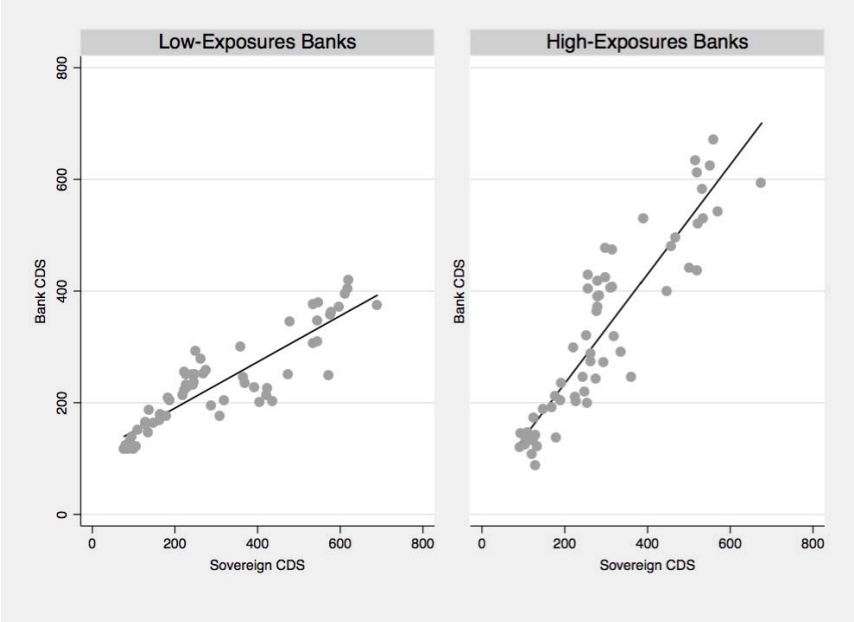

Figure 7: Sovereign CDS premia and average bank CDS premia, for low- and high-exposure banks in vulnerable countries. Each point is a monthly observation of the average bank and sovereign 5-year CDS premium. Banks with 2009 domestic sovereign exposure in the bottom quartile are low-exposure, those in the top quartile are high-exposure.

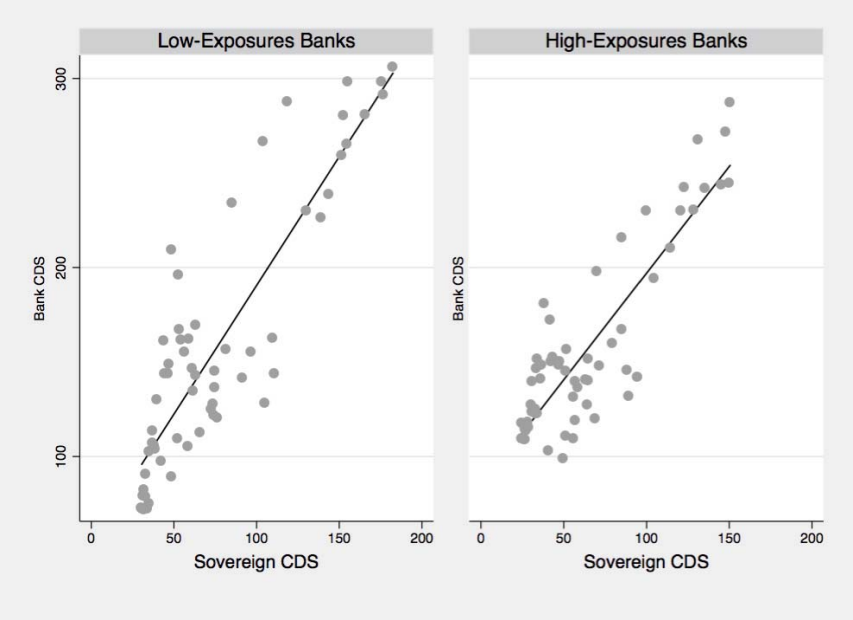

Figure 8: Sovereign CDS premia and average bank CDS premia, for low- and high-exposure banks in non-vulnerable countries. Each point is a monthly observation of the average bank and sovereign 5-year CDS premium. Banks with 2009 domestic sovereign exposure in the bottom quartile are low-exposure, those in the top quartile are high-exposure.

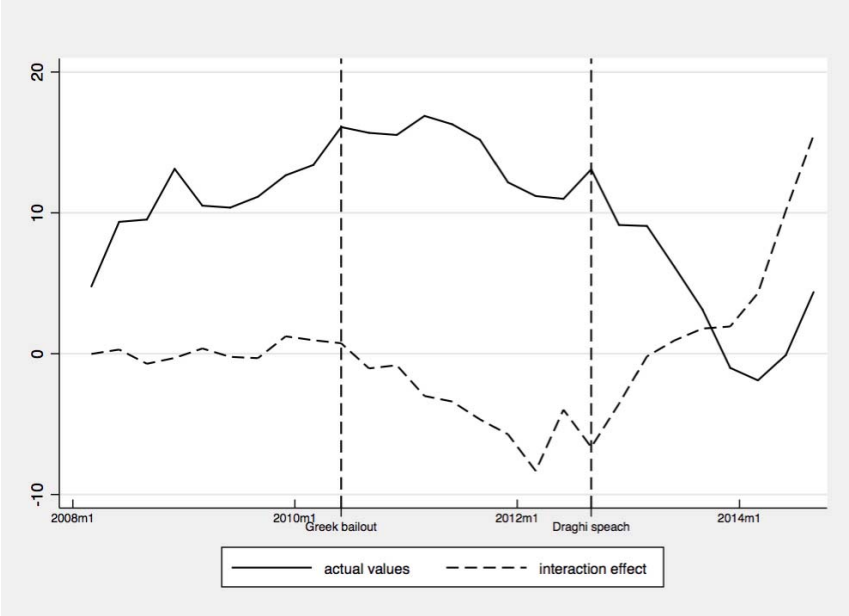

Figure 9: Actual bank lending and estimated amplification effect in vulnerable countries. The solid line plots actual average loans. The dashed line is the cumulated component of the loan growth rate predicted by the interaction term $(2.45 \times \Delta P_{jt-1}/P_{jt-2} \times Exp_{ijt-1})$, averaged across banks in vulnerable countries.