The fire-sale channels of universal banks in the European sovereign debt crisis *

Giulio Bagattini[⋆], Falko Fecht[⋆], and Patrick Weber[†]

[⋆]Frankfurt School of Finance and Management
[†]Deutsche Bundesbank

June 15, 2018

Abstract

We use a unique security-level data set to analyze whether German banks use their customer portfolios and affiliated mutual funds as an exit channel for risky sovereign bonds in the European sovereign debt crisis. Matching banks' proprietary holdings with the holdings of their funds and their retail customers for the period 2009-2016 at the security level, we find evidence that banks sold off risky Euro area sovereign bonds to both their retail customers and their affiliated mutual funds during the European sovereign debt crisis. For the mutual funds, the sell-offs were more pronounced to public funds compared to special funds dedicated to institutional investors. Overall, this enabled banks with affiliated mutual funds to sell off larger amounts of their risky sovereign bond holdings, while bank-affiliated mutual funds acquired more risky sovereign bonds compared to their unaffiliated peers. Our findings have important implications. First, they suggest that there is a severe conflict of interest between banks' own account trading and the asset and wealth management services they offer to retail investors, potentially calling for better consumer protection. At the same time our findings also show that the severity of fire-sale contagion depends on the organizational structure of the financial sector.

*The paper represents the authors' personal opinions and do not necessarily reflect the views of the Deutsche Bundesbank or the Eurosystem.

1 Introduction

Fire sales are considered as one of the major channels of financial contagion (see Shleifer and Vishny (2011) for a comprehensive survey). In the Euro area, fire sales of sovereign bonds have been pointed out as a main driver of systemic risk in the financial system and a key vulnerability of the banking sector (see, for instance, Greenwood et al. (2015)). Fire sales of sovereign bonds by distressed banks are also seen as a key element in the vicious circle linking banking and sovereign debt crises and contributing to an inherently fragile financial system (see Cooper and Nikolov (2013)). As a consequence regulators call for minimum capital requirements underlying banks' sovereign bond holdings (see, for example, European Systemic Risk Board (2015)) in order to mitigate fire-sale contagion and the doom loop between banking and sovereign defaults. At the same time, though, recent research highlights that a bank can opportunistically steer its customers' portfolios towards assets which the bank intends to sell off from its proprietary trading portfolio (see Fecht et al. (2017)). This suggests that banks which dispose of a large customer base and/or manage considerable wealth on behalf of customers might be able to mitigate fire-sale pricing by pushing those sovereign bonds that the bank intends to liquidate to bank-affiliated mutual funds or directly to their retail customers.

In this paper, we use a unique dataset from the Deutsche Bundesbank to shed light on the question whether banks used their affiliated mutual funds and customer portfolios to sell off risky or potentially illiquid Eurozone sovereign bonds at the onset of the European sovereign debt crisis in early 2010 and thereafter. For this purpose, we match security level data on all German banks' proprietary trading portfolios with the respective security holdings of the bank's affiliated mutual funds (if it has any) as well as the holdings of its retail customers for the period 2009 - 2016. In order to analyze which banks were more prone to use these exit channels, we match bank balance sheet data and profit and loss statistics to our data set. As a proxy for the riskiness of a country, we use credit default swap spread data from Markit at maturities matched to those of the individual sovereign bond holding.[1] Finally, as a proxy for a bond's market liquidity, we match the bid/ask spreads obtained from Bloomberg.

Our empirical strategy is based on the correlation of changes in a bank's holding of a particular bond and holding changes of the same bond in affiliated mutual funds' portfolios or the bank's aggregated retail customers' portfolio. More precisely, we estimate the extent to which a decrease in the holdings of a certain sovereign bond in the proprietary security portfolio of a bank is associated in the same quarter with an increase in the holdings of exactly this bond in the portfolio of the bank's mutual funds or the portfolio of the bank's retail customers. For the empirical identification, we use security-quarter fixed effects to control for any unobserved time-varying heterogeneity across securities in all regressions, such as the general sell-off of risky sovereign bonds across all banks due to their deleveraging. In addition, we use fund-quarter and fund-security fixed effects in the case of regressions for mutual funds to control for any fund-specific investment behavior over time as might, for instance, be due to excessive outflows at individual funds. In the

[1] In a robustness check, we also use the official credit ratings from S&P, Moodys and Fitch.

regressions for household holdings, we augment the model by bank-quarter fixed effects, thereby also controlling for unobserved time-varying heterogeneity across banks. This should also take care of time-varying cross sectional differences in banks' overall portfolio holdings.

Our main findings are as follows. Controlling for time-varying bank and security fixed effects we find that a decline of a bank's euro area sovereign bond holding in a particular quarter was associated with an increase in the bank's affiliated mutual funds' holdings of that bond as well as with an increase in the bank's retail customers' holdings of that bond in the same quarter. This correlation is economically and statistically particularly significant for sovereign bonds with an elevated default risk as measured by the CDS spread, i.e. for countries that suffered from the sovereign debt crisis.[2] Differentiating between retail and specialized funds, the latter catering mostly only other financial institutions, we find that mostly retail funds increased significantly their holdings of risky sovereign bonds when their parent bank sold off these securities, while there is only a marginally significant correlation between specialized funds' risky sovereign bond holdings and those of their parent bank. Furthermore, our results indicate that the negative correlation of sovereign bond sell off of banks and purchases of their affiliated funds was significantly more pronounced for fairly illiquid bonds, i.e. for bonds that were traded at high bid/ask spread. In sum, these findings suggest that banks used both their retail customers as well as their retail funds as an exit channel to liquidate crisis countries' sovereign bonds from their proprietary trading portfolio. Looking at the characteristics of those banks where the correlation between bank sales and customer or mutual funds purchases was most significant, we find evidence suggesting that particularly large banks and banks with a significant drop on their equity ratio used their customers and mutual funds as an exit channel.

In a second step, we compare the portfolio dynamics of funds that are affiliated to a bank with changes in the security holdings of independent mutual funds. Controlling for security and fund fixed effects, we find that bank-affiliated mutual funds increased their risky sovereign bond holdings significantly more than their unaffiliated peers. This suggests that affiliated funds did not offset the acquisition of risky bonds that their parent bank sold by reducing relatively their portfolio holdings of other risky sovereign bonds.

Finally, we also study whether having a mutual fund also allowed banks to sell off more risky bonds during the sovereign debt crisis. When restricting our sample to banks with a similarly large sovereign bond portfolio we find that indeed those banks with affiliated mutual funds reduced their holdings of risky bonds more significantly during the sovereign debt crisis.

Our findings have important implications. First, they suggest that there is a severe conflict of interest between banks' own account trading and the asset and wealth management services they offer to retail investors, potentially calling for better consumer protection. At the same time our findings also show that the severity of fire-sale contagion depends on the organizational structure of the financial sector. Universal banks, i.e. bank holding companies that comprise, besides proprietary trading, also asset management services

[2]We use the CDS on senior debt of the country with six different maturities (1y, 2y, 3y, 5y, 7y and 10y) which are matched to the remaining time to maturity of each individual bond.

for customers and asset management companies, might mitigate fire-sale contagion and contribute to a more resilient financial system.[3] Third, these findings also suggest that regulatory proposals suggesting a separation between bank proprietary trading and other bank activities – such as the Dodd-Frank Act in the U.S.[4], the Vickers Report in the U.K.[5], and the Liikanen Report in the EU[6] – might aggravate fire-sale contagion and lead to a more fragile banking system and a more severe doom loop between banking and sovereign defaults. As a consequence, with these institutional separations becoming effective, the need for minimum capital requirements covering banks' sovereign bond holdings becomes even more pressing.

The remainder of our paper is organized as follows. In the following section we discuss the related literature. Section 3 describes our data set and the measures we derive from it for our main analysis. In section 4 we present some descriptive statistics. Section 5 derives, from a simple univariate analysis, the correlation between bank sales of sovereign bonds and their affiliated mutual funds' trades, as well as their retail customers' trades. Section 6 uses a more sophisticated panel approach to analyze the correlation. In section 7 we study whether bank-affiliated funds acquired more risky sovereign bonds than their unaffiliated peers during the sovereign debt crisis, and in section 8 we focus on whether banks with affiliated funds sold off more risky bonds during the crisis period compared to other banks. Section 9 reports results from various robustness tests and section 10 concludes.

2 Literature review

Our paper contributes to various strands of the literature. First, our results add to the recent papers that document a conflict of interest between banks' different business units and an opportunistic behavior of multi-unit bank holding companies. Golez and Marin (2015) show that bank-affiliated mutual funds purchase stocks of the controlling bank to support the stock price if needed. Massa and Žaldokas (2017) provide evidence that bank-affiliated mutual funds trade on the private firm information obtained by the controlling bank in its lending business with the respective firm. Similarly, Ivashina and Sun (2011) show that institutional investors trade in stock market on private information obtained in the loan market for trades in the stock market.Del Guercio et al. (2017) find evidence for opportunistic behavior of managers that simultaneously manage a hedge and a mutual fund. Fecht et al. (2017) show that banks use their customers' portfolios to sell off underperforming stocks from their proprietary trading portfolio.

However, we do not argue that our results necessarily imply that banks abuse their mutual funds and their customers. Our results only indicate that bank holding companies use the different entities to achieve a mutual liquidity insurance. While our results show

[3]It is interesting to note that, while these implications suggest that the opportunistic behavior of banks has redistributional effects between bank owners and bank clients, they also imply that the risky assets are immediately shifted to unleveraged market investors, which eliminates the risk of further knock-on effects.

[4]Dodd-Frank Wall Street Reform and Consumer Protection Act, enacted on July 21, 2010.

[5]Final Report of the UK's Independent Commission on Banking from 2011, chaired by John Vickers

[6]Final Report of the High-level Expert Group on reforming the structure of the EU banking sector, chaired by Erkii Liikanen and initiated by EU Commissioner Michel Barnier.

that during the sovereign debt crisis largely banks benefited from the liquidity support of their mutual funds and directly through their customer portfolios,[7] Fecht and Wedow (2014) for instance provide evidence that banks also provide liquidity support for troubled funds that experience excessive outflows. Carlin et al. (2007) show that, in a market microstructure framework, a cooperative behavior can prevail even among independent market participants and might be mutually beneficial.

To that end, our results also speak to the analysis of fire-sale contagion and its role during the recent financial crises. There is a vast literature on fire-sale externalities highlighting the different channels of contagion. Ellul et al. (2011) provide evidence for the price effect of corporate bond fire sales. Coval and Stafford (2007) document spillovers through price pressure of excessive withdrawals at open-end mutual funds. In this context, the paper most closely related to ours is Greenwood et al. (2015), who use EBA data on Euro-area sovereign bond holdings by large Euro-area banks for a counterfactual fire-sale contagion study

Our paper also speaks to the growing literature on shadow banks and how relations between ordinary regulated banks and unregulated shadow banks might affect financial stability. This literature, as for instance Acharya et al. (2013), mostly argues that implicit or explicit exposures of traditional banks to the shadow banking sector might lead to domino effects and thereby increase the fragility of the regulated banking sector. In contrast, our paper highlights a channel through which the mutual ownership of banks and other financial institutions can improve resilience.

3 Data and variables definition

For our empirical analysis, we obtain two key data sets: the first is from the Deutsche Bundesbank's securities holdings statistics (SHS) and reports the proprietary security holdings of each bank operating in Germany, as well as, for each bank, the aggregate portfolio of all retail customers at the security level. The second data set comprises the security holdings for each investment fund operating in Germany from the investment funds statistics (IFS).

The data set for the securities holdings statistics and the investment funds statistics lists the quarterly holdings of banks, its customers and mutual fund companies on a security-by-security basis for the time period Q3 2009 to Q1 2016.[8] For our analysis, we exclude affiliates of foreign banks operating in Germany, as well as special-purpose banks, such as development banks.

We focus on the holdings of government bonds from the 19 Euro area countries and exclude from our analysis bonds not denominated in Euro. Our initial data set includes the nominal amount in the issue currency as well as the nominal amount converted in Euros at the contemporaneous exchange rate. The first measure does not ensure comparability in terms of magnitude of changes between different currencies. As for the second measure,

[7] Fecht et al. (2017) show that banks also push stocks to their retail customers when the market is relatively illiquid in order to mitigate the price impact.

[8] The starting point of our sample period is determined by the fact that, before September 2009, the investment funds statistics were not available at the security level, but only as an aggregate.

the fluctuation of the exchange rate over time introduces spurious changes in the holdings that are unrelated with the trading activity of banks/funds. For these reasons, we drop securities not denominated in Euros. These sovereign bonds only account for around 2% of the total, both in the banks' proprietary portfolios and in the investment funds' holdings.

We use a hand-collected matching list to match banks to their affiliated asset management companies, i.e. to asset management companies fully owned by the parent bank, and ultimately to the asset management companies' mutual funds. In doing so, we take into account changes in the ownership structure of asset management companies that occurred during our sample period and match the bank and fund holdings on a security-quarter basis. Bonds which are in a bank's proprietary portfolio, but are not held by any of the associated funds, do not appear in this sample; the same applies for bonds held by a fund but not by the parent bank.

In particular, we are interested in the quarter-on-quarter changes in holdings, at the security-quarter-fund level and at the security-quarter-bank level. We therefore construct as our key variables of interest:

$$\Delta\text{Bank Holding}_{ijt} = \text{Bank Holding}_{ijt} - \text{Bank Holding}_{ijt-1},$$
$$\Delta\text{Fund Holding}_{ijt} = \text{Fund Holding}_{ijt} - \text{Fund Holding}_{ijt-1}$$

where i denotes respectively the bank or the fund, j denotes the sovereign bond, and t denotes the last day of a quarter (when institutions are required to report). Table 1 summarizes the key variables used throughout the analysis. We use the maturity date of each bond, drawn from the CSDB statistics, in order to eliminate from our data set those observations in which bank and fund holdings of a bond simply dropped to zero as the bond matured in the respective quarter.

In total, 19 banks appear in the matched sample. As asset management companies typically own more funds, the median number of fund holdings matched with a single bank holding in the sample is 4, while the average is 7.77. Our data at the fund's ISIN level also contain an indicator for whether the fund is public (open to retail investors) or special (dedicated to a specific institutional investor). In our sample of matched holdings, the observations that refer to public funds are just over 20% of the total. All the most important asset management companies in our sample own at least some public funds. The median number of public fund holdings associated to a single bank holding is 2, while the average is 3.4.

We relate a bank's change in its own sovereign bond holdings to the changes in the same bond holdings of the bank's retail customers. For that reason we define as further key variable of interest

$$\Delta\text{Households Holding}_{ijt} = \text{Households Holding}_{ijt} - \text{Households Holding}_{ijt-1}$$

in the same way as for the variables already defined.

Tables 2 and 3 report summary statistics of our main variables respectively for the sample of common bank-fund holdings and for the sample of common bank-households holdings.

3.1 Measuring risk and liquidity of sovereign bonds

Since we are interested to identify those bonds that carried a high default risk at some stage in our sample, we complement our dataset with Markit data on the credit default swap (CDS) spreads for senior debt issued by the Euro area countries. The spread in a CDS contract is a proxy for the probability of default of the debt issuer; therefore, we take it as an indicator of the riskiness of the sovereign bonds. We use the spreads quoted by the market for the CDS contracts with six different maturities (1y, 2y, 3y, 5y, 7y, 10y), and we associate to each security j and quarter t the CDS spread of the country that issued the bond, at the end of the quarter, matching the bond's residual maturity with the closest of the six CDS maturities.[9] We disregard spreads on shorter (6m) and longer (15y, 20y, 30y) CDS contracts, which are more likely to be influenced by the instrument's illiquidity, and for which some data are missing.

Table 4 reports the number of observations in the sample of matched bank-fund holdings where to the security is associated a CDS spread higher than 300 basis points (around the 80th percentile of the set of Eurozone CDS spreads over the sample period). Most of the observations belong to the countries hardest hit by the crisis (notably the GIIPS countries), but there are other instances of mostly peripheral Euro-area countries where the CDS spreads trespassed at times the 300 b.p. mark. The 26,020 fund holdings of risky bonds that are common to the parent banks compare with a total of 69,444 fund holdings of the same securities, independent of the parent bank. That is, 37.5% of the times a fund was holding a risky sovereign bond, the parent bank also had it in its proprietary trading portfolio. Conversely, there are only 3,361 single bank holdings of these risky bonds in the sample (as multiple funds are associated to a single bank). For the same banks and securities, we can count 8,702 holdings overall: 38.6% of the times a bank was holding a risky sovereign bond, one of its associated funds also owned the security. These numbers show that, from both banks' and funds' perspective, there is a significant overlap between banks' and funds' holdings of risky sovereign bonds.

Table 5 reports the analogous statistics for the sample of bank-household holdings. There is a remarkable amount of Greek bonds. Here, the proportion of overlapping holdings from the banks' perspective is even higher: 14,017 out of 33,402 overall holdings of the same bonds and banks.

We also construct a time-varying measure of market liquidity at the single security level, using as a proxy the bid-ask spread quoted by Bloomberg. First, we collect the bid and ask prices of every bond in the sample at a weekly frequency, when available, and we construct the bid-ask spread with the formula

$$\text{B/A spread} = \text{Ask price} - \text{Bid price}.$$

[9] Specifically, at each quarter, we classify the bonds in six buckets according to their time left to maturity: up to 1.5 years, from 1.5 to 2.5 years, from 2.5 to 4 years, from 4 to 6 years, from 6 to 8.5 years, more than 8.5 years. These are associated respectively to the 1y, 2y, 3y, 5y, 7y, and 10y CDS spreads of the country of emission of the bond.

Then, we exclude the values lower than zero, and winsorize the sample at the 99th percentile. Finally, for each bond and each quarter, we average the values of the bid-ask spread available for that bond over that quarter.

4 Descriptive statistics

The European sovereign debt crisis had its peak in the last quarter of 2011 and the first semester of 2012, before the "whatever it takes" speech by the ECB president Draghi contributed to let the most acute stage of the crisis subside. The crisis affected mainly the so-called GIIPS countries (Greece, Ireland, Italy, Spain and Portugal), but started and peaked at slightly different times in each country. This is illustrated by Figure 1, which depicts the evolution of the 5-year CDS spread of the GIIPS countries and of Germany. The CDS spreads indicate that according to investors' perception Portugal and Ireland already posed a significantly heightened default risk around mid 2010, while Italy and Spain followed around one year later. For this reason, we use the CDS spread as a country-specific indicator to time the sovereign debt crisis.

On average, overall during the sample period a bank holds 329 distinct sovereign bonds that also appear in the sample of common bond holdings with mutual funds, 170 of which are German and 70 of which are issued by one of the GIIPS countries. However, this number varies highly: the three most important banks in the sample hold on average 1148 distinct securities, while 7 banks have few bonds in common with their asset management arm, with no common holding at all in several quarters.

The 31 asset management companies that appear in the sample own as many as 3059 different funds, each of which holds on average only 21 distinct bonds that the parent bank also has (median 11). The upper 10% hold from 47 to 396 distinct securities and the bottom 10% hold just one.[10]

Looking at the European sovereign bonds that banks have in common with their households customers, we have an average of 13 different securities per each of the 538 banks, out of which 45% are German and 38% are issued by the GIIPS countries: in particular, 24% are Greek bonds. Again ,the distribution is extremely skewed: 41% of these banks have only one bond in common with their households customers, while the largest held a total of 990 distinct securities.

Figure 2 shows the aggregate bank holdings of sovereign bonds issued by GIIPS countries. In the aggregate, banks started selling off Portuguese bonds in the second quarter of 2010, at the same time as Greek bonds, while holdings of Italian and Spanish debt remained approximately constant for most of 2010, before seeing a sharp decline in 2011. Thus, the different timing of the crisis is also reflected in banks' portfolio holdings and fire sales of sovereign bonds from the different countries.

Figure 3 and Figure 4 show how investment funds' and households' holdings of crisis-countries sovereign bonds evolved. Funds show a similar pattern in reducing their holdings

[10]The same funds' portfolios include overall (independently of whether they appear in the portfolio of the parent bank) an average of 43 distinct Euro-area sovereign bonds over the sample period (median 26, 10th percentile 5, 90th percentile 91, maximum 532).

of GIIPS bonds as banks, although for countries such as Italy and Spain the reduction looks less dramatic. Interestingly, we obtain a different picture when we focus only on public funds (i.e. open to retail investors). Figure 5 plots the aggregate amounts of bonds from some crisis countries for public funds, distinguishing those with a parent bank from those without. Focusing on Greece and Portugal, there is a clear divergence in 2010 – right when banks started to dramatically reduce their holdings of bonds from these two countries – between the amount held by public funds without a parent bank (which starts to decrease) and the amount held by public funds with a parent bank (which at first increases steeply, and starts to steadily drop only some months later).

The pattern for households' holdings is more striking, however: their holdings of sovereign debt from all the GIIPS countries increase manifold exactly in the course of the financial crisis, while the amount of German debt steadily declines. [11]

5 Univariate analysis

As a first step towards understanding the interaction between the bond trades of banks and those of their investment funds and retail customers, we examine the univariate relationship between our key variables. To this end, we drop from the sample the observations related to Greek bonds for quarters 1 and 2 of 2012: for this period, the changes in nominal holdings were caused by a swap of the Greek securities and the combined haircut imposed on private creditors.[12] Table 6 reports the correlation coefficients for bank and fund holdings at the security-quarter level. In column 1, we first look at the relationship between ΔFund Holding and ΔBank Holding over the full sample for those quarters where the bank purchased the bond (ΔBank Holding > 0). We find the unconditional correlation to be slightly positive and statistically significant. That is, on average, there is a slight tendency of investment funds to increase their holdings of a security when the parent bank is also purchasing that specific security. In column 2, we restrict our attention to the sell trades of banks. In this case, we find that the sign of the correlation coefficient reverses. This means that, conditioning on banks reducing their holdings of a government bond, investment funds tend to actually purchase more of the security that the parent bank sells.

Columns 3 and 4 consider the correlation between our key variables for bonds that are particularly risky. To define a risky bond, we take as a threshold a CDS spread of 300 basis points, which corresponds approximately to the 80th percentile of the set of Euro area CDS spreads over the sample period. For these holdings, the correlations are slightly negative, but not statistically significant.

In columns 5 and 6, we repeat the analysis restricting the sample to those funds that

[11] The amount of German government bonds issued to retail investors has been declining for over 20 years and retail investors have become meaninglessfor the German government. The treasury department stopped the direct selling of German government bonds to private investors in 2012.

[12] We exclude these observations throughout our analysis. Greece announced the restructuring on 21 February 2012. The swap with foreign private creditors took place throughout March and April of the same year. By the time the last of Greece's exchanged or amended foreign law bonds had settled on 25 April, Greece had achieved total participation of €199.2 billion, or 96.9% of the outstanding debt. As a result of the exchange, the face value of Greece's debt declined by €108 billion, or 52.5% of the eligible debt.

are open to the public, as opposed to funds that are managed for a specific investor, usually an institution. In this case, the correlation between changes in risky bond holdings of investment funds and changes in the holdings of their parent bank becomes markedly negative, if we condition on banks' sell trades. This shows that there is a tendency by public investment funds to purchase more of a high-default-risk bond if the parent bank was contemporaneously reducing its position in that bond. This tendency is specific to risky bonds: considering all bond holdings of public funds, the correlation reverts back to zero (not shown).

Table 7 reports the same analysis for the sample of banks and households. Again, we have a positive correlation for bank buy trades and a negative one for bank sells. For risky bonds, the negative correlation increases in absolute value from 2.09% to 2.74%.[13] This analysis is based on a sample that comprises more banks compared to the sample of banks' and funds' bond holdings, because many banks manage the security deposit account for customers in Germany, while only few banks own an asset management company and thus have affiliated mutual funds. Still, due to the high number of funds and the high number of government bonds held by funds compared to households, there are more observations for bank-fund pairs than at the bank-households level.

In sum, it is important to highlight that we find a negative correlation between a bank sovereign bond position and both its mutual funds' holdings and its retail customers' holdings of that bond only for the sell trades of the parent bank. Whenever the bank acquires a sovereign bond, the positions of its funds and customers are positively correlated. This finding, corroborated in our further analysis, suggests that our observations do not merely reflect a market-making activity of banks for their funds and retail customers.

6 Funds and retail customers as banks' fire-sale channel

6.1 The relationship between funds', households' and banks' bond trades

The univariate analysis provides already first suggestive evidence that banks might use their affiliated mutual funds and their retail customers when they intend to sell off risky bonds from their proprietary portfolio. In order to explore this further and provide stronger evidence for banks' opportunistic behavior, we next exploit the panel structure of our data set. Overall, the correlations in our univariate analysis might be a statistical artifact due to some unobserved variable problem, e.g. they might be a mere result of banks' deleveraging while investors simultaneously shift their investments from bank deposits into direct bond investments and/or mutual fund investments, accompanied by a "search-for-yield" of retail investors and fund managers. We can account for these effects since our panel approach allows to control for observed and unobserved time-varying heterogeneity both across banks and securities using bank-quarter and security-quarter fixed effects.

[13] Performing the same analysis with the portfolio of households replaced by the portfolio of non-financial corporations, we obtain the following correlation coefficients: for bank buy trades 2.9% ($p<0.01$), for bank sell trades -4.4% ($p<0.001$), for bank buy trades of risky bonds -3% ($p=0.42$), for bank sell trades of risky bonds 7.4% ($p=0.02$).

First, we investigate the relationship between bank trades and fund trades at the security level over time, estimating the following regression:

$$\begin{aligned}\Delta\text{Fund Holding}_{ijt} = \beta_0 \cdot \text{Sell}_{ijt} + \beta_1 \cdot \Delta\text{Bank Holding}_{ijt} \\ +\beta_2 \cdot \Delta\text{Bank Holding}_{ijt} \cdot \text{Sell}_{ijt} + \text{Fixed Effects,}\end{aligned} \tag{1}$$

with

$$\text{Sell}_{ijt} = \begin{cases} 1 & \text{if } \Delta\text{Bank Holding}_{ijt} < 0, \\ 0 & \text{otherwise.} \end{cases}$$

The changes in the mother institute's holdings are included as a standalone regressor, to capture the general relationship between bank and fund bond holding changes, and in interaction with an indicator variable for bank sells, to capture the relationship between bank and fund holding changes specific to when a bank is reducing its holding of a particular bond in a specific quarter.

Columns 1-3 of Table 8 show the result of the estimation with different sets of fixed effects. The coefficient on ΔBank Holding in columns 1 and 2 suggest that, overall, a change in bank holdings is related to a change in the same direction in funds holdings, even when we account for security fixed effects and time-varying fund fixed effects. However, this effect is more than canceled out in the case of bank sell trades. Accounting for quarter-by-quarter security-specific variation common to all funds (column 3) absorbs both the negative and the positive correlations. Next, we restrict the sample to public funds. We suspect that non-public (special) funds that mainly cater institutional investors are more closely monitored by investors. Thus public funds that are mainly held by retail customers might be in a better position to absorb fire sales of their parent banks. Columns 4 and 5 show that this seems to be indeed the case: the negative correlation between bank and fund trades when banks sell is stronger. However, when allowing for time-varying security fixed effects we again do not find any significant correlation (column 6). Thus based on these findings we cannot exclude that several funds often trade the same bond in the same direction in a given quarter, and some funds' purchases of a given bond coincide at times with the sales of that security by one of the affiliated bank – which might only cater the demand of its fund rather then using intentionally the fund as a channel for its fire sales.

In the next step we consider the relationship between banks' proprietary portfolio of government bonds and the portfolio of their retail customers. Similar to equation (1), we estimate the following regression:

$$\begin{aligned}\Delta\text{Household Holding}_{ijt} = \beta_0 \cdot \text{Sell}_{ijt} + \beta_1 \cdot \Delta\text{Bank Holding}_{ijt} \\ + \beta_2 \cdot \Delta\text{Bank Holding}_{ijt} \cdot \text{Sell}_{ijt} + \text{Fixed Effects.}\end{aligned} \tag{2}$$

Columns 1-3 of Table 9 present the results of the estimation of (2) with different sets of fixed effects. Again, the results confirm our findings from the univariate analysis: there is a positive correlation between changes in bank and household portfolios if the bank is increasing its holdings of a security (i.e. on average, households also increase their holdings in that security), but this correlation turns negative when a bank is decreasing its holdings of a security (i.e. on average, households still increase their holdings of that security). However, while for investment funds this relation could be explained by time-varying security fixed effects (the coefficients β_1 and β_2 turned non-significant), this is not the case for retail customers. Still, also in this case the statistical significance declines when allowing for time-varying security fixed effects.

Overall, for changes in both fund and household holdings, the negative correlation with bank sell trades becomes statistically less significant when including time varying security fixed effects. This suggests that a large part of funds' and households' portfolio changes reflects general market movements presumably in major (large volume) sovereign bonds. For those bonds, at times funds' and customers' purchases might simply coincide with a sell trade of that bond by an affiliated bank (explaining the more significant negative correlation when including only time invariant bond fixed effect).In order to more precisely focus on those bonds, which banks might have a particular incentive to sell to their affiliated mutual funds and/or retail customers, we disentangle in the subsequent sections 6.2 and 6.3 risky (i.e. crisis countries') and illiquid bonds, respectively. Obviously, the default risk of crisis countries' sovereign bonds and their market liquidity are closely related.

However, on one hand in a period in which banks had to top up their equity ratio[14], they were particularly loss averse and all banks simultaneously reduced their risky bonds holdings (see Figure 2). In such a buyers' market, banks might have been able to sell particularly those risky bonds at better terms than their peers, when trading with their affiliated funds or retail customers.

On the other hand, when selling off bonds banks will simply try to avoid market impact. Steering their funds' and customers' security purchases to those bonds that the bank intends to sell off allows it to mitigate market impact. In addition, sovereign bonds in the Euro area are traded OTC and selling off positions to affiliated funds or customers provides immediacyparticularly in an illiquid market.

6.2 Banks' fire sales of risky bonds

In order to study the relationship between fund trades and bank trades specifically for those bonds which at some point during the sample period carried a high default risk, we extend regression (1) to include the interaction with the CDS spread:

$$\begin{aligned}\Delta\text{Fund Holding}_{ijt} = \beta_0 \cdot \text{Sell}_{ijt} + \beta_1 \cdot \Delta\text{Bank Holding}_{ijt} + \beta_2 \cdot \Delta\text{Bank Holding}_{ijt} \cdot \text{Sell}_{ijt} + \\ + \beta_3 \cdot \Delta\text{Bank Holding}_{ijt} \cdot \text{CDS}_{jt} + \beta_4 \cdot \Delta\text{Bank Holding}_{ijt} \cdot \text{Sell}_{ijt} \cdot \text{CDS}_{jt} + \gamma_{jt} + \alpha_{it},\end{aligned} \tag{3}$$

where γ_{jt} and α_{it} represent sets of dummies which account, respectively, for quarter-security fixed effects and for quarter-fund fixed effects. The variable CDS_{jt} is the CDS spread associated to bond j at the end of quarter t. To make the CDS spread variable more telling about a bond's embedded risk, we floor the variable at 300 basis points, the 80th percentile of the distribution of the CDS spread over the sample period and the eurozone

[14]They had to do so for two reasons: first, because of the losses experienced in the aftermath of the Lehman crisis; second, to meet increased regulatory capital requirements due to Basel III.

countries (section 9 shows that the results are robust to alternative choices of the floor level). That is, we assign the value of 300 basis points to all the CDS spreads which are below that value. In this way, we hope to detect the effect of a change in the riskiness of the bond when it matters most, that is, when the bond is indeed unambiguously risky. Likely, for those countries which are considered safe and at no risk of default, a limited increase in the CDS spread hardly has a negative influence on the investment decisions of banks and funds. In fact, during the crisis, even CDS spreads of safe countries such as Germany saw a remarkable increase to reflect the heightened systemic risk embedded in the Euro area as a whole (the German CDS went from a few basis points to over 100 bps at the end of 2011 and for much of 2012). Nevertheless, the Bund was still considered a completely safe investment and holdings of German debt by German banks kept increasing. Additionally, we cap the variable at 1000, in order to account for distortions related to CDS spreads on Greece, which reached levels as high as 33,000 when they were discounting the upcoming haircut on Greek debt as well as outsized default risk.

Column 1 of Table 10 shows the result of this regression. There is no significant effect of a change in bank holdings when interacted only with the floored CDS variable. However, a negative and significant coefficient results if this interaction is limited to the changes that are sell trades. In other words, when a bank decreases its holdings, its funds' holdings increase more (or decrease less) the riskier the bond is.

Another way to account for the riskiness of a bond in our setting is to convert the CDS spread into a categorical variable. This allows to distinguish the effect of the variable for different levels of the variable itself, and facilitates the interpretation of the resulting coefficients. To keep the specification straight, we categorize the CDS into a dummy variable *Risky* that takes the value of 1 if the CDS spread is above the level we used as a floor in the previous specification, 0 otherwise. Column 2 of Table 10 reports the estimation results if we replace the CDS spreads by the dummy variable *Risky* in the interaction term. The coefficient of the interaction of *Risky* with *Sell* and $\Delta BankHolding$ is still negative and significant.

Next, we test whether banks use public and non-public (special) funds alike when selling off risky sovereign bonds. We suspect that special funds that are more tightly monitored by the specific institutional investors can hardly be used as exit channel by banks. Therefore, in a further diff-in-diff approach we test whether the effect of a risky bond sale is stronger for public than for non-public (special) funds. Column 3 of Table 10 confirms our prior: the relationship between bank sells and fund purchases of risky bonds can be ascribed to a large extent to the minority of funds that are public. With a coefficient of -0.8%, the effect is both economically and statistically much more significant for public funds.

A possible explanation for these findings might follow from heterogeneity in funds' investment style. Banks with larger proprietary trading in GIIPS bonds might have affiliated mutual funds that are also focusing on sovereign bond investments in these countries. In order to account for persistent unobserved heterogeneity in funds' security-specific investment strategies over the sample period, we run another set of estimates, where we saturate the regression also with fund-security fixed effects. Columns 4 and 5 in Table 10 report our estimates and show that the results remain both qualitatively and quantitatively intact.

The economic significance of these effects is visualized in Figure 6 by the marginal effects of changes in banks' holdings of risky bonds on the bank's affiliated public funds' holdings of the same bonds. Keeping all other explanatory variables constant (at their mean), a sell of risky bonds by a bank amounting to 100 Mio Euro is associated with a higher increase in the holdings of that bond by a public fund affiliated to that bank by roughly 1 Mio Euro.

As a next step, we want to focus on the relationship between banks' proprietary portfolios and households' portfolios for bonds with an elevated default risk. Therefore, we estimate a version of regression (3) for households:

$$\Delta \text{Households Holding}_{ijt} = \beta_0 \cdot \text{Sell}_{ijt} + \beta_1 \cdot \Delta \text{Bank Holding}_{ijt} + \beta_2 \cdot \Delta \text{Bank Holding}_{ijt} \cdot \text{Sell}_{ijt} + \\ + \beta_3 \cdot \Delta \text{Bank Holding}_{ijt} \cdot \text{CDS}_{jt} + \beta_4 \cdot \Delta \text{Bank Holding}_{ijt} \cdot \text{Sell}_{ijt} \cdot \text{CDS}_{jt} + \gamma_{jt} + \alpha_{it}, \tag{4}$$

where α_{it} in this case represents the bank-time fixed effects.

Column 1 of Table 11 reports the results of the estimation. The effect of a decrease in a bank's holding of a security is estimated to be significantly dependent on the CDS spread of the security. In particular, when banks are selling a bond, the higher the corresponding CDS spread, the more negative the correlation between bank's and customers' portfolios. In contrast, we see no significant interaction when a bank is increasing its holdings.

Also in this case, we repeat the estimation replacing the continuous CDS spread in (4) with a dummy *Risky* that indicates whether the spread is above or below 300bps. Column 2 reports the results and shows that this specification confirms our findings. In columns 3 and 4, we saturate the regressions with a set of fund-security fixed effects. Results with this highly restrictive estimation are statistically still significant and economically even stronger.

Figure 7 plots the marginal effect of a change in a bank's risky bond holdings on its customers' holdings of the same bond in order to visualize the economic significance. It shows that a decline in a bank's holding of a risky bond by 50 Mio Euros is associated with an increase of that bond by approximately 200.000 Euro in the portfolio of the banks' retail customers.

6.3 Banks' fire sales of illiquid bonds

So far, our results suggest that in a period when all banks sold off their risky sovereign bonds, those banks with affiliated mutual funds and/or a large customer base offloaded more of their risky bonds to their funds and/or customers. A bank might do so either because it obtained favorable rates or because it simply avoids market impact. In order to gauge more precisely, whether banks indeed tried to avoid market impact we next focus on illiquid bonds, i.e. bonds for which the market impact of a given transaction size is larger.

For each single security we use the bid-ask spread from Bloomberg, averaged over a quarter and appropriately winsorized, as a measure of time-varying market liquidity.[15] Table 12 reports the distribution by country and quarter of the observations in the sample of investment funds holdings with a bid-ask spread higher than 30 basis points (upper 10% of the sample with this ordering). This subsample contains securities issued by all the Euro area countries except Malta and Estonia. In 2011 and 2012, at the height of the sovereign bond crisis, there is a peak of holdings of illiquid bonds issued by the GIIPS countries, but also by Austria, Belgium, Germany and France.[16] We define a dummy variable Illiquid_{jt} being one for a bond j in quarter t whenever the average bid-ask-spread exceeds 30 bps. Overall, our liquidity measure overlaps only partially with the ordering by our default risk measure: the univariate correlation between the dummy for an illiquid bond, Illiquid_{jt}, and the dummy for a risky bond, Risky_{jt}, is 24%.

In order to test whether banks are more likely to sell illiquid bonds from their proprietary trading portfolio to their mutual funds we reestimate (3), but replace the CDS spread with the dummy Illiquid_{jt}. The result reported in column 1 of Table 13 confirms our hypothesis. When a bank sells off an illiquid sovereign bond, the bank's affiliated mutual funds are buying a significantly larger amount of that particular bond in the same quarter compared to when the bank sells a liquid bond. So banks tend to sell a significantly larger amount to their funds when trying to avoid market impact. These results prevail even though we account for time-varying security and time-varying fund fixed effect. Only when we additionally include security-fund fixed effects the coefficient is still negative but looses its significance at conventional levels. However, this does not necessarily invalidate the identification between bank and fund trades of illiquid bonds, but rather suggests that funds accumulated those illiquid bonds (presumably from their parent bank) over several quarters.

In the case of risky bonds, we found evidence that the negative correlation was especially remarkable for public funds. Next, we test whether we find a similar result for illiquid bonds. As shown in column 3, although the effect is somewhat more pronounced for public funds, the difference is neither economically, nor statistically significant. Thus, when simply trying to avoid market impact, banks seem to sell illiquid sovereign bonds not only to their public funds, but also to special funds.

Overall, our results so far suggest that banks sold both particularly risky as well as particularly illiquid bonds to their affiliated mutual funds. At the same time, Table 12 and Table 4 suggest that a bond's market liquidity and its perceived default risk by market participants is somewhat correlated.[17] For this reason, it is important to ascertain whether we obtain the results for risky bonds only because those bonds are often illiquid and banks actually only try to mitigate market impact. Furthermore, it is interesting to see whether

[15] Admittedly, the bid-ask-spread is not necessarily the best liquidity measure to grasp market impact. See Goyenko et al. (2009) for a comprehensive discussion of different market liquidity proxies. But due to a lack of transaction data at the security level, we cannot compute more appropriate measures such as the Amihud ratio.

[16] Actually, Germany is the country of issue of the most widely held illiquid bonds, with 22% of all the illiquid bond holdings, which is not surprising given around half of the observations in the sample are related to German bonds.

[17] As mentioned above, the univariate correlation between the dummy for an illiquid bond, *Illiquid*, and the dummy for a risky bond, *Risky*, is 24%.

banks are more likely to sell off risky bonds to their affiliated mutual funds when those bonds are illiquid, or whether banks used their mutual funds to offload risky securities irrespective of the market impact. We test for these considerations by interacting the volume a bank sells of a particular bond with both the dummy variable *Risky* and the dummy variable *Illiquid*, and include also an interaction term of the two dummy variables with each other and the bank sales volume.

Column 4 of Table 13 reports the results of the estimation. While for both risky and illiquid bonds the coefficient of bank sales has the expected negative sign, none of the effects is statistically significant anymore. This suggests that, indeed, for the sample as a whole a bond's default risk and its market illiquidity are too correlated to identify which of the two bond characteristics presumably induces banks to sell off positions to their affiliated mutual funds.

In our earlier analysis we obtained much stronger evidence of risky bonds flowing from banks to public funds in comparison to the overall sample of funds. Therefore, we next restrict our attention to public funds and reestimate the regression for that subsample. Column 5 shows that a different story indeed emerges: for these funds, the relationship can be traced back entirely to the default risk attributed to a bond. Illiquidity does not seem to play a role in this sample, neither *per se* nor in interaction with the bond's riskiness.

Next, we want to study whether banks used also the second channel to sell off illiquid sovereign bonds. In particular, we use the larger (in terms of banks) sample of matched bank-households sovereign bond holdings to assess whether banks simply tried to offload risky assets – presumably at favorable rates – with their retail customers, or also tried to avoid market impact by selling illiquid bonds. We apply the same threshold (30 basis points) to define illiquid bonds in the sample of matched households-bank holdings. This results in 25% of the observations being linked to illiquid bonds, a higher share than in the investment funds sample. Table 14 shows that, in this sample, the illiquid bond holdings are largely positions in Greek bonds, rather then German, Spanish, Irish or Portuguese. A univariate correlation analysis yields a correlation coefficient of 65% between the variables Illiquid_{jt} and Risky_{jt}.[18] Thus, compared to investment fund sovereign bond holdings, for the bonds in the sample of households holdings, high default risk and illiquidity are considerably correlated characteristics.

Table 15 reports the results we obtain when reestimating (4) with the dummy variable Illiquid_{jt} instead of CDS_{jt}. Surprisingly, the results are quite the opposite of what we found for investment funds: there is a baseline negative and significant coefficient for all bank sells, i.e. for sales of rather liquid sovereign bonds, but for illiquid governments bonds this effect is overcompensated by a positive effect (column 1 of Table 15), suggesting that banks rather pushed liquid sovereign bonds to their retail customers. However, both of these effects are partially absorbed by security-bank fixed effects, which render them insignificant (column 2).

At this stage, we include again both the dummy variable for illiquid and the dummy variable for risky bonds, as well as the interaction of these two dummy variables in our

[18] The correlation between the continuous variables CDS spread and B/A spread is 63%.

analysis. Column 3 of Table 15 reports the results. For non-risky and non-illiquid bonds, we find the baseline effect that we outlined in Table 9: a bank sell is significantly related to an increase of the holdings of households. Interestingly, we find again that, even when controlling for the separate effect of a bond's liquidity, a bank's sell of a risky bond is associated with a much larger acquisition of that bond by the bank's retail customers than if the bank sells a "safe" bond. But, surprisingly, this is not the case for illiquid risky bonds: in this case, a sell trade by the bank is associated with a sell trade also by its retail customers.

In sum, our results suggest that it is not the illiquidity of a sovereign bond that seems to induce banks to sell off risky bonds to their affiliated mutual funds or directly to their retail customers. When disentangling the effect of the two bond characteristics, illiquidity and riskiness, risky bonds seem to be sold by banks through these two exit channels controlling for a bond's liquidity. But neither are illiquid bonds *per se* sold more likely to banks' funds or customers when controlling for the bond's riskiness, nor are particularly risky, illiquid bonds pushed by banks to their fund or their customers.

So, avoiding market impact does not seem to be the main motive why banks supposedly sell sovereign bonds – in particular crisis countries sovereign bonds – to their affiliated funds or directly to their retail customers. Admittedly, these conclusions might be impaired by our measure for market liquidity. While the bid-ask-spread seems to be a decent measure for transaction costs, it might not be the best liquidity measure to capture the market impact.[19]

6.4 Which banks use retail investors particularly as exit channel?

In this section, we investigate which banks have stronger tendency to sell off risk sovereign bonds to their clients. Unfortunately, the cross section of banks in the sample of matched holdings of banks and affiliated mutual funds is too small to allow for a thorough analysis. However, in the sample of matched bank-household bond holdings we have 538 different banks providing us with sufficient cross-selectional variation in bank characteristics.

In order to further investigate the reasons why banks sold their risky sovereign bonds to their retail customers, we use various bank characteristics and interact each of these characteristics with the bank's sales volume of risky and non-risky sovereign bonds. Doing so allows us to see whether certain characteristics induced a bank to sell off a larger proportion of the risky bond position that it liquidated to its retail customers. As main bank characteristics, we considers a bank's size as measured by the sum of its assets, the size of its bond portfolio relative to its total assets and the contemporaneous change of its equity ratio.

Table 15b reports our main results. Interestingly, as column 1 shows, we find that larger banks tend to behave more opportunistically, selling more of their risky bonds to their customers. When they sell a risky bond position, a larger share of that position ends up in the bank's retail customers' portfolio compared to when smaller banks sell off the same position. One might suspect that this is the case because larger banks also

[19]See Goyenko et al. (2009) for a detailed discussion.

maintain larger security portfolios. But on the contrary, as column 2 indicates, banks with a relatively large bond portfolio are selling a smaller proportion of a bond position that they liquidate to their retail customers.

Most striking is the effect of changes in a bank's equity ratio as reported in column 3. Banks that experience an increase in their equity ratio seem to behave less opportunistically. Or vice versa, a bank that suffers from a decline in its equity ratio will push more of the risky bonds that it sells off to its retail customers the larger the decline in its equity ratio. This suggests that banks tend to use their customers more intensely as an exit channel during fire sales the more the bank needs to deleverage. While the coefficients on the two other bank characteristics do not hold when we simultaneously include all bank variables in the regression (see column 4), even in this specification the effect of banks' deleveraging is at least marginally significant.

7 The impact of having a parent bank on funds' bond trades

In Section 6 we found evidence that a relationship between bank sales and fund purchases of bonds exists specifically for those bonds that are perceived as carrying a high default risk. But did these trades induce bank-affiliated mutual funds to load up overall more risky sovereign bonds during the sovereign debt crisis? Or did bank-affiliated mutual funds sell more (or purchase fewer) of other risky sovereign bonds compared to their unaffiliated peers, thereby maintaining a similar aggregate exposure?

In order to assess whether having a parent bank during the crisis makes funds more likely to increase (or less likely to decrease) their holdings of risky bonds compared to those funds that do not have a parent bank, we first estimate the following regression:

$$\Delta \text{Fund Holding}_{ijt} = \beta \cdot \text{Has Bank}_{it} \cdot \text{Risky}_{jt} + \gamma_{jt} + \alpha_{it}, \tag{5}$$

where i denotes the investment fund, j denotes the sovereign bond, and t denotes the quarter. Has Bank_{it} is a dummy variable that is equal to 1 if fund i has a parent bank, zero otherwise.[20] As in Section 6, the variable Risky_{jt} denotes whether the CDS spread associated to bond j at the end of quarter t is above 300 basis points. The term α_{it} represents fund-time fixed effects that control for fund-specific investment behavior over time, on average across all bonds, as might result, for instance, from capital in- or outflows from the fund. The variable γ_{jt} represents a set of security-quarter fixed effects, which account for aggregate changes in the portfolio composition of the investment fund industry. Obviously, for this estimation we cannot resort to the sovereign bond holdings of only bank-affiliated mutual funds, but have to rather include also the respective holdings of unaffiliated funds from the Deutsche Bundesbank's Investment Fund Statistics.

Column 1 of Table 16 reports the results of the estimation. The conjecture that having a parent bank makes funds more likely to increase their holdings of high-default-risk bonds compared to those funds that do not have a parent bank seems to be supported: funds

[20] With the exception of one asset management company, in our sample this variable is constant over time.

which have a parent bank see a quarterly change in their holdings of risky bonds on average €150,000 higher than non-affiliated mutual funds.

Next we want use the enlarged sample to see whether bank-affiliated mutual funds purchase more of a risky sovereign bond if its parent bank sold that bond compared to both bank-affiliated funds whose parent bank did not sell the bank and unaffiliated funds. Thus we rerun a version of regression (5) where we replace the dummy Has Bank_{it} with a dummy Bank's Sell_{ijt}, which takes the value of 1 if bank i reduced its holdings of security j from $t-1$ to t. That is, this variable is always equal to zero if the fund belongs to an unaffiliated asset management company; in addition, it is zero if the fund was matched with a parent bank, but the security was not at that time part of the bank's proprietary portfolio; furthermore, it is zero also if the security was part of the parent bank's proprietary portfolio, but the bank did not contemporaneously reduce its holding of the security. Therefore, this variable identifies again whether a fund's investment decision was potentially influenced by the parent bank's decision to reduce its position in a given security.

Column 2 of Table 16 reports the results of the regression. Surprisingly, in this specification a bank's sale of a risky bond is not associated with an increase in the respective bond holdings by the bank's affiliated funds. Column 3 shows that, if we resort to a specification with the continuous CDS spread (where again we put a floor to the variable at 300bps), the interaction with $Bank'sSell$ turns indeed significant. If the parent bank is selling a non-risky security, the holdings of that security in the portfolio of its funds decrease by approximately 40,000€ for bonds with a 300 b.p. CDS spread ($-141,585 + 336.7 \times 300$). However, each 100 b.p. increase in the CDS spread of the bond corresponds to a 33,670€ increase in the effect of a bank's sells on fund holdings (336.7×100). To further corroborate our findings, in column 4 we include in addition to the time-varying fund and time-varying security fixed effects also security-fund fixed effects. This controls for persistent differences in funds' investment styles also between affiliated and unaffiliated mutual funds which might drive our results. But as the results show, when we control for different investment strategies of individual funds at the security level, the effects is only slightly weakened and is still marginally statistically significant (p=0.07).

In order to further focus on the question of whether bank-affiliated funds increased their holdings of risky bonds during the sovereign debt crisis more than their unaffiliated peers, we next take a longer-term perspective. We calculate the change in a fund i's portfolio share of a sovereign bond j from before the crisis (June 2010) to after the crisis (June 2012):

$$\Delta PortfolioShare_{ij} = \frac{FundHolding_{ijT}}{\sum_k FundHolding_{ikT}} - \frac{FundHolding_{ijt}}{\sum_k FundHolding_{ikt}},$$

where $t = 2010q2$ and $T = 2012q2$.

This permits us to run a cross-sectional regression to see whether this share increased in particular for risky bonds held by bank-affiliated funds. Specifically, we estimate

$$\Delta PortfolioShare_{ij} = HasBank_i \cdot CDS_j + \gamma_j + \alpha_i, \tag{6}$$

or alternatively with the dummy $Risky_j$, where both CDS_j and $Risky_j$ are the respective values for 2012q2. Here, γ_j and α_i represent respectively security fixed effects and fund fixed effects.

Table 17 summarizes our results for this cross-sectional analysis. Irrespective of whether we use our continuous measure for a sovereign bond's riskiness (column 1) or only the discrete dummy variable (column 2), we find that bank-affiliated mutual funds during the sovereign crisis increase their portfolio holdings of risky sovereign bonds significantly more than their non-affiliated peers.

In sum, while our findings in section 6 suggest that banks push risky bonds that they sell off partially to their mutual funds, the complementary results in this section indicate that bank-affiliated mutual funds overall increased their holdings of risky sovereign bonds compared to their unaffiliated peers. Thus affiliated funds did not reduce their holdings of other risky sovereign bonds equivalently when acquiring the risky bonds that their parent bank sold off. Similarly, bank-affiliated funds did not simply purchase the risky bonds that their parent bank sold off while non-affiliated mutual funds were purchasing the same amount of risky bonds in the market. As a consequence, other things equal, it seems that banks' sell-off of risky bonds to affiliated funds during the sovereign debt crisis made affiliated funds more risky than their peers.

8 The impact of having an asset management company on banks' fire sales

The results for previous sections provided evidence suggesting that affiliated funds acquired risky sovereign bonds from their parent bank and ended up holding a larger proportion of risky sovereign bonds than their peers. A natural question arising next is whether it was indeed easier for banks with an affiliated asset management company to sell such securities during the sovereign debt crisis than for banks who did not have an asset management unit. Were banks without affiliated funds able to offload the same amount of risky sovereign bonds in the market, or were these banks restricted in their ability to sell off these risky positions?

A way to answer this question is to look at whether banks with an asset management arm sold risky bonds in bigger quantities over the sample period than those without. We test this hypothesis with the following regression:

$$\Delta \text{Bank Holding}_{ijt} = \beta \cdot \text{Has Fund}_i \cdot \text{Risky}_{jt} + \gamma_{jt} + \alpha_{it}. \quad (7)$$

The binary variable Has Fund_i is equal to one for a bank which has affiliated investment funds. Since we only found evidence for banks using their affiliated mutual funds as an exit channel when they liquidate a position (we did not find evidence for a negative correlation when a bank increased its holding of a particular bond), we split the sample into banks' sell trades ($\Delta\text{Bank Holding}_{ijt} < 0$) and banks' buy trades ($\Delta\text{Bank Holding}_{ijt} > 0$) using the regression on bank buy trades as placebo tests.

When we run regression (7) using all German banks we do not find any significant difference in the changes of banks' risky sovereign bonds holdings between those banks that have an affiliated mutual fund and those that don't.[21] An obvious reason for this is that most of the banks without an affiliated asset management company are relatively small, do not trade very actively in bond markets and do not hold a sizable sovereign bond portfolio compared to those banks that have affiliated mutual funds. As a consequence, the difference in the trade size between the two groups of banks is largely explained by the time-varying bank fixed effects. In order to have a homogeneous sample of banks, we therefore estimate (7) only for those banks that are in the upper decile with respect to their Euro area sovereign bond holdings. Even with this restriction, the remaining banks hold over 90% of the total nominal value, on average over the sample period.

The results are shown in Table 19. Column 1 shows that having an affiliated mutual fund has no significant effect on the amount of a risky sovereign bond a bank purchased in our sample period. In contrast, for bank sales of risky bonds we find that the quarterly decrease in risky bond holdings is €6.7 million bigger on average for banks that have an affiliated fund. This effect is, however, only weakly statistically significant. In columns 3 and 4 we report the results of a regression with the continuous variable CDS_{jt}. While the results for bank purchases remain insignificant, the result for bank sales become more statistically significant using this specification.

For a bank that wants to liquidate its holdings of a sovereign bond, even when the security does not suffer of a high default risk, it can be particularly advantageous to have an asset management arm when the bond is relatively illiquid. Other banks, which do not have this exit channel available, might not be able to sell the bond as timely without a large market impact. In order to further test this effect, we define a dummy variable Liq. Shock_{jt} that is equal to one if the liquidity of bond j in quarter t suffered a severe drop – specifically if the bid-ask spread of the security increased by more than 7 bps from t to $t-1$ (this happens with a 10% frequency in the sample). Column 5 shows that banks' purchases of bonds that became illiquid do not vary between bank with and without affiliated mutual funds. However, banks with affiliated mutual funds were able to sell more of these illiquid bonds compared to banks without an asset management company: having an asset management arm allows a bank to sell a €8.3 million bigger stake of a security that suffers a liquidity shock in the market.

Overall, these findings complement the results from the previous sections. Banks seem to use their affiliated mutual funds as an exit channel when liquidating particularly risky bond holdings. This leads to a larger acquisition of risky bonds by bank-affiliated mutual funds, but at the same time to a larger reduction in risky bond holdings by banks with affiliated mutual funds.

[21] See the results reported in Table 18.

9 Robustness tests

In this section, we test the robustness of our results to alternative specifications of the threshold and floor for the CDS spread and for variations of the samples.

9.1 Robustness of banks' fire sales of risky bonds to funds and households

In our baseline sample, banks hold at times negative amounts of government bonds, i.e. they are short the securities. Since our argument focuses on the possibility of banks to get rid of specific securities by shifting them to investment funds rather than selling them on the market, we want to check that our results are not driven by banks that are already short on some bonds taking even more extreme negative positions. To this end, we repeat the estimation of (3), but restricting the sample to observations at quarter t where the bank's stock of a bond was positive at least in one quarter between t and $t-1$. That means, we exclude observations where a bank decreases an already negative position on a security. Columns 1 and 2 in Table 20 report the results of this exercise for the specification with the continuous CDS variable and for the specification with the binary variable *Risky* in interaction with *Public*: in both cases, the effect of a bank's sale of risky bonds is actually stronger if we exclude short sales than for the full sample (cf. Table 10).

In column 3 and 4, we repeat the analysis on a smaller sample that excludes bonds issued by state governments, local governments and social security funds, restricting the analysis to bonds issued by the central governments only (77% of the observations, with most of the excluded bonds issued by non-central governments being German). There is little change in the results from the baseline specification.

We now perform the same robustness test on our sample of bank-households bond holdings. Table 21 presents the results of the estimation of regression (4), where we exclude banks' short sales (columns 1 and 2) and government bonds not issued by a central government (columns 3 and 4). The only thing to note is that, in the latter case, the specification with the dummy variable for high-default-risk bonds yields a non-significant coefficient for the interaction of $\Delta BankHolding$ with *Sell* and *Risky*, although the coefficient is only slightly smaller than the one first reported in Table 11 (the main reason for the loss of statistical significance might be the reduced sample size).

Another concern with the estimation of our baseline regressions reported in Tables 10 and 11 is that the results might be dependent on the particular choice of the floor level for the continuous CDS spread, and of the threshold for the definition of the dummy variable *Risky*. Therefore, we first set the floor and the threshold at the 250 b.p. mark, which corresponds to the 75th percentile of the set of Eurozone countries, quarterly sampled CDS. Then, we set them at 375 basis points, which corresponds to the 85th percentile. However, this variation leaves all the results presented above unchanged: Table 22 and Table 23 show the results of this exercise respectively for investment funds and for households.

9.2 Robustness of the impact of having a parent bank

We now come to the specification (5), where we compared funds that have a parent bank with those that don't. Both restricting the sample to central government bonds and excluding the short sales of banks don't affect the results, or strengthen them (not reported). Table 24 reports the results of the estimation for alternative thresholds and floors. Columns 1 and 3 show that the coefficient β in regression (5) is indeed sensitive to changes of the threshold in the CDS spread for a risky bond. Both for a higher and for a lower threshold, the coefficient is still positive but not statistically significant. Columns 2 and 4 show, on the other hand, that with the continuous CDS spread results are robust to alternative levels of the floor: since as explanatory variable we use the indicator for a parent bank's sell trade of a bond, and not the mere condition of having a parent bank, the identification is much stronger.

9.3 Robustness of the impact of having an asset management company

In Table 25, we reestimate regression (7) for banks in the upper 10% Euro area sovereign bond holdings, changing the threshold in the CDS spread that determines whether a bond is considered at high risk of default.[22] As before, we first set the threshold at the 250 b.p. mark, which corresponds to the 75th percentile of the set of Eurozone countries, quarterly sampled CDS (columns 1 and 2). Then, we set it at 375 basis points, which corresponds to the 85th percentile (columns 3 and 4). In all cases, the coefficients on the interaction with the dummy variable $Risky$ turn markedly more negative (from -6.7 million to -8 million or more in the specification with $HasFund$; from -6.7 million to -7.7 million or more in the one with $HasFundHolding$). However, only when we set the threshold at a lower level the estimation is also more precise and leads to statistically clearly significant results.

9.4 Sovereign credit ratings as an alternative measure of risk

In the most insightful robustness test we replace our previous measure of a bond's default risk with the countries' credit ratings as provided by the main rating agencies. On one hand, as credit ratings are a less volatile indicator of a country's default risk than CDS spreads, the evaluations behind their update might align more closely to the motivations guiding banks' strategic risk management. Furthermore, in contrast to the CDS spread, credit ratings are not affected by changes in the market liquidity of credit derivatives. On the other hand, while the surge in CDS spreads of possibly risky countries took a decisive turn after the crisis peaked, reverting progressively until reaching pre-crisis levels, rating agencies refrained from promptly overturning their evaluations, and most of the credit ratings of crisis countries did not fully recover.

Table 26 reports the number of observations in the sample of matched household-bank holdings for which the sovereign credit rating associated to the bond is lower than or equal to BBB. To associate a credit rating to a bond, we code rating levels (long-term

[22] We also tried selecting the upper quartile of banks, instead of the upper decile. As expected, this results in an intermediate outcome, with regard to economic and statistical significance, between the one with the full sample and the one with the filtered sample.

and for obligations in local currency) at the end of the corresponding quarter on a discrete scale where 24 is the AAA rating and where 0-3 denote different default ratings. We then average over the three large rating agencies – Moody's, Fitch and S&P (see El-Shagi and von Schweinitz (2017)). As we can see from the table, holdings of bonds from Italy, Spain, Portugal, Greece, Cyprus and Slovenia had a poor rating at some point during the crisis.

In Table 27, we test our main specifications (regressions (3) and (4)) using the credit rating – instead of the CDS spread – as an explanatory variable for fund and household portfolio changes. Equivalent to our procedure with CDS spread, we winsorize the variable to the upper bound of 17 (corresponding to BBB+ for Fitch and S&P and to Baa1 for Moody's), to reflect our hypothesis that the variation in the credit rating has little influence on banks' investment decisions when the rating itself is not associated with considerable default risk. As a result, the variation of the rating variable is limited to the "worst-rated" 10% of the observations in our sample of mutual funds holdings, and to the "worst-rated" 25% of the observations in the sample of households holdings (which on average contains more bonds issued by low-rated countries).

Columns 1 and 2 of Table 27 show the results of the estimation on the mutual funds sample. The interaction between a negative change in bank holdings (sell trade) and the rating variable is positive and highly significant, even when we add security-fund fixed effects to the estimation. As a higher credit risk of an issuer country corresponds to a lower sovereign rating, this result is consistent with our previous results: for riskier bonds indicated by a low issuer credit rating a given sell trade by the bank is associated with a larger increase in the same bond holdings by the bank's affiliated mutual fund(s). Columns 3 and 4 show that in then case of households we obtain exactly the same results. Also here a bank selling off bonds with a poorer credit rating (lower credit score) will lead to a larger increase in the holdings of the same bond by the bank's retail customers. Interestingly in one case (column 2) the rating is also relevant for bank buy trades, suggesting that funds might actually sell lower-rated bonds when their parent banks purchase them.

10 Conclusion

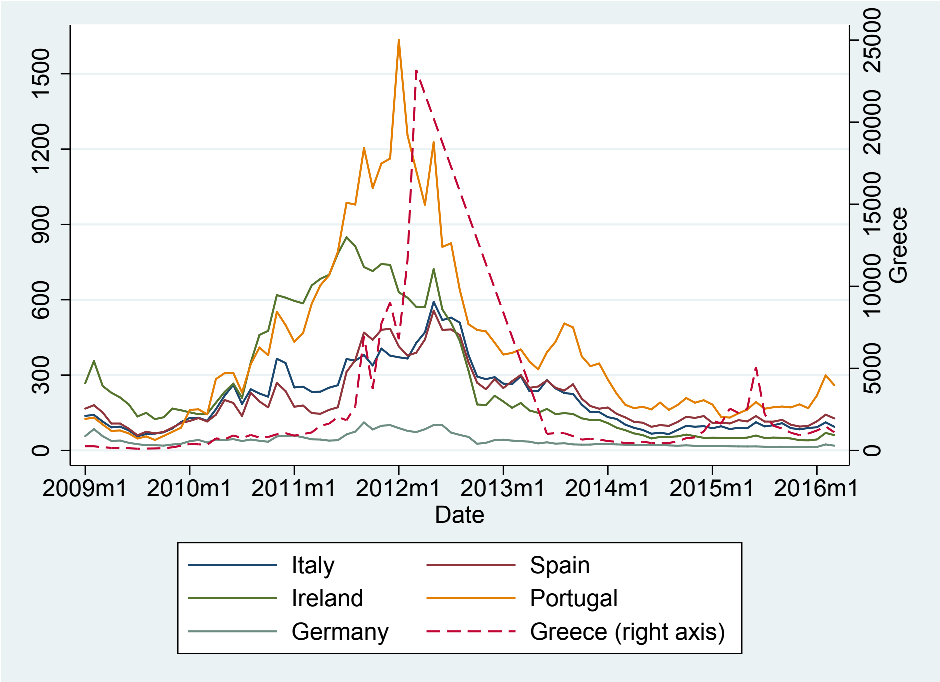
In this paper, we provide evidence suggesting that banks used both their affiliated mutual funds and their retail customers as an exit channel to sell off risky sovereign bonds. Some evidence indicates that banks did so to mitigate market impact: they seem to have particularly sold bonds with a relatively large bid-ask spread to their funds. But at the same time banks presumably pushed particularly liquid risky bonds to their affiliated funds and retail customers. Admittedly, our test on whether banks used funds and customers as exit channel to mitigate market impact suffers from the fact that our proxy for market liquidity – the bid-ask spread – is not the best measure for market impact.

Our further analysis shows that bank-affiliated mutual funds not only increased their holdings of those bonds that their parent bank sold, they also increased their overall portfolio share of risky sovereign bonds during the Euro area sovereign debt crisis significantly more than their unaffiliated peers. This suggests that those funds ended up being more risky than funds without a parent bank. At the same time banks with affiliated mutual funds were able to reduce their holdings of risky and illiquid sovereign bonds more significantly during the sovereign debt crisis than comparable banks without an affiliated asset management company.

While this seemingly opportunistic behavior of banks might undermine the efficiency of their clients' investment decisions, it presumably helped banks to offload risky sovereign holdings with only limited market impact. As a consequence, this exit channel might have also helped to mitigate fire-sale pricing and thus fire-sale externalities.

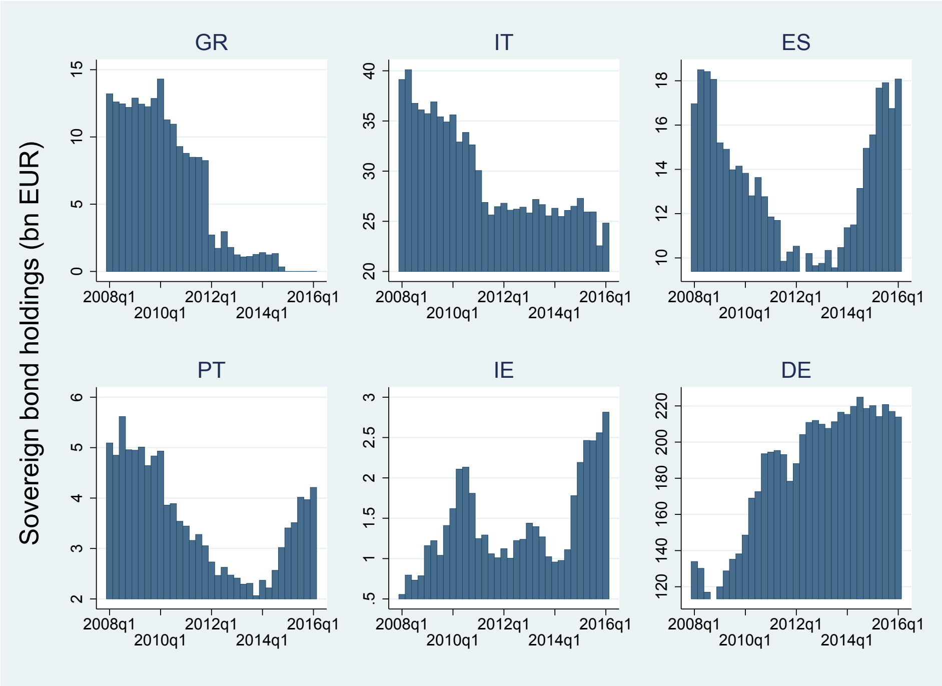
A Figures

Figure 1: Evolution of the CDS spread for selected European countries.



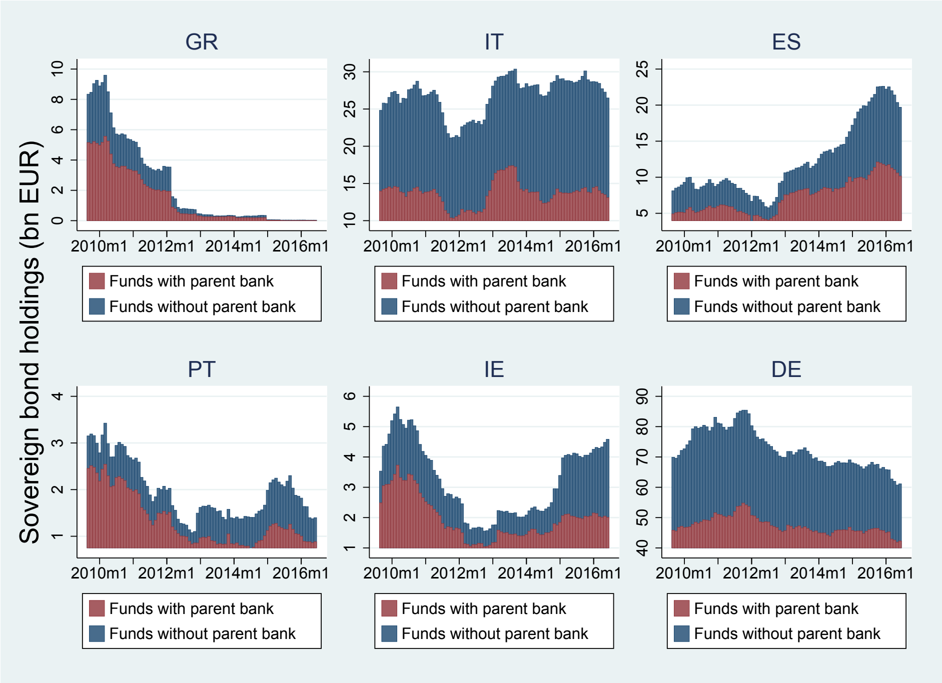
This figure shows the 5-year CDS spread of some key crisis countries plus Germany. Greece's CDS spread is missing from 2012m4 to 2013m5; the graphed line is a linear interpolation.

Figure 2: Evolution of German banks' holdings of government bonds from selected countries.



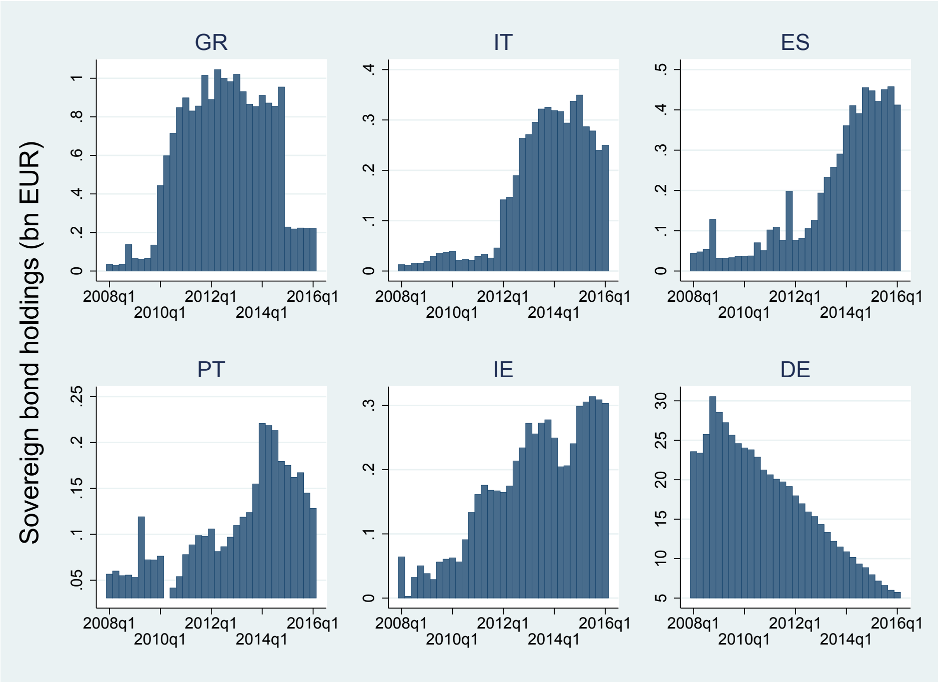
This figure shows the aggregate amount of government bonds held by German banks (excluding affiliates of foreign banks operating in Germany and special-purpose banks), classified by country of issue, for some key crisis countries and Germany.

Figure 3: Evolution of German mutual funds' holdings of government bonds from selected countries.



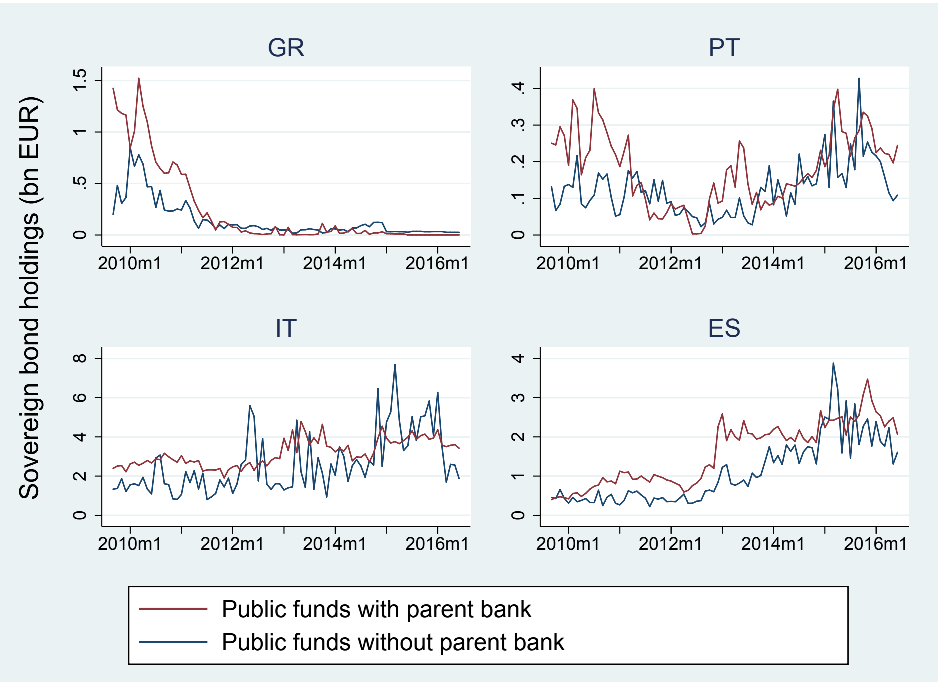
This figure shows the aggregate amount of government bonds held by German mutual fund companies, classified by country of issue, for some key crisis countries and Germany.

Figure 4: Evolution of household customers' holdings of government bonds from selected countries.



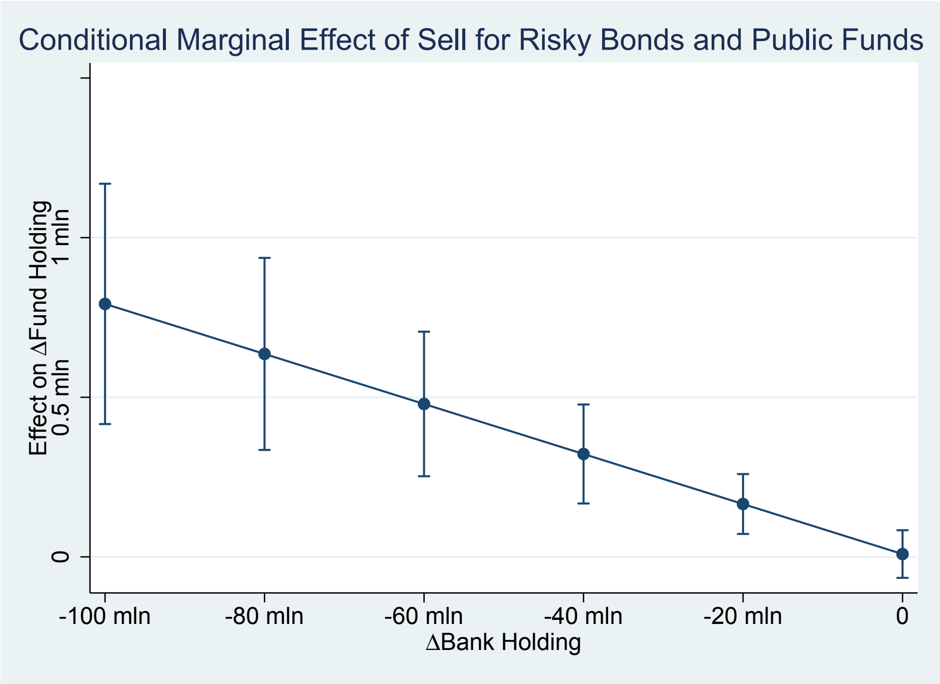
This figure shows the aggregate amount of government bonds held at German banks by household customers, classified by country of issue, for some key crisis countries and Germany.

Figure 5: Evolution of German public funds' holdings of government bonds from some key crisis countries.



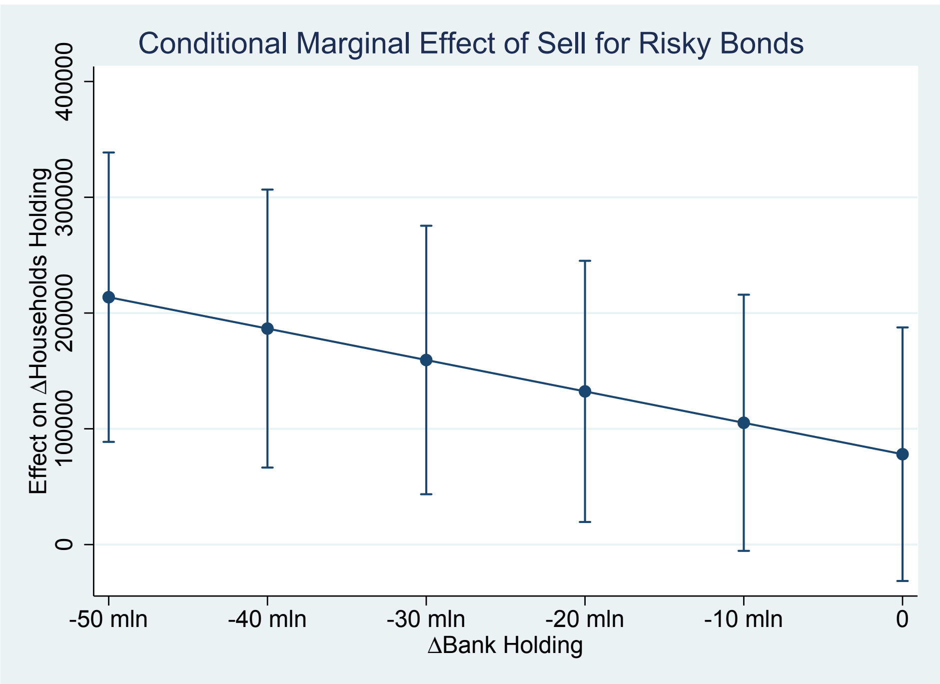
This figure shows the aggregate amount of government bonds held by German mutual funds that are open to retail investors, classified by country of issue, for some key crisis countries.

Figure 6: Estimated effect of banks' bond sales on the portfolios of mutual funds.



This figure shows the estimated effect of a bank selling a risky sovereign bond on the holdings of the same bond by the bank's affiliated public funds.

Figure 7: Estimated effect of banks' bond sales on the portfolio of households.



This figure shows the estimated effect of a bank selling a risky sovereign bond on the holdings of the same bond by the banks' retail customers.

B Tables

Table 1: Definition of the main variables.

Dependent variables	
$\Delta FundHolding_{ijt}$	Change in Euro holdings of bond j by fund i from quarter $t-1$ to quarter t. This variable exists if the fund held bond j in its portfolio in at least one of quarter $t-1$ and quarter t; it is set to missing if the bond comes to maturity in quarter t.
$\Delta HouseholdsHolding_{ijt}$	As in ΔFund Holding$_{ijt}$; change in the aggregate Euro amount of bond j held by households at bank i from quarter $t-1$ to quarter t.
Independent variables	
$\Delta BankHolding_{ijt}$	As in ΔFund Holding$_{ijt}$; change in Euro holdings of bond j by bank i, or by the parent bank of fund i, from quarter $t-1$ to quarter t.
$Sell_{ijt}$	Binary variable which is equal to 1 if ΔBank Holding$_{ijt} < 0$, and 0 otherwise.
$Public_i$	Binary variable which is equal to 1 if investment fund i is open to the public, and 0 otherwise (i.e., if it is dedicated to an institutional investor).
CDS_{jt}	Spread at the end of quarter t for a CDS contract on the country of issue of bond j with the maturity closest to the bond's time left to maturity.
$Risky_{jt}$	Binary variable which is equal to 1 if CDS_{jt}>300 bps, and 0 otherwise.
$Illiquid_{jt}$	Binary variable which is equal to 1 if the average bid-ask spread of bond j during quarter t (weekly sampling) is above 30 bps, and 0 otherwise.
$HasBank_i$	Binary variable which is equal to 1 if fund i has a parent bank, and 0 otherwise.
$Bank'sSell_{ijt}$	Binary variable which is equal to 1 if fund i has a parent bank for which ΔBank Holding$_{ijt}$ is not missing and $Sell_{ijt} = 1$ (that is, the parent bank was selling bond j at quarter t), and 0 otherwise.
$HasFund_i$	Binary variable which is equal to 1 if bank i has an asset management arm, with the additional condition that at least 10% of the bank's holdings of risky bonds are common also to the company's funds; 0 otherwise.
$HasFundHolding_{ijt}$	Binary variable which is equal to 1 if bank i has an asset management arm and there exist some funds for which ΔFund Holding$_{ijt}$ is not missing, and 0 otherwise.

Table 2: Summary statistics of funds' and banks' bond trades.

	$\lvert\Delta$Fund Holding$\rvert$ if $\neq 0$	$\lvert\Delta$Bank Holding$\rvert$ if $\neq 0$
Mean	2317922	2.50e+07
Median	800000	5918500
St. dev.	6563833	5.90e+07
p10	61000	85545
p90	5000000	6.54e+07
N	137720	303740

Table 3: Summary statistics of households' and banks' bond trades.

	$\lvert\Delta$Households Holding$\rvert$ if $\neq 0$	$\lvert\Delta$Bank Holding$\rvert$ if $\neq 0$
Mean	543872.5	1.86e+07
Median	43000	2794000
St. dev.	3943288	5.83e+07
p10	4000	27546
p90	670000	4.60e+07
N	22781	35069

Table 4: Bond holdings with CDS spread higher than 300 bps in the sample of matched fund and bank holdings.

	(1)											
	BE	CY	ES	GR	IE	IT	LT	LV	PT	SI	SK	Total
2009q4	0	0	0	0	0	0	8	1	0	0	0	9
2010q1	0	0	0	1448	0	0	0	0	0	0	0	1448
2010q2	0	0	0	1277	33	0	0	0	242	0	0	1552
2010q3	0	0	0	682	621	0	0	0	334	0	0	1637
2010q4	0	0	711	448	603	0	0	0	346	0	0	2108
2011q1	0	0	0	358	413	0	0	0	280	0	0	1051
2011q2	0	32	0	268	333	0	0	0	188	0	0	821
2011q3	0	5	703	155	268	1182	15	1	142	0	0	2471
2011q4	513	4	606	152	188	958	20	2	45	53	61	2602
2012q1	0	1	545	2866	144	694	0	0	32	20	0	4302
2012q2	0	1	551	2880	109	857	0	0	10	46	0	4454
2012q3	0	0	360	233	58	419	0	0	10	20	0	1100
2012q4	0	0	219	183	0	333	0	0	9	0	0	744
2013q1	0	0	219	38	0	532	0	0	14	23	0	826
2013q2	0	0	251	35	0	398	0	0	15	19	0	718
2013q3	0	0	0	35	0	0	0	0	39	11	0	85
2013q4	0	0	0	34	0	0	0	0	13	0	0	47
2014q1	0	0	0	6	0	0	0	0	0	0	0	6
2014q2	0	0	0	6	0	0	0	0	0	0	0	6
2014q3	0	0	0	6	0	0	0	0	0	0	0	6
2014q4	0	0	0	6	0	0	0	0	0	0	0	6
2015q1	0	0	0	5	0	0	0	0	0	0	0	5
2016q1	0	0	0	0	0	0	0	0	16	0	0	16
Total	513	43	4165	11121	2770	5373	43	4	1735	192	61	26020
N	26020											

This table reports, classified by quarter and country, the number of observations in the sample of matched fund-bank holdings for which the CDS spread associated to the bond is higher than 300 basis points (∼ 80th percentile of the set of quarterly Eurozone CDS spreads). This subsample corresponds to 3361 distinct bank holdings. This compares to 8702 distinct bank holdings for the sample of banks which have an asset management arm (including bonds not held by any fund), and 33,402 holdings for all German banks.

Table 5: Bond holdings with CDS spread higher than 300 bps in the sample of matched household and bank holdings.

	(1)											
	BE	CY	ES	GR	IE	IT	LT	LV	PT	SI	SK	Total
2009q4	0	0	0	0	0	0	17	9	0	0	0	26
2010q1	0	0	0	187	0	0	0	11	0	0	0	198
2010q2	0	0	0	209	2	0	0	10	26	0	0	247
2010q3	0	0	0	196	61	0	0	10	46	0	0	313
2010q4	0	0	95	195	69	0	0	0	54	0	0	413
2011q1	0	0	0	195	65	0	0	0	63	0	0	323
2011q2	0	19	0	184	67	0	0	0	56	0	0	326
2011q3	0	21	130	159	65	50	7	7	54	0	0	493
2011q4	45	22	119	158	57	83	9	11	52	11	13	580
2012q1	0	17	87	2163	60	71	0	0	48	8	0	2454
2012q2	0	16	120	2183	52	97	0	0	37	14	0	2519
2012q3	0	15	70	1357	25	48	0	0	38	10	0	1563
2012q4	0	15	42	1062	0	39	0	0	37	0	0	1195
2013q1	0	12	43	424	0	55	0	0	36	17	0	587
2013q2	0	7	46	379	0	41	0	0	37	19	0	529
2013q3	0	8	0	381	0	0	0	0	53	20	0	462
2013q4	0	8	0	358	0	0	0	0	23	0	0	389
2014q1	0	7	0	314	0	0	0	0	0	0	0	321
2014q2	0	6	0	252	0	0	0	0	0	0	0	258
2014q3	0	7	0	170	0	0	0	0	0	0	0	177
2014q4	0	8	0	169	0	0	0	0	0	0	0	177
2015q1	0	5	0	130	0	0	0	0	0	0	0	135
2015q2	0	5	0	78	0	0	0	0	0	0	0	83
2015q3	0	5	0	74	0	0	0	0	0	0	0	79
2015q4	0	1	0	64	0	0	0	0	0	0	0	65
2016q1	0	9	0	89	0	0	0	0	7	0	0	105
Total	45	213	752	11130	523	484	33	58	667	99	13	14017
N	14017											

This table reports, classified by quarter and country, the number of observations in the sample of matched household-bank holdings for which the CDS spread associated to the bond is higher than 300 basis points (∼ 80th percentile of the set of quarterly Eurozone CDS spreads). This subsample compares to 33,402 bank holdings for the same bonds and quarters when we include also those banks which don't hold a household portfolio, and viceversa 540,026 household holdings overall.

Table 6: Correlation between ΔFund Holding and ΔBank Holding.

	(1) Buy trades	(2) Sell trades	(3) Buy & Risky	(4) Sell & Risky	(5) Buy & Risky & Public	(6) Sell & Risky & Public
Correlation	0.0123***	-0.00537**	-0.00932	-0.00224	-0.0224	-0.0671***
Observations	155851	147889	9008	8824	2533	2544

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

This table reports the correlation coefficient between ΔFund Holding and ΔBank Holding for all the securities and quarters where there is a change in the bank holding (ΔBank Holding $\neq 0$). Column (1) reports the correlation for banks' net purchases over the quarter (ΔBank Holding > 0), while column (2) reports the correlation for banks' net sells (ΔBank Holding < 0). Column (3) reports the correlation for banks' net purchases and bonds whose country of emission, at the end of the corresponding quarter, had a CDS spread higher than 300bps. Column (4) reports the correlation for the same conditions but for banks' sell trades. Column (5) and column (6) report the correlation for the same risky bonds and bank trades when the investment fund is public. The observations that concern Greek sovereign bonds in the first two quarters of 2012 are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

Table 7: Correlation between ΔHousehold Holding and ΔBank Holding.

	(1) Buy trades	(2) Sell trades	(3) Buy & Risky	(4) Sell & Risky
Correlation	0.0319***	-0.0209***	0.00356	-0.0274
Observations	17461	17607	1994	3146

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

This table reports the correlation coefficient between ΔFund Holding and ΔHousehold Holding for all the securities and quarters where there is a change in the bank holding (ΔBank Holding $\neq 0$). Column (1) reports the correlation for banks' net purchases over the quarter (ΔBank Holding > 0), while column (2) reports the correlation for banks' net sells (ΔBank Holding < 0). Column (3) reports the correlation for banks' net purchases and bonds whose country of emission, at the end of the corresponding quarter, had a CDS spread higher than 300bp. Column (4) reports the correlation for the same conditions but for banks' sell trades. The observations that concern Greek sovereign bonds in the first two quarters of 2012 are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

Table 8: The relationship between funds' and banks' bond trades.

	(1) Full sample	(2) Full sample	(3) Full sample	(4) Public funds	(5) Public funds	(6) Public funds
$\Delta BankHolding$	0.00130***	0.000868***	0.0000903	0.00221*	0.00154*	0.000276
	(3.74)	(3.29)	(0.28)	(1.94)	(1.78)	(0.27)
Sell	58133.1**	4293.1	10156.3	226439.5**	115831.1	189530.3
	(1.99)	(0.16)	(0.27)	(2.29)	(1.35)	(1.61)
$\Delta BankHolding \times$ Sell	-0.00186***	-0.00130***	0.000369	-0.00332**	-0.00243**	0.00145
	(-3.97)	(-3.54)	(0.82)	(-2.15)	(-2.06)	(1.13)
Fund fixed effects	Yes	No	No	Yes	No	No
Security fixed effects	Yes	Yes	No	Yes	Yes	No
Fund-quarter fixed effects	No	Yes	Yes	No	Yes	Yes
Security-quarter fixed effects	No	No	Yes	No	No	Yes
Observations	355960	349305	343682	74250	73038	69818
R^2	0.029	0.208	0.273	0.024	0.216	0.321

t statistics in parentheses

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

This table reports coefficient estimates of different versions of regression (1). The t-statistics reported in parentheses use standard errors clustered at the fund level and at the security level. The observations that concern Greek sovereign bonds in the first two quarters of 2012 are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

Table 9: The relationship between households' and banks' bond trades.

	(1) $\Delta HouseholdsHolding$	(2) $\Delta HouseholdsHolding$	(3) $\Delta HouseholdsHolding$
Sell	-15332.7	-5343.8	78468.6
	(-0.48)	(-0.13)	(1.40)
$\Delta BankHolding$	0.000650***	0.000579***	0.000701*
	(4.34)	(4.40)	(1.80)
$\Delta BankHolding \times Sell$	-0.00129***	-0.00129***	-0.00107**
	(-51.86)	(-10.43)	(-2.31)
Bank fixed effects	Yes	No	No
Security fixed effects	Yes	Yes	No
Bank-quarter fixed effects	No	Yes	Yes
Security-quarter fixed effects	No	No	Yes
Observations	55896	51934	47529
R^2	0.069	0.083	0.278

t statistics in parentheses

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

This table reports the coefficient estimates for versions of regression (2). The t-statistics reported in parentheses use standard errors clustered at the bank level and at the security level. The observations that concern Greek sovereign bonds in the first two quarters of 2012 are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

Table 10: Funds' and banks' trades of bonds with high default risk.

	(1) $\Delta FundHolding$	(2) $\Delta FundHolding$	(3) $\Delta FundHolding$	(4) $\Delta FundHolding$	(5) $\Delta FundHolding$
Sell	9606.6	9097.7	8954.7	-1440.8	-1638.2
	(0.25)	(0.24)	(0.23)	(-0.04)	(-0.04)
$\Delta BankHolding$	0.000199	0.0000958	0.0000965	0.0000299	0.0000271
	(0.36)	(0.29)	(0.30)	(0.07)	(0.06)
$\Delta BankHolding \times Sell$	0.00217**	0.000448	0.000447	0.000326	0.000330
	(2.45)	(1.02)	(1.02)	(0.45)	(0.45)
$\Delta BankHolding \times CDS$	-0.000000341				
	(-0.27)				
$\Delta BankHolding \times CDS \times Sell$	-0.00000586**				
	(-2.37)				
$\Delta BankHolding \times Sell \times Risky$		-0.00291***		-0.00235*	
		(-2.69)		(-1.88)	
$\Delta BankHolding \times Sell \times Risky \times (1 - Public)$			-0.00187*		-0.00130
			(-1.65)		(-1.10)
$\Delta BankHolding \times Sell \times Risky \times Public$			-0.00819***		-0.00743***
			(-4.34)		(-3.01)
Fund-quarter fixed effects	Yes	Yes	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes	Yes	Yes
Security-fund fixed effects	No	No	No	Yes	Yes
Observations	343682	343682	343682	335509	335509
R^2	0.273	0.273	0.273	0.436	0.436

t statistics in parentheses

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

This table reports the coefficient estimates for versions of regression (3). The variable CDS is floored at 300 basis points. Additionally, there is a cap at 1000 bps. Risky is a binary variable that is equal to 1 if the CDS spread associated to the bond, at the end of the corresponding quarter, is above 300 basis points; 0 otherwise. The t-statistics reported in parentheses use standard errors clustered at the fund level and at the security level. The observations that concern Greek sovereign bonds in the first two quarters of 2012 are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

Table 11: Households' and banks' trades of bonds with high default risk.

	(1) $\Delta HouseholdsHolding$	(2) $\Delta HouseholdsHolding$	(3) $\Delta HouseholdsHolding$	(4) $\Delta HouseholdsHolding$
Sell	78603.7 (1.41)	78071.3 (1.40)	74273.2 (1.41)	73577.4 (1.39)
$\Delta BankHolding$	0.000416 (0.76)	0.000698* (1.74)	0.000118 (0.20)	0.000532 (1.36)
$\Delta BankHolding \times Sell$	0.000532 (1.21)	-0.000996** (-2.11)	0.00175* (1.69)	-0.000431 (-1.16)
$\Delta BankHolding \times CDS$	0.000000838 (1.44)		0.00000125 (1.36)	
$\Delta BankHolding \times CDS \times Sell$	-0.00000486*** (-5.19)		-0.00000702** (-2.55)	
$\Delta BankHolding \times Sell \times Risky$		-0.00135*** (-3.87)		-0.00211*** (-3.60)
Bank-quarter fixed effects	Yes	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes	Yes
Security-bank fixed effects	No	No	Yes	Yes
Observations	47529	47529	46493	46493
R^2	0.278	0.278	0.384	0.384

t statistics in parentheses

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

This table reports the coefficient estimates for versions of regression (4). The variable CDS has a floor at 300bps. Additionally, there is a cap at 1000 bps. Risky is a binary variable that is equal to 1 if the CDS spread associated to the bond, at the end of the corresponding quarter, is above 300bps; 0 otherwise. The t-statistics reported in parentheses use standard errors clustered at the bank level and at the security level. The observations that concern Greek sovereign bonds in the first two quarters of 2012 are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

Table 12: Bond holdings with bid-ask spread higher than 30 bps – investment funds sample.

	(1)																	
	AT	BE	CY	DE	ES	FI	FR	GR	IE	IT	LT	LU	LV	NL	PT	SI	SK	Total
2009q4	216	166	0	32	6	31	1	56	0	0	8	0	1	0	0	1	97	615
2010q1	276	164	5	38	8	0	1	65	0	4	9	0	0	0	0	17	17	604
2010q2	414	87	5	69	15	0	6	0	0	2	4	0	0	0	0	15	33	650
2010q3	570	81	1	51	8	0	7	3	0	4	13	0	0	0	0	23	18	779
2010q4	625	86	16	51	14	0	9	16	0	5	21	0	2	0	0	14	138	997
2011q1	88	144	31	127	215	0	10	357	413	163	27	60	1	4	279	37	142	2098
2011q2	13	54	32	506	82	0	17	268	333	25	28	16	1	39	188	75	113	1790
2011q3	305	94	5	719	282	0	58	155	268	257	32	50	2	13	142	59	116	2557
2011q4	939	820	4	1153	576	0	382	152	188	463	29	46	2	145	45	53	115	5112
2012q1	876	480	1	1386	349	4	371	0	144	206	35	91	5	123	32	45	84	4232
2012q2	186	235	1	1004	318	54	270	0	109	177	35	85	5	84	10	46	98	2717
2012q3	116	248	0	657	361	52	263	212	124	179	42	42	5	93	10	49	105	2558
2012q4	104	212	0	628	233	44	136	163	138	119	35	20	2	86	10	33	113	2076
2013q1	67	130	0	302	135	45	88	21	155	43	30	83	1	80	19	32	127	1358
2013q2	10	21	0	195	94	0	87	20	125	36	33	77	1	72	27	32	177	1007
2013q3	10	23	0	186	60	0	81	20	96	34	22	49	1	77	33	23	160	875
2013q4	11	126	0	98	38	0	77	20	16	32	21	67	0	75	31	27	165	804
2014q1	0	149	0	118	78	0	58	1	0	26	32	2	10	75	14	24	196	783
2014q2	0	20	0	58	92	0	72	1	0	26	30	4	22	75	1	57	191	649
2014q3	0	86	0	55	91	0	74	1	0	26	29	61	23	56	0	53	156	711
2014q4	36	25	0	48	47	19	55	1	0	23	24	59	30	52	3	95	106	623
2015q1	35	74	0	75	89	0	69	0	41	23	48	41	35	47	1	100	140	818
2015q2	40	100	0	123	79	0	141	0	109	94	59	40	33	46	1	98	153	1116
2015q3	36	29	0	232	80	4	117	0	69	27	70	38	39	43	1	88	141	1014
2015q4	28	37	0	309	133	4	198	0	30	86	59	44	40	38	0	94	145	1245
2016q1	30	21	0	298	75	4	127	0	23	38	54	18	38	35	7	15	128	911
Total	5031	3712	101	8518	3558	261	2775	1532	2381	2118	829	993	299	1358	854	1205	3174	38699
N	38699																	

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

This table reports, classified by quarter and country, the number of observations in the sample of matched fund-bank holdings for which the bond's bid-ask spread is higher than 30 basis points (∼10% of the observations).

Table 13: Funds' and banks' bond trades of illiquid bonds.

	(1) Full sample	(2) Full sample	(3) Full sample	(4) Full sample	(5) Public funds
Sell	8007.3	-1763.2	8007.3	8039.1	198699.6*
	(0.21)	(-0.05)	(0.21)	(0.21)	(1.69)
$\Delta BankHolding$	0.0000948	-0.0000695	0.0000948	0.0000980	0.000332
	(0.29)	(-0.17)	(0.29)	(0.30)	(0.32)
$\Delta BankHolding \times Sell$	0.000444	0.000409	0.000444	0.000470	0.00175
	(0.99)	(0.60)	(0.99)	(1.06)	(1.36)
$\Delta BankHolding \times Sell \times Illiquid$	-0.00510**	-0.00251		-0.00426	0.00170
	(-2.16)	(-1.38)		(-1.20)	(0.35)
$\Delta BankHolding \times Sell \times Illiquid \times (1 - Public)$			-0.00508*		
			(-1.94)		
$\Delta BankHolding \times Sell \times Illiquid \times Public$			-0.00517**		
			(-2.14)		
$\Delta BankHolding \times Sell \times Risky$				-0.00157	-0.0145***
				(-0.99)	(-3.49)
$\Delta BankHolding \times Sell \times Risky \times Illiquid$				-0.000120	0.00876
				(-0.03)	(1.20)
Fund-quarter fixed effects	Yes	Yes	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes	Yes	Yes
Security-fund fixed effects	No	Yes	No	No	No
Observations	339949	331725	339949	339949	69104
R^2	0.269	0.435	0.269	0.269	0.322
Adjusted R^2	0.152	0.191	0.152	0.152	0.137

t statistics in parentheses

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

This table reports the results of regressions where the dummy $Illiquid_{jt}$ is 1 if bond's j average bid-ask spread over quarter t (sampled weekly) is larger than 30 basis points. Risky is a binary variable that is equal to 1 if the CDS spread associated to the bond, at the end of the corresponding quarter, is above 300bps; 0 otherwise. The t-statistics reported in parentheses use standard errors clustered at the fund level and at the security level. The observations that concern Greek sovereign bonds in the first two quarters of 2012 are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

Table 14: Bond holdings with bid-ask spread higher than 30 bp – households sample.

	(1)																	
	AT	BE	CY	DE	ES	FI	FR	GR	IE	IT	LT	LU	LV	NL	PT	SI	SK	Total
2009q4	28	7	0	16	2	3	4	14	0	0	15	0	9	0	0	2	10	110
2010q1	35	6	3	15	2	0	2	15	0	0	17	0	11	0	0	2	7	115
2010q2	44	4	3	29	0	0	2	1	0	0	15	0	10	0	0	4	7	119
2010q3	48	4	4	23	0	0	3	6	0	0	16	0	10	0	0	4	6	124
2010q4	54	3	10	21	0	0	3	9	0	0	16	0	10	0	0	3	15	144
2011q1	16	7	14	45	37	0	5	195	65	5	21	3	11	0	63	5	17	509
2011q2	4	3	15	172	23	0	5	184	67	3	20	3	11	0	56	11	17	594
2011q3	32	4	17	236	58	0	9	157	65	13	23	3	11	1	54	11	21	715
2011q4	83	67	18	324	112	0	39	154	57	42	22	3	11	7	52	11	22	1024
2012q1	88	48	13	338	57	3	37	0	60	24	22	4	11	3	48	12	30	798
2012q2	28	20	12	268	63	1	27	0	52	27	18	4	11	1	37	14	30	613
2012q3	19	18	11	206	74	2	26	1290	57	29	23	5	10	5	38	14	25	1852
2012q4	15	16	11	172	49	1	13	1004	68	23	24	4	8	2	43	16	25	1494
2013q1	10	11	9	118	38	2	6	380	64	8	14	6	6	2	52	22	32	780
2013q2	0	0	4	82	22	0	5	338	44	7	13	6	6	3	52	26	32	640
2013q3	0	0	4	43	14	0	6	340	42	5	14	9	6	3	53	26	33	598
2013q4	0	12	4	43	11	0	4	319	3	5	14	11	6	3	44	26	37	542
2014q1	0	13	4	47	18	0	1	278	0	2	14	1	5	3	16	26	34	462
2014q2	1	0	7	39	20	0	5	215	0	1	11	1	4	3	2	22	34	365
2014q3	0	7	9	40	19	0	4	136	0	0	12	13	4	2	0	20	30	296
2014q4	12	1	8	42	13	3	4	138	0	1	5	13	3	1	3	19	27	293
2015q1	14	11	5	31	17	0	7	101	2	2	5	14	3	1	7	18	27	265
2015q2	12	12	6	46	13	0	12	77	11	3	5	13	3	1	7	18	23	262
2015q3	11	0	6	54	19	2	9	73	5	2	6	13	3	2	6	17	25	253
2015q4	10	4	6	50	22	2	14	64	2	5	2	13	3	2	1	13	21	234
2016q1	10	0	9	52	17	1	3	88	2	3	2	13	1	2	3	6	21	233
Total	574	278	212	2552	720	20	255	5576	666	210	369	155	187	47	637	368	608	13434
N	13434																	

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

This table reports, classified by quarter and country, the number of observations in the sample of matched households-bank holdings for which the bond's bid-ask spread is larger than 30 basis points.

Table 15: Households' and banks' bond trades of illiquid bonds.

	(1) $\Delta CustomerHolding$	(2) $\Delta CustomerHolding$	(3) $\Delta CustomerHolding$
Sell	73481.2	70363.4	73266.4
	(1.30)	(1.33)	(1.32)
$\Delta BankHolding$	0.000584	0.000411	0.000577
	(1.50)	(1.25)	(1.47)
$\Delta BankHolding \times Sell$	-0.00106**	-0.000463	-0.000896*
	(-2.14)	(-0.98)	(-1.96)
$\Delta BankHolding \times Sell \times Illiquid$	0.00170*	0.00125	0.000225
	(1.79)	(1.07)	(0.57)
$\Delta BankHolding \times Sell \times Risky$			-0.00442***
			(-4.48)
$\Delta BankHolding \times Sell \times Risky \times Illiquid$			0.00818**
			(2.47)
Bank-quarter fixed effects	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes
Security-bank fixed effects	No	Yes	No
Observations	46806	45785	46806
R^2	0.274	0.385	0.274
Adjusted R^2	-0.022	-0.031	-0.022

t statistics in parentheses

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

This table reports the results of regressions where the dummy Illiquid$_{jt}$ is 1 if bond's j average bid-ask spread over quarter t (sampled weekly) is larger than 30 basis points. Risky is a binary variable that is equal to 1 if the CDS spread associated to the bond, at the end of the corresponding quarter, is above 300bps; 0 otherwise. The t-statistics reported in parentheses use standard errors clustered at the bank level and at the security level. The observations that concern Greek sovereign bonds in the first two quarters of 2012 are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

Table 15b: Regressions with bank characteristics.

	(1) $\Delta HouseholdsHolding$	(2) $\Delta HouseholdsHolding$	(3) $\Delta HouseholdsHolding$	(4) $\Delta HouseholdsHolding$
Sell	67329.9	67153.9	65840.5	63464.8
	(1.31)	(1.30)	(1.31)	(1.25)
$\Delta BankHolding$	0.000972***	0.000972***	0.000975***	0.000981***
	(2.88)	(3.04)	(3.09)	(2.64)
$\Delta BankHolding \times Sell$	-0.000429	-0.00190***	-0.00139***	-0.00342
	(-0.51)	(-2.87)	(-3.66)	(-1.21)
$\Delta BankHolding \times Sell \times$ Bank Size	-1.69e-12			1.63e-12
	(-0.32)			(0.49)
$\Delta BankHolding \times Sell \times Risky$	0.00711***	-0.00389	0.00102	-0.0405
	(25.93)	(-0.88)	(0.77)	(-0.80)
$\Delta BankHolding \times Sell \times Risky \times$ Bank Size	-1.03e-11***			4.31e-11
	(-3.88)			(0.00)
$\Delta BankHolding \times Sell \times$ Bond Holdings		0.00493		0.00977
		(1.08)		(1.02)
$\Delta BankHolding \times Sell \times Risky \times$ Bond Holdings		0.0639***		0.192
		(3.76)		(1.03)
$\Delta BankHolding \times Sell \times \Delta$Equity Ratio			0.0696	0.0989
			(1.07)	(1.55)
$\Delta BankHolding \times Sell \times Risky \times \Delta$Equity Ratio			0.855**	0.992*
			(2.39)	(1.91)
Bank-quarter fixed effects	Yes	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes	Yes
Observations	47164	47164	47164	47164
R^2	0.285	0.285	0.285	0.285

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

This table reports the coefficient estimates for versions of regression (4) where some bank characteristics are added to the regressors. Risky is a binary variable that is equal to 1 if the CDS spread associated to the bond, at the end of the corresponding quarter, is above 300bps; 0 otherwise. The t-statistics reported in parentheses use standard errors clustered at the bank level and at the security level. The observations that concern Greek sovereign bonds in the first two quarters of 2012 are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

Table 16: Fund bond trades: having vs. not having a parent bank.

	(1) Δ Fund Holding	(2) Δ Fund Holding	(3) Δ Fund Holding	(4) Δ Fund Holding
Has Bank × Risky	151607.7**			
	(1.99)			
Bank's Sell		-38729.9	-141585.3***	-116214.3*
		(-1.48)	(-2.71)	(-1.79)
Bank's Sell × Risky		41281.2		
		(0.64)		
Bank's Sell × CDS			336.7**	304.7*
			(2.43)	(1.79)
Fund-quarter fixed effects	Yes	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes	Yes
Security-fund fixed effects	No	No	No	Yes
Observations	1381926	1381926	1381926	1362893
R^2	0.205	0.205	0.205	0.378

t statistics in parentheses

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

This table reports coefficient estimates of different versions of regression (5). Risky is a binary variable that is equal to 1 if the CDS spread of the country of emission of the bond, at the end of the corresponding quarter, is above 300 basis points; 0 otherwise. The variable CDS is floored at 300 basis points. Additionally, there is a cap at 1000bps. The t-statistics reported in parentheses use standard errors clustered at the fund level and at the security level. The observations that concern Greek sovereign bonds in the first two quarters of 2012 are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

Table 17: Funds' portfolio shares of risky bonds: having vs. not having a parent bank.

	(1) Δ Portfolio Share	(2) Δ Portfolio Share
Has Bank × CDS	0.000163***	
	(4.90)	
Has Bank × Risky		0.0520***
		(12.14)
Fund fixed effects	Yes	Yes
Security fixed effects	Yes	Yes
Observations	64535	64535
R^2	0.398	0.401

t statistics in parentheses

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

This table reports coefficient estimates of regression (6) where the dependent variable is $\Delta PortfolioShare$. Risky is a binary variable that is equal to 1 if the CDS spread of the country of emission of the bond, at the end of the corresponding quarter, is above 300 basis points; 0 otherwise. The variable CDS is floored at 300 basis points. Additionally, there is a cap at 1000bps. The t-statistics reported in parentheses use standard errors clustered at the fund level and at the security level. The observations that concern Greek sovereign bonds are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

Table 18: Regressions from banks' perspective

	(1) Bank buys	(2) Bank sells	(3) Bank buys	(4) Bank sells
Has Fund × Risky	-3579760.5	-4641045.7		
	(-1.38)	(-1.36)		
Has Fund Holding			-2404805.4	-2398653.0
			(-1.28)	(-0.80)
Has Fund Holding × Risky			-2160288.2	-4852207.7
			(-0.86)	(-1.28)
Bank-quarter fixed effects	Yes	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes	Yes
Observations	54806	38518	54806	38518
R^2	0.438	0.438	0.438	0.438

t statistics in parentheses

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

This table reports the coefficient estimates for regression (7). "Risky" is a binary variable that is equal to one if the CDS spread of the country of emission of the bond, at the end of the corresponding quarter, is above 300bps; zero otherwise. "Has Fund Holding" is a binary variable that is equal to one if that security was part of the holdings of a fund associated to that bank on that specific quarter, zero otherwise. "Has Fund" is a binary variable that is always equal to one for a bank which has an associated asset management company, with the additional condition that at least 10% of the bank's holdings of risky bonds are common also to the company's funds. The t-statistics reported in parentheses use standard errors clustered at the bank level and at the security level. The observations that concern Greek sovereign bonds in the first two quarters of 2012 are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

Table 19: Regressions from banks' perspective with homogeneous sample.

	(1) Bank buys	(2) Bank sells	(3) Bank buys	(4) Bank sells	(5) Bank buys	(6) Bank sells
Has Fund × Risky	-1865054.2	-6698968.6*				
	(-0.67)	(-1.91)				
Has Fund × CDS			-1806.1	-5812.2**		
			(-1.36)	(-2.55)		
Has Fund × Liq. Shock					128294.2	-8272640.0**
					(0.04)	(-2.55)
Bank-quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	42505	33912	42505	33912	34343	32685
R^2	0.444	0.444	0.444	0.444	0.431	0.442

Dependent variable: ΔBank Holding. Subsample of the 10% bigger banks by sovereign bond holdings.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. t statistics in parentheses.

This table reports the coefficient estimates for regressions (7), for a sample that includes the upper decile of banks by eurozone government bond holdings (average holdings over the sample period). "Risky" is a binary variable that is equal to one if the CDS spread of the country of emission of the bond, at the end of the corresponding quarter, is above 300bps; zero otherwise. "Has Fund" is a binary variable that is always equal to one for a bank which has an associated asset management company, with the additional condition that at least 10% of the bank's bond holdings considered risky are common also to the company's funds. "Liq. Shock" is a binary variable that is equal to one if the security liquidity dropped in that quarter (bid-ask spread increased by more than 7 bps). The t-statistics reported in parentheses use standard errors clustered at the bank level and at the security level. The observations that concern Greek sovereign bonds in the first two quarters of 2012 are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

Table 20: Robustness regressions for funds' and banks' trades of risky bonds.

	(1) No short sales	(2) No short sales	(3) Central govt	(4) Central govt
Sell	-113480.8*	-114395.4*	5638.5	4777.5
	(-1.84)	(-1.85)	(0.11)	(0.09)
$\Delta BankHolding$	-0.000229	-0.0000918	0.0000859	0.0000873
	(-0.30)	(-0.19)	(0.16)	(0.26)
$\Delta BankHolding \times Sell$	0.00278***	0.000865	0.00231**	0.000474
	(2.59)	(1.26)	(2.56)	(1.05)
$\Delta BankHolding \times CDS$	0.000000381		-1.43e-08	
	(0.27)		(-0.01)	
$\Delta BankHolding \times CDS \times Sell$	-0.00000652***		-0.00000624**	
	(-2.70)		(-2.48)	
$\Delta BankHolding \times Sell \times Risky \times (1 - Public)$		-0.00361***		-0.00202*
		(-3.62)		(-1.72)
$\Delta BankHolding \times Sell \times Risky \times Public$		-0.00911***		-0.00819***
		(-3.95)		(-4.27)
Fund-quarter fixed effects	Yes	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes	Yes
Observations	216849	216849	263791	263791
R^2	0.297	0.297	0.268	0.268

t statistics in parentheses

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

This table reports the coefficient estimates for regression (3) for subsamples without bank short sales and without bonds issued by regional governments. The variable CDS represents the CDS spread associated to the bond at the end of the corresponding quarter and has a floor at 300bps. Additionally, there is a cap at 1000. Risky is a binary variable that is equal to 1 if the CDS spread associated to the bond, at the end of the corresponding quarter, is above 300bps; 0 otherwise. The t-statistics reported in parentheses use standard errors clustered at the fund level and at the security level. The observations that concern Greek sovereign bonds in the first two quarters of 2012 are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

Table 21: Robustness regressions for households' and banks' trades of risky bonds.

	(1) No short sales	(2) No short sales	(3) Central govt	(4) Central govt
Sell	75460.5	74533.7	110887.5	110462.4
	(1.06)	(1.04)	(1.51)	(1.50)
$\Delta BankHolding$	0.00103**	0.00112***	0.000149	0.000539
	(2.01)	(2.97)	(0.28)	(1.44)
$\Delta BankHolding \times Sell$	-0.000237	-0.00166***	0.000738	-0.000828
	(-0.52)	(-3.10)	(1.25)	(-1.65)
$\Delta BankHolding \times CDS$	0.000000250		0.00000116*	
	(0.43)		(1.87)	
$\Delta BankHolding \times CDS \times Sell$	-0.00000458***		-0.00000492***	
	(-5.05)		(-3.34)	
$\Delta BankHolding \times Sell \times Risky$		-0.00198***		-0.00112
		(-4.57)		(-1.51)
Bank-quarter fixed effects	Yes	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes	Yes
Observations	40310	40310	32941	32941
R^2	0.310	0.310	0.275	0.275

t statistics in parentheses

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

This table reports the coefficient estimates for versions of regression (4) for subsamples without bank short sales and without bonds issued by regional governments. The variable CDS represents the CDS spread associated to the bond at the end of the corresponding quarter and has a floor at 300bps. Additionally, there is a cap at 1000. Risky is a binary variable that is equal to 1 if the CDS spread associated to the bond, at the end of the corresponding quarter, is above 300bps; 0 otherwise. The t-statistics reported in parentheses use standard errors clustered at the bank level and at the security level. The observations that concern Greek sovereign bonds in the first two quarters of 2012 are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

Table 22: Robustness regressions with alternative definition of risky bonds.

	(1) Floor at 250bps	(2) Threshold at 250bps	(3) Floor at 375bps	(4) Threshold at 375bps
Sell	9473.4	8851.5	9761.8	9380.6
	(0.25)	(0.23)	(0.26)	(0.25)
$\Delta BankHolding$	0.000136	0.0000952	0.000307	0.0000946
	(0.29)	(0.29)	(0.45)	(0.29)
$\Delta BankHolding \times Sell$	0.00183**	0.000421	0.00285**	0.000407
	(2.45)	(0.96)	(2.43)	(0.92)
$\Delta BankHolding \times CDS$	-0.000000165		-0.000000558	
	(-0.14)		(-0.38)	
$\Delta BankHolding \times CDS \times Sell$	-0.00000563**		-0.00000652**	
	(-2.36)		(-2.34)	
$\Delta BankHolding \times Sell \times Risky \times (1 - Public)$		-0.000658		-0.00141
		(-0.52)		(-1.10)
$\Delta BankHolding \times Sell \times Risky \times Public$		-0.00677***		-0.00641***
		(-3.77)		(-2.96)
Fund-quarter fixed effects	Yes	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes	Yes
Observations	343682	343682	343682	343682
R^2	0.273	0.273	0.273	0.273

t statistics in parentheses

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

This table reports the coefficient estimates for regression (3). The variable CDS represents the CDS spread associated to the bond at the end of the corresponding quarter. In column 1, the variable has a floor at 250 bps; in column 3, the floor is at 375 bps. Additionally, there is a cap at 1000. In column 2, Risky is a binary variable that is equal to 1 if the CDS spread associated to the bond, at the end of the corresponding quarter, is above 250 bps; 0 otherwise. In column 4, the threshold is at 375 bps. The t-statistics reported in parentheses use standard errors clustered at the fund level and at the security level. The observations that concern Greek sovereign bonds in the first two quarters of 2012 are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

Table 23: Robustness regressions with households portfolio with alternative definition of risky bonds.

	(1) Floor at 250bps	(2) Threshold at 250bps	(3) Floor at 375bps	(4) Threshold at 375bps
Sell	78525.6	77868.6	78704.5	78154.6
	(1.41)	(1.40)	(1.41)	(1.40)
$\Delta BankHolding$	0.000477	0.000698*	0.000301	0.000696*
	(0.92)	(1.76)	(0.50)	(1.78)
$\Delta BankHolding \times Sell$	0.000177	-0.000997**	0.00118**	-0.000964**
	(0.42)	(-2.09)	(2.30)	(-2.04)
$\Delta BankHolding \times CDS$	0.000000764		0.000000976	
	(1.27)		(1.51)	
$\Delta BankHolding \times CDS \times Sell$	-0.00000442***		-0.00000561***	
	(-5.34)		(-4.86)	
$\Delta BankHolding \times Sell \times Risky$		-0.00126***		-0.00226***
		(-4.22)		(-6.77)
Bank-quarter fixed effects	Yes	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes	Yes
Observations	47529	47529	47529	47529
R^2	0.278	0.278	0.278	0.278

t statistics in parentheses

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

This table reports the coefficient estimates for versions of regression (4). The variable CDS represents the CDS spread associated to the bond at the end of the corresponding quarter. In column 1, the variable has a floor at 250 bps; in column 3, the floor is at 375 bps. Additionally, there is a cap at 1000. In column 2, Risky is a binary variable that is equal to 1 if the CDS spread associated to the bond, at the end of the corresponding quarter, is above 250 bps; 0 otherwise. In column 4, the threshold is at 375 bps. The t-statistics reported in parentheses use standard errors clustered at the bank level and at the security level. The observations that concern Greek sovereign bonds in the first two quarters of 2012 are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

Table 24: Having vs. not having a parent bank: robustness to the definition of risky bonds.

	(1) Threshold at 250bps	(2) Floor at 250bps	(3) Threshold at 375bps	(4) Floor at 375bps
Has Bank × Risky	82922.6		28711.6	
	(1.26)		(0.23)	
Bank's Sell		-112875.8**		-187112.8***
		(-2.48)		(-2.88)
Bank's Sell × CDS		287.9**		392.7***
		(2.16)		(2.58)
Fund-quarter fixed effects	Yes	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes	Yes
Observations	1381926	1381926	1381926	1381926
R^2	0.205	0.205	0.205	0.205

t statistics in parentheses

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

This table reports coefficient estimates for versions of regression (5). The variable CDS represents the CDS spread associated to the bond at the end of the corresponding quarter. In column 2, the variable has a floor at 250 bps; in column 4, the floor is at 375 bps. Additionally, there is a cap at 1000. In column 1, Risky is a binary variable that is equal to 1 if the CDS spread associated to the bond, at the end of the corresponding quarter, is above 250 bps; 0 otherwise. In column 3, the threshold is at 375 bps. The t-statistics reported in parentheses use standard errors clustered at the fund level and at the security level. The observations that concern Greek sovereign bonds in the first two quarters of 2012 are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

Table 25: Regressions from banks' perspective: robustness to the definition of risky bonds (bank sell trades).

	(1) Threshold at 250bps	(2) Threshold at 250bps	(3) Threshold at 375bps	(4) Threshold at 375bps
Has Fund × Risky	-8045717.8***		-8771865.1*	
	(-2.68)		(-1.84)	
Has Fund Holding		-1893580.8		-2134182.3
		(-0.63)		(-0.72)
Has Fund Holding × Risky		-7772984.2**		-7963046.2
		(-2.30)		(-1.43)
Bank-quarter fixed effects	Yes	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes	Yes
Observations	33912	33912	33912	33912
R^2	0.444	0.444	0.444	0.444

t statistics in parentheses

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

This table reports the coefficient estimates for versions of regression (7), conditional to $\Delta BankHolding < 0$, for a sample that includes the upper decile of banks by eurozone government bond holdings (average holdings over the sample period). In columns 1 and 2, Risky is a binary variable that is equal to 1 if the CDS spread associated to the bond, at the end of the corresponding quarter, is above 250 bps; 0 otherwise. In columns 3 and 4, the threshold is at 375 bps. "Has Fund Holding" is a binary variable that is equal to one if that security was part of the holdings of a fund associated to that bank on that specific quarter, zero otherwise. "Has Fund" is a binary variable that is always equal to one for a bank which has an associated asset management company, with the additional condition that at least 10% of the bank's bond holdings considered risky are common also to the company's funds. The t-statistics reported in parentheses use standard errors clustered at the bank level and at the security level. The observations that concern Greek sovereign bonds in the first two quarters of 2012 are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

Table 26: Bond holdings with average rating BBB or below in the sample of matched household and bank holdings.

	(1)									
	CY	ES	GR	IE	IT	LT	LV	PT	SI	Total
2009q4	0	0	0	0	0	17	9	0	0	26
2010q1	0	0	0	0	0	17	11	0	0	28
2010q2	0	0	209	0	0	17	10	0	0	236
2010q3	0	0	196	0	0	18	10	0	0	224
2010q4	0	0	195	69	0	18	10	0	0	292
2011q1	0	0	195	65	0	21	11	63	0	355
2011q2	0	0	184	67	0	23	11	56	0	341
2011q3	21	0	159	65	0	23	11	54	0	333
2011q4	22	0	158	57	0	22	11	52	0	322
2012q1	17	0	2163	60	0	22	11	48	0	2321
2012q2	16	120	2183	52	0	18	11	37	0	2437
2012q3	15	116	1357	57	108	23	10	38	0	1724
2012q4	15	116	1062	68	108	24	8	43	0	1444
2013q1	12	120	424	76	0	14	6	52	0	704
2013q2	7	111	379	66	110	13	6	57	26	775
2013q3	8	111	381	68	114	14	6	53	26	781
2013q4	8	124	358	70	115	14	6	52	26	773
2014q1	7	140	314	71	128	14	7	55	29	765
2014q2	10	139	252	0	125	0	0	52	25	603
2014q3	9	135	170	0	113	0	0	55	24	506
2014q4	8	134	169	0	117	0	0	50	23	501
2015q1	5	140	130	0	120	0	0	45	19	459
2015q2	6	141	78	0	122	0	0	51	19	417
2015q3	6	142	74	0	108	0	0	47	19	396
2015q4	6	129	64	0	97	0	0	43	18	357
2016q1	9	117	89	0	89	0	0	41	23	368
Total	207	2035	10943	911	1574	332	165	1044	277	17488
N	17488									

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

This table reports, classified by quarter and country, the number of observations in the sample of matched household-bank holdings for which the credit rating associated to the bond is lower than or equal to BBB.

Table 27: Regressions with sovereign credit ratings.

	(1) $\Delta FundHolding$	(2) $\Delta FundHolding$	(3) $\Delta HouseholdsHolding$	(4) $\Delta HouseholdsHolding$
Sell	10013.0	-2829.7	78623.4	74252.2
	(0.26)	(-0.07)	(1.41)	(1.40)
$\Delta BankHolding$	0.0000866	0.0147**	0.00100**	0.00144**
	(0.09)	(2.21)	(2.59)	(2.01)
$\Delta BankHolding \times Sell$	-0.00470**	-0.0343**	-0.00492***	-0.00748***
	(-2.32)	(-2.47)	(-18.76)	(-2.88)
$\Delta BankHolding \times Rating$	0.000000169	-0.000870**	-0.0000186	-0.0000545
	(0.00)	(-2.21)	(-0.40)	(-0.94)
$\Delta BankHolding \times Rating \times Sell$	0.000299***	0.00204**	0.000232***	0.000417***
	(2.63)	(2.54)	(4.11)	(2.62)
Fund-quarter fixed effects	Yes	Yes	No	No
Security-quarter fixed effects	Yes	Yes	Yes	Yes
Security-fund fixed effects	No	Yes	No	No
Bank-quarter fixed effects	No	No	Yes	Yes
Security-bank fixed effects	No	No	No	Yes
Observations	343682	335509	47529	46493
R^2	0.273	0.436	0.278	0.384

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

This table reports the coefficient estimates for regressions (3) and (4), where the variable CDS_{jt} is replaced with the variable $Rating_{jt}$, representing the credit rating at the end of quarter t of the country that issued bond j. The rating is calculated as an average of the long-term ratings of Fitch, Moody's and S&P, and the variable is "capped" at BBB+. The t-statistics reported in parentheses use standard errors clustered at the fund level and at the security level in the regressions with investment funds; at the bank level and at the security level in the regressions with households. The observations that concern Greek sovereign bonds in the first two quarters of 2012 are omitted from the sample because of the haircut and subsequent bond swap imposed on private creditors.

References

Acharya, V., I. Drechsler, and P. Schnabl (2014). A Pyrrhic Victory? Bank Bailouts and Sovereign Credit Risk. *The Journal of Finance 69*(6), 2689–2739.

Acharya, V. V., P. Schnabl, and G. Suarez (2013, mar). Securitization without risk transfer. *Journal of Financial Economics 107*(3), 515–536.

Buch, C. M., M. Koetter, and J. Ohls (2016, aug). Banks and sovereign risk: A granular view. *Journal of Financial Stability 25*, 1–15.

Carlin, B., M. Lobo, and S. Viswanathan (2007, oct). Episodic Liquidity Crises: Cooperative and Predatory Trading. *The Journal of Finance 62*(5), 2235–2274.

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

Coval, J. and E. Stafford (2007). Asset fire sales (and purchases) in equity markets. *Journal of Financial Economics 86*(2), 479–512.

Del Guercio, D., E. Genc, and H. Tran (2017). Playing Favorites: Conflicts of Interest in Mutual Fund Management. *Journal of Financial and ... forthcomin.*

El-Shagi, M. and G. von Schweinitz (2017). Why they keep missing: An empirical investigation of rational inattention of rating agencies. *IWH Discussion Papers 1/2017.*

Ellul, A., C. Jotikasthira, and C. T. Lundblad (2011). Regulatory pressure and fire sales in the corporate bond market. *Journal of Financial Economics 101*(3), 596–620.

European Systemic Risk Board (2015). ESRB report on the regulatory treatment of sovereign exposures, March 2015. Technical report.

Fecht, F., A. Hackethal, and Y. Karabulut (2017). Is proprietary trading detrimental to retail investors? *Journal of Finance forthcomin.*

Fecht, F. and M. Wedow (2014). The dark and the bright side of liquidity risks: Evidence from open-end real estate funds in Germany. *Journal of Financial Intermediation 23*(3), 376–399.

Golez, B. and J. M. Marin (2015). Price support by bank-affiliated mutual funds. *Journal of Financial Economics 115*(3), 614–638.

Goyenko, R. Y., C. W. Holden, and C. a. Trzcinka (2009). Do liquidity measures measure liquidity? *Journal of Financial Economics 92*(2), 153–181.

Greenwood, R., A. Landier, and D. Thesmar (2015). Vulnerable banks. *Journal of Financial Economics 115*(3), 471–485.

Ivashina, V. and Z. Sun (2011). Institutional stock trading on loan market information. *Journal of Financial Economics 100*(2), 284–303.

Massa, M. and A. Žaldokas (2017). Information transfers among co-owned firms. *Journal of Financial Intermediation 31*, 77–92.

Shleifer, A. and R. Vishny (2011). Fire sales in finance and macroeconomics. *Journal of Economic Perspectives 25*(1), 29–48.