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Abstract

Using novel data on individual euro area bank balance sheets this paper shows that exposure to stressed European sovereigns is associated with a contraction in international funding. The loan component of euro area bank asset portfolios is most adversely affected by this decline in international liquidity. Controlling for bank risk and credit demand, during the sovereign debt crisis credit supply to households declined less for non-stressed country banks, with relatively greater exposure to stressed sovereigns, and that accessed the ECB's unconventional monetary policy measures in the form of the first 3-year Long-Term Refinancing Operations (VLTROs) in December 2011. In contrast, the VLTROs in February 2012 were not effective in mitigating the effect of the European sovereign debt crisis on private non-financial sector credit supply.

Keywords: European sovereign crisis, cross-border banking, international shock transmission, unconventional monetary policy, ECB liquidity.

JEL Classification: F65, G21, G15, H63

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1 Introduction

This paper investigates the effectiveness of the ECB's unconventional monetary policy in mitigating the consequences of the European sovereign debt crisis on euro area bank supply of credit to the real economy. The escalation of the European sovereign debt crisis led international investors to reallocate their portfolios away from euro area banks, manifesting in a sharp decline in their international funding. In particular, euro area banks witnessed a sharp retraction by wholesale investors, most notably US money market funds, from their US affiliates. To alleviate interbank funding stress, among its unconventional monetary policy measures, the ECB established two 36 month Long-Term Refinancing Operations (VLTROs), in December 2011 and February 2012, and injected in excess of €1 trillion euro into the euro area financial system.

To explore the influence of the downward shift in international liquidity, driven by bank exposure to stress European sovereigns and the VLTROs on private sector credit supply, the empirical analysis in this paper employs a monthly panel dataset of 138 euro area banks, between 2009 and 2012. First, to analyse the effect of stressed sovereign exposure on euro area bank international funding a difference-in-difference methodology is followed. Next, the effect of the contraction in international funding on the asset portfolios of euro area banks is assessed using an instrumental variables approach to account for potential endogeneity concerns. Exploiting propriety information on euro area bank access to the VLTRO facilities, a difference-in-difference methodology is again employed to identify the effect of the ECB's unconventional monetary policy on private non-financial sector credit supply and investment in euro area government securities. Banks exposed to stressed sovereign debt that accessed the VLTRO facilities are distinguished from those that are identified as having relatively greater holdings of stressed sovereign debt and did not draw on official liquidity under the VLTRO operations.

The empirical findings confirm that euro area bank exposure to stressed European sovereigns led to a contraction in their international funding. This downward shift was reflected in a retrenchment by extra-euro area investors from euro area banks, as well as a retraction by wholesale investors from the US affiliates of euro area banks. The results also provide empirical support for the hypothesis that internationally active banks play a role in transmitting liquidity shocks across borders and into domestic economies. Moreover, for banks relatively more exposed to stressed sovereigns, the empirical analysis shows that the VLTROs launched in December 2011 had a beneficial

effect on the supply of credit to households in non-stressed countries. The second round of VLTROs in February, however, were limited in their effectiveness to stem the decline in credit supply to the real economy by banks with larger holdings of stressed sovereign debt. For the relatively most affected banks, defined as those with larger holdings of stressed sovereign debt and accessing ECB liquidity, the second round of VLTROs mitigated the decline in their investment in domestic sovereign debt during the sovereign debt crisis. These results, indicative of increasing home bias, provide support for the moral suasion hypothesis (Acharya and Steffen, 2015).

Analysing the response of bank balance sheets to liquidity shocks necessitates the separate identification of credit demand and credit supply factors. Euro area banks were not isolated in experiencing negative effects from the sovereign debt crisis. Deteriorating euro area macroeconomic conditions, associated with declining borrowers' incomes and asset values, negatively affected their creditworthiness. The consequential balance sheet contraction for borrowers not only increased their probability of loan default but also reduced the eligibility of their collateral for new loans. Similar to Khajwa and Mian (2008), an interaction term between country fixed effects and time fixed effects is incorporated in the empirical analysis as a control for shifts in credit demand.¹

The theoretical motivation underpinning this research relates to two strands of literature. First, the bank-sovereign nexus includes a number of channels through which this interconnectedness has implications for bank balance sheets (Committee on the Global Financial System, 2011). The willingness of a bank to hold sovereign debt stems from its key attributes, namely liquidity and safety. Increased sovereign risk, reflected in rising yields on sovereign bonds, has repercussions for the balance sheets of banks. The related fall in prices on sovereign bonds leads to a reduction in the mark-to-market value of bank assets, has negative consequences for their capital, and therefore, their ability to leverage. Furthermore, an increase in sovereign risk will reduce the eligibility of sovereign bonds as collateral to secure funding in the interbank market and with central banks.

Second, the mechanism through which the shock to international funding is transmitted to domestic credit supply is considered in the spirit of the banking model of Khajwa and Mian (2008). Their framework, based on the equilibrium of loan supply and demand, facilitates the identification of a credit supply shock following a bank

¹Other authors adopting this approach include: Schnabl, 2012; De Haas and van Horen, 2012; Popov and van Horen, 2014; and Ongena et al., 2012.

specific balance sheet shock. Using firm- and bank-level data Khajwa and Mian (2008) analyse how a liquidity shock to banks is transmitted to borrowing firms. The liquidity shock faced by banks is related to the unanticipated 1998 nuclear tests in Pakistan which ultimately led to a contraction in US dollar deposit accounts causing a liquidity shock for banks reliant on this funding source. Larger firms are found to be relatively more affected by a bank liquidity shock compared to small firms but the former was able to mitigate the effects by accessing credit markets.

This paper builds on the empirical literature that considers the ability of a bank to mitigate the effects of a funding shock depends on the structure and strength of its balance sheet. Cornett et al. (2011) study the effects of the liquidity shock during the global financial crisis on US bank lending. They find that banks with comparatively illiquid assets reduced lending relative to banks whose funding base was drawn from stable sources including core deposits and capital. Using bank-level data, Ceterolli and Goldberg (2012b) illustrate how a parent bank's holdings of asset-backed commercial paper affects the lending activity of their branches. In principle, a decline in credit supply should in principle be more prevalent for banks with greater exposure to impaired or illiquid assets and are, therefore, subject to increased liquidity risk.

The literature on the transmission of bank liquidity shocks to the real economy demonstrates how banks experiencing liquidity shortages (for example through contractionary monetary policy) supply less credit (Bernanke and Blinder, 1998). A number of studies highlight the role banks play in international shock transmission. Peek and Rosengren (1997) analyse the effects of the Japanese banking crisis in the 1990s, and find the US branches of Japanese banks reduced lending as a result of the fall in their parents' capital. Schnabl (2008) shows how the Russian 1998 crisis spilled over into Peru through reduced lending by foreign banks. Ongena et al. (2013) study the effects of shocks from banks to the real economy during the global financial crisis, and find that internationally active banks contract their credit supply relatively more than purely domestic banks. Ceterolli and Goldberg (2011) show that shocks to advanced countries' banks were transmitted to emerging markets through the internal capital markets of international banks.

A number of recent studies have explored the effects of the European sovereign debt crisis on the lending activities of banks. Popov and Van Horen (2014) demonstrate how multinational banks transmit financial shocks across borders. Controlling for credit demand and bank time-varying characteristics these authors find that banks from non-

stressed countries holding stressed country sovereign debt increased syndicated lending by 23.5 per cent less than non-affected banks. The negative effect of increasing sovereign risk on the US funding of European banks and related consequences for their US lending has been provided by Correa et al. (2012).

In a study related to this paper, Darracq-Paries and De Santis (2013) examine the effect of the VLTROs on the macroeconomy. Applying a panel VAR to euro area Member States, they find that the VLTROs are positively associated with credit supply during the first half of 2012. Similarly, Gambacorta et al. (2014) analyse the effectiveness of unconventional monetary policy on macroeconomic conditions across eight advanced countries. These authors find that an expansionary unconventional monetary policy provides a temporary but effective increase in economic output and prices. Evidence of the use of ECB liquidity to fund bank investment in stressed country sovereign debt is provided by Acharya and Steffen (2015). A number of explanations underpinning bank motivation for carry trade behaviour are explored by these authors, who conclude the carry trade behaviour diverted bank resources from lending to the real economy.

By studying the consequences of bank exposure to impaired sovereigns for their international funding, this paper makes a number of contributions to these strands of literature. First, it confirms that the withdrawals experienced by euro area banks from international investors were attributable to their interconnectedness to stressed European sovereigns. Second, consistent with the findings in the related literature, the evidence suggests that international liquidity shocks do spill over into the domestic economy through a reduction across both bank liquid assets and credit supply. Finally, there is heterogeneity in the effects of the injection of the ECB's unconventional monetary policy, in the form of the VLTROs, across lending to the private non-financial sector and investment in euro area government securities by banks with relatively greater exposure to stressed sovereigns during the sovereign debt crisis.

The remainder of the paper is structured as follows. The conceptual background is presented in Section 2. Section 3 describes the data. The empirical approach is outlined in Section 4. Section 5 presents the econometric specification. The results are reported and discussed in Section 6. Finally, Section 7 concludes.

2 Conceptual background

Following a protracted period of cross-border banking inflows to the euro area during the mid-2000s, the escalation of the European sovereign debt crisis did little to stem the continued contraction of foreign funding, which had commenced during the global financial crisis (Figure 1). In contrast, for non-euro area European banks, the period following the global financial crisis witnessed a rebound in foreign funding. The focus of this section is on the expansion and subsequent contraction of euro area bank international funding.

The evolution of internationally sourced funding has played an important role in the expansion and contraction of domestic private sector credit in the euro area (Figure 2). Cross-border funding as proportion of domestic credit was 88 per cent on the eve of the introduction of the euro, peaked at 126 per cent in June 2007, and had fallen back to pre-euro levels of 87 per cent by end-2013. This shift in bank funding toward international sources amplified the credit booms in a number of euro area countries in the mid-2000s, including Ireland and Spain (Lane and McQuade, 2014; BIS, 2011).

Euro area bank demand for US dollar denominated assets exceeded their supply of retail deposits leading the US wholesale funding market, particularly money market funds, to become a key financing jurisdiction for euro area banks during the 2000s (Figure 3).² A wide range of euro area banks, in particular French banks, were notably active in this US dollar funding market (Ivashina et al., 2012).

While the proceeds of this US funding were employed for a range of purposes, including local lending in the US market, it was also channelled back to the headquarters of euro area banks who reinvested it across two asset categories. First, part of the US sourced funding was reinvested back in the US market through their acquisition of US assets, including asset-backed securities (Bertaut et al., 2011; Bernanke et al., 2011). Second, euro area banks also employed this US sourced funding to expand their domestic assets, through increased lending either directly in US dollars to facilitate the demand for US dollars for exporting companies, or by swapping it into euro and meeting increasing local credit demand (Blowers and Forsman, 2013). It is worth noting the path of funds from US-based affiliates may not have been direct between the US and the euro area as offshore intermediaries and financial centres are frequently used to channel funds globally (Lane and Milesi-Ferretti, 2011; Gourinchas and Obstfeld, 2012).

²Baba et al., 2009; Correa et al., 2012.

The dynamics of this international financial intermediation between banks active in global financial markets and domestic banking systems operating in the retail credit market is consistent with the liquidity management of globally active banks, who employ their internal capital markets to allocate liquidity across the banking group (Ceterolli and Goldberg, 2012a). The evolution of euro area bank foreign funding and domestic credit developments complement the Bruno and Shin (2014) theoretical model of global banking, whereby global banks draw on dollar funding from US money market funds, disseminate it internationally through cross-border lending to domestic banks, who in turn employ this foreign funding in local credit markets.

A number of developments in 2011 led US investors to retract their financing of the US affiliates of euro area banks, manifesting in a liquidity shock to their balance sheets. The introduction of a regulatory requirement in the US for money market funds to disclose their asset portfolios, restrained euro area banks ability to fund their operations from this group of wholesale investors (Correa et al., 2012). Moreover, the escalation of the European sovereign debt crisis in summer 2011, driven by the rising sovereign borrowing costs for Spain and Italy, led US investors to assess their exposures to euro area banks, reflected in the increasing costs of US dollar-euro swaps. The widening of the Euribor OIS, a measure of interbank counterparty risk, mirrored the increasingly scarce liquidity at this time.³ Stress in the interbank market was also evident in US dollar and Sterling money markets, indicated by the increased spreads in the Libor OIS USD and Libor OIS GBP (Figure 4). The interconnectedness between euro area banks and their sovereigns is evident in the 90 day rolling correlations between the Libor OIS USD and the sovereign credit default swaps, where sharp increases in the correlation are evident as the sovereign debt crisis intensified (Figure 5).

Declines in the correlations are associated with the timing of extended and enhanced central bank actions, including, in November 2011, the broadening of the US dollar swap line by the US Federal Reserve in cooperation with a number of central banks at a reduced price.⁴ Bilateral currency swap arrangements were also established between the ECB and a range of central banks, including Bank of Canada, Bank of England, Bank of Japan, Federal Reserve and Swiss National Bank. To ease funding stress in the interbank market, as part of the ECBs unconventional monetary policy measures, two

³The Euribor/Libor OIS is the spread between the interbank rate and the overnight index swap of corresponding maturity.

⁴The price of swaps was reduced from Libor OIS USD +100 basis points to Libor OIS USD + 50 basis points.

VLTROs were established, each with a maturity of 36 months and the possibility of repayment after one year. Across the two 36 month liquidity operations, €489 billion was provided to 523 banks in December 2011, and 800 banks drew on €530 billion in February 2012.

3 Data

To comprehensively analyse whether euro area banks' exposure to stressed European sovereigns affected their international funding, and to assess the success of the ECB's unconventional monetary policy measures, a dataset is constructed from a number of micro-level bank databases.

3.1 *Sovereign exposures*

European bank exposures to stressed European sovereigns are extracted from the results of the European Banking Authority's (EBA) stress tests. These results, published for each participating bank on a consolidated group basis, contain information on bank exposure to individual countries' sovereign debt. Balance sheet information, including total assets and capital, is also included. The approach of Popov and van Horen (2014) is followed to capture the exposure of individual bank i to stressed European sovereigns. The specification considered is:

$$Exposure_{it} = \sum_k \frac{SovDebt_{ikt} * CreditDefaultSwap_{kt}}{Assets_{it}} \quad (1)$$

where $k \in \{\text{Cyprus, Greece, Ireland, Italy, Portugal, Spain}\}$ and t is December 2010. Bank exposures at December 2010, $SovDebt$, are weighted by the credit default swap of each stressed sovereign at end-2010, and scaled by their total assets, $Assets$. Bank exposures at December 2010 are employed as these reflect the balance sheet of banks in advance of the escalation of the European sovereign debt crisis in 2011 (Popov and van Horen, 2014).

Next, the sample of banks is split into two categories. An exposure dummy is constructed whereby a bank with exposures greater than the median bank is assigned a value of 1 and categorised as *Exposed bank*, and a bank with exposure less than

that of the median bank is deemed to be comparatively less exposed and is assigned a value of 0, *Non – exposed bank*. The exposure of the median bank is chosen as it effectively separates the sample into two equal categories. *Exposed banks* and *Non – exposed banks* (i.e. *Otherwise*) are, therefore, defined as:

$$Exposure_{ij} = \begin{cases} 1 & \text{Exposed bank;} \\ 0 & \text{Otherwise.} \end{cases} \quad (2)$$

Exposed banks have relatively higher holdings of stressed sovereigns debt and are, therefore, more likely to witness a contraction in international funding due to a deterioration in the quality of their balance sheets. The second category of banks contains those that have comparatively less or no exposure to stressed sovereigns, *Non – exposed banks* and are, therefore, less likely to experience a contraction in their international funding due to sovereign exposures. The treatment group of banks comprises 71 *Exposed banks* and the control group contains 67 *Non – exposed banks*.

Individual bank exposures to stressed European sovereigns, ranked by balance sheet size, are presented in Table 1. The exposure of larger banks whose parents are based in non-stressed European countries are found to have relatively lower holdings of stressed country sovereign debt. The banks located in stressed countries, which tend to be comparatively smaller in size but are of systemic local importance, have higher relative exposure to their own sovereigns. For example, the data show that Deutsche Bank held sovereign debt issued by each of the stressed sovereigns at end-2010, whereas Allied Irish Bank (AIB), Ireland’s second largest bank, was also exposed to each stressed sovereign but its holdings were skewed towards its own sovereign.

3.2 Bank balance sheets

Individual bank balance sheet data for euro area banks are taken from a proprietary ECB database (IBSI). This database contains monthly balance sheet information for 244 banks resident in 17 euro area countries commencing in August 2007. These data are based on the residency principle, and are collated according to a methodology similar to balance of payments and international investment position statistics (IMF BPM6, 2011). A primary advantage of this approach is that it provides for the exclusion of

securitisations, write-offs and valuation effects (price and exchange rate movements), thereby facilitating an accurate measure of international funding growth and the supply of credit. This is an important feature of the dataset given the extent of non-transaction based effects on bank balance sheets during the period under review. The annual growth rate a_t for balance sheet items is calculated using the following formula:

$$a_t = \left[\prod_{i=1}^M \left(1 + \frac{F^M}{L_{t-1i}} \right) - 1 \right] \quad (3)$$

where F^M is the monthly flow or transactions of the balance sheet item in question and L represents the outstanding stock of total assets.

Banks with extreme changes in total assets are excluded from the data. To remove outliers from the dataset, all dependent variables are topped and tailed at the 1st and 99th percentile. Merging these data with the EBA bank data and data cleaning reduces the sample of banks to 138 individual bank offices which are part of 67 consolidated banking groups.

3.3 Unconventional monetary policy

These data are merged with information on bank access to the ECB's VLTROs in December 2011 and February 2012. Information on whether a bank participated in these VLTROs is sourced from a Central Bank of Ireland internal database.⁵ A dummy variable for each VLTRO is constructed, taking a value of 1 if a bank took part in the operations implemented in December 2011 (*VLTRO1*) and/or February 2012 (*VLTRO2*), and 0 otherwise.

3.4 Additional data

Relevant balance sheet data not included in the IBSI database, including total assets, Tier 1 capital ratios, customer deposits, income and loan provisioning on a consolidated

⁵Data on bank-level amounts drawn under the VLTRO facilities are confidential and are not currently available for research purposes. While euro area banking systems use of central bank liquidity is available at a country level, it contains withdrawals of official liquidity under a range of facilities including, Exceptional Liquidity Assistance and Main Refinancing Operations, which during the period under review were significant for a number of stressed countries.

banking group basis are sourced from Bloomberg, under the assumption that banks resident in the 17 euro area countries can rely on their banking group for support. Conditions in interbank markets are represented by the Euribor OIS and the LIBOR OIS USD, measured as the spread between the Euribor/Libor USD three month rate and the corresponding three month overnight index swap, and are sourced from Bloomberg.

The EBA data are also merged with euro area bank funding in the US via their US-based affiliates. This is proxied by the balance sheets of these banks, sourced from the Federal Reserve Structure and Share Data for the US Offices of Foreign banks. Of the 90 banks covered by EBA stress tests, 45 banks across 11 countries are found to have US-based affiliates whose activities are covered by this dataset.

The final data sample is a monthly panel of 138 euro area banks over the period 2009 to 2012. Table 2 provides the summary statistics and description of the main variables employed in the empirical analysis.

Banks with relatively greater exposure to stressed sovereigns tend to be smaller in size, have less Tier 1 capital, greater deposit funding and larger provisions for bad loans compared with banks with less or no exposure to stressed sovereigns.

4 Empirical approach

To analyse the effect of euro area bank exposures to stressed European sovereigns on their international funding, the dependent variable is *IntFunding* of euro area bank i , which is the annual flow of funding from extra-euro area investors. The funding of bank i in the US market is also considered, $IntFunding^{US}$, and is measured as the annual change in the log of the assets of the US affiliate of euro area bank i . Furthermore, to account for the effect of bank exposures to stressed sovereigns on their intra-euro area funding, for example to capture the declines in international funding by a German bank to an Irish bank with exposures to its own stressed sovereign, a variable $IntFunding^{EA}$ is included as an alternative dependent variable to capture intra-euro area interbank funding (comprising both loans and securities).

The explanatory variable, *Exposure*, is the euro area bank i holdings of stressed European sovereign debt. A minus sign on this variable is indicative that the exposure of bank i to stressed European sovereigns negatively effects its international funding. *Post* is a time dummy variable equal to 1 from 2011 onward, and 0 otherwise. The main variable of interest, is the interaction term, $Exposure * Post$, which captures the

shift in international funding for relatively more exposed banks during the sovereign debt crisis. A negative and significant sign on this interaction term would suggest an adverse sensitivity of international investors to euro area banks relatively more exposed to stressed European sovereigns during a period of increased tensions in the interbank market.

The specific characteristics of euro area bank i which may account for heterogeneous developments across bank balance sheets are captured by a range of bank-level time varying control variables.

Size represents the size of euro area bank i and is given by the log of its total assets. Larger banks are expected to be less sensitive to sharp shifts in liquidity, and may be relatively better placed to access alternative sources of external funding when faced with a decline in international funding. The expected sign on this coefficient is positive.

The capital of euro area bank i , *Capital*, is given by its Tier 1 capital. Better capitalised banks are considered to have access to alternative funding sources to mitigate the effects of a change in international liquidity, therefore a positive sign is anticipated on this variable.

An indicator of the funding stability of euro area bank i is also included, denoted by *Deposits*. Customer deposits are considered to be a relatively stable source of funding, and banks more reliant in this source of funding are also those more likely to be insulated from a shift in their international funding.

Measures of the health of euro area bank i are also included, whereby relatively weaker banks may be more vulnerable to changes in international liquidity. Included are *Income*, which is the net income of euro area bank i , and *LoanProvisions* measured as the level of euro area bank i 's provisioning for impaired loans. Banks with weaker balance sheets are likely to lend less given their motivation to rebalance their portfolio away from risky assets.

Next, the asset portfolio of individual euro area bank i is considered. Total assets, *Assets*, are measured as the total assets of euro area bank i at time t . Assets are decomposed into: *Loans*, which comprises the flow of aggregate credit of bank i to euro area borrowers; *HHLoans*, *NFCLoans* and *FinancialLoans* represent the flow of credit to households, non-financial corporates, and financial companies respectively; the change in the liquid assets of bank i is denoted by *Liquid*, and reflects the growth in bank i 's interbank lending (loans and debt securities) and private sector debt securities,

Domestic represents the growth in total euro area assets, and *Foreign* reflects the growth in the non-euro area assets of bank i at time t . All of these variables are normalised by the outstanding stock of total assets in the previous period.

Official liquidity can serve to improve the ability of a bank to extend loans during a period of credit contraction. To empirically account for the ECB's unconventional monetary policy measures in the form of 3 year LTROs two dummy variables are included for each euro area bank, taking a value of 1 if euro area bank i drew on ECB liquidity in December 2011, *VLTRO1*, and/or in February 2012, *VLTRO2*, and 0 otherwise. These dummy variables are then separately interacted with the dummy *Exposed bank* representing those banks defined as being relatively more exposed to stressed European sovereigns. Within the category of *Exposed banks* (71), 38 accessed the first VLTRO facility and/or the second VLTRO facility and 33 did not access either facility. This interaction term, *Exposure * Post * VLTRO* captures the effect on the change in bank lending for *Exposed banks* which also drew on central bank facilities in the form of the VLTROs, from the pre-sovereign crisis period to the post-sovereign crisis period, relative to *Exposed banks* that did not access the VLTRO facilities.

To account for unobservable country level factors that potentially affect euro area countries demand for international funding and asset portfolios, country fixed effects are included. In addition, to account for the possibility that bank balance sheet composition is driven by time-invariant bank-specific unobservable factors such as risk appetite, business model or funding strategy, bank fixed effects are included. To capture time-specific changes in bank balance sheets common across all banks, time fixed effects are included. Shifts in credit demand are controlled for by interacting country fixed effects and time fixed effects.

The regressions are estimated over the period 2009 to 2012, thereby having 24 months in the pre-period and 24 months in the post-period. This period is associated with heightened risk in the interbank market reflecting the increased intensity of the sovereign debt crisis in Europe (Figure 4). In addition, limiting the period of the empirical analysis to end-2012 alleviates the issue of accounting for the early repayment of the VLTROs.

5 Empirical specification

The effect of euro area bank holdings of stressed sovereign debt on their international funding is assessed using a difference-in-difference approach. The econometric model considers that the international funding of bank i is dependent on bank i 's exposure to stressed European sovereigns during the period of the sovereign debt crisis which was reflected in increased liquidity risk, as well as a range of controls for the other time-varying observable and time-invariant unobservable characteristics of bank i , and unobservable characteristics of its home country j , and year t . The main regression specification is given as:

$$\Delta IntFunding_{ijt} = \beta Exposure_{ij} * Post_t + \theta X_{ijt} + \gamma B_i + \delta C_j + \tau T_t + \epsilon_{ijt} \quad (4)$$

where $\Delta IntFunding$ is the international funding of euro area bank i resident in country j at time period t , $Exposure$ is the exposure of euro area bank i to stressed European sovereigns, $Post$ is a dummy variable taking a value of 1 from 2011 onwards, and 0 otherwise, X_{ijt} , B_i , C_j , and T_t are vectors of time-varying bank-level control variables, bank fixed effects, country fixed effects and time fixed effect, respectively, and ϵ is the error term. $Exposure$ and $Post$ do not enter equation (2) directly as their main affects are assumed to be captured by bank and time fixed effects, respectively.⁶

Next, the effect of changes in international funding due to bank exposure to stressed sovereign is traced to the asset portfolios of euro area banks. The following empirical specification is considered:

$$\Delta Asset_{ijt} = \beta \Delta IntFunding_{ijt} + \theta X_{ijt} + \gamma B_i + \delta C_j + \tau T_t + \epsilon_{ijt} \quad (5)$$

where $\Delta Assets$ represents the change in bank i 's asset portfolio, and can be decomposed into aggregate loan growth, liquid asset growth, domestic (domestic and intra-euro area) asset growth and foreign (non-euro area) asset growth:

⁶The main effects of these variables are examined in the empirical analysis for purposes of comparability.

$$\Delta Assets_{ijt} = \left[\frac{\Delta Loans_{ijt}}{Assets_{ijt-1}}, \frac{\Delta Liquid_{ijt}}{Assets_{ijt-1}}, \frac{\Delta Domestic_{ijt}}{Assets_{ijt-1}}, \frac{\Delta Foreign_{ijt}}{Assets_{ijt-1}} \right] \quad (6)$$

whereby *Loans* can further be broken down into *HHLoans*, *NFCLoans* and *FinancialLoans* representing loans to households, non-financial corporates and financial companies respectively. X_{ijt} , B_i , C_j and T_t are vectors of time-varying bank-level control variables, bank fixed effects, country fixed effects and time fixed effect, respectively. Finally, ϵ is the error term.

Potential exists for reverse causality or simultaneity between changes in international funding and changes in bank assets. Decreases in international funding may decrease domestic credit supply, and the corollary is feasible, whereby decreased demand for credit can induce banks to reduce their international funding. This is addressed by instrumenting variable $\Delta IntFunding_{ijt}$. Three instruments are considered. First the interaction term *Exposure * Post* is included to capture euro area bank exposure to stressed sovereigns during the sovereign crisis. As is common in the related literature on international capital flows, lagged values of changes in international funding are also included as instruments (Lane and McQuade, 2014). Stress in the interbank market has also been employed as an instrument for international funding (Aiyar, 2012). In that context, Euribor OIS, is adopted as the third instrument.⁷

Finally, to explore the effectiveness of the ECB's unconventional monetary policy in the form of the VLTROs, the following equation is estimated:

$$\Delta Asset_{ijt} = \beta Exposure_{ij} * Post_t * VLTRO_{ij} + \theta X_{ijt} + \gamma B_i + \delta C_j + \tau T_t + \epsilon_{ijt} \quad (7)$$

where *Exposure* and *Post* are defined as per equation (2), *VLTRO* is a dummy variable representing the access of euro area bank i to the ECB's 36 month LTROs in December 2011 and/or February 2012, taking a value of 1 if the facilities were accessed and 0 otherwise. X_{ijt} , B_i , C_j and T_t are vectors of time-varying bank-level control variables,

⁷A range of other instruments were also considered, including various combinations of the interaction term *Exposure * Post*, bank fixed effects, time fixed effects and time-varying bank characteristics. Postestimation tests for overidentifying restrictions indicate that these instruments are invalid.

bank fixed effects, country fixed effects and time fixed effect, respectively. Finally, ϵ is the error term.

6 Regression results

6.1 *International liquidity and stressed sovereign exposure*

Table 3 reports the results of the regressions based on specification (4), where the dependent variable is the growth in euro area bank extra-euro area international funding and different sets of control variables are sequentially included. The regressions consist of a balanced panel dataset of 138 banks, and are based on monthly data from 2009 to 2012.

Overall, the empirical results indicate that relatively greater euro area bank exposure to stressed sovereigns manifested in a contraction in their international funding during the sovereign debt crisis. In column (1), the estimates suggest that euro area banks with relatively greater exposure to stressed European sovereigns experienced a decline in their international funding during a period of heightened tensions in the interbank money markets reflecting the sovereign debt crisis. To address the possibility that euro area bank holdings of stressed sovereign debt and appetite for international funding are driven by time-invariant unobservable factors specific to each bank (for example risk preferences, business strategy, and home bias towards euro area debt), bank fixed effects are included in these regression results, as are time fixed effects. The main effect variables, *Exposure* and *Post*, replace bank and time fixed effects in column (2). To allay concerns that shifts in extra-euro area cross-border funding capture a change in euro area bank demand for international funding, an interaction between fixed effects of the bank i 's country j and time fixed effects is included in column (3). This interaction term should control for unobserved changes in demand across the home countries of euro area banks.

In column (4), bank specific shocks are controlled for, and the negative effect of greater euro area bank exposure to stressed European sovereigns on international funding during a period of tensions in the interbank market continues to hold. The regression reported in column (5) replicates that of column (4) but controls for within country time-varying differences in demand for international funding. In column (6) the Euribor OIS is included in place of time fixed effects to capture the common shock affecting

all banks and the magnitude of the main effect $Exposure * Post$ is broadly similar to that reported in column (4). Few of the bank balance sheet variables are reported with significant signs. $LoanProvisions$ enters columns (4), (5) and (6) with a negative and significant sign, indicating larger provisions for bad loans is associated with less funding from extra-euro area investors. This could indicate that investors are reluctant to provide funding to banks that anticipate the write-off of bad loans.

The sample of banks is narrowed to only include French banks, motivated by their reliance on international funding, in column (7). French banks with relatively greater exposures to stressed sovereigns during a period of increased dollar costs experienced a decline in their international funding from extra-euro area investors. Considered next is whether the findings in the baseline regression are driven by the retraction of international investors from banks resident in stressed countries due to the deterioration in their macroeconomic environment. When banks located in stressed countries and French banks are both excluded from the regression in column (8), the coefficient on $Exposure * Post$ continues to be significant and reports the correct negative sign. The results are robust, therefore, to the exclusion of stressed countries banks. This implies that the international funding of banks in non-stressed countries with exposure to stressed sovereigns declined on average by 12 per cent more than that of banks resident in the same group of countries with less or no exposure to stressed sovereigns during the period associated with European sovereign debt crisis.

To the extent that euro area banks experienced a significant contraction in their international funding in the US during the European sovereign debt crisis, the effect the stressed sovereign exposure of euro area banks had on the funding of their US-based affiliates is considered. In Table 4 the estimates are reported for specification (4), with the growth in the US funding of the affiliates of euro area banks as the dependent variable and the sequential addition of control variables reflects those included in Table 3.

Consistent with the results reported in Table 3, the regression estimates in columns (1) and (2) suggest that euro area *Exposed banks* on average experienced a greater decline in their US sourced funding during a period of heightened tensions in the US dollar interbank market, related to the sovereign debt crisis, relative to euro area *Non-exposed banks*. Controlling for bank-specific shocks, bank risk appetite and time-varying credit demand across the home countries in columns (3), (4) and (5), the coefficient on the $Exposure * Post$ reports a negative and significant sign, suggesting

relatively higher bank exposures to stressed sovereigns is associated with a contraction in the US-sourced funding for the US affiliates of euro area banks by on average 13 to 18 per cent during the European sovereign debt crisis period. These results continue to hold when the Libor OIS is included in column (6). The coefficient on *Size* enters columns (4) to (6) with a positive and significant sign indicating that greater funding from US investors is associated with larger euro area banks.

The estimates in column (7) focus on French banks. The coefficient on *Exposure * Post* is no longer significant but reports the correct negative sign. The sample of banks is reduced to banks resident in non-stressed countries, excluding French banks, in column (8). The coefficient on the interaction term *Exposure * Post* enters the regression with a negative and significant sign indicating that during the period of the sovereign debt crisis US investment in the US-based affiliates of euro area banks declined on average by 18 per cent more for *Exposed banks* whose parent banks are from non-stressed non-French countries relative to *Non – exposed banks* whose parent banks are from non-stressed non-French countries.

The interconnectedness between increasingly weak sovereigns and intra-euro area interbank funding is next considered. Access to wholesale funding within the euro area was increasingly problematic, particularly for banks in stressed countries, during 2011 and 2012 reflecting increased tensions in the interbank market. In Table 5 the results are reported for specification (4) where the dependent variable is the annual growth rate in intra-euro area interbank funding and the addition of control variables follows the sequence previously employed in Tables (3) and (4). The coefficients on the interaction term of interest *Exposure * Post* is of the correct sign across all regressions, with the exception of that in column (7) which narrows the sample to French banks. *Exposure*Post* enters columns (1), (2) and (4) as significant. The economic magnitude of the significant coefficient is smaller than those previously reported for other types of international funding. The results indicate that intra-euro area bank lending contracted during the sovereign debt crisis by on average 3 per cent more for *Exposed banks* relative to *Non – exposed banks*. *Exposure*Post* no longer retains its significance when controls for credit demand and bank specific time-varying characteristics are included in columns (3), (5) and (6). Narrowing the sample to non-stressed and non-French banks in column (8) does not alter the lack of significance on *Exposure * post*.

6.2 *Tracing the effect to bank asset portfolios and the real economy*

Next, the effects of changes in international funding on euro area bank asset portfolios are considered. Exclusive of euro area bank sovereign assets, the effects of the changes in international liquidity on the asset portfolio of euro area banks using OLS regressions are reported in Table 6.⁸

Overall the results indicate a decrease in international funding growth is associated with a decline in euro area bank asset growth. In column (1) where total credit supply is the dependent variable, a ten per cent decline in international funding would decrease euro area bank total credit supply by 1.1 per cent. Total credit supply is decomposed into credit supply to households, non-financial corporates and financial institutions in columns (2) to (4). The sign on these coefficients in columns is positive and significant for each asset category with the exception of credit supply to households, and the economic magnitude is greatest for lending to financial institutions. The coefficient on $\Delta IntFunding$ is of a similar size in column (5) when the change in liquid assets is the dependent variable. This suggests that shifts in international funding mainly affect growth in lending to the financial sector and investment in liquid assets. In columns (7) and (8) the balance sheet of euro area banks is split between growth in domestic assets and foreign assets. The coefficients on $\Delta IntFunding$ are of the predicted sign and statistically significant, but the coefficient is greater in column (7) indicating that decreases in international funding are associated with greater declines euro area bank domestic assets relative to foreign assets.

In Table 7 the results of the 2SLS estimation are presented using $Exposure * Post$, $Euribor OIS$ and lagged values of $\Delta IntFunding$ as instruments. Column (1) reports the first stage regressions. The coefficients on all explanatory variables are of the predicted sign and all, except the coefficient on $Euribor OIS$, are reported as significant. The first stage regression F-statistic is reported in Table 7 to assess the strength of the instruments. The F-statistic is 506 and, therefore, clearly exceeds the recommended minimum value of 10 (Stock et al., 2002). The partial R^2 of the first stage regression is 0.52 indicating that the instruments are relevant.

The second stage regressions are reported in columns (2) to (8) in Table 7. The coefficient of interest $\Delta IntFunding$ is both positive and significant for all regressions.

⁸The 2SLS regressions are the preferred results as the potential endogeneity of $\Delta IntFunding$ is controlled for, the OLS regressions are reported for completeness.

Similar to the OLS results reported in Table 6, the pattern on the coefficient of interest $\Delta IntFunding$ suggests that decreases in euro area bank international funding is associated with a decline in growth across most asset categories. Within domestic assets, the economic magnitude of changes in international liquidity is largest for the growth in $\Delta Loans$ which comprises the supply of credit to financial institutions (including banks and non-bank financial institutions) as well as to the private non-financial sector in the euro area. The effects of changes in international liquidity on lending to the real economy are considered in columns (2) and (3), where the dependent variables are the credit supply to households and non-financial corporates, respectively. Having controlled for credit demand, by including an interaction between country and time fixed effects, the results in columns (2) and (3) indicate that credit supply to the real economy was affected by a shift in euro area bank international funding during the sovereign debt crisis.

Credit supply to financial companies and liquid assets are also negatively affected by changes in international liquidity, and to a greater extent than lending to the real economy, indicating that when faced with a deterioration in international funding, banks dispose of their most liquid assets first. To examine whether the effects of changes in international liquidity differed across euro area banks' domestic and foreign portfolios, the growth in domestic and foreign assets are considered in columns (7) and (8). Consistent with the results in columns (2) to (6), a positive relation is evident between changes in international liquidity and euro area banks' domestic assets and foreign assets in the regression results presented in columns (7) and (8). The economic magnitude is greater for euro area bank domestic assets suggesting euro area banks protected their foreign assets, including their intra-group funding, during the European sovereign debt crisis.

Postestimation tests are also reported in Table 7. The instrumental variables employed must be uncorrelated with the error term. Given the number of instruments exceeds the number of endogenous regressors the model estimated is categorised as overidentified. The Woolridge score test statistics are reported in columns (2) to (8) in Table 7. The null hypothesis that instruments are valid is not rejected in columns (3), (4), (7) and (8). The test statistics are rejected in columns (2), (5) and (6) indicating that one or more than one instruments are invalid where the dependent variable is $\Delta Loans$, $\Delta Financial\ loans$ and $\Delta Liquid\ assets$.

6.3 Success of the VLTROs

To investigate the role of unconventional monetary policy, the results of the estimation of specification (7) inclusive of the VLTROs are reported in Table 8. In columns (1) and (3) the dependent variables are household credit supply and in columns (2) and (4) they are non-financial corporate credit supply. The coefficients on *Exposure*Post*VLTRO* in columns (1) and (2) are positive but not significant across both household and non-financial corporate credit supply growth, suggesting a lack of evidence as to the success of the initial round of VLTROs in December 2011 in mitigating the effects of the sovereign debt crisis on bank credit supply to the real economy. In columns (3) and (4) when the effect of the second VLTRO in February 2012 is considered, the coefficients reported on the *Exposure * Post * VLTRO* variables are negative for both categories of borrowers, and only enters significantly for credit supply to non-financial corporates. This indicates that *Exposed banks* who accessed the second VLTRO facilities decreased lending to non-financial corporates by on average 2 per cent relative to *Exposed banks* that did not draw on this official liquidity during the period of the sovereign debt crisis.

To examine whether there is heterogeneity across the euro area in the supply of credit to the private non-financial sector during the sovereign debt crisis by *Exposed banks* that drew on the VLTRO facilities relative to *Exposed banks* that did not, the sample of euro area banks is split between those resident in stressed countries and those in non-stressed countries. For the sample of *Exposed banks* resident in non-stressed countries, reported in columns (5) to (8), credit supply to households declined by on average 1.2 per cent less for *Exposed banks* that accessed the first VLTRO facility during a period associated with the sovereign debt crisis. A contrasting effect is evident for the group of *Exposed banks* resident in stressed countries. A decrease in credit supply to households and non-financial corporates of on average 1.3 per cent and 3 per cent, respectively, is estimated for *Exposed banks* resident in stressed countries that accessed the second VLTRO facility relative to *Exposed banks* in stressed countries that did not access these facilities during the sovereign debt crisis.

Further to the supply of credit to the private non-financial sector, the VLTROs also provided euro area banks with arbitrage and carry trade opportunities (Cour-Thimann and Winkler, 2012; Acharya and Steffen, 2015). To investigate the effects of euro area *Exposed bank* borrowings under the VLTRO liquidity operations and their investment in government securities, the estimates of specification (7) with transactions

in government securities as the dependent variable are reported in Table 9.⁹

The first VLTRO facility is considered in columns (1) to (3) where the dependent variables are investment in euro area government securities, investment in government securities issued by the *Exposed bank* own sovereign, and investment in non-domestic euro area issued government securities. None of the related coefficients on *Exposure * Post * VLTRO* are reported as significant. The effect of the second VLTRO facility is considered in columns (4) to (6), where the dependent variables are consistent with those in the first three regressions. In column (5) the positive and significant coefficient on *Exposure * Post * VLTRO* indicates that investment in domestically issued government securities increased by on average 1 per cent more for *Exposed banks* which accessed the second VLTRO facility relative to *Exposed banks* which did not, during the sovereign debt crisis. In contrast investment in other euro area government issued securities declined on average for *Exposed banks* which drew on official liquidity in February 2012 relative to *Exposed banks* which did not access these facilities during the period associated with a deterioration in sovereign balance sheets.

In columns (7) and (8) the sample of banks is split into *Exposed banks* in stressed and non-stressed countries, respectively, to capture diverging investment behaviour across *Exposed banks* resident in countries experiencing diverging macroeconomic conditions. The focus is on the VLTRO operations in February 2012 given a larger injection of official liquidity was evident in the second round of the VLTROs with a greater number of euro area banks participating.¹⁰ The significant results in column (7) suggest that *Exposed banks* in stressed countries that accessed the second VLTRO increased their investment in domestic government securities during the period of escalated sovereign stress on average by 1.3 per cent more than *Exposed banks* in stressed countries that did not access these facilities. These findings no longer hold, however, in column (8) where the dependent variable is investment in other euro area government securities for the sample of *Exposed banks* in non-stressed countries.

⁹It is not possible to distinguish between the maturities of government securities purchased requiring the assessment of arbitrage and carry trade opportunities to be considered in unison.

¹⁰Greater participation may have been partly motivated by Mario Draghi's, the ECB's president, assertion on 9 February 2012 in advance of the second round of VLTROs, that there is "*no stigma whatsoever attached to these facilities*"

6.4 *Discussion of results*

In summary, the results confirm that euro area banks with relatively greater exposure to stressed sovereign debt during a period of elevated risk on European sovereign balance sheets experienced a sharp negative shift in their international funding, by extra-euro area investors, US wholesale investors and to a lesser extent the euro area interbank market. This finding is consistent with the related research on the effects of the European sovereign debt crisis on the liquidity of internationally active banks. Correa et al., (2012) document how the increase in European sovereign risk created an obstacle to the financial intermediation of European bank branches and subsidiaries in the US, in particular vis-à-vis US money market funds.

In addition, the retraction in international funding during the sovereign debt crisis, from extra-euro area investors but not US investors, is particularly pronounced for French *Exposed banks*. These results contrast with the observations in the literature that the sharp reduction in US money market fund exposure to French banks in mid-2011 was a consequence of their exposure to stressed European sovereigns (Caruana and Van Rixtel, 2013; Ivasina et al., 2012).

The contraction in international liquidity when the sovereign debt crisis intensified negatively affected both the domestic assets and foreign assets of euro area *Exposed banks*, where the economic magnitude was greater for domestic assets. These findings are in line with those of the EBA, that the liquid assets of European banks denominated in US dollars were of lower quality relative to their European asset portfolio (Blowers and Forsman, 2013). An alternative explanation for this finding is that global banks actively manage their liquidity across their banking group, by allocating liquidity through their internal capital markets (Ceterolli and Goldberg 2012a, 2012b). Correa et al. (2012) provide empirical evidence of this internal liquidity management by European banks during the sovereign debt crisis, whereby European parent banks allocated funding to their US affiliates in the aftermath of the contraction by US wholesale investors.

Euro area *Exposed* primarily responded to the sharp decline in international liquidity through a combined reduction of both liquid assets and less liquid assets in the form of credit, where the effect was most pronounced for the latter asset category. In tracing the effect of the changes in international funding to the real economy, credit supply to households and non-financial corporates is negatively affected for *Exposed banks* relative to *Non – exposed banks* during the sovereign debt crisis. In line with the related

literature, these results illustrate that cross-border funding facilitates the transmission of international liquidity shocks, and has consequences for domestic bank credit supply (Schnabl, 2012; Peek and Rosengren, 2000; Cetorelli and Goldberg, 2011).

Controlling for credit demand, partial evidence is found in support for the ECB's unconventional monetary policy in the form of the VLTROs. ECB liquidity via the VLTRO operations in December 2011 is associated with increased lending (or a smaller decline) to households by euro area banks with relatively greater exposure to stressed sovereigns resident in non-stressed countries during the crisis period. The second round of the VLTROs is not found to have been effective in offsetting the decline in credit to non-financial corporates for banks with relatively larger exposures to stressed sovereigns. *Exposed banks* in stressed countries appear to be driving this result. Furthermore, the second round of VLTROs did not relieve the funding strains of *Exposed banks* in stressed countries in their credit supply to households.

Evidence is found in support of the moral suasion hypothesis, highlighted in the context of the sovereign debt crisis by Acharya and Steffen (2015), where governments in stressed countries encourage domestic banks to invest in their debt to counteract the fall in demand for these assets and the aim of reducing expanding yields. This home bias effect is evident for *Exposed banks* in stressed countries. No evidence of a carry trade is found for *Exposed banks* in non-stressed countries that accessed the VLTRO facilities indicating that the carry trade phenomena was possibly driven by banks with no or relatively low exposure to stressed sovereigns. This is an avenue of research that warrants greater future investigation.

7 Conclusions

Greater interconnectedness between euro area banks and their sovereigns during the European sovereign debt crisis has increased the impetus to understand the implications of this relationship for credit supply to the real economy. This paper investigates the influence of euro area bank holdings of impaired sovereign debt on their international funding and traces the effect through to their credit supply by employing a bank-level monthly dataset of 138 euro area banks between 2009 and 2012.

Controlling for bank risk and credit demand, the empirical analysis finds that greater exposure to stressed European sovereigns is associated with a decline in international funding from extra-euro area investors, in the US funding of their US-based affiliates,

and to a lesser extent from the euro area interbank market. Tracing the effects of the change in international liquidity through to the asset portfolio of euro area banks, the empirical analysis indicates there was a contraction in both liquid assets and credit supply for banks with relatively greater exposure to stressed sovereigns. The ECB's unconventional monetary policy, in the form of the VLTROs, is found to have partially mitigated the effects of the sovereign debt crisis on the credit supply of euro area banks - with relatively higher exposure to stressed sovereigns - to households, but not to non-financial corporates. Evidence is found in support of increased home bias towards investment in home sovereign debt during the crisis by banks with higher holdings of stressed sovereign debt and that drew on the VLTRO facilities in February 2012.

Overall these findings suggest that bank-sovereign nexus bound tightly during a period of elevated sovereign risk and propagated across borders through the international activities of euro area banks. The establishment of unconventional monetary policy by the ECB in response highlights the importance in future work in understanding the transmission mechanism of official liquidity to the real economy.

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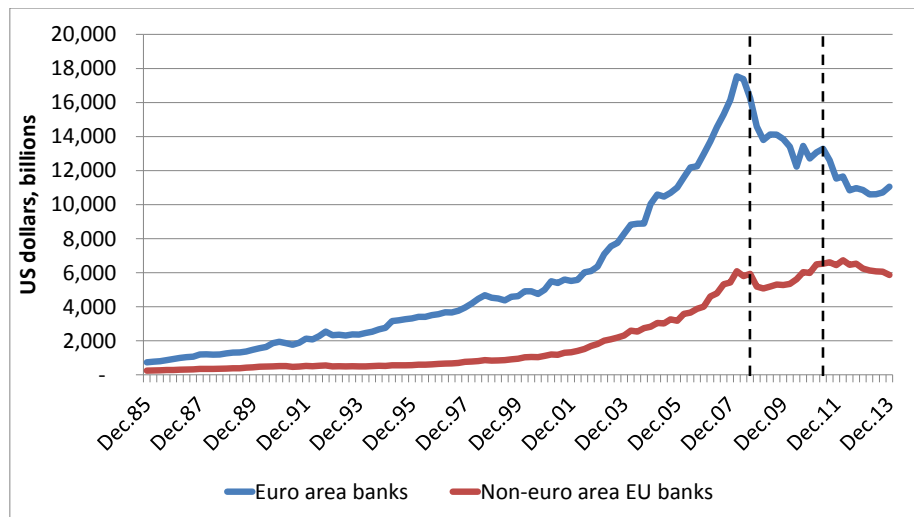
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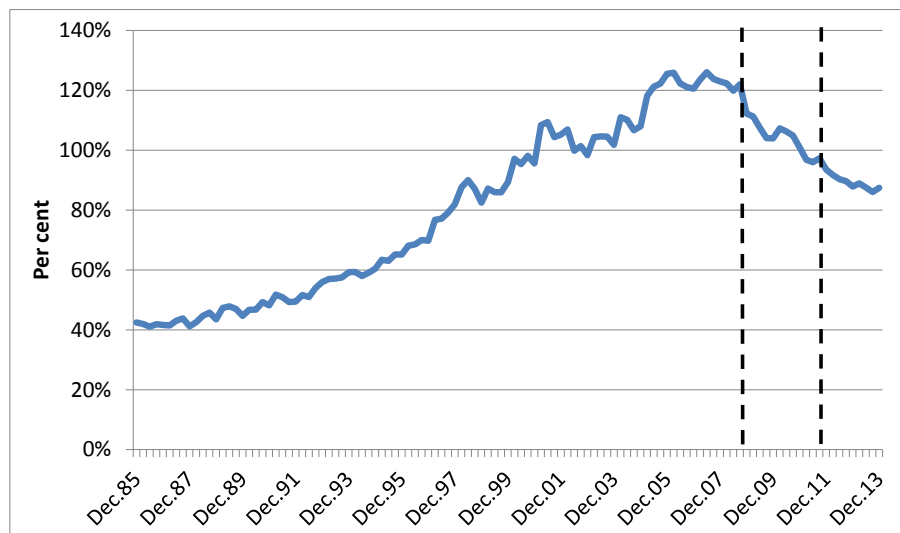
Appendix: Figures and tables

Figure 1: Evolution of European banks' cross-border funding, 1985 – 2013



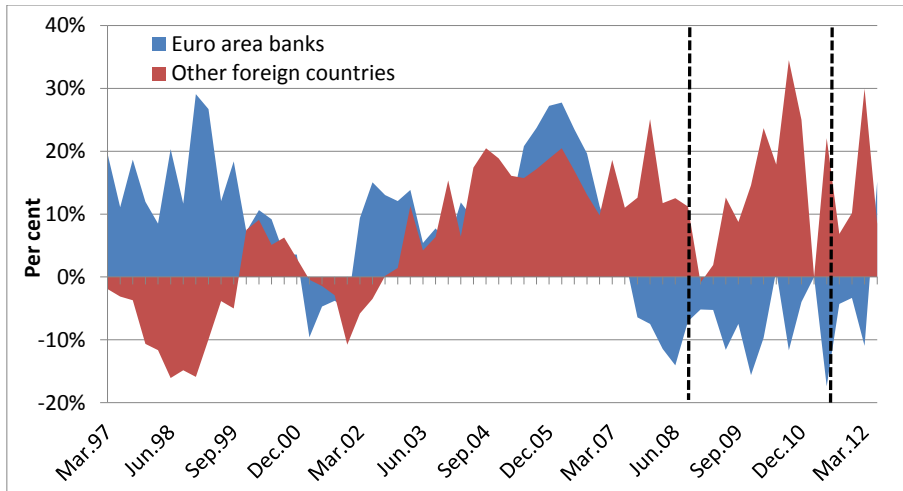
Notes: (i) Data are sourced from the Bank for International Settlements Locational Banking Statistics, (ii) Euro area countries include Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain.

Figure 2: Cross-border funding as a proportion of domestic private sector credit



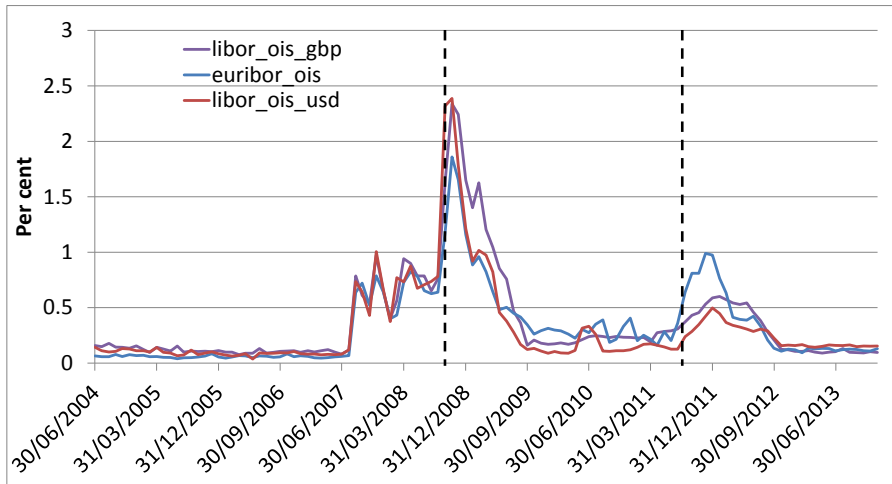
Notes: (i) Data are sourced from the Bank for International Settlements locational banking statistics and the credit to the private non-financial sector database, (ii) the black vertical lines represent September 2008 and August 2011, respectively.

Figure 3: Asset growth of foreign banks' US-based affiliates



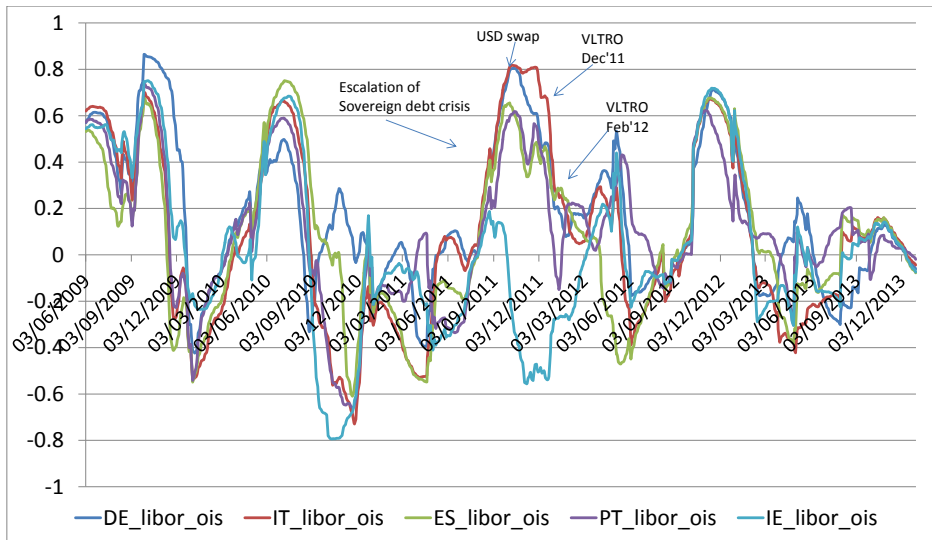
Notes: (i) Data are sourced from the Structure and Share Data for US Banking Offices of Foreign Entities published by the Federal Reserve Board, (ii) the black vertical lines represent September 2008 and August 2011, respectively.

Figure 4: Indicators of interbank market stress



Data source: Bloomberg

Figure 5: Correlations between Libor OIS USD and sovereign credit default swaps



Data source: Bloomberg

Table 1: Exposure of banks to stressed European sovereigns, end-December 2010

Institution name	Nationality	Total assets(€m)	Country of exposure							Total
			CY	ES	GR	IE	IT	PT		
BNP PARIBAS	FR	2,003,234	0.01	0.53	1.96	0.14	2.09	0.36	5.08	
DEUTSCHE BANK AG	DE	1,905,630	0.00	0.29	0.70	0.12	0.60	0.03	1.75	
HSBC HOLDINGS plc	UK	1,783,199	0.00	0.24	0.55	0.07	0.83	0.18	1.87	
BARCLAYS plc	UK	1,725,709	0.00	1.08	0.08	0.14	0.81	0.24	2.36	
CREDIT AGRICOLE	FR	1,506,595	0.00	0.55	0.33	0.05	1.07	0.25	2.23	
BANCO SANTANDER S.A.	ES	1,223,267	0.00	7.97	0.11	0.00	0.09	0.94	9.11	
SOCIETE GENERALE	FR	1,053,839	0.00	0.96	2.01	0.41	1.25	0.27	4.90	
BPCE	FR	1,003,626	0.03	0.21	1.00	0.15	0.81	0.11	2.31	
LLOYDS BANKING GROUP plc	UK	951,826	0.00	0.01	0.00	0.00	0.00	0.00	0.02	
ING BANK NV	NL	933,073	0.01	0.44	0.60	0.04	1.23	0.25	2.57	
UNICREDIT S.p.A	IT	931,283	0.00	0.44	0.54	0.03	7.87	0.03	8.92	
COMMERZBANK AG	DE	730,467	0.04	1.17	3.14	0.02	2.39	0.42	7.19	
ROYAL BANK OF SCOTLAND GROUP plc	UK	622,772	0.00	0.50	1.44	0.32	1.69	0.14	4.09	
RABOBANK NEDERLAND	NL	607,483	0.00	0.06	0.46	0.04	0.11	0.04	0.72	
INTESA SANPAOLO S.p.A	IT	576,962	0.01	0.30	0.80	0.09	15.58	0.04	16.82	
NORDEA BANK AB (PUBL)	SE	542,853	0.00	0.03	0.00	0.00	0.03	0.00	0.05	
BANCO BILBAO VIZCAYA ARGENTARIA S.A. (BB)	ES	540,936	0.00	21.84	0.18	0.00	1.15	0.38	23.54	
DEXIA	BE	509,387	0.02	0.61	5.09	0.00	4.64	1.18	11.54	
DANSKE BANK	DK	404,168	0.00	0.07	0.00	0.45	0.22	0.09	0.82	
ABN AMRO BANK NV	NL	379,599	0.00	0.06	0.00	0.15	0.52	0.00	0.73	
LANDESBANK BADEN-WURTTMBERG	DE	356,383	0.02	0.32	1.63	0.00	0.59	0.08	2.64	
HYPO REAL ESTATE HOLDING AG	DE	328,119	0.00	2.19	0.00	0.06	3.25	0.47	5.97	
BFA-BANKIA	ES	327,930	0.00	16.42	0.12	0.00	0.00	0.00	16.54	
DZ BANK AG	DE	323,578	0.01	2.74	1.69	0.07	1.27	0.98	6.76	
BAYERISCHE LANDESBANK	DE	316,354	0.01	0.44	0.34	0.03	0.24	0.00	1.07	
CAJA DE AHORROS Y PENSIONES DE BARCELONA	ES	275,856	0.00	27.25	0.00	0.00	0.72	0.03	27.99	
KBC BANK	BE	267,053	0.00	1.13	1.24	0.45	3.12	0.19	6.12	
BANCA MONTE DEI PASCHI DI SIENA S.p.A	IT	246,799	0.00	0.24	0.02	0.00	19.66	0.25	20.19	
SVENSKA HANDELSBANKEN AB (PUBL)	SE	240,202	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
NORDEUTSCHE LANDESBANK -GZ-	DE	228,586	0.00	0.46	0.49	0.08	1.22	0.35	2.61	
SKANDINAVISKA ENSKILDA BANKEN AB	SE	212,240	0.01	0.09	0.43	0.00	0.20	0.19	0.92	
DNB NOR BANK ASA	NO	209,385	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
ERSTE BANK GROUP	AT	205,938	0.02	0.14	1.26	0.09	0.44	0.16	2.10	
SWEDBANK AB	SE	191,365	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
WESTLB AG, DUSSELDORF	DE	190,935	0.00	0.83	1.35	0.08	0.86	0.00	3.12	
NYKREDIT	DK	175,703	0.00	0.00	0.09	0.00	0.07	0.00	0.17	
HSB NORDBANK AG, HAMBURG	DE	150,930	0.00	0.25	0.50	0.00	0.65	0.13	1.53	
BANCO POPOLARE - S.C.	IT	140,043	0.00	0.30	0.46	0.00	12.56	0.00	13.33	
BANK OF IRELAND	IE	139,827	0.00	0.00	0.00	0.00	17.66	0.03	17.69	
ALLIED IRISH BANKS PLC	IE	137,000	0.00	0.52	0.22	16.31	0.89	0.55	18.49	
LANDESBANK BERLIN AG	DE	133,861	0.02	0.59	2.51	0.00	0.37	0.00	3.48	
UNIONE DI BANCHE ITALIANE SCPA	IT	131,559	0.00	0.00	0.14	0.00	11.98	0.00	12.12	
RAIFFEISEN BANK INTERNATIONAL (RBI)	AT	131,173	0.00	0.01	0.01	0.00	0.51	0.01	0.53	
DEKABANK DEUTSCHE GROSZENTRALE	DE	130,304	0.00	0.29	0.50	0.10	0.31	0.08	1.28	

Table 1 continued

Institution name	Nationality	Total assets(€m)	Country of exposure							Total
			CY	ES	GR	IE	IT	PT		
BANCO POPULAR ESPANOL, S.A.	ES	129,183	0.00	14.56	0.00	0.00	0.24	1.55	16,335	
CAIXA GERAL DE DEPOSITOS, SA	PT	119,318	0.00	0.35	0.32	0.08	0.00	17.06	17,81	
NATIONAL BANK OF GREECE	GR	118,832	0.29	0.00	118.40	0.07	0.00	0.00	118,75	
BANCO COMERCIAL PORTUGUES	PT	100,010	0.00	0.00	5.44	0.94	0.07	20.12	26,58	
BANCO DE SABADELL, S.A.	ES	96,703	0.00	15.99	0.00	0.18	0.00	0.29	16,46	
ESPIRITO SANTO FINANCIAL GROUP, SA	PT	85,644	0.00	0.14	2.70	0.00	0.00	9.78	12,62	
EFG EURO BANK ERGASIAS S.A.	GR	84,199	0.36	0.00	78.15	0.00	0.18	0.00	78,69	
CAIXA DESTALVIS DE CATALUNYA, TARRAGONA	ES	77,732	0.00	7.74	0.00	0.00	0.00	0.00	7,74	
SNS BANK NV	NL	76,854	0.00	0.16	0.46	0.90	1.48	0.00	3,00	
CAIXA DE AHORROS DE GALICIA, VIGO, OUREN	ES	75,941	0.00	12.20	0.00	0.00	0.32	0.55	13,07	
OP-POHIOLA GROUP	FI	74,927	0.00	0.00	0.03	0.24	0.00	0.00	0,27	
CAJA DE AHORROS DEL MEDITERRANEO	ES	74,834	0.00	15.83	0.00	0.09	0.04	0.02	15,98	
GRUPO BANCA CIVICA	ES	71,902	0.00	14.00	0.06	0.00	0.00	0.00	14,05	
GRUPO BMN	ES	70,397	0.00	10.90	0.00	0.00	0.00	0.39	11,29	
ALPHA BANK	GR	66,798	0.12	0.00	61.36	0.00	0.00	0.00	61,48	
PIRAEUS BANK GROUP	GR	57,680	0.09	0.00	106,68	0.00	0.00	0.00	106,77	
EFFIBANK	ES	55,042	0.00	11.33	0.50	0.00	0.00	0.09	11,92	
BANKINTER, S.A.	ES	53,476	0.00	14.25	0.00	0.00	0.00	0.00	14,25	
IRISH LIFE AND PERMANENT	IE	48,541	0.00	0.00	0.00	16.91	0.00	0.00	16,91	
CAJA ESPAÑA DE INVERSIONES, S.A. MANANCA Y	ES	46,120	0.00	34.81	0.00	0.00	0.00	0.18	35,00	
OESTERREICHISCHE VOLKSBANK AG	AT	44,745	0.00	0.31	1.90	0.13	0.51	0.20	3,05	
GRUPO BBK	ES	44,628	0.00	14.78	0.00	0.04	0.00	0.02	14,84	
BANCO BPI, SA	PT	43,348	0.00	0.00	5.61	2.89	3.35	28.01	39,86	
MARFIN POPULAR BANK PUBLIC CO LTD	CY	43,068	1.63	0.00	59,21	0.40	0.00	0.00	61,24	
CAJA DE AHORROS Y M.P. DE ZARAGOZA, ARAG	ES	42,716	0.00	14.43	0.00	0.00	1.34	0.00	15,78	
BANK OF CYPRUS PUBLIC CO LTD	CY	41,996	6.77	0.29	42,91	3.40	0.13	0.00	53,50	
POWSZECHNA KASA OSZCZEDNOSCI BANK POLSKI	PL	35,673	0.00	0.00	0.00	0.00	0.00	0.00	0,00	
OTP BANK NYRT.	HU	34,517	0.00	0.00	0.00	0.00	0.00	0.00	0,00	
MONTE DE PIEDAD Y CAJA DE AHORROS DE RON	ES	34,263	0.00	18.24	0.13	0.00	1.35	0.00	19,72	
JYSKE BANK	DK	32,635	0.00	0.10	1.47	0.30	0.00	0.18	2,04	
ANTEQUERA Y JAEN BANCO PASTOR, S.A.	ES	31,135	0.00	15.61	0.98	0.00	0.49	1.16	18,25	
CAIXA DESTALVIS UNIO DE CAIXES DE MANLL	ES	28,878	0.00	18.89	0.00	0.20	0.06	0.00	19,15	
AGRICULTURAL BANK OF GREECE S.A.	GR	26,807	0.00	0.00	219,21	0.00	0.00	0.00	219,21	
CAJA DE AHORROS Y M.P. DE GIPUZKOA Y SAN	ES	20,786	0.00	15.42	0.00	0.00	0.00	0.00	15,42	
SYDBANK	DK	20,158	0.00	0.00	0.00	0.00	0.00	0.00	0,00	
GRUPO CAJAS	ES	20,144	0.00	15.93	0.00	0.18	0.00	0.00	16,12	
WGZ BANK AG WESTDT. GENO. ZENTRALBK. DDF	DE	18,105	0.09	13.69	13.07	5.43	11.58	7.92	51,77	
NOVA LIUBLJANSKA BANKA D.D.	SI	17,736	0.00	0.31	0.84	0.37	0.81	0.26	2,60	
TT HELLENIC POSTBANK S.A.	GR	16,783	0.00	0.00	236,98	0.00	0.00	0.00	236,98	
BANCA MARCH, S.A.	ES	12,744	0.00	2.49	0.00	0.00	0.00	0.00	2,49	
CAJA DE AHORROS DE VITORIA Y ALAVA	ES	8,644	0.00	14.65	0.00	0.00	0.00	0.00	14,65	
BANK OF VALLETTA (BOV)	MT	6,382	0.23	0.00	1.18	0.49	0.09	0.14	2,12	
CAJA DE AHORROS Y M.P. DE ONTINYENT	ES	931	0.00	1.37	0.00	0.00	0.00	0.00	1,37	
COLONYA - CAIXA DESTALVIS DE POLLENSA	ES	351	0.00	15.54	0.00	0.00	0.00	0.00	15,54	

This table shows the list of banks included in the EBA stress tests, their nationality, total assets and the exposure by bank to stressed European sovereigns, weighted by CDS, and scaled by total assets at end-December 2010.

Table 2: Summary statistics

Variable	Definition	All banks (6318 observations) (684 US International funding)					Exposed banks (3200 observations) (365 US International funding)					Non-exposed banks (3118 observations) (319 US International funding)				
		Mean	Std. Dev.	Min.	Max.	Dev.	Mean	Std. Dev.	Min.	Max.	Dev.	Mean	Std. Dev.	Min.	Max.	Dev.
International funding (extra euro area)	Annual flow of extra-euro area funding	0.00	0.38	-0.85	1.91	0.33	-0.05	0.33	-0.85	1.90	0.06	0.41	-0.84	1.91		
International funding (US)	Annual log change in US assets of euro area banks	-0.10	0.35	-1.41	1.01	0.41	-0.12	0.41	-1.41	1.01	-0.08	0.27	-1.31	0.84		
International funding (intra euro area)	Annual flow of intra-euro area interbank funding	0.01	0.13	-0.62	1.91	0.01	0.01	0.10	-0.47	1.18	0.02	0.16	-0.62	1.91		
Exposure	1/0 dummy variable taking a value of 1 if <i>Exposed bank</i> , and 0 otherwise	0.51	0.50	0.00	1.00	1.00	1.00	0.00	1.00	1.00	-	-	-	-		
Post	1/0 time dummy variable taking a value of 1 from 2011m1, and 0 otherwise	0.50	0.50	0.00	1.00	0.49	0.49	0.50	0.00	1.00	-	-	-	-		
Size	Total assets of euro area bank (€ billion)	797	890	-	3,598	594	715	-	2,542	1,005	997	-	3,598			
Capital	Tier 1 capital of euro area bank (%)	7.78	5.32	-6.10	20.40	7.14	4.94	-6.10	20.40	8.44	5.60	0.00	18.90			
Deposits	Customer deposits of euro area bank	0.27	0.21	0.00	1.17	0.28	0.21	0.00	0.91	0.25	0.21	0.00	1.17			
Income	Net income of euro area bank scaled by total assets	0.00	0.01	-0.09	0.18	-0.00	0.01	-0.09	0.01	0.00	0.01	-0.02	0.18			
Provisions	Loan provisions of euro area bank scaled by total assets	0.22	0.38	-0.40	5.63	0.29	0.50	0.00	5.63	0.14	0.18	-0.40	1.46			
Euribor OIS	Spread between Euribor 3 moth rate and 3 month overnight index swap	0.97	0.44	0.19	2.09	0.97	0.45	0.19	2.09	0.98	0.44	0.19	2.09			
Libor OIS	Spread between Libor USD 3 moth rate and USD 3 month overnight index swap	0.27	0.21	0.09	0.97	0.27	0.21	0.09	0.97	0.27	0.21	0.09	0.97			
Total loans	Flow of total domestic loans scaled by total assets	0.01	0.20	-2.38	1.89	-0.01	0.22	-2.38	1.35	0.04	0.16	-0.62	1.89			
Household loans	Flow of household loans scaled by total assets	0.01	0.04	-0.44	0.88	0.01	0.04	-0.44	0.88	0.01	0.03	-0.29	0.34			
NFC loans	Flow of NFC loans scaled by total assets	0.00	0.03	-0.20	0.25	-0.00	0.02	-0.20	0.13	0.00	0.03	-0.20	0.25			
Financial loans	Flow of financial loans scaled by total assets	0.01	0.13	-0.62	1.91	0.00	0.10	-0.50	1.18	0.03	0.16	-0.62	1.91			
Liquid assets	Flow of liquid assets (debt and equity securities) scaled by total assets	0.02	0.13	-0.62	1.91	0.01	0.10	-0.46	1.18	0.03	0.16	-0.62	1.91			
Domestic assets	Flow of total domestic assets scaled by total assets	0.02	0.20	-2.39	1.89	-0.00	0.23	-2.39	1.26	0.04	0.17	-0.62	1.89			
Foreign assets	Flow of foreign (extra-euro area) assets scaled by total assets	0.01	0.13	-0.73	3.41	0.00	0.08	-0.53	1.64	0.01	0.16	-0.73	3.41			
VLTRO1	1/0 dummy variable if bank participated in VLTRO in December 2011	0.42	0.49	0.00	1.00	0.56	0.50	0.00	1.00	0.28	0.45	0.00	1.00			
VLTRO2	1/0 dummy variable if bank participated in VLTRO in February 2012	0.41	0.49	0.00	1.00	0.55	0.50	0.00	1.00	0.26	0.44	0.00	1.00			

Table 3: International funding and stressed sovereign exposure

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δ Int funding	Δ Int funding	Δ Int funding	Δ Int funding	Δ Int funding	Δ Int funding	Δ Int funding	Δ Int funding
Exposure*Post	-0.113** (0.04)	-0.113** (0.04)	-0.094** (0.05)	-0.107** (0.04)	-0.099** (0.05)	-0.102*** (0.03)	-0.318* (0.11)	-0.119* (0.07)
Exposure		-0.049 (0.04)						
Post		0.017 (0.03)						
Euribor OIS						0.037 (0.02)		
Size				-0.011 (0.01)	-0.006 (0.01)	-0.010 (0.01)	-1.167** (0.24)	-0.001 (0.02)
Capital				0.003 (0.01)	0.000 (0.01)	0.007 (0.01)	-0.019 (0.03)	-0.003 (0.03)
Deposits				0.007 (0.17)	-0.083 (0.18)	-0.069 (0.16)	0.610 (1.15)	-0.290 (0.29)
Income				0.629 (0.47)	-0.295 (0.63)	0.811 (0.53)	41.829 (22.91)	-5.304 (10.95)
Loan provisions				-0.059** (0.02)	-0.070** (0.03)	-0.061*** (0.02)	-0.373* (0.12)	0.114 (0.17)
Observations	6318	6318	6318	6318	6318	6318	1080	2065
R-squared	0.255	0.028	0.342	0.257	0.343	0.246	0.353	0.391
Adjusted R-squared	0.232	0.027	0.227	0.234	0.228	0.228	0.304	0.187
Bank fixed effects	Y	N	Y	Y	Y	Y	Y	Y
Time fixed effects	Y	N	N	Y	N	N	Y	N
Country fixed effects	N	N	N	N	N	N	N	N
Country*time fixed effects	N	N	Y	N	Y	N	N	Y

This table shows the effect of euro area banks' exposure to stressed sovereigns on international funding. The dependent variable is the annual flow of monthly extra-euro area international funding of euro area banks, over the period 2009 to 2012. Regression (7) narrows the data sample to French-owned banks and regression (8) narrows the sample to non-stressed countries' banks minus French-owned banks. All regressions are estimated with a constant (not reported). Standard errors are clustered by bank. Robust standard errors appear in the parentheses and ***, **, * correspond to significance at the one, five and ten per cent level of significance, respectively.

Table 4: US funding and stressed sovereign exposure

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\Delta \text{Inftunding}^{\text{US}}$	$\Delta \text{Inftunding}^{\text{US}}$	$\Delta \text{Inftunding}^{\text{US}}$	$\Delta \text{Inftunding}^{\text{US}}$	$\Delta \text{Inftunding}^{\text{US}}$	$\Delta \text{Inftunding}^{\text{US}}$	$\Delta \text{Inftunding}^{\text{US}}$	$\Delta \text{Inftunding}^{\text{US}}$
Exposure*Post	-0.152** (0.05)	-0.152** (0.05)	-0.167** (0.06)	-0.140** (0.05)	-0.132** (0.06)	-0.125** (0.04)	-0.080 (0.17)	-0.183** (0.05)
Exposure		0.038 (0.05)						
Post		0.033 (0.04)						
Libor USD OIS						-0.019 (0.05)		
Size				0.022* (0.01)	0.043** (0.02)	0.022** (0.01)	1.411 (0.57)	0.079 (0.05)
Capital				-0.002 (0.01)	-0.016 (0.02)	-0.002 (0.01)	0.216** (0.04)	-0.063 (0.05)
Deposits				0.240 (0.16)	0.038 (0.26)	0.224 (0.17)	-1.118 (1.41)	0.284 (0.46)
Income				-1.898 (1.80)	-20.884 (12.74)	-1.761 (1.88)	-108.439 (126.48)	-61.751* (20.47)
Loan provisions				0.006 (0.04)	-0.031 (0.06)	0.004 (0.05)	0.345 (0.34)	-0.348 (0.29)
Observations	684	684	684	684	684	684	44	254
R-squared	0.255	0.028	0.342	0.257	0.343	0.246	0.353	0.391
Adjusted R-squared	0.232	0.027	0.227	0.234	0.228	0.228	0.304	0.187
Bank fixed effects	Y	N	Y	Y	Y	Y	Y	Y
Country*time fixed effects	Y	N	N	Y	N	N	Y	N
Time fixed effects	N	N	N	N	N	N	N	N
Country fixed effects	N	N	Y	N	Y	N	N	Y

This table shows the effect of euro area banks' exposure to stressed sovereigns on international funding. The dependent variable is the annual log change in the funding of European banks' affiliates in the US, over the period 2009 to 2012. Regression (7) narrows the data sample to French-owned banks and regression (8) narrows the sample to non-stressed countries' banks minus French-owned banks. All regressions are estimated with a constant (not reported). Standard errors are clustered by bank. Robust standard errors appear in the parentheses and ***, **, * correspond to significance at the one, five and ten per cent level of significance, respectively.

Table 5: Intra euro area interbank funding and stressed sovereign exposure

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\Delta \text{IntFunding}_{EA}$	$\Delta \text{IntFunding}_{EA}$	$\Delta \text{IntFunding}_{EA}$	$\Delta \text{IntFunding}_{EA}$	$\Delta \text{IntFunding}_{EA}$	$\Delta \text{IntFunding}_{EA}$	$\Delta \text{IntFunding}_{EA}$	$\Delta \text{IntFunding}_{EA}$
Exposure*Post	-0.026** (0.01)	-0.026** (0.01)	-0.019 (0.02)	-0.026* (0.01)	-0.025 (0.02)	-0.012 (0.01)	0.005 (0.03)	-0.031 (0.04)
Exposure		-0.002 (0.01)						
Post		0.017** (0.01)						
Euribor OIS						0.002 (0.01)		
Size				-0.003 (0.00)	-0.003 (0.00)	-0.003 (0.00)	0.224 (0.14)	0.000 (0.00)
Capital				0.003 (0.00)	0.002 (0.00)	0.003 (0.00)	-0.007 (0.01)	0.000 (0.01)
Deposits				-0.028 (0.07)	-0.094 (0.08)	-0.022 (0.07)	-0.398 (0.33)	0.047 (0.04)
Income				0.074 (0.19)	0.001 (0.29)	-0.031 (0.19)	20.401 (17.64)	-0.497 (2.93)
Loan provisions				-0.006 (0.01)	0.001 (0.01)	-0.007 (0.01)	-0.045 (0.04)	0.003 (0.02)
Observations	6318	6318	6318	6318	6318	6318	1080	2065
R-squared	0.303	0.006	0.376	0.304	0.378	0.288	0.303	0.597
Adjusted R-squared	0.282	0.006	0.267	0.282	0.269	0.271	0.250	0.462
Bank fixed effects	Y	N	Y	Y	Y	Y	Y	Y
Country*time fixed effects	Y	N	N	Y	N	N	Y	N
Time fixed effects	N	N	N	N	N	N	N	N
Country fixed effects	N	N	Y	N	Y	N	N	Y

This table shows the effect of euro area banks' exposure to stressed sovereigns on international funding. The dependent variable is the annual flow of monthly intra-euro area inter-bank funding, over the period 2009 to 2012. Regression (7) narrows the data sample to French-owned banks and regression (8) narrows the sample to non-stressed countries' banks minus French-owned banks. All regressions are estimated with a constant (not reported). Standard errors are clustered by bank. Robust standard errors appear in the parentheses and ***, **, * correspond to significance at the one, five and ten per cent level of significance, respectively.

Table 6: Effects of international liquidity on asset portfolio of euro area banks: OLS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	ΔLoans	ΔHH loans	ΔNFC loans	ΔFinancial loans	ΔLiquid assets	ΔDomestic assets	ΔForeign assets
ΔIntFunding	0.109** (0.03)	0.005 (0.00)	0.004* (0.00)	0.096** (0.03)	0.092** (0.03)	0.111** (0.03)	0.034* (0.02)
Size	-0.021 (0.02)	-0.002* (0.00)	0.001 (0.00)	-0.001 (0.00)	-0.002 (0.00)	-0.021 (0.02)	0.000 (0.00)
Capital	0.017 (0.02)	0.000 (0.00)	-0.001 (0.00)	0.001 (0.00)	0.001 (0.00)	0.017 (0.02)	0.002 (0.00)
Deposits	-0.097 (0.06)	-0.008 (0.01)	0.002 (0.01)	-0.057 (0.07)	-0.039 (0.08)	-0.076 (0.07)	-0.034 (0.05)
Income	2.061* (1.21)	0.114* (0.06)	0.137** (0.06)	0.183 (0.30)	0.095 (0.30)	1.981 (1.27)	0.237 (0.16)
Loan provisions	0.155 (0.09)	0.002 (0.01)	0.000 (0.00)	0.005 (0.02)	0.011 (0.01)	0.159 (0.10)	0.003 (0.01)
Observations	6318	6318	6318	6318	6318	6318	6318
R-squared	0.518	0.375	0.467	0.408	0.413	0.513	0.233
Adjusted R-squared	0.433	0.266	0.374	0.304	0.311	0.427	0.098
Bank fixed effects	Y	Y	Y	Y	Y	Y	Y
Country*time fixed effects	Y	Y	Y	Y	Y	Y	Y

This table shows the effects of the change in international liquidity on euro area banks' asset portfolio using OLS regressions. The dependent variables are the supply of total credit, the supply of credit to households, the supply of credit to NFCs, the supply of credit to financial companies, the growth in liquid assets (debt and equity securities), the growth in total domestic assets and the growth in foreign (extra-euro area) assets, over the period 2009 to 2012. All regressions are estimated with a constant (not reported). Standard errors are clustered by bank. Robust standard errors appear in the parentheses and ***, **, * correspond to significance at the one, five and ten per cent level of significance, respectively.

Table 7: Effects of international liquidity on asset portfolio of euro area banks: 2SLS

	First stage			Second stage				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\Delta \text{IntFunding}$	ΔLoans	$\Delta \text{HH loans}$	$\Delta \text{NFC loans}$	$\Delta \text{Financial loans}$	$\Delta \text{Liquid assets}$	$\Delta \text{Domestic assets}$	$\Delta \text{Foreign assets}$
Exposure*Post	-0.025* (0.01)							
$\Delta \text{IntFunding (t-1)}$	0.592*** (0.04)							
$\Delta \text{IntFunding (t-2)}$	0.172*** (0.03)							
Euribor OIS	-46.536 (34.00)							
$\Delta \text{IntFunding (predicted)}$		0.100*** (0.02)	0.008** (0.00)	0.008** (0.00)	0.077** (0.02)	0.075** (0.03)	0.105*** (0.03)	0.041** (0.02)
Size	-0.004 (0.00)	-0.021 (0.02)	-0.003** (0.00)	0.001 (0.00)	-0.001 (0.00)	0.000 (0.00)	-0.021 (0.02)	0.001 (0.00)
Capital	0.001 (0.00)	0.017 (0.01)	0.001 (0.00)	0.000 (0.00)	-0.001 (0.00)	-0.001 (0.00)	0.017 (0.01)	0.002 (0.00)
Deposits	0.085 (0.08)	-0.059 (0.05)	-0.006 (0.01)	0.004 (0.01)	-0.022 (0.05)	0.000 (0.06)	-0.036 (0.06)	-0.025 (0.04)
Income	0.048 (0.34)	1.997* (1.09)	0.125** (0.05)	0.140** (0.06)	0.114 (0.26)	0.011 (0.26)	1.911* (1.14)	0.228* (0.13)
Loan provisions	0.005 (0.01)	0.154* (0.09)	0.003 (0.00)	0.001 (0.00)	0.002 (0.01)	0.007 (0.01)	0.158* (0.09)	0.003 (0.01)
Observations	6183	6183	6183	6183	6183	6183	6183	6183
Weak instruments (H_0 : Instruments are weak)								
F statistic	506.29	506.29	506.29	506.29	506.29	506.29	506.29	506.29
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Overidentifying restrictions (H_0 : Instruments are valid)								
Woolridge F statistic		8.168	4.220	4.40	20.505	25.572	5.466	0.632
p-value		0.00	0.24	0.93	0.00	0.00	0.14	0.89

This table shows the effect of changes in international liquidity on euro area banks' asset portfolios using 2SLS. Column (1) reports the First Stage estimation, and columns (2) to (8) report the Second Stage where $\Delta \text{IntFunding}$ is instrumented using Exposure*Post , its lagged values and Euribor OIS . The dependent variables are the supply of total credit, the supply of credit to households, the supply of credit to NFCs, the supply of credit to financial companies, the growth in liquid assets (debt and equity securities), the growth in total domestic assets and the growth in foreign (extra-euro area) assets, over the period 2009 to 2012. All regressions are estimated with a constant (not reported). All regressions include both bank fixed effects and country*time fixed effects. Standard errors are clustered by bank. Robust standard errors appear in the parentheses and ***, **, * correspond to significance at the one, five and ten per cent level of significance, respectively.

Table 8: Effect of VLTROs on credit supply

	All countries												Non-stressed countries												Stressed countries											
	VLTRO1			VLTRO2			VLTRO1			VLTRO2			VLTRO1			VLTRO2			VLTRO1			VLTRO2			VLTRO1			VLTRO2								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Exposure*Post*VLTRO	0.006 (0.01)	0.000 (0.01)	-0.005 (0.01)	-0.021** (0.01)	0.012* (0.01)	-0.006 (0.01)	0.007 (0.01)	-0.007 (0.01)	0.002 (0.01)	0.007 (0.01)	-0.007 (0.01)	0.002 (0.01)	0.004 (0.01)	-0.013* (0.01)	-0.030** (0.01)																					
Size	-0.001 (0.02)	0.039 (0.02)	-0.003 (0.02)	0.038 (0.02)	0.015 (0.02)	0.098** (0.04)	0.009 (0.02)	0.101** (0.04)	-0.014 (0.03)	0.009 (0.02)	0.101** (0.04)	-0.014 (0.03)	-0.009 (0.02)	-0.017 (0.03)	-0.015 (0.02)																					
Capital	0.001* (0.00)	0.000 (0.00)	0.001* (0.00)	0.000 (0.00)	0.002* (0.00)	-0.001 (0.00)	0.002* (0.00)	-0.002 (0.00)	0.001 (0.00)	0.002* (0.00)	-0.001 (0.00)	0.001 (0.00)	0.000 (0.00)	0.000 (0.00)	0.000 (0.00)																					
Deposits	0.030** (0.01)	-0.007 (0.03)	0.030** (0.01)	-0.004 (0.03)	0.022 (0.01)	-0.014 (0.04)	0.022 (0.02)	-0.015 (0.04)	0.039* (0.02)	0.022 (0.02)	-0.015 (0.04)	0.039* (0.02)	0.004 (0.05)	0.047** (0.02)	0.026 (0.05)																					
Income	-0.06 (0.11)	-0.101 (0.11)	-0.059 (0.11)	-0.067 (0.11)	0.317 (0.49)	-0.354 (0.53)	0.266 (0.49)	-0.333 (0.53)	-0.099 (0.12)	0.266 (0.49)	-0.333 (0.53)	-0.099 (0.12)	-0.094 (0.09)	-0.084 (0.12)	-0.061 (0.08)																					
Loan provisions	-0.004 (0.00)	-0.001 (0.00)	-0.004 (0.00)	-0.001 (0.00)	-0.003 (0.01)	-0.012 (0.02)	-0.004 (0.01)	-0.012 (0.02)	-0.004* (0.00)	-0.004 (0.01)	-0.012 (0.02)	-0.004* (0.00)	-0.001 (0.00)	-0.004 (0.00)	-0.001 (0.00)																					
Observations	3200	3200	3200	3200	1504	1504	1504	1504	1696	1504	1504	1696	1696	1696	1696																					
R-squared	0.552	0.516	0.552	0.533	0.570	0.530	0.569	0.530	0.466	0.569	0.530	0.466	0.527	0.473	0.570																					
Adjusted R-squared	0.424	0.376	0.423	0.399	0.391	0.333	0.389	0.333	0.362	0.389	0.333	0.362	0.434	0.371	0.487																					
Bank fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y																					
Country*time fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y																					

This table shows the effect of the VLTROs for euro area *Exposed banks* during the sovereign debt crisis period on euro area banks' credit supply to the private non-financial sector. All regressions are estimated with a constant (not reported). Standard errors are clustered by bank. Robust standard errors appear in the parentheses and ***, **, * correspond to significance at the one, five and ten per cent level of significance, respectively.

Table 9: Effect of VLTROs on investment in government securities by euro area *Exposed banks*

	VLTROI				VLTRO2				Stressed		Non-stressed	
	(1) ΔGvt securities	(2) ΔGvt securities domestic	(3) ΔGvt securities other euro area	(4) ΔGvt securities	(5) ΔGvt securities domestic	(6) ΔGvt securities other euro area	(7) ΔGvt securities domestic	(8) ΔGvt securities other euro area				
Exposure*Post*VLTRO	0.001 (0.01)	0.002 (0.01)	-0.001 (0.00)	0.006 (0.01)	0.010* (0.01)	-0.004* (0.00)	0.013* (0.01)	-0.001 (0.00)				
Size	-0.009 (0.02)	-0.015 (0.02)	0.007 (0.01)	-0.009 (0.02)	-0.016 (0.02)	0.007 (0.01)	-0.055** (0.02)	0.013** (0.01)				
Capital	0.000 (0.00)	0.001 (0.00)	0.000 (0.00)	0.000 (0.00)	0.001 (0.00)	0.000 (0.00)	0.001 (0.00)	-0.001 (0.00)				
Deposits	-0.003 (0.03)	0.000 (0.03)	-0.003 (0.01)	-0.004 (0.03)	-0.002 (0.03)	-0.002 (0.01)	0.045 (0.05)	-0.002 (0.01)				
Income	0.009 (0.22)	0.106 (0.15)	-0.097 (0.13)	-0.002 (0.22)	0.087 (0.15)	-0.089 (0.13)	0.077 (0.15)	-0.030 (0.15)				
Loan provisions	-0.004* (0.00)	-0.002 (0.00)	-0.002 (0.00)	-0.004* (0.00)	-0.002 (0.00)	-0.001 (0.00)	-0.002* (0.00)	0.006 (0.00)				
Observations	3200	3200	3200	3200	3200	3200	1696	1504				
R-squared	0.430	0.467	0.413	0.431	0.473	0.415	0.410	0.533				
Adjusted R-squared	0.266	0.314	0.244	0.267	0.321	0.246	0.295	0.337				
Bank fixed effects	Y	Y	Y	Y	Y	Y	Y	Y				
Country*time fixed effects	Y	Y	Y	Y	Y	Y	Y	Y				

This table shows the effect of the VLTROs for euro area *Exposed banks* during the sovereign debt crisis period on euro area banks' investment in government securities. All regressions are estimated with a constant (not reported). Standard errors are clustered by bank. Robust standard errors appear in the parentheses and ***, **, * correspond to significance at the one, five and ten per cent level of significance, respectively.