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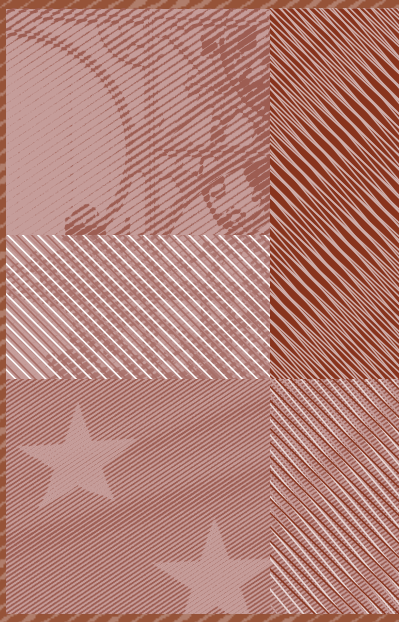

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Abstract

We study determinants of sovereign portfolios of Spanish banks over a long time-span, starting in 2008. Our findings challenge the view that banks engaged in moral hazard strategies to exploit the regulatory treatment of sovereign exposures. In particular, we show that being a weakly capitalized bank is not related to higher holdings of domestic sovereign debt. While a strong link is present between central bank liquidity support and sovereign holdings, opportunistic strategies or reach-for-yield behavior appear to be limited to the non-domestic sovereign portfolio of well-capitalized banks, which might have taken advantage of their higher risk-bearing capacity to gain exposure (via central bank liquidity) to the set of riskier sovereign bonds. Furthermore, we document that financial fragmentation in EMU markets has played a key role in reshaping sovereign portfolios of banks. Overall, our results have important implications for the ongoing discussion on the optimal design of the risk-weighted capital framework of banks.

Keywords: banks' sovereign holdings, sovereign crisis, moral hazard, central bank liquidity, EMU financial fragmentation.

JEL Classification: G01, G21, H63.

Resumen

Estudiamos los determinantes de las tenencias de bonos soberanos de los bancos españoles sobre un período prolongado, que comienza en 2008. Nuestros resultados cuestionan la hipótesis de que los bancos decidieron sus estrategias de inversión en función de factores de riesgo moral, explotando el tratamiento regulatorio de las exposiciones soberanas. En concreto, mostramos que no hay relación entre un nivel bajo de capitalización bancaria y unas tenencias más elevadas de deuda soberana nacional. Aunque existe un fuerte vínculo entre el apoyo del banco central, a través de sus programas de liquidez, y las tenencias de deuda soberana, los comportamientos de tipo oportunista, o de búsqueda de rentabilidad, parecen limitarse a la cartera de deuda soberana extranjera de los bancos mejor capitalizados. Estos podrían haberse beneficiado de su mayor capacidad de absorción de riesgos para aumentar su exposición (vía liquidez del banco central) a los bonos soberanos más arriesgados. Por otro lado, también documentamos que la fragmentación financiera en los mercados de la zona del euro ha desempeñado un papel clave en la composición de las carteras soberanas. Nuestros resultados tienen implicaciones importantes para la discusión en curso sobre el diseño óptimo del tratamiento regulatorio de las exposiciones soberanas.

Palabras clave: tenencias bancarias de deuda soberana, crisis soberana, riesgo moral, liquidez del banco central, fragmentación financiera en la zona del euro.

Códigos JEL: G01, G21, H63.

1 Introduction

The 2010-2012 European sovereign crisis coincided with a strong upsurge of domestic sovereign exposures of banks based in distressed countries. What drives sovereign debt portfolios in a crisis context? Some authors claim that *undercapitalized* banks took advantage of the particular design of prudential regulation, which assigns a zero risk-weight to domestic sovereign exposures (see, for instance, Acharya and Steffen, 2015). According to their view, those weak banks would have made risky bets on distressed sovereign debt, sometimes with the purpose of generating sufficient profits to avoid a default (gambling for resurrection), other times simply to boost profitability through carry trade. Whatever the ultimate reason, these authors argue that the banks that followed this strategy did not internalize bad outcomes, in which the credit quality of distressed sovereigns would further deteriorate. If and when the risk had materialized, resulting losses in sovereign portfolios might have ended up being shared with banks´ creditors, or even taxpayers. Thus, this strand of the literature links the increase in holdings of distressed sovereign debt during the crisis to the execution of moral hazard or risk-shifting strategies.

In our paper, we empirically study to what extent the above-mentioned statements are supported by the data using a very granular dataset with information from Spanish banks, starting in 2008. We go beyond the period of sovereign turmoil, which ensures that our conclusions are not delimited to this crisis-event (although we also test the validity of our findings in that period). Contrary to other papers, we also consider holdings of non-domestic debt to enrich the analysis. Spain is a perfect "laboratory" for this exercise: tensions in the sovereign market followed the real estate crisis, which put the banking industry under strong profitability pressures against a backdrop of reduced lending opportunities in the economy. In this context, banks´ holdings of Spanish sovereign debt augmented sharply. However, not all banks were symmetrically affected by the economic crisis. Stronger international players and some more prudent domestic players were able to weather the crisis in better conditions. This cross-sectional heterogeneity is essential to assess how weaker and stronger banks reacted to the same shocks. In addition, the fact that the Eurosystem was an active lender of last resort in this period adds an interesting dimension to the study.

We start by discussing some relevant graphical evidence on the evolution of sovereign debt holdings of larger EMU banking systems, including a breakdown of non-domestic sovereign debt holdings between debt issued by distressed and non-distressed governments in the EMU, or by countries more and less affected by the crisis (MAC and LAC, respectively). The latter set of data is obtained from the Securities Holdings Statistics by Sector (SHSS) of the ECB, which collects (at the ISIN level) holdings of debt of different institutional sectors in each jurisdiction, including banks. The data shows the well-known fact that banks in MAC countries augmented domestic bond holdings during the sovereign crisis period. We also observe that, at the height of the sovereign crisis, banks from MAC countries got rid of a substantial part of their non-domestic MAC debt portfolios. This result is striking. If, according to some authors, there was a bet on domestic sovereign bonds, why did banks not extend the bet to non-domestic MAC debt? Thus, considering both domestic and non-domestic sovereign debt holdings is key to answer this question.

Our empirical exercise exploits a rich dataset obtained from confidential supervisory reporting data, which offers an extensive coverage of sovereign portfolios and other relevant

balance sheet items of Spanish banks. With this dataset, we control for several time-varying bank-level variables, including size, international activity, solvency and banks´ complexity, ensuring that we are able to disentangle moral hazard motivations from alternative drivers of purchases of sovereign bonds. In addition, we consider several relevant macro-financial variables to control for overall business conditions, drawing information from private and public data sources. Within the former group of variables, we introduce a novel indicator developed by the ECB (ECB, 2018), which measures financial fragmentation in EMU markets, or price dispersion across countries of *in theory* very similar assets. We argue that this variable captures *inter alia* EMU break-up concerns. An increase in financial fragmentation could result in a "re-nationalization" of sovereign portfolios (Angelini et al., 2014), or a substitution of non-domestic debt for domestic debt.

In our initial set of regressions, the dependent variable is the quarterly change in domestic sovereign debt banks' holdings. We first assess whether moral hazard (risk-shifting) mechanisms *alla* Altavilla et al (2017) played a role in redrawing banks´ sovereign portfolios. In this respect, we do not find evidence in favor of moral hazard. First, we find that being a poorly capitalized bank is *not* associated with higher holdings of domestic sovereign bonds. In addition, we show that weak banks did not take advantage of depressed market conditions/sentiment to expand their portfolios of sovereign bonds. Finally, we document a positive link between *bank-level* central bank funding and (the growth of) sovereign debt holdings. This might give the impression that banks engaged in carry trade/opportunistic strategies *alla* Acharya and Steffen (2015), using proceeds from Eurosystem lending operations to invest in high-yield sovereign debt. The relationship central bank liquidity-sovereign bonds is, however, unrelated to the capital level of banks, which suggests that the moral hazard hypothesis does not hold.

Our analysis concludes that macroeconomic factors, rather than opportunistic strategies, play an important role in sovereign holdings. In particular, banks tend to increment (domestic) sovereign holdings during downturns (when GDP drops), and decrease these holdings in upturns. Interestingly, financial fragmentation in the EMU also *explains* higher holdings of domestic sovereign debt. We associate this behavior with a search for "hedge": elevated fragmentation in financial markets reflect the risk of an EMU break-up, or the risk of a redenomination of banks´ balance sheet items from euros to new national currencies. In this context and to prevent currency mismatches, banks have an incentive to re-nationalize their (sovereign) portfolios. In addition, self-preservation motives (ESRB, 2015) may also push banks to increase their domestic sovereign debt holdings to reduce the likelihood of an event that would have devastating consequences for them, regardless of their domestic sovereign exposures (see also Andreeva and Vlassopoulos, 2016).

Lastly, we look further into the moral hazard hypothesis by exploring the behavior of distressed banks. In our framework, an institution in distress is characterized by a weak level of capital, and a high level of non-performing loans (NPLs), both expressed in relative terms with respect to its peers. Of course, high NPL levels reflect bad past decisions (granting low-quality loans), but might also indicate that the set of investment/lending opportunities of a bank has narrowed down: a bank may not be able to find solvent borrowers in its traditional market niche, and it may even be harder to reach other markets under a general economic recession. In our empirical exercise, we find that distressed institutions have a stronger propensity to pile up domestic sovereign bonds. We link this relationship to the particular portfolio constrains that this set of banks confronts rather than to moral hazard behavior.

We perform several robustness checks to confirm the validity of our results. First of all, we formally study the preference of banks for 1) holding domestic versus non-domestic EMU sovereign debt (propensity to *domestic concentration*[1]), and 2) holding non-domestic MAC debt in detriment of LAC debt (preference for higher-yielding sovereign securities). This analysis serves us to double check the validity of our main findings, but it also offers some interesting new insights. In particular, we study the preference for holding domestic sovereign debt instead of debt with similar risk-return characteristics (non-domestic MAC debt), thus controlling for moral suasion mechanisms *alla* Altavilla et al (2017), according to which some public authority would be pushing banks towards holding more domestic sovereign debt. Our results do not offer support for the presence of moral suasion or moral hazard mechanisms. Financial fragmentation, on the contrary, emerges as a major driver of domestic concentration. Finally, our results are consistent with the execution of opportunistic strategies in the *non-domestic* debt portfolio. These strategies would be led by well-capitalized banks, or banks with higher *risk-bearing* capacity.

Our results are further robust to alternative specifications. In particular, we examine their validity at the height of the sovereign crisis, and we find that they firmly hold. Interestingly, in this period there is modest evidence that banks followed contrarian strategies in the sovereign market, buying sovereign debt when prices were more depressed. This could be consistent with the view that banks are willing to support sectors in distress for which they hold large exposures, a channel recently documented by Giannetti and Saidi (2017) for industries in distress. As before, the relationship prices-sovereign holdings is unrelated to banks' capital levels. On another level, our results are robust to different strategies for identifying the set of weakly capitalized banks. Lastly, our findings hold when controlling for the behavior of banks that during the crisis were acquired by other institutions (in the main body of the paper, we consider them as part of their current banking group).

To the best of our knowledge, our paper is the first to confront at the same time bank-level factors (similarly to Altavilla et al., 2017) together with the impact of financial fragmentation in EMU to explain changes in sovereign bond holdings. It is also the first that empirically shows that the latter element, rather than opportunistic strategies, was determinant in explaining home bias behavior (propensity to hold domestic bonds instead of foreign securities) during the crisis, confirming the hypothesis enunciated by Angelini et al. (2014). In line with Peydró et al. (2017), we also find evidence that banks dealt with domestic and non-domestic sovereign debt in a different fashion, and that well-capitalized banks could bet on high-yield, non-domestic MAC bonds *using proceeds* from Eurosystem lending operations. Finally, the finding that distressed banks with high levels of non-performing assets buy *more* (domestic) sovereign bonds is an important one. It suggests that portfolio constraints, i.e. the lack of investment opportunities in the economy, could drive sovereign bonds holdings. This, in turn, could challenge moral hazard/gambling for resurrection theories (see, for instance, Acharya and Steffen, 2015).

On the policy front, we think that our research might contribute to the ongoing discussion on the optimal risk-weighted capital framework of banks (see BCBS, 2018). In particular, the finding that banks increased their sovereign debt holdings when market sentiment was depressed and no other investors were willing to step in adds an interesting dimension to the discussion about the so-called "diabolic loop" or the nexus between sovereign risk and bank credit risk. This term is used to refer to the fact that strains in one of the two sectors, the sovereign or the banking sector, feed tensions in the other (see, for

1 Other authors have also studied home bias of banks´ sovereign portfolios in the Eurozone crisis context. See, for instance, Battistini et al. (2014) or Horváth et al. (2015).

instance, Acharya et al., 2014). Since the nexus might be more intense when banks hold large sovereign exposures, the idea of imposing penalties on the latter has gained ground in the policy discussion. However, our research reveals a novel feature of the nexus: in a crisis context, domestic banks could help stabilize the sovereign market (see Angelini et al., 2014, for similar findings in the case of Italy). This, in turn, translates into financial stability dividends.

Our paper is structured as follows. Section 2 provides a rationale of why banks decide to hold sovereign bonds in a crisis context. Section 3 describes the evolution of sovereign portfolios of larger EMU banking systems, including the Spanish banking system. Section 4 describes the data and presents the empirical study. Section 5 incorporates some extensions and robustness tests. Finally, section 6 concludes.

2 Why do banks hold sovereign debt in a crisis context?

In a crisis context, banks gain exposure to distressed sovereign debt for different reasons. After a thorough review of the literature, we can summarize the channels that could be present in the following list:

I. *Moral hazard or risk-shifting channel*. The asymmetric nature of the pay-offs of distressed sovereign bonds would give undercapitalized banks a strong incentive to invest in this market segment (Drechsler et al., 2016). In the good states of nature, strained sovereigns honor their debt and banks´ shareholders cash in the (sometimes substantial) credit risk premium embedded in these securities. In the bad states, though, distressed sovereigns default and subsequent losses in poorly capitalized institutions end up being shared between shareholders and creditors. Thus, according to this channel, a transfer of risks (from shareholders to debt holders, and ultimately to taxpayers) seems to operate when weak institutions invest in distressed sovereign bonds. Acharya and Steffen (2015) further suggest that the appeal of holding these bonds would be amplified by the design of the credit risk framework of Basilea, which assigns a zero risk-weight to sovereign exposures irrespective of the associated credit risk.[2]

II. *Non-moral hazard hypotheses*, comprising two modalities:

   a. Execution of opportunistic strategies. As other investors, banks would be screening opportunities in the marketplace in view of their risk-return preferences. If yields rise sufficiently for sovereign debt, banks would gain exposure to this segment to seize what they perceive as a valuable market opportunity. Thus, at times of stress, reach-for-yield behavior could play a role in the set-up of sovereign portfolios.[3]

   b. Role of central bank liquidity. The build-up of sovereign debt holdings might be facilitated by the availability of central bank liquidity, particularly if provided at favorable terms (Brutti and Sauré, 2016). When this happens, opportunistic strategies could still be present but interact with exogenous interventions by the central bank, which targets price stability. In parallel, banks might tap Eurosystem loans and buy sovereign debt to increase their collateral cushion (*liquidity hoarding*), deteriorated in a crisis context (Peydró et al., 2017). This is clearly dissociated from opportunistic behavior.

Before introducing the empirical section, we address two potential concerns related to the identification of the aforementioned channels.

   a. Do moral hazard and opportunistic behavior overlap? Our answer is no. Opportunistic behavior is in some aspects observationally equivalent to moral

2 Risk-weight of sovereign bonds issued by non-domestic issuers can also be set at 0%. For instance, for any banking system based in the Economic and Monetary Union (EMU), bonds denominated in euros and issued by the central government of other EMU jurisdictions receive the same regulatory treatment as domestic government debt.

3 Alternatively and in light of risk-return considerations, banks might increase sovereign debt holdings in detriment of other exposures, including credit to the private sector. Our paper, however, does not address real effects. Thus, we do not study this channel.

hazard: banks buy distressed sovereign debt and capture the extra yield of this asset class. But it differs from the moral hazard hypothesis in the central aspect that undercapitalized institutions do not lead distressed bonds purchases, i.e. either strong banks do it (taking advantage of their higher risk-bearing capacity) or simply all institutions embrace opportunistic strategies, irrespective of their capital level.

b. Omitted variable bias: presence of macro shocks. We note that, beyond the previous channels, sovereign holdings might be sensitive to macro-financial or overall conditions. Channels of transmission of macro shocks are multifaceted. For instance, the lack of solvent credit demand during downturns would narrow down the set of banks' investment opportunities, which would react by increasing their sovereign exposures (Castro and Mencía, 2014). Furthermore, in connection with the particular set-up of the EMU, tensions in the sovereign market might introduce the perception that the monetary union is not irreversible (fears of an EMU break-up). The resulting financial fragmentation could lead banks to increase their domestic sovereign debt holdings, a "natural" hedge against the risk of redenomination in banks´ balance sheets (Angelini et al., 2014). In our empirical exercise, we treat macro factors as *common* shocks to banks, and deal with them either by introducing different time-varying macro variables or with time fixed effects. Together with bank-level controls, this approach should allow us to disentangle moral hazard behavior from the alternative channels.

3 Graphical evidence: sovereign portfolios in Spain and other EMU countries

This section describes some stylized facts relating to banks' sovereign debt holdings. While our empirical exercise focuses on Spanish banks, here we present a concise description of the evolution of sovereign debt holdings for the whole EMU. This will show that some developments in Spanish banks´ sovereign portfolios, like the increase in home bias over the sample period, largely mirror dynamics in other jurisdictions, especially in *more-affected-by-the-crisis* (MAC) countries. Based on these similarities, we argue that the more formal results that we obtain in the subsequent sections of the paper using Spanish data provide conclusions that are also valid in a broader context.

We use the following data sources: balance sheet items are obtained from the Statistical Data Warehouse (SDW) of the ECB and the Bruegel database of Eurosystem lending operations developed by Pisani-Ferry and Wolff (2012), while macroeconomic and financial variables are obtained from Eurostat and Reuters. We also add a breakdown of non-domestic EMU sovereign debt holdings for each banking system. This granularity is provided by the SHSS of the ECB, an innovative and proprietary database which collects, among other, holdings of debt of different institutional sectors in each jurisdiction, including banks, at the ISIN level.

As is widely known, EMU banks augmented their holdings of domestic sovereign bonds following the financial crisis (figure 1). The increase was more pronounced in MAC banking systems, including the Spanish one, than in *less-affected-by-the-crisis* (LAC) systems: holdings in the former more than tripled since the aftermath of the financial crisis, while the upsurge of domestic debt holdings in LAC systems was more modest.[4] In both cases, however, the tendency to accumulate domestic bonds halted at the end of 2013.

Which are the driving forces behind this re-composition of banks´ portfolios? The following figures offer initial insights founded on the theoretical discussion from the previous sections. Figure 2 displays the Return on Equity of the largest EMU banking systems as well as sovereign yields in 2012Q2, when they hit record levels in the MAC markets. The figure illustrates that profitability pressures were stronger in the MAC area at the peak of sovereign strains (higher sovereign yields, lower profitability in the banking sector), when sovereign spreads escalated sharply. On the other hand, figure 3 shows the use by banks of Eurosystem lending operations as well as their holdings of domestic sovereign debt. These two variables grew at a similar pace until the end of 2012, when compression in MAC yields sped up. Finally, figure 4 shows the evolution of GDP in MAC and LAC countries, together with holdings of domestic sovereign bonds. With activity falling across the board at critical moments, like after the advent of the financial crisis or during the period of more acute sovereign strains, banks might have needed to resort to sovereign securities to maintain the value of their asset portfolio. This link seems to be stronger in the MAC area, where activity was hit more severely.

Finally, we also analyse holdings of non-domestic bonds issued by EMU governments, differentiating between holdings of debt issued by LAC (figure 5) and MAC countries (figure 6). While holdings of LAC country bonds remained relatively stable over the sample period (apart from an uptick in the after-crisis period), holdings of MAC debt appear to be negatively

4 Countries are classified as MAC or LAC according to Altavilla et al. (2017). LAC countries are Austria, Belgium, Estonia, Finland, France, Germany, Luxembourg, Malta, The Netherlands and Slovakia. MAC countries are Cyprus, Greece, Ireland, Italy, Portugal, Slovenia and Spain.

correlated with domestic bond holdings: coinciding with the outbreak of the sovereign crisis, banks reduced their exposure to this type of debt (as domestic debt holdings augmented), while this dynamic somewhat reversed in the final years of the sample (in these years, domestic debt holdings stopped growing). This result is interesting since it shows that home bias prevailed over the incentive to gain the credit risk premium of non-domestic distressed sovereign debt, especially in MAC countries. It further suggests that confronting domestic and non-domestic debt holdings could clarify the determinants behind changes in sovereign exposures.

4 Empirical exercise

4.1 The data

Our empirical exercise aims to examine the hypotheses outlined in section 2. For this purpose, we consider quarterly observations from 2008Q1 to 2016Q4 on domestic sovereign debt holdings as well as other relevant balance sheet items of Spanish banks, together with macro-financial variables for Spain and the EMU. In this way, we formally study the determinants of debt holdings beyond the period of more acute sovereign strains, which is usually the target of the most recent literature. We also provide some rationale about why banks decide to hold domestic instead of non-domestic sovereign bonds, which will help enrich our analysis.

Our data refer to the fourteen significant institutions identified in Spain as of the end of 2016.[5] Each banking group is treated as a single unit according to its composition as of 2016Q4 to control for the intense activity of banking mergers and acquisitions in recent years.[6] This ensures that the sample covers the vast majority of banks´ assets in Spain (on average, we cover 96% of total banking assets over the sample period). For this set of banks, we obtain sovereign holdings and balance sheet items on a consolidated basis from their confidential reporting statements to Banco de España (Table 1, panel A).[7] The previous set of data is complemented with market and macro indicators obtained from Reuters and Eurostat (Table 1, panel B).

With regard to bank-level variables, we go beyond the standard controls related to size and solvency and try to capture in addition key elements of banks´ business models. This is important, since some Spanish banks are global institutions with a large set of subsidiaries and branches operating abroad, while other institutions function almost exclusively in the domestic market. International banks might be more prone to diversify their sovereign portfolios; consequently, we introduce a control related to the cross-border activity of banks. In addition, some institutions focus on the more traditional business model of taking deposits from the public and granting loans, while others are more active conducting market making services, providing credit to other banks in interbank markets or trading in the derivatives markets. The latter might be less prone to concentrating bond holdings in the domestic sovereign segment, since their greater resources might allow them to identify other profitable opportunities. Complexity, thus, should be taken on board. We do so by considering aspects like the weight of derivatives in banks' balance sheets or the prevalence of market-based versus retail sources of funding.

4.2 Moral hazard versus alternative channels

We begin with a specification that partially follows the strategy of Altavilla et al. (2017), who test the validity of the moral hazard hypothesis for a sample of European banks. Our proposed equation is as follows:

5 List of significant Spanish institutions, in alphabetical order, according to the Single Supervisory Mechanism: ABANCA Holding Financiero S.A., Banco Bilbao Vizcaya Argentaria, S.A., Banco de Sabadell, S.A., BFA Tenedora De Acciones S.A.U., Banco Mare Nostrum, S.A, Banco Santander, S.A., Banco Popular Español, S.A., Bankinter, S.A., Ibercaja Banco, S.A., Criteria Caixa S.A.U., Banco de Crédito Social Cooperativo, S.A., Kutxabank, S.A., Liberbank, S.A. and Unicaja Banco, S.A.

6 Nevertheless, we also re-estimate the main regressions without merging banks backwards in the robustness checks section.

7 The panel is unbalanced due to some data gaps on balance sheet items at the beginning of the sample.

$$Y_{it} = \alpha_i + \beta_1 WEAK_{it-1} + \beta_2 Price10Y_t + \beta_3 Price10Y_t * WEAK_{it-1} + \beta_4 CBfunding_{it} + \beta_5 CBfunding_{it} * WEAK_{it-1} + \beta_6 GDP_{t-1} + \delta X_{it-1} + \varepsilon_{it} \quad (1)$$

The dependent variable Y_{it} is the quarterly percentage change in holdings of domestic sovereign bonds of bank i in quarter t.[8] To avoid that the results are driven by outliers, we impose a cap on portfolio growth equal to 100% QoQ. WEAK is a dummy that identifies banks with a (lagged) capital Tier 1 ratio below the median value across the sample of banks on the same period (for these banks, WEAK = 1; otherwise, WEAK = 0). Price10Y is the quarterly percentage change in the price of the 10 year on-the-run Spanish government bond, with which we aim to capture the relative attractiveness of sovereign debt (lower prices increase the appeal of debt, as it becomes cheaper –yields to maturity increase in these circumstances).[9] CBfunding, on the other hand, is the quarterly variation of funding from Eurosystem lending operations, expressed as a percentage of the total assets of each bank.[10] GDP is the (lagged) annual percentage change in Gross Domestic Product and stands as our macro-financial control. Besides, the specification incorporates a vector of (lagged) bank-level variables to control for the different business models and characteristics of banks (X_{it-1}), including solvency (Tier 1 ratio and its interaction with WEAK), complexity (derivatives in the asset side of the balance sheet and the structure of liabilities of each institution- deposit, interbank, bond and the stock of net central bank funding-, divided by total assets) and international activity (exposures to other jurisdictions over total assets). Bank-fixed effects (α_i) are further included to control for unobserved heterogeneity across banks. We cluster standard errors at the bank level.

Our model allows us to test the group of hypotheses labelled previously:

I. The moral hazard proposition holds if weak banks 1) invest more in domestic sovereign debt than other institutions ($\beta_1 > 0$) and/or 2) engage in contrarian strategies, buying (selling) bonds after a drop (an increase) in debt prices, when peers do not follow such strategies, or do so but to a lesser extent ($\beta_3 < 0$, when the sum of β_2 and β_3 is also negative). Besides, moral hazard could be present if weak banks use the proceeds from central bank lending operations to invest in domestic sovereign debt, again when, ceteris paribus, stronger banks adopt a different strategy or resort to this mechanism less intensively ($\beta_5 > 0$, if the sum of β_4 and β_5 is also positive). The key behind this channel is that weak banks take the lead in capturing the credit spread embedded in sovereign bonds.

II. Set of non-moral hazard hypotheses. Banks follow contrarian or opportunistic strategies but the moral hazard proposition does not hold when $\beta_2 < 0$ and β_3 is non-negative. Non-moral hazard strategies might also be present (including, but not only, opportunistic behavior) if the relationship between holdings of debt and funding from the central bank is positive for the whole banking system ($\beta_4 > 0$).[11] To alleviate potential moral hazard concerns, β_5 should be non-positive. In sum,

8 Holdings of (distressed) domestic sovereign bonds are particularly suitable for testing moral hazard behavior. In the good states in which macro conditions improve, banks' balance sheets benefit from a "double dividend": not only sovereign spreads abate but also the level of non-performing loans. In the bad scenario, banks are hit by the double blow of impaired sovereign debt holdings and higher non-performing loans. The contending outcomes show that domestic sovereign debt is more likely to be the target of risk-shifting strategies (Crosignani, 2017).

9 Price changes obtained by multiplying yield changes in the benchmark security times its duration.

10 We use consolidated data on central bank funding as a proxy for funds drawn from Eurosystem lending operations. Central bank funding is adjusted for deposits made with central banks.

11 In the sample period, yields of Spanish sovereign bonds at any maturity over two years have been generally higher than the cost of drawing funds from main Eurosystem lending operations. Thus, banks had the possibility of engaging in carry trades, capturing the spread between the yield of Spanish bonds and the funding costs of repo operations.

for this hypothesis to hold undercapitalized banks should be at most replicating the strategies of stronger/well-capitalized institutions.

Finally, banks are expected to increase sovereign exposures during downturns in the business cycle. The condition is satisfied when the coefficient associated with our macro control (changes in GDP) is negative: $\beta_6 < 0$.

4.2.1 RESULTS

Table 2 tests the previous hypotheses. Column 1 displays the estimated coefficient associated with WEAK (β_1). The estimate is not significantly different from zero, which suggests that purchases of sovereign debt do not depend on banks´ capital.[12]

Column 2 adds the estimates of the coefficients for Price10Y (β_2) and for the interaction between WEAK and Price10Y (β_3), as well as the estimates of the coefficients linked to CBfunding (β_4) and to the interaction between the latter variable and WEAK (β_5). The first two estimates (β_2 and β_3) are far from significant at the standard confidence levels, which implies that banks, including those defined as WEAK, did not leverage on falling prices in government debt to expand their sovereign portfolios.[13] In contrast, funding from central banks retains a significant role in explaining changes in debt holdings: the estimate of β_4 is positive and highly significant. Of course, the immediate question is whether the moral hazard hypothesis could hold, namely if poorly capitalized banks made a more intense use of the former mechanism. The answer from the regression to this question is *no*: we find that the estimate of β_5 is not significant at the relevant confidence levels.

Column 3 includes the full set of variables as well as the estimate of β_6, the coefficient associated with our macro control (GDP). The estimate is negative and largely significant.

Taken together, macro-financial conditions and central bank liquidity have played a role in redrawing sovereign portfolios of Spanish banks. For now, we remain silent on whether the latter relationship (central bank funding-sovereign exposures) is driven by opportunistic strategies or whether other motivations apply (we will revisit this issue later on).[14] Finally, evidence on moral hazard is absent.

4.2.2 IS FINANCIAL FRAGMENTATION A DRIVER OF DOMESTIC BOND PURCHASES?

Financial fragmentation in a monetary union ultimately relates to the risk of redenomination, or the risk of a change in the currency in which assets (including holdings of sovereign debt) and liabilities of banks are denominated. If the risk materializes, assets issued under national law would presumably be converted to the new *national* currency, which in turn might create currency mismatches between the two sides of banks´ balance sheets. Thus, when the risk of redenomination is substantial, banks have a strong incentive to tilt the sovereign portfolio towards domestic bonds (Angelini et al., 2014). Importantly, this motivation might also exist even when the risk of a currency conversion is not imminent, but financial fragmentation remains a concern. For instance, in a scenario of low conversion risk, the presence of non-negligible interest rate differentials across EMU markets, a symptom of financial fragmentation,

12 Besides, neither the estimate of the coefficient of T1 nor the estimate of the coefficient of the interaction between WEAK and T1 are statistically significant.

13 This result is robust to different metrics, including price changes in the 5 year benchmark or the level of sovereign spreads at different maturities (not reported).

14 We also find that the estimate of bond funding (bank-level control) is positive and significant in columns 1 and 2. This could be related to the mechanics of repo operations with the Eurosystem, which allowed banks to post retained bonds as collateral to obtain liquidity. The significance of the coefficient, however, vanishes when we control for macro factors.

translates into a myriad of banks´ funding costs at the country level. This might condition the allocation of sovereign portfolios between domestic and non-domestic debt. In particular, banks based in *higher-yielding* markets might be more prone to bias their sovereign portfolios towards domestic bonds because, given their funding costs, this set of bonds offers better *ex ante* returns than the alternative of investing in *lower-yielding*, non-domestic sovereign debt.

We introduce a new variable, Fragmentation, to assess the impact of financial fragmentation in EMU markets on holdings of domestic sovereign debt. Fragmentation is derived from a synthetic measure developed by the ECB (see ECB, 2018; and Hoffmann et al., 2016), which collects data on prices of instruments issued in different market segments (money, bond, equity and banking markets) of each EMU country. Following a predefined methodology, the ECB computes measures of prices dispersion across jurisdictions. On the assumption that higher (lower) values of prices dispersion of (in theory) *very similar financial assets* signal less (more) financial integration, the ECB develops an index bounded between cero and one. Our derived variable is designed to be close to one when financial fragmentation is high, and near zero when financial fragmentation recedes.[15] Figure 7 shows the historical evolution of this fragmentation proxy over the sample period. As expected, this measure deteriorated in the aftermath of the financial crisis and particularly at the height of the sovereign crisis. Later, it recovered in parallel to the stabilization of EMU sovereign markets.

In column 4 of Table 2, we replace GDP with the new variable, Fragmentation. To deal with endogeneity concerns, the estimation is conducted using the first lag of this variable. The estimate of the coefficient associated with Fragmentation is statistically significant and positive, which implies that when financial fragmentation augments, banks buy domestic sovereign bonds. This supports the intuitive idea that financial fragmentation in EMU, including fears of a break-up of the euro, increases the propensity to hold domestic bonds in banks´ portfolios. Apart from this outcome, regression results are fairly aligned with those of previous specifications.[16]

4.2.3 UPSURGE OF SOVEREIGN EXPOSURES DURING THE V-LTRO PERIOD AND DRIVERS

The two very long-term refinancing operations (V-LTRO) conducted by the Eurosystem in 2011Q4 and 2012Q1 respectively, in which banks had access to ample central bank liquidity at very favorable conditions,[17] provide a very interesting natural experiment to test our set of hypotheses (in our sample of banks, domestic debt holdings increased 22%QoQ in this period). Coinciding with these operations, sovereign spreads in EMU MAC markets hit record levels. How did these elements condition banks´ portfolio choices? Did any moral hazard mechanism pop up in the V-LTRO period?

The regression results shown in Table 3 address these questions. The new group of regressions are an extended version of equation (1), in which we complement the variable CBfunding with different sets of dummies. In particular, in column 1 we introduce a dummy equal to 1 in 2011Q4 and 2012Q1 (LTRO), when the two V-LTRO were held, and zero otherwise; in column 2, we introduce a dummy equal to 1 only in 2011Q4 (LTRO-1); in column 3, the dummy is equal to 1 only in 2012Q1 (LTRO-2). All specifications include the interaction

15 The ECB´s index is also bounded between 0 and 1, but close to one values signal high financial integration in EMU markets (and close to zero values poor integration). To interpret the index as a measure of financial fragmentation, we use the following expression: Fragmentation = 1 – x, where x is the value of the ECB´s index.

16 When we jointly estimate the coefficients of GDP and Fragmentation (not reported), we find that the latter is not statistically significant. This could be due to the correlation between the two variables. The Spanish crisis evolved in parallel to the rise in fragmentation risks. This makes it very difficult to disentangle the two effects using Spanish data only.

17 The maturity of the two operations was three years (with an option of early repayment after one year). The interest rate was set at the average rate of the main refinancing operations over the life of each liquidity injection.

of the corresponding "LTRO" dummy with WEAK. Column 4 further adds the interactions between LTRO-2, CBfunding and WEAK.

The former statistical relationships found in Table 2 still hold: in all regressions, the relationship between new central bank funding (CBfunding) and changes in debt holdings continues to be significant and positive, and the point estimate is similar to the obtained in preceding specifications. On the other hand, the effect of macro conditions (GDP) on debt holdings remains large and negative, as expected.

With regard to the new coefficients, we find that the estimates of the slopes of the "LTRO" dummies are always significant and positive except for the specification of column 2 (LTRO-1). This result is consistent with the idea that banks dealt with each liquidity injection differently, and that the "upload" of sovereign portfolios was more substantial during the second operation.[18] Hence, LTRO-2 is more interesting for our exercise. In this respect, in column 3 we find that the estimate of the interaction between LTRO-2 and WEAK is negative and significant, which implies that weak banks took less advantage (and, consequently, strong banks took more advantage) of the second operation to increase their domestic sovereign exposures. This estimate, however, is no longer significant in the extended specification of column 4. Besides, in the latter regression we find that the estimates of the coefficients linked to the set of interactions between CBfunding, LTRO-2 and WEAK are not statistically different from zero.

We think that these results do not support the moral hazard hypothesis for different reasons. To begin with, they show once again that weak institutions did not take the lead in exploiting cheap official funding to enlarge sovereign holdings, even when the V-LTRO operations were conducted. In a similar vein, it is also noteworthy that the *propensity* to buy sovereign bonds funded through central bank money did not change during the V-LTRO period: according to our estimations, the coefficient on CBfunding, which captures this *propensity*, remained invariant in this period (no explanatory power of the interaction between CBfunding and LTRO-2). Besides, the estimated coefficient is not statistically different for weak and strong banks (the interaction between LTRO-2, CBfunding and WEAK does not explain changes in debt holdings). This latter result is important: if moral hazard mechanisms were at play during the V-LTRO period, one would expect undercapitalized banks to have increased the proportion of central bank liquidity dedicated to buy sovereign debt. This did not happen, though.

Another interesting conclusion from our results is that the link central bank liquidity/LTRO-sovereign holdings cannot be mechanically associated with the emergence of carry trade strategies : given that the two V-LTRO were aimed at supporting the adequate transmission of monetary policy, i.e. "to maintain the appropriate credit supply to households and firms, to ultimately guarantee price stability" (Praet, 2012), the expansion of sovereign portfolios against a backdrop of ample official liquidity can be seen as an expected effect of monetary policy to alleviate tensions in EMU financial markets, including the sovereign segment, and cope with deflationary pressures. This does not rule out the presence of *opportunistic* motivations in the composition of sovereign portfolios, but demonstrates, as stated in section 2, that this channel is closely intertwined with monetary policy interventions, which should further alleviate moral hazard concerns.

18 This is aligned with evidence found by Fonseca et al., (2015) for Portuguese banks. The authors argue that banks had only two weeks to "prepare" the first V-LTRO in 2011Q4 and, as a result, during this operation many institutions merely roll over short-term central bank funding into V-LTRO "funding". The second operation was conducted at the end of 2012Q1. At that moment, banks could gather more collateral. As a result, the uptake of the second V-LTRO was higher and its allocation to sovereign bonds purchases was also more pronounced.

4.3 Distressed institutions and sovereign holdings

We look further into the moral hazard hypothesis by exploring the behavior of distressed banks. We define an institution in distress as a weakly capitalized bank whose productive resources (portfolio of loans) have a poor quality. In practical terms, this definition is operationalized by defining banks in distress as those with a high level of non-performing exposures. Of course, this reflects bad past decisions (i.e.: banks in distress may have granted low-quality loans in the past), but might also indicate that the set of investment/lending opportunities of the bank has narrowed down (i.e.: their traditional clients have been severely impacted by the economic crisis). In this context, these banks may not be able to find new solvent borrowers in their market niche. With this in mind, rising sovereign exposures in distressed institutions can be seen as the result of two contending forces:

I. *Gambling for resurrection*. Distressed banks invest in zero-risk weight, higher-yielding sovereign debt in a "desperate" attempt to make sufficient profits to avoid a default (Acharya and Steffen, 2015). We note that gambling for resurrection is similar to moral hazard: when distressed banks buy strained sovereign debt, risk-shifting from shareholders to creditors could occur. However, it differs from pure moral hazard motivations since distressed institutions would view buying sovereign debt as (almost) the *only* highly profitable, non-capital consuming investment alternative to bet on their resurrection.

II. *Demand-side view*. Poor overall (macro) and business (micro) conditions completely dominate portfolio strategies of distressed institutions. They gain exposure to the sovereign market because few profitable alternatives, if any, remain at their disposal (in risk-adjusted terms). There is no bet on sovereign debt, but simply a profit maximizing strategy in an environment in which the traditional business of distressed banks is no longer profitable.

The next equation aims to identify the behavior of distressed institutions. For this purpose, we add time fixed effects to equation (1), which make macro factors and conditions in the sovereign market (Price10Y) redundant, and incorporate the new variables related to banks' assets quality.

$$Y_{it} = \alpha_i + \gamma_t + \beta_1 WEAK_{it-1} + \beta_2 NPLbank_{it-1} + \beta_3 NPLbank_{it-1} * WEAK_{it-1} + \beta_4 CBfunding_{it} + \beta_5 CBfunding_{it} * WEAK_{it-1} + \delta X_{it-1} + \varepsilon_{it} \quad (2)$$

The dependent variable is again the quarterly percentage change in holdings of domestic sovereign debt (Y_{it}), trimmed at 100% QoQ. In the right-hand side of the equation, WEAK and CBfunding are the same variables as in equation (1), while NPLbank is the difference between the non-performing loans ratio (NPL) of each bank at time t-1 minus the average NPL ratio of our sample of banks, also at t-1.[19] The specification includes the same vector of bank-level controls of the previous equation (X_{it-1}), as well as bank-fixed effects (α_i) and time-fixed effects (γ_t). Standard errors are clustered at the bank level.

The coefficient of interest now is β_3. Distressed banks are institutions identified by the interaction of the WEAK dummy with high NPLbank values.[20] If these institutions increase

19 We cover doubtful loans in Spain on a consolidated basis.

20 The simpler NPL ratio is also a valid proxy for the quality of the credit portfolio of each bank, but is sensitive to downturns in the business cycle: NPL ratios tend to be high when economic conditions deteriorate, even for profitable or "good" banks. An additional criterion is thus needed to distinguish between "good" and "bad", less profitable institutions. NPLbank does so by comparing NPL ratios across banks.

ceteris paribus their sovereign exposures more than other (non-distressed) institutions, then the estimate of β_3 should be positive and significant.

We show the results for this specification in columns 1 to 3 of Table 4. The estimates of β_1 and β_2 are not statistically significant, which suggests that sovereign portfolios are neither affected by the level of capital of banks (no moral hazard) nor by NPLbank when considered in isolation. However, the interaction between the two variables has explanatory power: the estimation of β_3 is statistically significant and positive in column 2, and also in column 3 in which we introduce CBfunding and its interaction with WEAK (baseline specification). This result confirms the positive statistical link between banks in distress and domestic sovereign bond holdings.

Is this evidence consistent with gambling for resurrection? We cannot assess whether distressed banks *actively* bet on distressed sovereign debt or whether they buy it as a result of portfolio constraints, since both alternatives are observationally equivalent in equation (2). This is true despite the fact that our regression controls for macro effects that are common to all banks in each quarter (through time fixed effects). It could be the case that macro shocks have impacted banks differently (at the micro level). For instance, some distressed institutions might be operating in geographical areas in which the economic crisis has been more severe. Since we do not capture this element in our specification, the door remains open for the demand-side view narrative. To shed further light, we revisit this discussion using non-domestic sovereign exposures in subsection 4.D.

In addition, we also find that the estimate of β_4 is significant and positive (column 3), which confirms the explanatory power of the channel linked to the availability of central bank funding. Besides, and contrary to specifications in previous sections, the estimate of the coefficient associated with the interaction between CBfunding and WEAK (β_5) is now significant and negative, which would imply that strong (weak) banks *benefited more* (less) from new central bank funding to expand their sovereign portfolios. The last result is, nevertheless, not robust to alternative specifications, as we will show immediately.

4.3.1 DO THESE RESULTS HOLD FOR DIFFERENT CALIBRATIONS OF "WEAK"?

Hitherto, we have considered a weak bank (WEAK=1) as a bank with capital below the median value of the Tier 1 ratio of our set of banks in t-1. However, banks within this group could behave in a different manner, i.e. sovereign portfolios of *slightly* undercapitalized banks do not necessarily move in tandem with portfolios of *heavily* undercapitalized banks as moral hazard/gambling for resurrection motivations might be stronger in the second group. To check this possibility, we re-estimate equation (2) considering different variations of the variable WEAK. In particular, we replace WEAK in each equation with dummies that take the value of 1 for banks with capital levels in the preceding period below the 40th, 35th, 30th and 25th percentile values of the T1 of the system.

Columns 4 to 7 of Table 4 show the new results for each calibration of WEAK. We find further evidence in favor of the relationship distressed institutions-sovereign holdings: the estimates of the coefficient associated with the interaction between WEAK and NPLbank are highly significant and positive. Once again, regardless of the WEAK measure employed, we do not find evidence of moral hazard motivations, as estimations of the WEAK coefficients are all far from significant.

Lastly, the link between central bank funding and sovereign debt holdings remains present. Moreover, we find that this relationship is identical for all institutions, i.e. both for undercapitalized and well-capitalized banks (the estimates of the coefficients linked to the interaction between CBfunding and the different calibrations of WEAK are not significant), which is consistent with the outcome of section 4.B.1. An open question is whether the link between central bank liquidity and bond purchases can be entirely attributed to opportunistic strategies or if different motivations apply. The next section offers evidence in this respect.

4.4 Breakdown of sovereign portfolios: holdings of domestic and non-domestic sovereign debt

So far, we have focused on which drivers explain changes in banks´ portfolios exclusively formed by *domestic* sovereign bonds. However, we can extend our analysis by considering holdings of debt issued by *other governments in EMU* to address the issue of home bias. In particular, banks´ propensity to hold domestic versus non-domestic sovereign debt could shed light on whether moral suasion mechanisms have played a relevant role. Under moral suasion, the government would have been able to push banks towards holding more domestic sovereign debt (De Marco and Macchiavelli, 2016). At the same time, the analysis of the composition of sovereign portfolios should serve us to double check the validity of some of the channels we have already examined, and to offer new insights into some of them. Specifically, we propose the next equation:

$$Y_{it} = \alpha_i + \beta_1 Fragmentation_{t-1} + \beta_2 WEAK_{it-1} + \beta_3 Size_{it-1} + \beta_4 CROSS_{it-1} + \delta Z_{it-1} + \varepsilon_{it} \quad (3)$$

The dependent variable (Y_{it}) is one of the following ratios of bank i in quarter t:

- *Ratio 1* is the ratio of holdings of Spanish government bonds to the entire portfolio of sovereign debt;
- *Ratio 2* is the ratio of holdings of Spanish government bonds to holdings of all MAC government debt, *including* Spanish bonds in the denominator.
- *Ratio 3* is the ratio of holdings of Spanish government bonds to a portfolio formed by these bonds and LAC government debt.
- *Ratio* 4, finally, is the ratio of holdings of MAC government debt, *excluding* Spanish government debt, to holdings of bonds issued by all non-domestic EMU governments.

The first three ratios are different *home concentration* measures.[21] Ratio 4 refers to the concentration of debt holdings in non-domestic, high-yield (EMU) sovereign securities.[22] In the right-hand side of the equation, Fragmentation and WEAK are the same variables as before. In addition, we have split the vector of (lagged) bank-level controls of equations (1) and (2) into three components: Size, which is the natural logarithm of banks´ total assets, CROSS, which is banks´ cross-border and domestic exposures to other jurisdictions divided by total assets,[23] and Z_{it-1}, containing the rest of bank-level variables. We do this because we think that Size and CROSS might be determinant to explain the composition of cross-border sovereign portfolios. The specification further includes bank-fixed effects (α_i), while standard errors are clustered at the bank level.

21 We prefer the term home concentration instead of the term home bias because the latter implies that there is a natural or equilibrium level for home sovereign holdings, which we do not estimate.

22 MAC government debt represents any exposure of banks to liabilities of governments in Italy, Portugal, Greece and Ireland. LAC country government debt is any exposure to liabilities of governments in Germany, France, The Netherlands, Belgium, Austria and Finland.

23 We have dropped exposures to the public sector from CROSS to deal with potential endogeneity concerns.

The model is suitable for testing different hypothesis, in which we include a novel channel, *moral suasion*:

I. *Impact of financial fragmentation*. Financial fragmentation shocks were already tested in section 4.B.2 using a different approach, so results reported here can be deemed as complementary to the preceding analysis. When financial fragmentation in EMU markets augments, banks might prefer domestic sovereign bonds (instead of bonds issued by other sovereigns) either because they want to hedge redenomination risk or because non-domestic debt does not offer an adequate "compensation" given the level of interest rates in domestic versus non-domestic jurisdictions. If this hypothesis holds, β_1 should be significant and positive whatever the home concentration measure considered (Ratio 1, Ratio 2 or Ratio 3).

II. *Novel channel: moral suasion*. If banks are exhorted by the government to hold more domestic debt, home concentration should increase. Moral suasion is likely to be more effective for weak institutions since, at the extreme, they might depend on government decisions to remain as "going concerns" (Horváth et al., 2015). If moral suasion has operated through weak banks, then these institutions should tend *more* to tilt their sovereign portfolios towards domestic bonds ($\beta_2 > 0$) *in relation to* sovereign debt with similar risk-return characteristics, i.e. debt issued by other MAC governments. Hence, the relevant dependent variable to test moral suasion is Ratio 2.

III. *Moral hazard (risk-shifting) and opportunistic behavior/reach-for-yield*. Moral hazard exists when weak banks prefer, *to a greater extent than other banks*, high-yield sovereign debt over low-yield sovereign debt. In our context, this happens when $\beta_2 > 0$ and the dependent variable is Ratio 3 or Ratio 4. We note that Ratio 3 is suitable for testing moral hazard *provided* that the moral suasion hypothesis does not hold (otherwise the empirical analysis would be confounded). Both ratios will also serve as to explore opportunistic/reach-for-yield behavior, as we will clarify now.

4.4.1 RESULTS

Table 5 summarizes our results for this section. Columns 1 to 3 of Panel A contain the set of specifications in which the dependent variable is Ratio 1. Also in Panel A, columns 4 to 6 present Ratio 2 as the dependent variable. In columns 1 to 3 of Panel B, the dependent variable is Ratio 3, while in columns 4 to 6 of this panel the dependent variable is Ratio 4. The first column in each set refers to the baseline specification. The second column adds CBfunding and time fixed-effects to enhance controls in our regressions, although this comes at the cost of making the Fragmentation variable redundant[24] (this variable does not vary in the cross-section). Finally, the third column incorporates the variable NPLbank and its interaction with WEAK to further control for the behavior of "distressed" banks.[25]

Financial fragmentation. We find that banks react to fragmentation in EMU markets by increasing the share of domestic bonds in their sovereign portfolios: the estimate of β_1 is

24 This variable does not vary in the cross-section.

25 We drop one bank from the sample because it exclusively invested in home sovereign bonds. A few observations are missed for Ratio 3 and 4. In these observations, no debt holdings are reported in the denominator. As a result, it was not possible to compute these ratios.

positive and largely significant for the three measures of home concentration, Ratio 1, Ratio 2 and Ratio 3 (columns 1 and 4 of Panel A, and column 1 of Panel B, respectively).

Moral suasion. No moral suasion mechanisms arise in the regressions: none of the estimates of β_2 in columns 4 to 6 of Panel A, in which the dependent variable is Ratio 2 (the best measure to test moral suasion), is significantly different from zero. This also applies to distressed banks, since the interaction between NPLbank and WEAK does not explain home concentration either (column 6 of Panel A).[26]

Moral hazard and opportunistic motivations/reach-for-yield. We find no signs of risk-shifting or moral hazard strategies by poorly capitalized banks, and from different angles. In columns 1 to 3 of Panel B (in which Ratio 3 is the dependent variable) and in columns 4 to 6 of the same panel (Ratio 4), the estimate of β_2 (WEAK) is not statistically significant. In columns 3 and 6 we further study whether the set of distressed banks shows a preference for higher-yielding sovereign debt, whether domestic or non-domestic. In this respect, estimates of the coefficient associated with the interaction between NPLbank and WEAK are not significant at the usual confidence bands. This result seems to reject the idea that this set of banks engaged in gambling for resurrection strategies (see last section). In any case, these results should be taken with caution given that non-domestic debt holdings constitute a minor part of total debt holdings of banks.

Our results also shed light on whether non-moral hazard strategies, particularly reach-for-yield behavior, have been at play. Reach-for-yield is understood here as in Becker and Ivashina (2015), who study preferences of U.S. insurance companies (which, like banks, are heavily regulated entities) for holding higher-yielding bonds *within the same regulatory risk category*. Since both MAC and LAC debt form part of the same (regulatory risk) category, opportunistic behavior is present if an inclination exists for the former debt type. We study this preference in connection with the use of central bank liquidity: if reach-for-yield holds, a positive statistical relationship would surge between CB funding (cheap official liquidity) and either Ratio 3, which measures home concentration over LAC debt holdings, or Ratio 4, which identifies biases towards non-domestic, higher-yielding debt. Ratio 3 is suitable for this test because we have ruled out moral suasion.

According to the outcome of our regressions, the link between central bank liquidity and MAC debt holds for Ratio 4 (estimates of the coefficient associated with CBfunding in columns 5 and 6 of Panel B are positive and significant) but is absent for Ratio 3 (see same estimates for columns 2 and 3 in the same panel). Therefore, reach-for-yield holds but seems to be constrained to the non-domestic MAC debt portfolio. This finding is interesting: banks cope with domestic and non-domestic debt of similar risk-return characteristics differently. Banks′ bets appear to be restricted to non-domestic MAC debt markets. In addition, our estimations show that opportunistic strategies are led by well-capitalized institutions: the estimate of the coefficient of the intersection between CBfunding and WEAK is significant and strongly negative (columns 5 and 6). Therefore, banks with higher risk-bearing capacity are those that take on more risk, contrary to what the moral hazard channel predicts. [27]

26 The latter result is interesting when compared to the outcome of the preceding section. Then, we demonstrated that distressed banks increase more than other banks holdings of domestic sovereign bonds. Is this a reflection of government pressure? Since these banks do not have a preference between buying home over non-home sovereign bonds with similar risk-return characteristics, moral suasion does not apply.

27 This set of results is consistent with evidence for Italian banks in Peydró et al. (2017).

Bank-level controls. With regard to bank-level controls, we find that for the first two measures of home concentration in Panel A, Ratio 1 (columns 1 to 3) and Ratio 2 (columns 4 to 6), the estimate of β_3 (coefficient of Size) is, apart from the specification in column 1, negative and significant. This means that when total assets increase banks tend to hold more diversified sovereign portfolios, i.e. less home concentration. In this respect, the estimate of β_4 (coefficient of CROSS) is not statistically significant, which suggests that the size of banks, rather than their international exposures, better captures the tendency to home concentration. In contrast, CROSS turns out to explain better the changes in the propensity to pile up non-domestic MAC versus LAC country government debt (in columns 4 to 6 of Panel B, in which Y_{it} is Ratio 4, the estimate of β_4 or the coefficient of CROSS is always positive, and significant in the first two columns), possibly due to the greater presence of some banks in MAC jurisdictions. Fragmentation, which is a control in the specification of column 4 of Panel B (Ratio 4), plays no role in this relationship (the estimate of β_1 is far from significant).

Overall, these results confirm the findings of previous sections. Importantly, they do not support the hypothesis that moral suasion mechanisms have conditioned the composition of sovereign portfolios, and further show that the link central bank liquidity-sovereign holdings cannot be mechanically associated with opportunistic or reach-for-yield behavior.[28]

28 As an additional robustness check, we have re-estimate the set of regressions in this section for different calibrations of WEAK. Our results broadly hold in the alternative specifications.

5 Extensions and further robustness checks

5.1 Did determinants of sovereign holdings change at the height of the sovereign crisis?

We assess whether the hypotheses we have identified so far changed at the height of the sovereign crisis. We check this because our sample covers a large time-span (36 quarters), which might mask temporary statistical relationships in the data, potentially more evident when sovereign strains were more pronounced. To explore this possibility, we propose the next equation:

$$Y_{it} = \alpha_i + \beta_1 WEAK_{it-1} + \beta_2 PRICE_t^y + \beta_3 PRICE_t^y * WEAK_{it-1}$$
$$+ \beta_4 CBfunding_{it} + \beta_5 CBfunding_{it} * WEAK_{it-1} + \beta_6 GDP_{t-1} + \omega_1 crisis + \omega_2 crisis * WEAK_{it-1}$$
$$+ \omega_3 crisis * PRICE_t^y + \omega_4 crisis * PRICE_t^y * WEAK_{it-1}$$
$$+ \omega_5 crisis * CBfunding_{it} + \omega_6 crisis * CBfunding_{it} * WEAK_{it-1} + \delta X_{it-1} + \varepsilon_{it} \quad (4)$$

The specification is basically an extension of equation (1). The variable PRICE is exactly the same as before, namely the contemporaneous quarterly price change in government debt, but now we will show results for the 10 year and the 5 year on the run benchmarks, represented by the superscript y. We cover the same time period/set of banks while adding a variable, crisis, which is a dummy equal to 1 from 2010Q2 to 2012Q3 and zero otherwise, and some interactions between the new dummy and other variables.[29] The starting point of the crisis dummy, 2010Q2, coincides with the first bail out of Greece, which put the MAC sovereign segment in the spotlight. The final point (2012Q3) refers to the announcement of the *Outright Monetary Transactions programme*, which marked a turning point in the EMU sovereign crisis. This period is definitively special: not only due to the existing tensions in the sovereign market, but also because of the appeal of risk-shifting strategies over these two years. At the height of the sovereign crisis, 1) sovereign spreads on Spanish government debt rocketed; 2) banks could readily access central bank funding, including funding from the two *ad hoc* V-LTRO (see also section 4.B.3); (3) in parallel, as a result of the severe economic crisis, the solvency of some institutions was eroded, making the transfer of risks from banks' shareholders to creditors more likely.

Table 6 shows the results for the estimations of equation (4).

As expected, banks' capital does not condition bond purchases, neither in "normal" times (estimates of β_1 are not statistically significant) nor during the crisis period (estimates of ω_2 are not significantly different from zero). Central bank funding and macro conditions are once more major drivers of sovereign holdings: the estimates of β_4 (CBfunding) and β_6 (GDP) are significant in all specifications, and their signs are the expected ones. Interestingly, the amount of central bank liquidity dedicated to buy sovereign bonds did not change during the crisis (estimates of ω_5 and ω_6 are not significant).

Furthermore, the advent of the crisis did not *per se* move banks to increase their holdings of sovereign bonds (estimates of ω_1 are not statistically significant), but their investment behavior somewhat shifted. In particular, we find that banks adopted contrarian strategies in the domestic sovereign market during the crisis period, buying debt when bond prices were falling, and selling it when prices were increasing/recovering (the estimate of ω_3 is

29 These specifications include the same vector of bank-level controls and bank-fixed effects of equation (1). Errors are again clustered at the bank level.

negative and significant in column 4, in which PRICE reflects price changes in the 5 year benchmark bond).[30] This was not the only driver of sovereign bond purchases: central bank liquidity and macro effects still retained a major role in this period. However, the countercyclical role played by banks over a sovereign stress episode offers interesting insights. Specifically, it shows that the interconnectedness between banks and the sovereign might provide financial stability dividends in a crisis context.[31]

Is the preceding evidence consistent with the execution of moral hazard strategies? We have argued that for the risk-shifting hypothesis to hold poorly capitalized banks should take *more* advantage of opportunistic strategies than their peers (see section 4.B). In this respect, the estimate of the coefficient associated with the interaction between PRICE, T1 and crisis (ω_4) is not significant at the relevant confidence levels. This supports the idea that weak banks did not embrace risk-shifting strategies, even during the sovereign stress episode.

5.2 Alternative proxies for solvency and results

As an additional robustness check, we re-estimate results of equations (1) and (2) considering different proxies for measuring the solvency position of banks. In particular, we replace the Tier 1 ratio of banks with three alternative measures:

- *Own funds ratio*, which covers all instruments included in the numerator of the Tier 1 and further adds Tier 2 items, divided by risk-weighted assets (RWA).
- *Leverage_1*, defined as the ratio of total assets to all Tier 1 instruments.
- *Leverage_2*, or the ratio of total assets to own funds.

For each measure, we recalibrate the WEAK dummy accordingly.[32]

Table 7 shows the results. Columns 1 to 3 show specifications of equation (1) with the new solvency measures. Columns 4 to 6 do the same for equation (2). These new results confirm once more the importance of macro-financial conditions and central bank liquidity as drivers of sovereign portfolios: gloomy economic conditions (drop in GDP) translate into an increase in sovereign holdings, while an upsurge in central bank funding (CBfunding) leads to higher debt holdings, too. On the contrary, evidence in favor of the moral hazard hypothesis is absent: the estimates of the coefficient linked to WEAK are far from significant in all regressions. Moreover, this set of specifications reveals that less capitalized institutions took little advantage of central bank funding to expand their sovereign portfolios (this relationship was less clear using the T1 as a proxy for solvency), which further rules out the moral hazard proposition. In addition, the specification of column 4 confirms that banks in distress invested more in the sovereign market: the estimate of the coefficient of the interaction between NPLbank and WEAK is positive and significant. This result, however, does not hold for Leverage_1 and Leverage_2, which might simply capture that risk-weighted capital measures do a better job at identifying distressed institutions when interacted with NPL ratios.

30 In column 3 (price changes in the 10 year benchmark security), the sign of this coefficient is also negative, but the estimate is not significant at the 10% confidence level. The negative relationship between prices and sovereign holdings goes against the hypothesis that banks generally respond in a pro-cyclical manner to price changes (Timmer, 2018).

31 Support of banks to distressed sectors seems to be not limited to the public sector. Giannetti and Saidi (2017), for instance, show that banks have a higher propensity to lend to industries in distress to which they hold large exposures.

32 For instance, for the own funds ratio, WEAK is equal to 1 if, instead of the Tier 1, the (lagged) own funds ratio of bank i falls below the median of the system in t-1; we follow a similar calibration for the rest of solvency measures.

5.3 What if being a weak bank was the norm?

All through the empirical analysis we have worked on the assumption that weak banks are banks with low capital levels when compared to the median values of the system. However, if the sample of banks is dominated by weak banks, our identification strategy would be flawed. While we do not believe that this is the case, we propose hereafter an alternative specification to deal with this issue.

In the next equation, we omit the step relative to the identification of weak banks (i.e. we drop WEAK) and directly test the moral hazard channel by linking changes in sovereign holdings with the Tier 1 ratio of banks, which was previously a bank-level control. An important drawback of this approach is that we treat any change in the Tier 1 ratio in the same way, no matter whether the absolute solvency position of the bank is strong (high level of Tier 1 capital) or weak (low level):

$$Y_{it} = \alpha_i + \beta_1 \text{Fragmentation}_{it-1} + \beta_2 T1_{it-1} + \beta_3 \text{Size}_{it-1} + \beta_4 \text{CROSS}_{it-1} + \beta_5 \text{CBfunding}_{it} + \beta_6 \text{CBfunding}_{it} * T1_{it-1} + \delta V_{it-1} + \varepsilon_{it} \quad (5)$$

The dependent variable (Y_{it}) is one of the following: (i) quarterly changes in holdings of domestic sovereign debt (in percentage), trimmed at 100% QoQ; (ii) Ratio 1; (iii) Ratio 2; (iv) Ratio 3; and (v) Ratio 4 as defined in section 4.D. Fragmentation (the common macro control for all specifications), CBfunding, Size and CROSS are known variables. The Tier 1 capital ratio (T1 for short) is included as an explanatory variable separated from the vector of bank-level controls (V_{it-1}). The equation incorporates bank-fixed effects (α_i) and standard errors are again clustered at the bank level. Table 8 shows the results for this specification, which is aligned with earlier evidence.

As expected, an increase in Fragmentation is associated with higher domestic bond holdings and stronger home concentration: the estimate of β_1 is positive and largely significant in specifications of columns 1 to 4. In contrast, the level of banks´ capital, T1, plays no role in explaining changes in sovereign debt holdings, nor leads banks to hold more domestic bonds or higher-yielding sovereign debt in detriment of other sovereign securities (the estimate of β_2 is not statistically significant across all specifications).

According to estimates in column 1, banks tend to increase their domestic sovereign debt holdings when they draw funds from the central bank (the estimate of β_5 is positive and statistically significant), in line with previous findings. This tendency seems to increase when banks´ capital augment (the estimate of β_6 is also positive and significant in this column), which suggests that when banks count on a more ample capital cushion, they are more willing to gain exposure to the domestic sovereign market. It is not clear that this is driven by reach-for-yield strategies: central bank funding does not lead to higher holdings of higher-yielding sovereign debt, either domestic or foreign (see estimates of the same coefficients in columns 3 and 4). Contrary to the outcome of section 4.D.1, this finding also applies to well-capitalized institutions.

5.4 New aggregation strategy: composition of banking groups for each date

In our regressions, we aggregate information from individual banks according to the set-up of banking groups existing as of the end of 2016. The main advantage of this approach is that it is insensitive to mergers and acquisitions activity, which has been intense in recent years. This, in turn, allows us to construct smoother long time series for each bank. A drawback of this strategy is that it results in lower bank heterogeneity, which might bias our results. In particular,

weak banks could have been those absorbed by solvent institutions. If this is the case, we would be erroneously treating these banks as well-capitalized.

To control for biases derived from the consolidation of banks as of 2016Q4, we now employ a new dataset in which we consider the original composition of banks at each date. This increases significantly the number of banks in the sample (37 institutions). Of course, this comes at the cost of several discontinuities in our time series, and a panel that becomes more unbalanced, as many institutions ceased to exist during the crisis.[33]

Table 9 shows regressions results using the new dataset. In columns 1 to 4, the dependent variable is again the quarterly growth of domestic sovereign debt (trimmed at 100% QoQ). In columns 5 to 8, we analyze home bias and the propensity to hold non-domestic MAC debt over LAC debt (in this set of regressions, the sample of banks collapses to only 23 institutions as many of them invest exclusively in domestic debt markets). Compared to the previous regressions, the connection between central bank liquidity and sovereign holdings is weaker for the set of poorly capitalized banks. The estimate of the coefficient associated with the interaction between NPLbank and WEAK is less significant, too. But apart from these results, the outcome of this set of regressions is broadly consistent with prior findings. In particular, the effect of financial fragmentation is strong across all specifications. On the other hand, no results in the new regressions validate the moral hazard behavior.

33 The dataset includes all significant institutions as well as banks that ended up being part of them. We have also included other small banks to improve the coverage of our dataset.

6 Conclusions

In this paper, we study the determinants of sovereign debt holdings of Spanish banks over a long time-span, covering the worst part of the sovereign crisis. Spain is a perfect "laboratory" for this exercise: banks had to manage their sovereign portfolios under strong profitability pressures, resulting from a deteriorated macro scenario that followed the real estate crisis and turmoil in the domestic sovereign market. On top of that, non-conventional support from the Eurosystem (e.g. low repo rates, full allotment, large-scale liquidity injections) incorporates an interesting dimension to our setting.

Our analysis yields several interesting results. First, we do not find evidence of *moral hazard*, since weakly capitalized banks were not associated with higher (distressed) sovereign holdings. Undercapitalized banks did not take advantage of depressed market conditions (low prices in sovereign debt) to gain exposure to this market segment, either. Besides, we do not find evidence supporting the view that weaker banks were *persuaded* to hold domestic sovereign debt in detriment of other sovereign securities or even credit to the private sector (no *moral suasion*).

Second, the link between central bank liquidity and holdings of sovereign debt is positive and strong. This might give the impression that banks engaged in carry trade/reach-for-yield strategies. We see this narrative as incomplete. Without neglecting the possibility that opportunistic motivations played a role, we show that the upload of sovereign holdings is associated with exogenous monetary policy interventions like V-LTRO liquidity injections. Moreover, when we compare the propensity to hold higher-yielding versus lower-yielding sovereign debt, we fail to find a clear preference for the former debt type. While reach-for-yield could have operated in non-domestic MAC debt portfolios, evidence is far from conclusive and, importantly, limited to the group of more strongly capitalized and larger institutions. These institutions should have a higher *risk-bearing capacity*. In addition, some of them have a stronger presence in foreign markets, which may explain this strategy in the context of their operations in host countries.

Finally, we show that macro conditions play an important role in sovereign holdings. In this same vein, we find that financial fragmentation in EMU markets (a measure of price dispersion across countries of *in theory* very similar assets) was a strong driver of home concentration (i.e. propensity to hold domestic bonds instead of non-domestic debt in sovereign portfolios). We think that this supports the hypothesis that banks re-nationalized sovereign portfolios at the height of the sovereign crisis as a means of hedging against an EMU-break up. Furthermore, since financial fragmentation still remains a concern in EMU (although less acute than during the sovereign crisis), its effects are likely to reach sovereign portfolios today.

Our research has important policy implications. The Basel Committee on Banking supervision has recently published a discussion paper for a potential revision of the current treatment of sovereign exposures, which currently assigns a zero risk weight to domestic exposures (BCBS, 2018). In this sense, the counter-cyclical role that banks appeared to play at the height of the crisis (buying debt at times of stress) adds an interesting perspective to the discussion on the so-called nexus between sovereign risk and bank credit risk. Some commentators believe that large sovereign exposures strengthen the loop. However, the evidence from this paper shows that support from banks could stabilize sovereign markets at critical moments.

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Table 1. Descriptive statistics

Panel A. Bank-level variables

	mean	sd	p25	p75
Holdings of domestic sovereign debt (% of total assets)	9.6	8.0	5.4	10.9
growth rate, QoQ (%)	6.2	36.2	-5.9	10.9
Home bonds / Total sovereign bonds, %	89.6	11.8	83.4	98.3
Home bonds / (Home bonds and non-local MAC bonds), %	92.6	9.9	89.9	99.5
Home bonds / (Home bonds and LAC bonds), %	96.2	6.9	94.4	100.0
Non-local MAC bonds / (Non-local MAC and LAC bonds), %	71.3	33.7	48.0	100.0
Assets (EUR billion)	237.0	319.0	57.2	310.0
Cross_claims (% of total assets)	13.5	19.1	2.5	11.3
Interbank funding (% of total assets)	6.6	3.2	3.9	9.1
Deposit funding (% of total assets)	58.8	11.4	48.6	69.1
Use of derivatives (% of total assets)	0.018	0.026	0.001	0.020
Bond funding (% of total assets)	12.1	7.4	6.5	17.0
Central bank funding (% of total assets)	5.1	5.3	1.6	8.1
quarterly variation (% of total assets)	0.1	2.0	-0.7	0.9
Tier 1 capital ratio (% of risk-weighted assets)	10.3	2.1	8.9	11.7
NPL ratio (% of total loans; only loans in Spain)	8.9	5.2	4.9	12.0

Panel B. Macro-financial variables

	mean	sd	p25	p75
Domestic sovereign debt, price changes (QoQ, %)	0.6	4.3	-1.3	3.5
GDP growth (YoY, %)	0.0	2.5	-2.2	2.5
Fragmentation index	0.6	0.1	0.5	0.7

Panel A shows characteristics of our set of banks, i.e. the fourteen significant institutions identified in Spain as of the end of 2016Q4, including their sovereign portfolios. All data in Panel A are obtained on a consolidated basis. Home bonds refer to holdings of domestic sovereign debt. Non-domestic MAC bonds refer to exposures to liabilities of a set of EMU *more affected by the crisis* governments, excluding the Spanish public sector (domestic market): Italy, Portugal, Greece and Ireland. LAC country bonds represent exposures to liabilities of a set of EMU *less affected by the crisis* governments: Germany, France, The Netherlands, Belgium, Austria and Finland. Cross_claims are international exposures divided by total assets and include not only international claims (cross-border claims or domestic claims in foreign currency), but also domestic claims in domestic currency. Use of derivatives refers to the weight of trading derivatives registered in the assets side of banks´ balance sheets. Central bank funding is adjusted for assets (deposits) against the central bank. The NPL ratio is the ratio of non-performing loans to total loans.

In Panel B, Domestic sovereign debt, price changes (QoQ, %) refer to the quarterly price changes in the 10 year on the run Spanish government bond. GDP growth, YoY (%) is the yearly percentage change in GDP. Finally, Fragmentation index is derived from an index developed by ECB staff (2018) and bounded between 0 and 1. It measures financial fragmentation in EMU markets.

Table 2. Moral hazard versus alternative channels

	(1)	(2)	(3)	(4)
WEAK	-15.68	-19.29	-15.02	-18.88
	(22.65)	(21.28)	(20.08)	(20.39)
PRICE10Y		-0.200	-0.227	-0.191
		(0.575)	(0.557)	(0.561)
PRICE10Y x WEAK		0.257	0.260	0.246
		(0.526)	(0.522)	(0.524)
CBfunding		3.387***	3.299***	3.277***
		(0.593)	(0.609)	(0.603)
CBfunding x WEAK		-1.692	-1.682	-1.701
		(1.199)	(1.233)	(1.213)
GDP			-1.228***	
			(0.398)	
Fragmentation				14.12**
				(5.323)
Observations	500	500	500	500
Bank controls	Y	Y	Y	Y
Bank fixed effects	Y	Y	Y	Y
Time fixed effects	N	N	N	N
Number of banks	14	14	14	14
Overall R^2	0.028	0.041	0.035	0.035

Robust standard errors are shown in parentheses and are clustered at the bank level: * p<0.10, ** p<0.05, *** p<0.01

The table studies the determinants of holdings of domestic sovereign bonds. Our sample consists of the fourteen significant banks identified in Spain as of the end of 2016Q4. We cover the period from 2008Q1 to 2016Q4 on a quarterly basis. The dependent variable is the quarterly percentage change in holdings of domestic sovereign bonds of each bank (holdings trimmed at 100% QoQ to avoid outliers). WEAK is a dummy equal to one when a bank has, in the preceding quarter, a Tier 1 capital ratio (T1) below the median value of the T1 of our sample of banks, and it is zero otherwise. PRICE10Y is the quarterly percentage change in the price of the 10 year on the run Spanish government bond. CBfunding is the quarterly variation of funding from the central bank (adjusted for assets against this institution) divided by total assets. GDP is the lagged yearly percentage change in GDP. Fragmentation is the first lag of a financial fragmentation measure derived from an index for EMU markets developed by the ECB (the index is bounded between zero and one; when close to one, financial fragmentation rises). The specification incorporates a vector of (lagged) bank-level variables to control for characteristics of banks, including size (natural logarithm of total assets), international activity (exposures to other jurisdictions over total assets) and complexity (use of derivatives and the structure of liabilities of each institution- deposit, interbank, bond and the stock of central bank funding-, divided by total assets). Estimates of coefficients of bank-level controls are omitted in the table. At this respect, the estimate of the coefficient of Bond funding is statistically significant and positive in columns 1 (**) and 2 (*). No other estimates are statistically different from zero. The specification includes bank-fixed effects.

Table 3. Upsurge of sovereign exposures during the V-LTRO period and drivers

	(1)	(2)	(3)	(4)
WEAK	-14.60	-15.39	-14.97	-15.41
	(20.11)	(20.47)	(19.88)	(20.07)
PRICE10Y	-0.243	-0.219	-0.213	-0.210
	(0.563)	(0.562)	(0.550)	(0.550)
PRICE10Y x WEAK	0.270	0.246	0.262	0.261
	(0.525)	(0.529)	(0.512)	(0.516)
CBfunding	2.536**	3.399***	2.310**	2.372***
	(0.927)	(0.738)	(0.781)	(0.772)
CBfunding x WEAK	-1.101	-1.871	-0.803	-0.823
	(1.638)	(1.319)	(1.507)	(1.582)
GDP	-1.119**	-1.227***	-1.128**	-1.118**
	(0.407)	(0.393)	(0.423)	(0.422)
LTRO	13.55*			
	(6.889)			
LTRO x WEAK	-8.978			
	(8.905)			
LTRO-1		-4.341		
		(8.751)		
LTRO-1 x WEAK		8.340		
		(11.09)		
LTRO-2			28.15***	36.87**
			(5.772)	(14.77)
LTRO-2 x WEAK			-24.30*	-29.88
			(11.46)	(23.10)
LTRO-2 x CBfunding				-1.880
				(3.205)
LTRO-2 x CBfunding x WEAK				0.901
				(5.731)
Observations	500	500	500	500
Bank controls	Y	Y	Y	Y
Bank fixed effects	Y	Y	Y	Y
Time fixed effects	N	N	N	N
Number of banks	14	14	14	14
Overall R^2	0.036	0.036	0.041	0.040

Robust standard errors are shown in parentheses and are clustered at the bank level: * p<0.10, ** p<0.05, *** p<0.01

The table studies the determinants of holdings of domestic sovereign bonds during the period in which the Eurosystem conducted the first two very long-term refinancing operations (V-LTRO), in 2011Q4 and 2012Q1. Our sample consists of the fourteen significant banks identified in Spain as of the end of 2016Q4. We cover the period from 2008Q1 to 2016Q4 on a quarterly basis. The dependent variable is the quarterly percentage change in holdings of domestic sovereign bonds of each bank (holdings trimmed at 100% QoQ to avoid outliers). WEAK is a dummy equal to one when a bank has, in the preceding quarter, a Tier 1 capital ratio (T1) below the median value of the T1 of our sample of banks, and it is zero otherwise. PRICE10Y is the quarterly percentage change in the price of the 10 year on the run Spanish government bond. CBfunding is the quarterly variation of funding from the central bank (adjusted for assets against this institution) divided by total assets. GDP is the lagged yearly percentage change in GDP. LTRO is a dummy equal to 1 in 2011Q4 and 2012Q1 (LTRO);

LTRO-1 is a dummy equal to 1 only in 2011Q4; LTRO-2 is a dummy equal to 1 only in 2012Q1 (LTRO-2). The specification incorporates a vector of (lagged) bank-level variables to control for characteristics of banks, including size (natural logarithm of total assets), international activity (exposures to other jurisdictions over total assets) and complexity (use of derivatives and the structure of liabilities of each institution- deposit, interbank, bond and the stock of central bank funding-, divided by total assets). Estimates of coefficients of bank-level controls are omitted in the table. At this respect, the estimate of the coefficient of Bond funding is statistically significant and positive in column 2 (*). No other estimates are statistically different from zero. The specification includes bank-fixed effects.

Table 4. Distressed institutions and sovereign holdings

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
WEAK	-11.93	-11.06	-10.29				
	(24.99)	(24.68)	(23.43)				
NPLbank	-0.102	-0.313	-0.441	-0.389	-0.501	-0.500	-0.320
	(0.480)	(0.405)	(0.384)	(0.364)	(0.420)	(0.420)	(0.383)
NPLbank x WEAK		0.466*	0.538**				
		(0.244)	(0.215)				
CBfunding			2.334***	1.535**	1.599**	1.597**	1.546
			(0.692)	(0.617)	(0.669)	(0.674)	(0.910)
CBfunding x WEAK			-1.900*				
			(1.013)				
WEAK40				-12.50			
				(13.08)			
NPLbank x WEAK40				0.728*			
				(0.338)			
CBfunding x WEAK40				-0.587			
				(1.276)			
WEAK35					-5.628		
					(12.04)		
NPLbank x WEAK35					1.352***		
					(0.374)		
CBfunding x WEAK35					-0.930		
					(1.011)		
WEAK30						-6.255	
						(12.19)	
NPLbank x WEAK30						1.353***	
						(0.374)	
CBfunding x WEAK30						-0.920	
						(1.017)	
WEAK25							-7.216
							(9.431)
NPLbank x WEAK25							0.989**
							(0.386)
CBfunding x WEAK25							-1.188
							(1.191)
Observations	500	500	500	500	500	500	500
Bank controls	Y	Y	Y	Y	Y	Y	Y
Bank fixed effects	Y	Y	Y	Y	Y	Y	Y
Time fixed effects	Y	Y	Y	Y	Y	Y	Y
Number of banks	14	14	14	14	14	14	14
Overall R^2	0.167	0.170	0.148	0.176	0.189	0.189	0.185

Robust standard errors are shown in parentheses and are clustered at the bank level: * p<0.10, ** p<0.05, *** p<0.01

The table explores drivers behind the composition of sovereign portfolios of distressed banks. Our sample consists of the fourteen significant banks identified in Spain as of the end of 2016Q4. We cover the period from 2008Q1 to 2016Q4 on a quarterly basis. The dependent variable is the quarterly percentage change in holdings of domestic sovereign bonds of each bank (holdings trimmed at 100% QoQ to avoid outliers). WEAK is a dummy equal to one when a bank has, in the preceding quarter, a Tier 1 capital ratio (T1) below the median value of the T1 of our sample of banks, and it is zero otherwise. WEAK40, WEAK35, WEAK30 and WEAK25, in turn, identify banks with T1 below 40th, 35th, 30th and 25th percentile values in

the preceding quarter. NPLbank is the lagged difference between the non-performing loans ratio (NPL) of each bank (considering only its business activities in Spain) minus the average NPL of the whole banking system at time t-1. CBfunding is the quarterly variation of funding from the central bank (adjusted for assets against this institution) divided by total assets. The specification incorporates a vector of (lagged) bank-level variables to control for characteristics of banks, including size (natural logarithm of total assets), international activity (exposures to other jurisdictions over total assets) and complexity (use of derivatives and the structure of liabilities of each institution- deposit, interbank, bond and the stock of central bank funding-, divided by total assets). Estimates of coefficients of bank-level controls are omitted in the table and they are not statistically different from zero. The specification includes bank-fixed effects and time-fixed effects.

Table 5. Breakdown of sovereign portfolios: domestic and non-domestic sovereign debt

Panel A. Tests for financial fragmentation and moral suasion channels

Dependent variable	Ratio1: Home bonds to total bonds			Ratio 2: Home bonds to (home bonds + non-local MAC bonds)		
	(1)	(2)	(3)	(4)	(5)	(6)
Fragmentation	29.65***			23.29**		
	(8.994)			(8.673)		
WEAK	-12.42	-7.916	-8.089	-13.62	-9.770	-10.02
	(10.82)	(10.92)	(10.39)	(9.903)	(10.34)	(9.751)
Size	-13.07	-15.13*	-15.02*	-14.59**	-15.66**	-15.55**
	(7.960)	(7.431)	(7.091)	(6.271)	(6.665)	(6.312)
CROSS	-0.425	-0.289	-0.330	-0.440	-0.365	-0.404
	(0.451)	(0.472)	(0.507)	(0.418)	(0.435)	(0.462)
CBfunding		-0.182	-0.155		-0.337	-0.314
		(0.218)	(0.223)		(0.237)	(0.234)
CBfunding x WEAK		-0.271	-0.301		-0.199	-0.227
		(0.277)	(0.269)		(0.298)	(0.285)
NPLbank			-0.272			-0.230
			(0.408)			(0.372)
NPLbank x WEAK			-0.0532			-0.105
			(0.392)			(0.422)
Observations	464	464	464	464	464	464
Bank controls	Y	Y	Y	Y	Y	Y
Bank fixed effects	Y	Y	Y	Y	Y	Y
Time fixed effects	N	Y	Y	N	Y	Y
Number of banks	13	13	13	13	13	13
Overall R^2	0.314	0.323	0.327	0.248	0.270	0.272

Panel B. Tests for financial fragmentation, moral hazard and reach-for-yield channels

Dependent variable	Ratio 3: Home bonds to (home bonds + LAC bonds)			Ratio 4: Non-local MAC bonds to all non-local bonds		
	(1)	(2)	(3)	(4)	(5)	(6)
Fragmentation	10.27**			7.210		
	(3.722)			(22.84)		
WEAK	1.768	2.399	2.511	-14.10	-15.13	-13.61
	(4.357)	(4.723)	(4.725)	(32.98)	(31.10)	(30.18)
Size	2.824	1.049	1.060	-13.87	-18.79	-18.38
	(5.307)	(4.171)	(4.192)	(27.21)	(29.38)	(29.10)
CROSS	0.006	0.085	0.0909	1.103*	1.184*	1.108
	(0.162)	(0.140)	(0.152)	(0.605)	(0.652)	(0.673)
CBfunding		0.179	0.178		1.547*	1.654**
		(0.108)	(0.108)		(0.732)	(0.702)
CBfunding x WEAK		-0.132	-0.128		-1.777*	-1.848*
		(0.080)	(0.0877)		(0.926)	(0.962)
NPLbank			0.015			-1.040
			(0.115)			(1.635)
NPLbank x WEAK			0.062			1.067
			(0.133)			(1.449)
Observations	461	461	461	459	459	459
Bank controls	Y	Y	Y	Y	Y	Y
Bank fixed effects	Y	Y	Y	Y	Y	Y
Time fixed effects	N	Y	Y	N	Y	Y
Number of banks	13	13	13	13	13	13
Overall R^2	0.267	0.300	0.295	0.360	0.360	0.358

Robust standard errors are shown in parentheses and are clustered at the bank level:
* p<0.10, ** p<0.05, *** p<0.01

This table studies the preference of banks for domestic sovereign bonds and higher-yielding EMU sovereign debt. The dependent variables are: in panel A, “Ratio 1” or the ratio of holdings of Spanish government bonds to the entire portfolio of sovereign debt, and “Ratio 2” or the ratio of holdings of Spanish government bonds to holdings of MAC government debt, including Spanish bonds in the denominator; in panel B, “Ratio 3” or the ratio of holdings of Spanish government bonds to a portfolio formed by these bonds and LAC government debt, and “Ratio 4” or the ratio of holdings of MAC government debt, excluding Spanish government debt, to holdings of bonds issued by all non-domestic EMU governments. Fragmentation is the first lag of a financial fragmentation measure derived from an index for EMU markets developed by the ECB (the index is bounded between zero and one; when close to one, financial fragmentation rises). Size is total assets of each bank (we take the natural logarithm) and Cross_claims are banks´ exposures to other jurisdictions divided by total assets. WEAK is a dummy equal to one when a bank has, in the preceding quarter, a Tier 1 capital ratio (T1) below the median value of the T1 of our sample of banks, and it is zero otherwise. NPLbank is the lagged difference between the non-performing loans ratio (NPL) of each bank (considering only its business activities in Spain) minus the average NPL of the whole banking system at time t-1. The specification incorporates a vector of (lagged) bank-level variables to control for complexity (use of derivatives and the structure of liabilities of each institution- deposit, interbank, bond and the stock of central bank funding-, divided by total assets). At this respect, the estimate of the coefficient of Bond funding is statistically significant and negative in columns 1 to 3 of Panel B (**). No other estimates are statistically different from zero. The specifications include bank-fixed effects in all columns and time-fixed effects in columns 2, 3, 5 and 6 of each panel.

Table 6. Determinants of sovereign holdings at the height of the sovereign crisis

	(1)	(2)	(3)	(4)
WEAK	-15.09	-13.72	-13.04	-13.85
	(20.01)	(20.81)	(20.34)	(20.73)
PRICE10Y	-0.187	-0.136	0.445	
	(0.534)	(0.481)	(0.434)	
PRICE10Y x WEAK	0.252	0.149	-0.127	
	(0.519)	(0.465)	(0.659)	
CBfunding	3.265***	3.205***	2.717*	2.651*
	(0.644)	(0.642)	(1.383)	(1.321)
CBfunding x WEAK	-1.694	-1.566	0.130	0.144
	(1.225)	(1.313)	(2.485)	(2.431)
GDP	-1.218**	-1.222**	-1.229**	-1.192**
	(0.405)	(0.407)	(0.421)	(0.426)
crisis	1.308	3.155	2.080	2.509
	(1.995)	(3.907)	(3.516)	(3.575)
crisis x WEAK		-3.688	-1.894	-1.242
		(5.875)	(5.397)	(5.516)
crisis x PRICE10Y			-1.487	
			(0.901)	
crisis x WEAK x PRICE10Y			0.401	
			(1.523)	
crisis x CBfunding			1.287	1.415
			(2.099)	(2.030)
crisis x CBfunding x WEAK			-4.085	-4.189
			(3.178)	(3.113)
PRICE5Y				0.618
				(0.567)
PRICE5Y x WEAK				0.559
				(0.765)
crisis x PRICE5Y				-2.010*
				(1.025)
crisis x WEAK x PRICE5Y				-0.289
				(1.793)
Observations	500	500	500	500
Bank controls	Y	Y	Y	Y
Bank fixed effects	Y	Y	Y	Y
Time fixed effects	N	N	N	N
Number of banks	14	14	14	14
Overall R^2	0.033	0.031	0.040	0.042

Robust standard errors are shown in parentheses and are clustered at the bank level: * p<0.10, ** p<0.05, *** p<0.01

This table tests whether determinants of holdings of domestic sovereign bonds changed at the height of the sovereign crisis. Our sample consists of the fourteen significant banks identified in Spain as of the end of 2016Q4. We cover the period from 2008Q1 to 2016Q4 on a quarterly basis. The dependent variable is the quarterly percentage change in holdings of domestic sovereign bonds of each bank (holdings trimmed at 100% QoQ to avoid outliers). WEAK is a dummy equal to one when a bank has, in the preceding quarter, a Tier 1 capital ratio (T1) below the median value of the T1 of our sample of banks, and it is zero otherwise. PRICE10Y and PRICE5Y are, respectively, the quarterly percentage change in the

price of the 10 year and the price of the 5 year Spanish government benchmarks. CBfunding is the quarterly variation of funding from the central bank (adjusted for assets against this institution) divided by total assets. GDP is the lagged yearly percentage change in GDP. crisis is a dummy equal to 1 from 2010Q2 to 2012Q3 and zero otherwise. The specification incorporates a vector of (lagged) bank-level variables to control for characteristics of banks, including size (natural logarithm of total assets), international activity (exposures to other jurisdictions over total assets) and complexity (use of derivatives and the structure of liabilities of each institution- deposit, interbank, bond and the stock of central bank funding-, divided by total assets). Estimates of coefficients of bank-level controls are omitted in the table and they are not statistically significant. The specification includes bank-fixed effects.

Table 7. Alternatives proxies for solvency and results

	Equation (1)			Equation (2)		
Proxy for solvency	Own funds	Leverage_1	Leverage_2	Own funds	Leverage_1	Leverage_2
	(1)	(2)	(3)	(4)	(5)	(6)
WEAK	4.332	8.361	7.561	8.264	6.036	7.970
	(8.329)	(14.65)	(10.81)	(9.404)	(16.88)	(12.53)
PRICE10Y	-0.517	-0.686	-0.536			
	(0.528)	(0.681)	(0.577)			
PRICE10Y x WEAK	0.828	1.103	0.797			
	(0.475)	(0.716)	(0.487)			
CBfunding	3.393***	3.621***	4.115***	2.242***	2.927**	3.260**
	(0.539)	(0.956)	(1.053)	(0.718)	(1.114)	(1.138)
CBfunding x WEAK	-1.923*	-2.505*	-3.201**	-1.884*	-3.223**	-3.557**
	(0.916)	(1.210)	(1.381)	(0.970)	(1.383)	(1.419)
GDP	-1.401***	-1.366**	-1.547***			
	(0.416)	(0.457)	(0.494)			
NPLbank				-0.493	-0.0816	-0.416
				(0.526)	(0.594)	(0.506)
NPLbank x WEAK				0.544*	-0.445	0.150
				(0.261)	(0.421)	(0.363)
Observations	500	500	500	500	500	500
Bank controls	Y	Y	Y	Y	Y	Y
Bank fixed effects	Y	Y	Y	Y	Y	Y
Time fixed effects	N	N	N	Y	Y	Y
Number of banks	14	14	14	14	14	14
Overall R^2	0.039	0.039	0.052	0.140	0.132	0.172

Robust standard errors are shown in parentheses and are clustered at the bank level: * p<0.10, ** p<0.05, *** p<0.01

This table tests whether our results hold for alternative measures to the Tier 1 capital ratio (T1). Our sample consists of the fourteen significant banks identified in Spain as of the end of 2016Q4. We cover the period from 2008Q1 to 2016Q4 on a quarterly basis. The dependent variable is the quarterly percentage change in holdings of domestic sovereign bonds of each bank (holdings trimmed at 100% QoQ to avoid outliers). WEAK is a dummy equal to one when a bank has, in the preceding quarter, a level of solvency below the system-wide median value of the following list of solvency measures: (i) the own funds ratio, which adds Tier 2 items to the numerator of the T1; (i) Leverage_1, or the ratio of total assets to all T1 instruments; and (3) Leverage_2, or the ratio of total assets to own funds. PRICE10Y is the quarterly percentage change in the price of the 10 year on the run Spanish government bond. CBfunding is the quarterly variation of funding from the central bank (adjusted for assets against this institution) divided by total assets. GDP is the lagged yearly percentage change in GDP. NPLbank is the lagged difference between the non-performing loans ratio (NPL) of each bank (considering only its business activities in Spain) minus the average NPL of the whole banking system at time t-1. The specification incorporates a vector of (lagged) bank-level variables to control for characteristics of banks, including size (natural logarithm of total assets), international activity (exposures to other jurisdictions over total assets) and complexity (use of derivatives and the structure of liabilities of each institution- deposit, interbank, bond and the stock of central bank funding-, divided by total assets). Estimates of coefficients of bank-level controls are omitted in the table. At this respect, the estimate of the coefficient of Bond funding is statistically significant and positive in columns 2 (*) and 3 (**), and the estimate of the coefficient of Size is significant and negative in column 5 (*). No other estimates are significantly different from zero. The specification includes bank-fixed effects in all columns and time-fixed effects in columns 4 to 6.

Table 8. What if being a weak bank has been the norm?

Dependent variable	Quarterly changes in home sovereign debt (in percent)	Ratio1: Home bonds to total bonds	Ratio 2: Home bonds to (home bonds + non-local MAC bonds)	Ratio 3: Home bonds to (home bonds + LAC bonds)	Ratio 4: Non-local MAC bonds to all non-local bonds
	(1)	(2)	(3)	(4)	(5)
Fragmentation	13.32**	30.24***	24.25**	9.750**	4.437
	(5.930)	(9.544)	(9.238)	(3.625)	(21.43)
T1	-0.721	-0.818	-0.665	-0.055	-0.245
	(0.567)	(0.631)	(0.538)	(0.234)	(1.218)
Size	-13.81	-12.46	-13.93*	2.657	-13.77
	(11.89)	(7.962)	(6.595)	(5.397)	(28.66)
CROSS	0.0225	-0.372	-0.385	0.009	1.199*
	(0.329)	(0.433)	(0.409)	(0.160)	(0.617)
CBfunding	2.498***	-0.178	-0.271	0.083	0.549
	(0.615)	(0.198)	(0.194)	(0.064)	(0.562)
CBfunding x T1	0.487*	-0.0826	-0.0864	0.002	-0.0562
	(0.237)	(0.0980)	(0.0929)	(0.028)	(0.167)
Observations	500	464	464	461	459
Bank controls	Y	Y	Y	Y	Y
Bank fixed effects	Y	Y	Y	Y	Y
Time fixed effects	N	N	N	N	N
Number of banks	14	13	13	13	13
Overall R^2	0.039	0.316	0.249	0.266	0.362

Robust standard errors are shown in parentheses and are clustered at the bank level: * p<0.10, ** p<0.05, *** p<0.01

* p<0.10, ** p<0.05, *** p<0.01

This table explores drivers of changes in domestic sovereign bond holdings as well as the preference of banks for home sovereign bonds and higher-yielding EMU sovereign debt. The dependent variables are: the quarterly percentage change in holdings of domestic sovereign bonds of each bank (holdings trimmed at 100% QoQ to avoid outliers); “Ratio 1”or s the ratio of holdings of Spanish government bonds to the entire portfolio of sovereign debt; “Ratio 2” or the ratio of holdings of Spanish government bonds to holdings of MAC government debt, including Spanish bonds in the denominator; “Ratio 3” or the ratio of holdings of Spanish government bonds to a portfolio formed by these bonds and LAC government debt; and “Ratio 4” or the ratio of holdings of MAC government debt, excluding Spanish government debt, to holdings of bonds issued by all non-domestic EMU governments. T1 is the Tier 1 capital ratio. Fragmentation is the first lag of a financial fragmentation measure derived from an index for EMU markets developed by the ECB (the index is bounded between zero and one; when close to one, financial fragmentation rises). Size is total assets of each bank (we take the natural logarithm) and Cross_claims are banks´ exposures to other jurisdictions divided by total assets. The specification incorporates a vector of (lagged) bank-level variables to control for characteristics of banks (use of derivatives and the structure of liabilities of each institution- deposit, interbank, bond and the stock of central bank funding-, divided by total assets). Estimates of coefficients of bank-level controls are omitted in the table. At this respect, the estimate of the coefficient of Bond funding is statistically significant and positive in column 1 (*). No other estimates are significantly different from zero. The specification includes bank-fixed effects.

Table 9. New aggregation strategy: composition of banking groups at each date

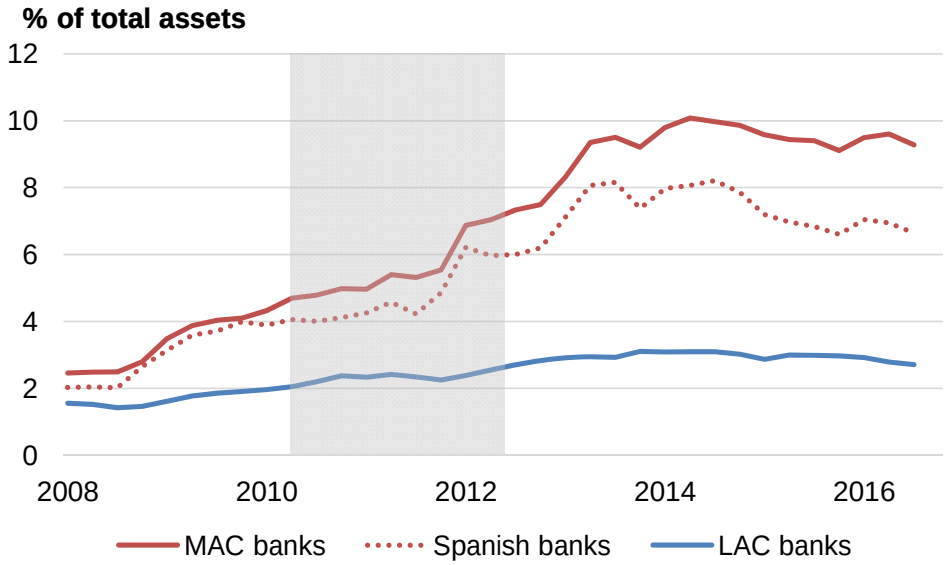
Dependent variable	Quarterly changes in home sovereign debt (in percent)				Ratio1: Home bonds to total bonds	Ratio 2: Home bonds to (home bonds + non-local MAC bonds)	Ratio 3: Home bonds to (home bonds + LAC bonds)	Ratio 4: Non-local MAC bonds to all non-local bonds
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WEAK	-23.90	-23.78	-23.45		-15.69	-15.55	-4.523	-32.69
	(17.24)	(17.27)	(16.75)		(11.36)	(9.899)	(7.130)	(28.77)
PRICE10Y	-0.183	-0.170						
	(0.372)	(0.371)						
PRICE10Y x WEAK	0.184	0.181						
	(0.483)	(0.482)						
CBfunding	3.056***	2.818***	2.627***	1.972***	-0.111	-0.0508	-0.0674	-0.0419
	(0.650)	(0.618)	(0.721)	(0.586)	(0.156)	(0.112)	(0.163)	(0.559)
CBfunding x WEAK	-2.823***	-2.660***	-3.105***		0.114	-0.110	0.147	0.381
	(0.797)	(0.817)	(0.819)		(0.175)	(0.173)	(0.126)	(0.824)
Fragmentation	21.60***	19.27***			23.36***	11.89**	16.04**	19.94
	(6.941)	(6.425)			(6.863)	(4.871)	(6.222)	(16.54)
LTRO-2		14.90*						
		(8.760)						
LTRO-2 x WEAK		-10.75						
		(11.65)						
NPLbank			-0.933*	-0.821*				
			(0.499)	(0.435)				
NPLbank x WEAK			0.671					
			(0.436)					
WEAK35				-7.378				
				(14.00)				
NPLbank x WEAK35				0.760*				
				(0.414)				
CBfunding x WEAK35				-2.516***				
				(0.803)				
Observations	660	660	660	660	473	473	473	463
Bank controls	Y	Y	Y	Y	Y	Y	Y	Y
Bank fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Time fixed effects	N	N	Y	Y	N	N	N	N
Number of banks	37	37	37	37	23	23	23	23
Overall R^2	0.032	0.034	0.152	0.147	0.132	0.192	0.096	0.264

Robust standard errors are shown in parentheses and are clustered at the bank level: * p<0.10, ** p<0.05, *** p<0.01

The table uses a different approach to aggregate bank-level information, in which we take the composition of banking groups at each date. Dependent variables are: the quarterly percentage change in holdings of domestic sovereign bonds of each bank (holdings trimmed at 100% QoQ to avoid outliers); “Ratio 1”or s the ratio of holdings of Spanish government bonds to the entire portfolio of sovereign debt; “Ratio 2” or the ratio of holdings of Spanish government bonds to holdings of MAC government debt, including Spanish bonds in the denominator; “Ratio 3” or the ratio of holdings of Spanish government bonds to a portfolio formed by these bonds and LAC government debt; and “Ratio 4” or the ratio of holdings of MAC government debt, excluding Spanish government debt, to holdings of bonds issued by all non-domestic EMU governments. WEAK (WEAK 35) is a dummy equal to one when a bank

has, in the preceding quarter, a Tier 1 capital ratio (T1) below the median (35th percentile) value of the T1 of our sample of banks, and it is zero otherwise. PRICE10Y is the quarterly percentage change in the price of the 10 year on the run Spanish government bond. CBfunding is the quarterly variation of funding from the central bank (adjusted for assets against this institution) divided by total assets. Fragmentation is the first lag of a financial fragmentation measure derived from an index for EMU markets developed by the ECB (the index is bounded between zero and one; when close to one, financial fragmentation rises). LTRO-2 is a dummy equal to 1 in 2012Q1. NPLbank is the lagged difference between the non-performing loans ratio (NPL) of each bank (considering only its business activities in Spain) minus the average NPL of the whole banking system at time t-1. Estimates of coefficients of bank-level controls are omitted in the table. At this respect, the estimate of the coefficient of trading derivatives is statistically significant and positive in columns 1 (*), 2 (*), 5(**), 6(***), and significant and negative in 8(**). The estimate of cross exposures to total assets (adjusted for sovereign holdings) is negative and significant in column 6. Finally, Bond funding is significant and positive in column 3 (*).No other estimates are significantly different from zero. All specifications include bank-fixed effects, while some incorporate time-fixed effects, too.

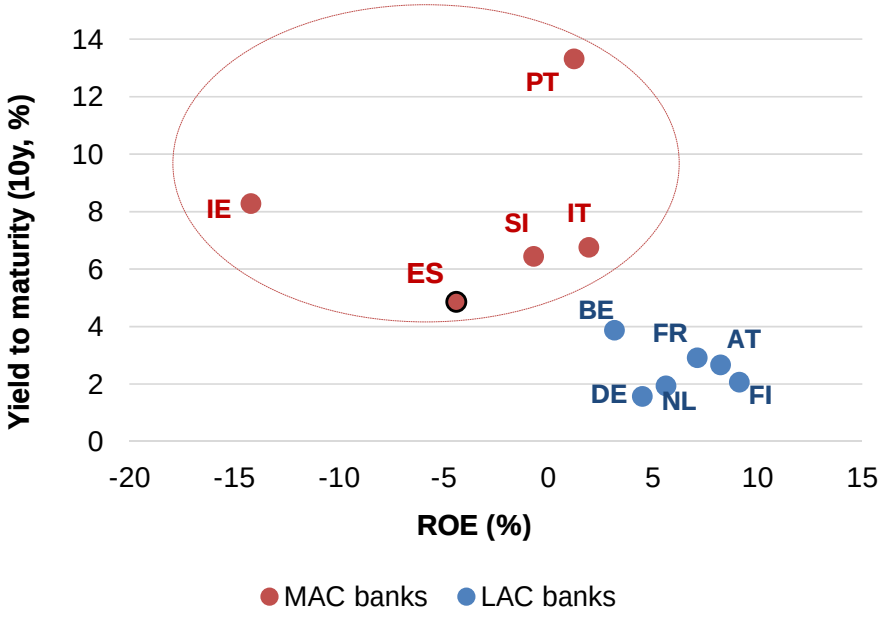
Figure 1. Holdings of domestic sovereign bonds



SOURCE: Statistical Data Warehouse.

As reported by Monetary Financial Institutions (MFI) in each country excluding the European System of Central Banks. Debt holdings of more affected and less affected by the crisis banking systems (from now on, MAC and LAC systems) weighted by MFI assets of each country. LAC banks are MFI based in Austria, Belgium, Estonia, Finland, France, Germany, Luxembourg, Malta, The Netherlands and Slovakia. MAC banks are MFI based in Cyprus, Greece, Ireland, Italy, Portugal, Slovenia and Spain. The shaded area represents the sovereign crisis period (2010Q2-2012Q3).

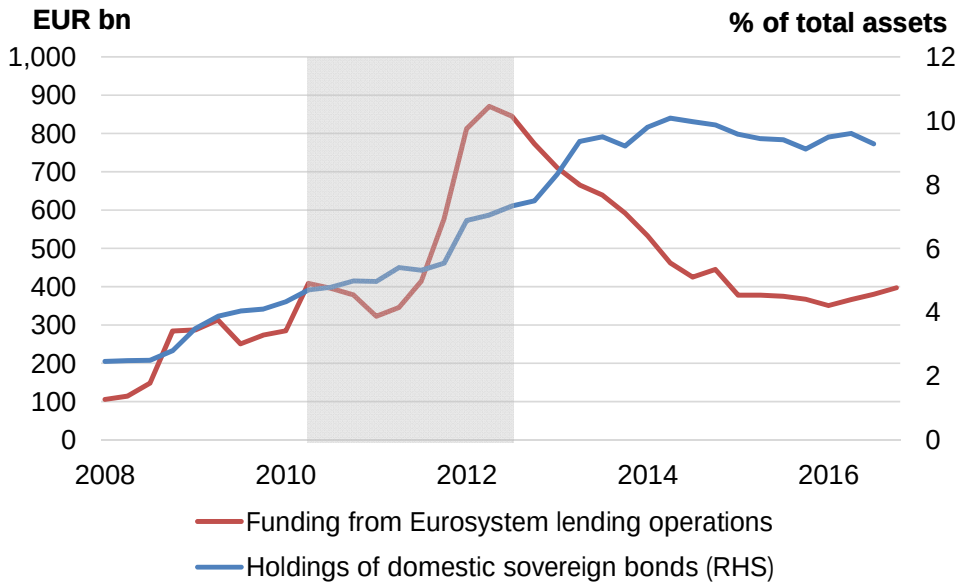
Figure 2. Sovereign yields and Return on Equity (RoE) of banks as of 2012Q2



SOURCE: Statistical Data Warehouse and Reuters.

LAC banking systems in the figure: AT (Austria), Belgium (BE), Finland (FI), France (FR), Germany (DE) and The Netherlands (NL). MAC banking systems in the figure: Ireland (IE), Italy (IT), Portugal (PT), Slovenia (SI) and Spain (ES). Greece not included in the figure (no data for ROE). Yields are computed over the 10 year on-the-run Treasury note.

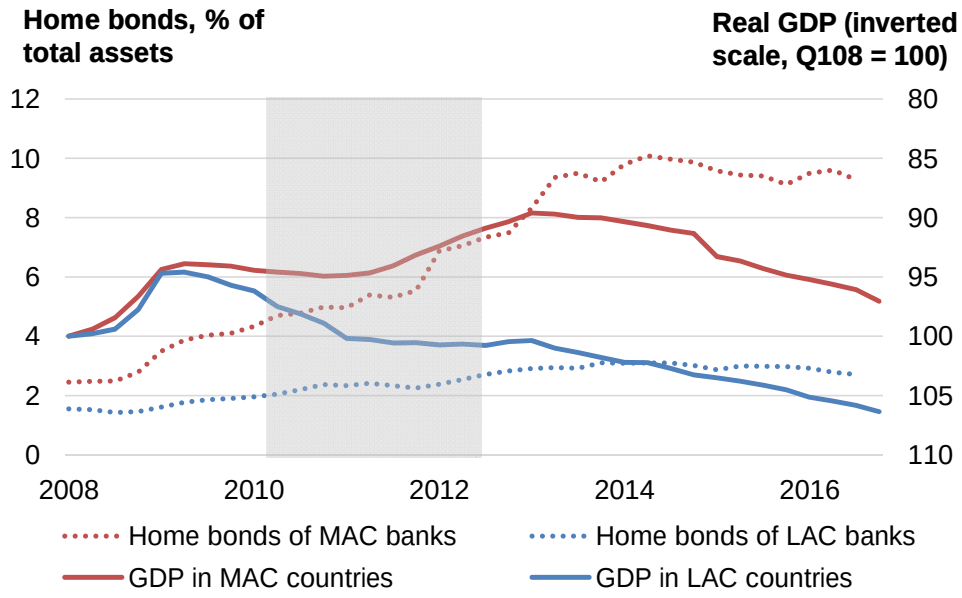
Figure 3. EMU *more affected by the crisis* banks: funding from Eurosystem lending operations and holdings of domestic sovereign bonds



SOURCE: Statistical Data Warehouse and Bruegel database of Eurosystem lending operations developed in Pisani-Ferry and Wolff (2012).

MAC banks are banks based in Cyprus, Greece, Ireland, Italy, Portugal, Slovenia and Spain. The shaded area represents the sovereign crisis period (2010Q2-2012Q3).

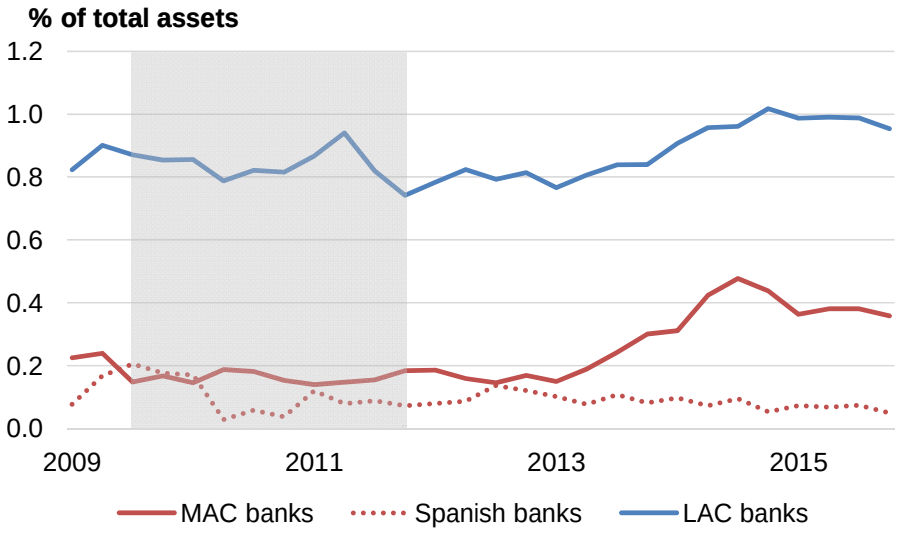
Figure 4. GDP and holdings of domestic sovereign bonds in *more and less affected by the crisis* banking systems



SOURCE: Statistical Data Warehouse and Eurostat.

Debt holdings as reported by Monetary Financial Institutions (MFI) in each country excluding the European System of Central Banks, and weighted by MFI assets of each country. GDP changes weighted according to nominal GDP in each group. MAC countries are Cyprus, Greece, Ireland, Italy, Portugal, Slovenia and Spain. LAC countries are Austria, Belgium, Estonia, Finland, France, Germany, Luxembourg, Malta and the Netherlands. The shaded area represents the sovereign crisis period (2010Q2-2012Q3).

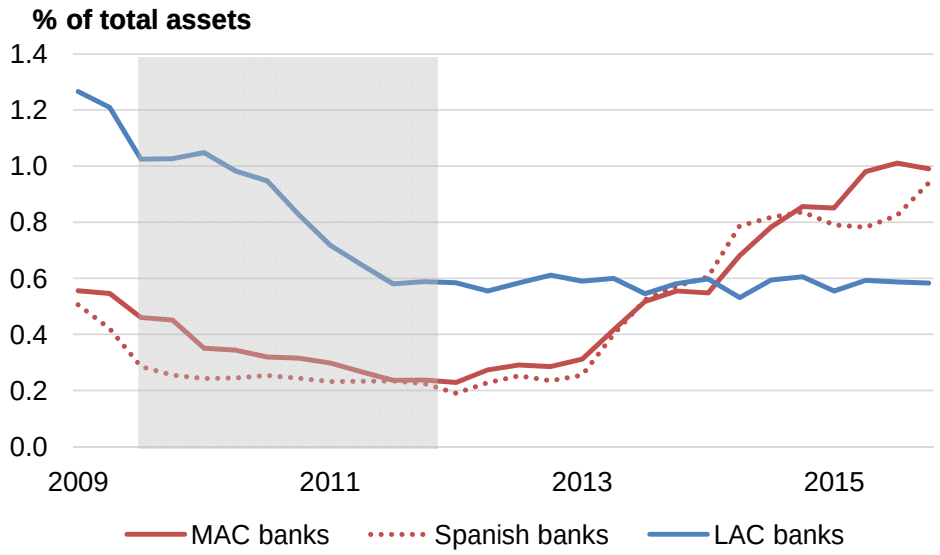
Figure 5. Holdings of government debt issued by countries *less affected by the crisis*



SOURCE: ECB (Securities Holdings Statistics by Sector) and Statistical Data Warehouse.

As reported by deposit-taking corporations in each country, excluding home bonds. Debt holdings of MAC and LAC banks weighted by MFI assets of each country. LAC banks are banks based in Austria, Belgium, Estonia, Finland, France, Germany, Luxembourg, Malta, the Netherlands and Slovakia. MAC banks are banks based in Cyprus, Greece, Ireland, Italy, Portugal, Slovenia and Spain. Shaded area: sovereign crisis period (2010Q2-2012Q3).

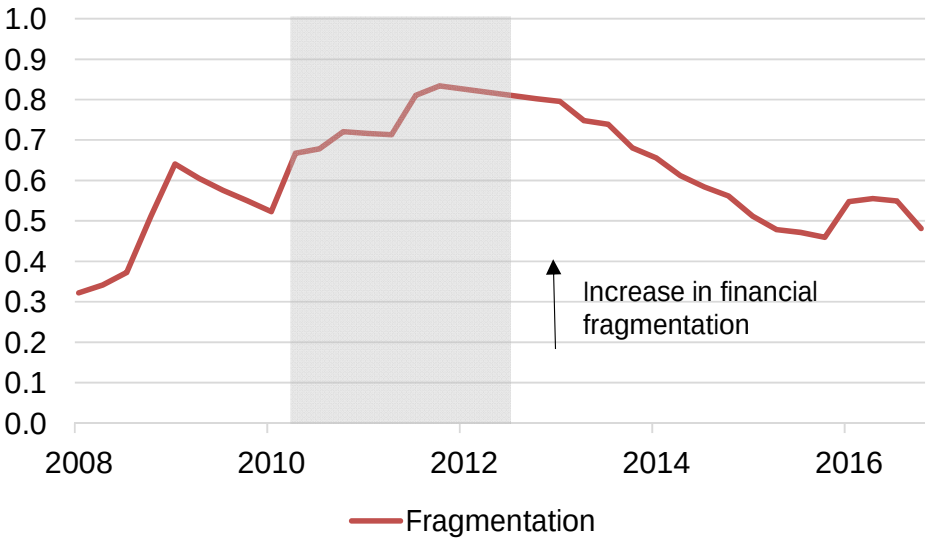
Figure 6. Holdings of government debt issued by countries *more affected by the crisis*



SOURCE: ECB (Securities Holdings Statistics by Sector) and Statistical Data Warehouse.

As reported by deposit-taking corporations in each country, excluding home bonds. Debt holdings of MAC and LAC banks weighted by MFI assets of each country. LAC banks are banks based in Austria, Belgium, Estonia, Finland, France, Germany, Luxembourg, Malta, the Netherlands and Slovakia. MAC banks are banks based in Cyprus, Greece, Ireland, Italy, Portugal, Slovenia and Spain. The shaded area represents the sovereign crisis period (2010Q2-2012Q3).

Figure 7. Financial fragmentation in EMU markets



SOURCE: ECB.

The shaded area represents the sovereign crisis period (2010Q2-2012Q3).

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