DEUTSCHE
BUNDESBANK
EUROSYSTEM

Discussion Paper

Deutsche Bundesbank
No 43/2019

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

Giulio Bagattini
(Frankfurt School of Finance and Management)

Falko Fecht
(Frankfurt School of Finance and Management)

Patrick Weber
(Deutsche Bundesbank)

Deutsche Bundesbank, Wilhelm-Epstein-Straße 14, 60431 Frankfurt am Main,
Postfach 10 06 02, 60006 Frankfurt am Main

Tel +49 69 9566-0

Please address all orders in writing to: Deutsche Bundesbank,
Press and Public Relations Division, at the above address or via fax +49 69 9566-3077

Internet http://www.bundesbank.de

ISBN 978–3–95729–644–3 (Printversion)
ISBN 978–3–95729–645–0 (Internetversion)

Non-technical summary

Research Question

Recent research highlights that a bank can strive to steer its customers' portfolios towards assets which the bank intends to sell off from its proprietary trading portfolio out of the bank's self-interest. In this paper we shed light on the question whether banks with large private wealth or asset management activities are able to mitigate fire-sale pricing by pushing sovereign bonds which the bank intends to liquidate due to a higher riskiness of the respective asset to bank-affiliated mutual funds or directly to their retail customers.

Contribution

We use a unique dataset from the Deutsche Bundesbank that allows us to match security-level data on all German banks' proprietary sovereign bond holdings with the respective security holdings of the bank's affiliated mutual funds and the holdings of its retail customers. If there is a conflict of interest between banks' own account trading and the asset and wealth management services they offer to retail investors, this may call for better consumer protection. In addition, if the severity of fire-sale contagion depends on the organizational structure of the financial sector, universal banks might mitigate fire-sale contagion and contribute to a more resilient financial system.

Results

We find evidence that banks used both their affiliated mutual funds and their retail customers as an exit channel to sell off risky sovereign bonds, in particular those bonds with low market liquidity. Our further analysis shows that bank-affiliated mutual funds not only increased their holdings of those bonds that their parent bank sold, but they also increased their overall portfolio share of risky sovereign bonds during the euro-area sovereign debt crisis significantly more than their unaffiliated peers. 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 a mutual funds business.

Nichttechnische Zusammenfassung

Fragestellung

Neuere Forschungsergebnisse zeigen, dass eine Bank aus Eigeninteresse darauf hinwirken kann, dass die Portfolios ihrer Kunden auf Vermögenswerte ausgerichtet werden, die sie aus ihrem Eigenhandelsportfolio verkaufen möchte. In diesem Papier gehen wir der Frage nach, ob Banken mit Aktivitäten im Vermögensverwaltungsgeschäft in der Lage sind, Fire-Sale-Preise zu vermeiden, indem sie Staatsanleihen, die die Banken aufgrund eines gestiegenen Risikos zu liquidieren beabsichtigen, an ihre eigenen Investmentfondsgesellschaften oder direkt an ihre Privatkunden weitergeben.

Beitrag

Wir nutzen alle Wertpapierbestände von Staatsanleihen, die Banken in ihrem eigenen Portfolio halten, und verknüpfen diese mit den jeweiligen Wertpapierbeständen der mit der Bank verbundenen Investmentfondsgesellschaften und den Beständen ihrer direkten Privatkunden. Wenn es einen Interessenkonflikt zwischen dem Eigenhandel der Banken und den von ihnen angebotenen Vermögensverwaltungsdienstleistungen für Privatanleger gibt, deutet dies potentiell darauf hin, dass der Verbraucherschutz weiter verbessert werden muss. Wenn die Schwere von Ansteckungsrisiken durch Fire-Sales von der Organisationsstruktur des Finanzsektors abhängt, könnte die Struktur von Universalbanken dazu beitragen, die Ansteckungen durch Fire-Sales-Verkäufe abzumildern was zu einem robusteren Finanzsystem beiträgt.

Ergebnisse

Wir finden Hinweise darauf, dass Banken Verkäufe an ihre verbundene Investmentfondsgesellschaft als auch an ihre direkten Privatkunden dazu genutzt haben, aus Positionen mit risikoreichen Staatsanleihen, insbesondere solchen mit geringer Marktliquidität, auszusteigen. Unsere weitere Analyse zeigt, dass Investmentfondsgesellschaften, die einer Bank angegliedert sind, nicht nur ihren Bestand an Anleihen, die ihre Mutterbank verkauft hat, steigerten, sondern auch ihren Anteil an risikoreichen Staatsanleihen im Gesamtportfolio während der europäischen Staatsschuldenkrise deutlich stärker erhöhten als ihre nicht mit einer Bank verbundenen Wettbewerber. Zeitgleich konnten Banken mit einer angeschlossenen Investmentfondsgesellschaft ihre Bestände an risikoreichen und illiquiden Staatsanleihen während der Staatsschuldenkrise deutlich stärker reduzieren als vergleichbare Institutionen ohne eine angegliederte Investmentfondsgesellschaft.

Bundesbank Discussion Paper No 43/2019

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, DG Statistics

April 5, 2019

Abstract

We use a unique security-level data set to analyze correlations in bond trading of banks, their respective retail customers and their affiliated mutual funds. 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 (particularly their public funds) during the European sovereign debt crisis. 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. The larger the risky sovereign bond position a fund acquired from its parent bank, the lower are the fund's short-term raw returns controlling for the risky bonds the fund overall acquired. Our findings show that banks use their customers portfolio and their affiliated funds as liquidity provider when they sell off their risk bonds without paying the funds the adequate liquidity premium. On the one hand, this points to a severe conflict of interest between banks' own account trading and their asset and wealth management services. On the other hand, it highlights that the severity of fire-sale contagion depends on the organizational structure of the financial sector.

Keywords: Fire sales, sovereign bonds, own account trading, bank-affiliated mutual funds, conflict of interest

JEL clasification: G01, G21, G23

*We would like to thank Tarun Ramadorai, Linda Goldberg, Dragon Tang, Jens Christensen, Milos Bozovic, Corinna Woyand and Christian Buschmann (discussants), conference participants at the 11th LSE Annual Paul Woolley Centre Conference, the 18th Annual FDIC Bank Research Conference, the FSB-CBoI Research Workshop on Non-bank Financial Intermediation, the 14th Annual Central Bank Conference on the Microstructure of Financial Markets, the EFA 2018, the EEA 2018, the 21st Annual Conference of the Swiss Society for Financial Market Research, the Belgrade Young Economists Conference, the Universität Augsburg-Deutsche Bundesbank-Universität Wien 7th Workshop Banks & Financial Markets, and seminar participants at the Deutsche Bundesbank, the University of St. Gallen, the European Central Bank, the Banque de France, the University College Dublin, University of Hohenheim, the Central Bank of Ireland, and Frankfurt School of Finance & Management for helpful comments and suggestions. We would also like to thank Gabriele Meinert and the Division Securities and Money Market Statistics. The paper represents the authors' personal opinions and does 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 (2018)). 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. (2018)). 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 test this hypothesis using a unique dataset from the Deutsche Bundesbank that allows us to match for the period 2009Q3–2016Q1 security-level data on all German banks' proprietary sovereign bond holdings 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. As a proxy for the time-varying riskiness of a particular country's sovereign, we use credit default swap spread data from Markit at maturities matched to those of the individual sovereign bond.[1]

In a fist set of panel regressions, we find that whenever a bank sells a risky sovereign bond during the crisis the changes in the bank's holdings are negatively correlated with both its retail customers' and its affiliated mutual funds' holdings of the same bond. This negative correlation increases the riskier the respective sovereign bond. These findings hold even if we fully saturate the model with time-varying security, time-varying bank (or fund) and bank (or fund)-security fixed effects to account for market wide changes in funds' (households') risky bond investments, changes in a mutual funds' (bank customers') overall bond purchase and persistent differences in fund (bank customers') specific investments in certain bonds. Our findings are particularly pronounced for public fund, in contrast to specialized funds that cater other financial institutions and are presumably more closely monitored. Interestingly, these results are robust if we also control for the fact that banks might sell particularly illiquid bonds (as proxied by the bid-ask spreads obtained from Bloomberg) to their customers and mutual funds to mitigate market impact. However, we do not find that a bank's sales of risky *and illiquid* sovereign bonds are more correlated

[1] We use the CDS on senior debt of the country with six different maturities (1y, 2y, 3y, 5y, 7y and 10y. In a robustness check, we also use the official credit ratings from S&P, Moody's and Fitch.

with the bank customers' and funds' purchases than for liquid risky bonds. As regards bank characteristics, especially banks that experience a severe drop in their equity ratio (and presumably therefore have to deleverage fast and on a larger scale) tend to sell risky sovereign bonds to their customers.

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 time-varying security and fund fixed effects, we find that bank-affiliated mutual funds increased their risky sovereign bond holdings significantly more than their unaffiliated peers. Similarly, when a fund has a parent bank and the parent bank reduced its holdings of a risk sovereign bond, we see that the affiliated fund purchases more of the respective risky bond than its peers, again taking time-varying fund and security fixed effects into account. Overall, we find that from the beginning of the sovereign debt crisis to its peak the portfolio share of risky sovereign bonds increased more at bank-affiliated mutual funds compared to the unaffiliated peers. This difference is the more pronounced the riskier the sovereign bond. These findings suggest that affiliated funds did not or could not offset the acquisition of risky bonds from their parent bank by reducing relatively their portfolio holdings of other risky sovereign bonds.

We next turn to the impact of a bank's fire sales of risky sovereign bonds to affiliated funds on the performance of those bank-affiliated funds. When we compare the raw returns of funds, we find that a fund's short-term performance is significantly lower if it has a parent bank and seemingly acquired more risky bonds from its parent bank. This holds even if we include time and fund fixed effects and control for a fund's overall risky bond holdings and acquisitions. This suggests that bank-affiliated funds provided price support when purchasing risky sovereign bonds sold off by their parent bank. In turn this compressed the liquidity premium those funds obtained compared to other funds that purchased risk bonds at fire sale prices in the market.

Finally, we study whether having a mutual fund also allowed banks to reduce their portfolio share of risky sovereign bonds during the sovereign debt crisis. When regressing for each bank the changes in the portfolio share of the different bonds, we find that banks with an affiliated fund were able to reduce their holdings of risky sovereign bonds significantly more than banks without an asset management company. This effect is robust to the inclusion of time-varying bank and security fixed effects and appears stronger the riskier the respective bond.

Our findings have important implications. First, they suggest that there is a 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. The EU regulation Mifid II rolled out in January 2018, which requires trading prices for certain fixed-income instruments to be published, might be a step in that direction.[2] However,

[2] In a study of OTC secondary trades in corporate bonds in the United States, Edwards et al. (2007) find that transaction costs are lower for bonds with transparent trade prices, and they drop when the TRACE reporting system starts to publicly disseminate their prices.

outstanding sovereign bonds are subject to the new rules only if the initial size of the offering was greater than €1 billion, which is the case for only a small percentage of them.

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 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 the institutional background that led banks to large-scale sovereign debt sell-offs. In section 4 we present our data set, sample and main variables. Section 5 derives, from a simple univariate analysis, first suggestive evidence of trading in risky sovereign bonds between banks and their affiliated mutual funds, as well as their retail customers. 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, and Ber et al. (2001) find that bank-managed funds in Israel pay too much for bank-underwritten IPOs, at the expense of the investors in the funds. On the other hand, Massa and Rehman (2008) provide evidence that bank-affiliated mutual funds trade on private information obtained by the controlling bank in its

[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.

lending business with the respective firm. Ferreira et al. (2018) show that bank-affiliated funds underperform because their investment policy supports the bank's lending business. Similarly, Ivashina and Sun (2011) show that institutional investors trade in the stock market on private information obtained in the loan 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. (2018) show that banks use their customers' portfolios to sell off underperforming stocks from their proprietary trading portfolio. Gil-Bazo et al. (2017) show that bank affiliated funds purchase bonds issued by the parent bank in the primary market in times of market distress.

However, we do not argue that our results necessarily imply that banks abuse their mutual funds and their customers. Our findings are compatible with bank holding companies using the different entities to achieve a mutual liquidity insurance. While our results show 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 give evidence that banks also provide liquidity support for their troubled open-end real estate funds that experience excessive outflows. Fecht et al. (2018) show that banks use their distribution network to generate liquidity inflows into affiliated funds that otherwise 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

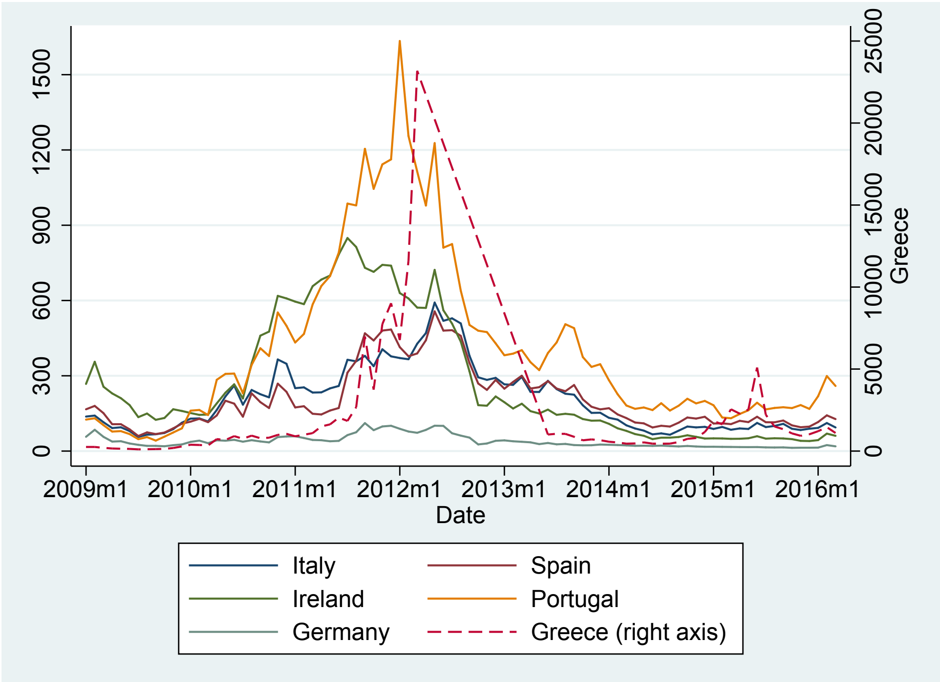
Our paper also speaks to the growing literature on shadow banks and how relations between ordinary regulated banks and unregulated shadow banks might affect financial stability. This literature, as for instance Acharya et al. (2013), mostly argues that implicit or explicit exposures of traditional banks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

[7] Fecht et al. (2018) show that banks also push stocks to their retail customers when the market is relatively illiquid in order to mitigate the price impact.

3 Institutional background

In April 2010, after revelations that previous data on government debt levels and deficits had been manipulated by the government, credit rating agencies downgraded Greek bonds to junk status presumably marking the begin of the sovereign debt crisis. By then, the CDS spread had already trespassed the 500 bps mark. In 2011 the crisis gained momentum and spread to several other countries, until on July 26th, 2012 the ECB president Mario Draghi calmed down markets stating that "ECB is ready to do whatever it takes to preserve the euro". Figure 1 depicts the evolution of the 5-year CDS spread of the GIIPS countries and of Germany. As this chart indicates, the crisis affected mainly the GIIPS countries, but started and peaked at slightly different times in each country.

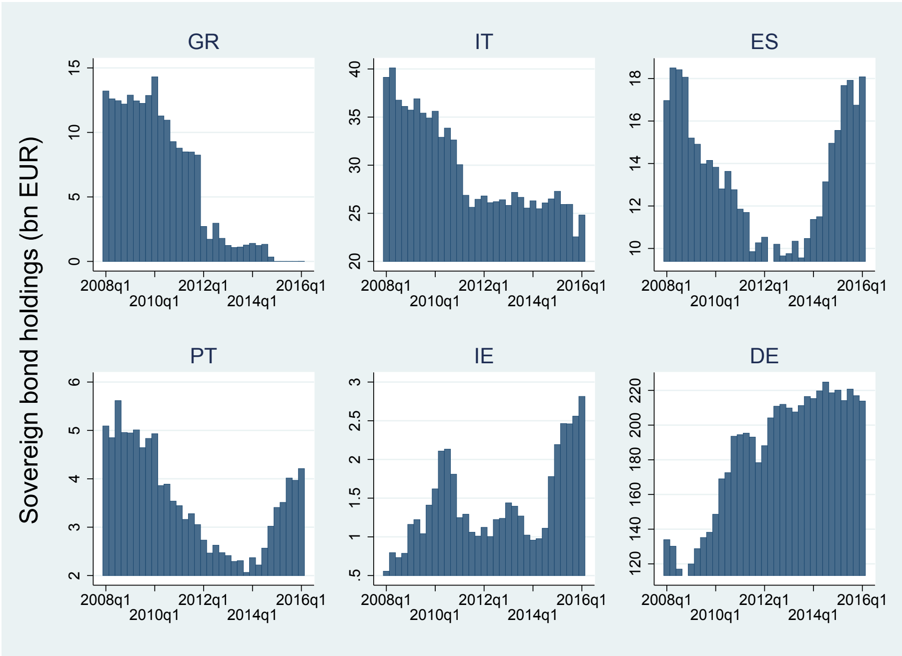
Figure 1: Evolution of the CDS spread for selected European countries.



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.

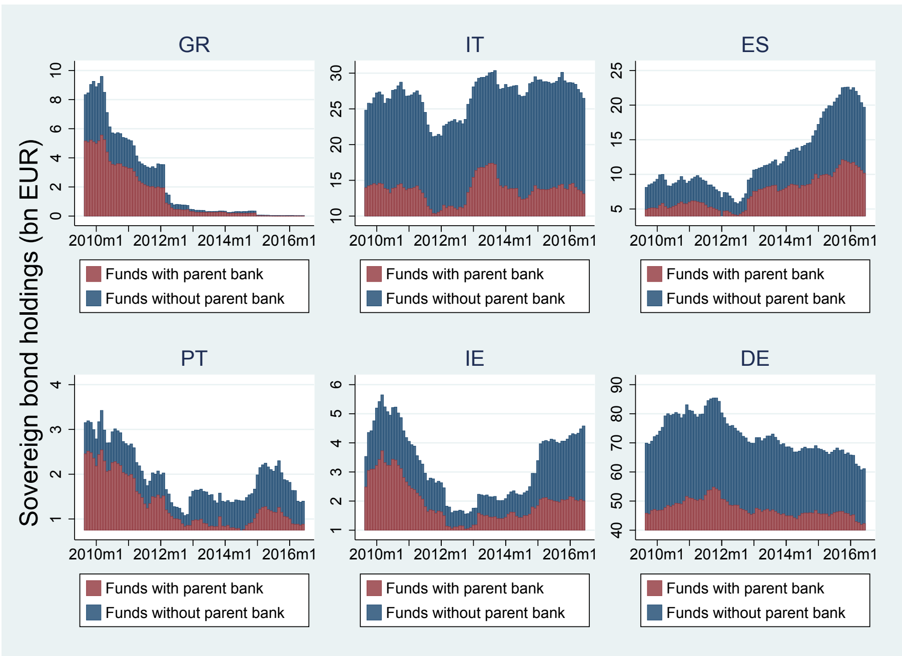
Figure 2 shows on aggregate German banks' holdings of sovereign bonds issued by GIIPS countries. Obviously, German banks drastically reduced their GIIPS bond holdings during the crisis. However, also here cross-country differences in the timing of the crisis are reflected in banks' sell-offs of bonds issued by the different sovereigns. Figure 3 depicts how German investment funds' holdings of crisis-countries sovereign bonds evolved, revealing a relatively similar pattern. In contrast, as Figure 4 reveals, households increased their holdings of GIIPS sovereign bonds during the sovereign debt crisis, although the amounts are economically small when compared to their German bond holdings. The amount of German debt in the hands of retail investors, however, steadily declines.

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



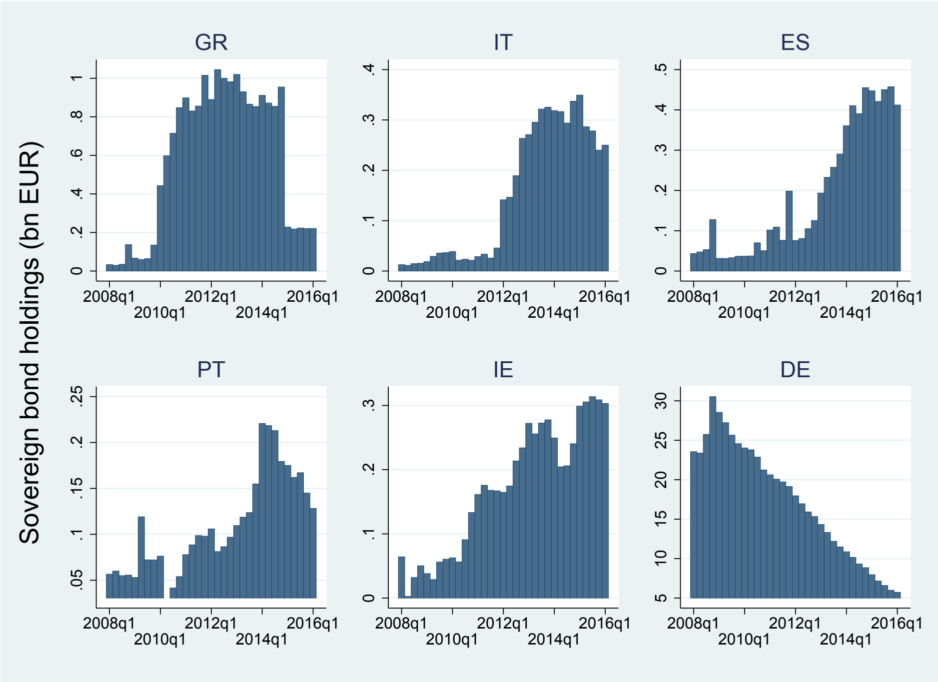
This figure shows the aggregate amount of government bonds held by German banks, classified by country of issue, for some key crisis countries and Germany.

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



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.

Even though risky sovereign bond holdings do not add to banks' risk-weighted equity requirements,[8] financial institutions might have several reasons to sell off sovereign bonds that become particularly risky. First, when banks hold those bonds in their trading book they are marked to market. Consequently, when they become riskier they lose market value, which leads to book losses and reduces banks' equity. Second, even if banks hold these assets in the banking book and do not mark them to market, bank financiers who learn about a bank holding sizable risky sovereign bonds will charge a higher risk premium increasing the bank's funding costs. Third, this is particularly true since EBA stress test consider also risky sovereign bond exposures and stress test results are not only closely monitored by regulators but also by market participants. Fourth, banks use sovereign bonds mostly as collateral to secure wholesale funding. A credit rating downgrade, for instance, reduces the eligibility of these securities as collateral, with negative consequences for banks' funding capacity.[9]

[8]In the current regulatory framework, EU member state bonds are assigned a risk-weighting of zero; that is, banks are not required to set aside a certain amount of capital to match their holdings of EU sovereign debt.

[9]Supporting these arguments De Marco (2017) finds that short-term funding from US money market mutual funds contracted significantly more for banks with high marked-to-market losses on their sovereign bond holdings. He finds that, although 85% of GIIPS sovereign bonds in 2010 were placed in the banking book and classified as held-to-maturity, the deterioration in the market value of sovereign debt had an adverse effect on credit supply of European banks to the real economy. Boissel et al. (2016) also show that repos backed by GIIPS collateral on average faced higher repo rates during the crisis.

4 Data and sample description

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).

4.1 Bond holdings of banks, funds and households

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.[10] 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.[11] These sovereign bonds only account for around 2% of the total, both in the banks' proprietary portfolios and in the investment funds' holdings.

The *first sample* we construct focuses on banks' and their affiliated mutual funds' sovereign bond 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. 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 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 match the bank and fund holdings on a security-quarter basis and drop observations when a bond only appeared in the bank's proprietary portfolio, but not in any of the bank's affiliated mutual funds' portfolios. Similarly, we disregard observations of sovereign bond holdings by a fund when the parent bank does not hold the same bond. Overall during

[10] Before September 2009 the investment funds statistics were not available at the security level.

[11] If we kept non-euro denominatade bonds in the original currency in our data, changes in the nominal holdings would have different magnitudes for different currencies. Alternatively we could convert them into euro. But then exchange rate fluctuations would introduce spurious correlations in the holdings that are unrelated with the trading activity of banks/funds. For these reasons, we drop securities not denominated in euro.

the sample period, the average bank holds 329 distinct sovereign bonds that also appear in the sample of common bond holdings with its mutual funds, 170 of which are German Bunds and 70 of which are issued by one of the GIIPS countries. However, this number varies widely: 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 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.[12]

The *second sample* focuses on banks' and their retail customers' holdings of sovereign bonds. Here no matching is required, because each German bank has to report besides their own security holdings the aggregate holdings of its retail customers on a security-by-security basis directly to the SHS. In total, 538 banks report at least one euro-area sovereign bond held both in the bank's and its customers' portfolio. We have on average 13 different securities for each of these 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.

We use the two separate samples not only because analyzing bank-fund level correlations and bank-customer level correlations is interesting in its own right. The bank-fund level sample also has a much larger cross-section of bonds, while the bank-customer sample has a larger cross-section of banks allowing us to also study the effects of bank characteristics.

4.2 Key variables of interest

We are interested in the correlation of quarterly net trades. Thus we use 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 Centralised Securities Database (CSDB), 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. Furthermore, we drop

[12]The same funds' portfolios include overall (independently of whether they appear in the portfolio of the parent bank) an average of 40 distinct euro-area sovereign bonds over the sample period (median 24).

from the sample the observations related to Greek bonds for Q1 and Q2 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.[13]

Table 1: Definition of dependent and independent variables.

Dependent variables	
$\Delta FundHolding_{ijt}$	Change in holdings at nominal value 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 nominal amount of bond j held by households at bank i from quarter $t-1$ to quarter t.
$\Delta PortfolioShare_{ij}$	Change in a fund i's portfolio share of sovereign bond j (calculated as the nominal amount held divided by the fund's assets under management) from 30th June 2010 to 30th June 2012.
$FundBuy_{ijt}$	Binary variable which is equal to 1 if $\Delta FundHolding_{ijt} > 0$, and 0 otherwise.
$\Delta BankHolding_{ijt}/TA_{it}$	As in ΔFund Holding$_{ijt}$; change in holdings at nominal value of bond j by bank i, from quarter $t-1$ to quarter t, divided by total assets at the end of t.
Independent variables	
$\Delta BankHolding_{ijt}$	As in ΔFund Holding$_{ijt}$; change in holdings at nominal value of bond j 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, floored at 300 bps.
$Risky_{jt}$	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.
$Liq.Shock_{jt}$	Binary variable which is equal to 1 if the average bid-ask spread of bond j (weekly sampling) increased by more than 5 bps from quarter $t-1$ to quarter t, and 0 otherwise.
$HasBank_{it}$	Binary variable which is equal to 1 if fund i has a parent bank, and 0 otherwise.

[13] 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.

Table 1: Definition of dependent and independent variables.

$Bank'sSell_{ijt}$	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.
$Return_{i,t \to t+k}$	Fund's i logarithmic return from the end of quarter t to the end of quarter $t+k$.
$Fund - bank\ trade_{it}$	Maximum net nominal amount of risky bonds sold to fund i by its parent bank during quarter t, if it has any; otherwise zero. See (7).
$RiskySov_{it}$	Share of risky sovereign bonds held by fund i at time t over fund's assets under management.
$HasFund_i$	Binary variable which is equal to 1 if bank i has an asset management arm; 0 otherwise.
$Rating_{jt}$	Average of the three main rating agencies' credit ratings – converted to a numeric scale from 24 (best) to 0 (worst) – assigned to the country of issue of bond j at the end of quarter t. Winsorized at the upper bound of 17.

We also 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 above.

Tables 2 and 3 report summary statistics of our key variables for the sample of matched bank-fund holdings and for the sample of matched bank-households holdings, respectively. Banks' trades over a quarter are on average 8 times larger than the affiliated funds' trades (€18.4 million vs. €2.3 million), but given that the average bank bond position is matched to almost 8 affiliated funds' positions in the same bond, the volumes traded by a bank and on aggregate by its affiliated funds are similar. Volumes traded by households are smaller (€0.5 million per bank on average), yet they vary widely (the standard deviation is €3.9 million).[14]

[14] Since we are looking at the net changes in securities holdings over a quarter, we implicitly assume that most of the times agents don't sell and buy the same security in the same quarter.

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

	$\|\Delta$ Fund Holding$\|$ if $\neq 0$	$\|\Delta$ Bank Holding$\|$ if $\neq 0$
Mean	2317922	1.84e+07
St. dev.	6563833	5.53e+07
10th pct	61000	40000
25th pct	254974.6	350000
Median	800000	3000000
75th pct	2000000	1.50e+07
90th pct	5000000	4.76e+07
N	137720	35969

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

	$\|\Delta$ Households Holding$\|$ if $\neq 0$	$\|\Delta$ Bank Holding$\|$ if $\neq 0$
Mean	543872.5	1.86e+07
St. dev.	3943288	5.83e+07
10th pct	4000	27546
25th pct	11000	270000
Median	43000	2794000
75th pct	176600	1.38e+07
90th pct	670000	4.60e+07
N	22781	35069

4.3 Risky and illiquid sovereign bonds

We are interested in identifying whether banks sell risky sovereign bonds, that were presumably more difficult to sell in the market during the crisis, to their customers and affiliated funds. Thus, we complement our dataset with Markit data on the credit default swap (CDS) spreads for senior debt issued by the euro-area countries to identify those bonds that carried a high default risk at a particular point in time. 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.[15] We disregard spreads on shorter (6m) and longer (15y, 20y,

[15] 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.

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 the security has been attributed a CDS spread higher than 300 basis points (bps). This threshold corresponds to 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 bps mark. The 20,274 fund-quarter holdings of risky sovereign bonds that are common to the parent banks compare with a total of 60,892 fund-quarter holdings of risky bonds by affiliated funds, independent of their parent bank's holdings. That is, one third of the times an affiliated fund was holding a risky sovereign bond, the parent bank also had it in its proprietary trading portfolio. Conversely, there are 2,999 single bank holdings of these risky bonds in the sample (as multiple funds are associated to a single bank). For the same banks, we can count 8,428 risky sovereign bond holdings overall: that is, 36% of the times a bank was holding a risky euro-area bond, at least 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 4: Bond holdings with CDS spread higher than 300 bps in the sample of matched fund and bank holdings.

	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	0	144	694	0	0	32	20	0	1436
2012q2	0	1	551	0	109	857	0	0	10	46	0	1574
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	5375	2770	5373	43	4	1735	192	61	20274
N	20274											

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 bps (∼ 80th percentile of the set of quarterly eurozone CDS spreads). This subsample corresponds to 2999 distinct bank holdings. This compares to 8235 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. 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 5 reports analogous figures for the sample of bank-households holdings. Households hold a remarkable number of Greek securities. Here, the proportion of overlapping holdings from the banks' perspective is even higher: while the matched sample contains 9,671 observations, looking at the same securities, banks and sample period in isolation yields 27,931 observations.

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

	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	0	60	71	0	0	48	8	0	291
2012q2	0	16	120	0	52	97	0	0	37	14	0	336
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	6784	523	484	33	58	667	99	13	9671
N	9671											

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 bps (∼ 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. 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.

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

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

Then, we exclude negative values, 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.

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. 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, whenever a bank is selling a sovereign bond, on average its affiliated mutual funds tend to purchase this security.

Columns 3 and 4 consider the correlation between our key variables for bonds that are particularly risky. We define a bond as risky if its corresponding CDS spread is greater than or equal to 300 bps. 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 are open to the public, as opposed to specialized funds that only cater specific institutional investors. 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 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 300 bps. 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.

Table 7 reports the same analysis for the sample of banks and households. Again, there is 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%, although it loses statistical significance.[16] 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.

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 300 bps. Column (4) reports the correlation for the same conditions but for banks' sell trades.

In sum, it is important to highlight that we find a negative correlation between a bank's 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.

[16] 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). That is, banks and their NFC clients seem to sell risky bonds at the same time.

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 Multivariate analysis

6.1 Bond trades between banks, funds and households

The univariate analysis provides already first suggestive evidence that banks might sell off risky bonds from their proprietary portfolio to their affiliated mutual funds and their retail customers. In order to explore this further and provide stronger evidence for this interpretation, 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 a 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.

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

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

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). 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 the parent banks – which might only cater the demand of its funds rather then using them intentionally as a channel for their sales.

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.

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:

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

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 a bank's and its customers' portfolios if the bank is buying a security, but this correlation turns negative when a bank is selling a 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. Here we even find significantly negative correlation between a bank's sells and its customers trades when allowing for time-varying security fixed effects, although both the economic and statistical significance declines.

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.

Overall, for changes in both fund and households holdings, the 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' trades might simply coincide with trades of the same security by the parent bank.

However, in a period – such as the sovereign debt crisis – in which they had to top up their equity ratio,[17] banks were particularly loss averse and the majority of them simultaneously reduced their risky bonds holdings (see Figure 2). In such a buyers' market, banks might have been able to sell those risky bonds at better terms than their peers, when trading with their affiliated funds or retail customers.

Additionally, when selling off possibly illiquid bonds banks will 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 illiquidity discounts. In addition, sovereign bonds in the euro area are traded OTC and selling off positions to affiliated funds or customers provides immediacy particularly in an illiquid market.

[17] 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.

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 and illiquid bonds, respectively.

6.2 Banks' fire sales of risky bonds

In order to study whether the relationship between fund trades and bank trades changes when a particular bond carries a high default risk in the respective period, we extend our baseline model (1) and run the following regression:

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

where γ_{jt} and α_{it} represent sets of dummies which account, respectively, for security-quarter fixed effects and for fund-quarter 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 bps, the 80th percentile of the distribution of the CDS spread over the sample period and the eurozone countries (section 9 discusses the robustness of our results to alternative choices of the floor level). That is, we assign the value of 300 bps 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, investors considered the Bund a safe haven and holdings of German debt by German banks kept increasing. Additionally, we cap the variable at 1000 bps, in order to account for distortions related to CDS spreads on Greece, which reached levels as high as 33,000 bps when they were discounting the upcoming haircut on Greek debt.

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 sells a sovereign bond, affiliated funds tend to buy it more the riskier the bond is.

To make sure that this result does not depend on the specific construction of the CDS spread variable, we categorize the variable into a dummy *Risky* that takes the value of 1 if the CDS spread is above 300 bps, 0 otherwise. This also eases the interpretation of the resulting coefficients. Column 2 of Table 10 reports the estimation results if we replace the

CDS spreads with 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 special funds. Column 3 of Table 10 confirms our conjecture: 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.

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

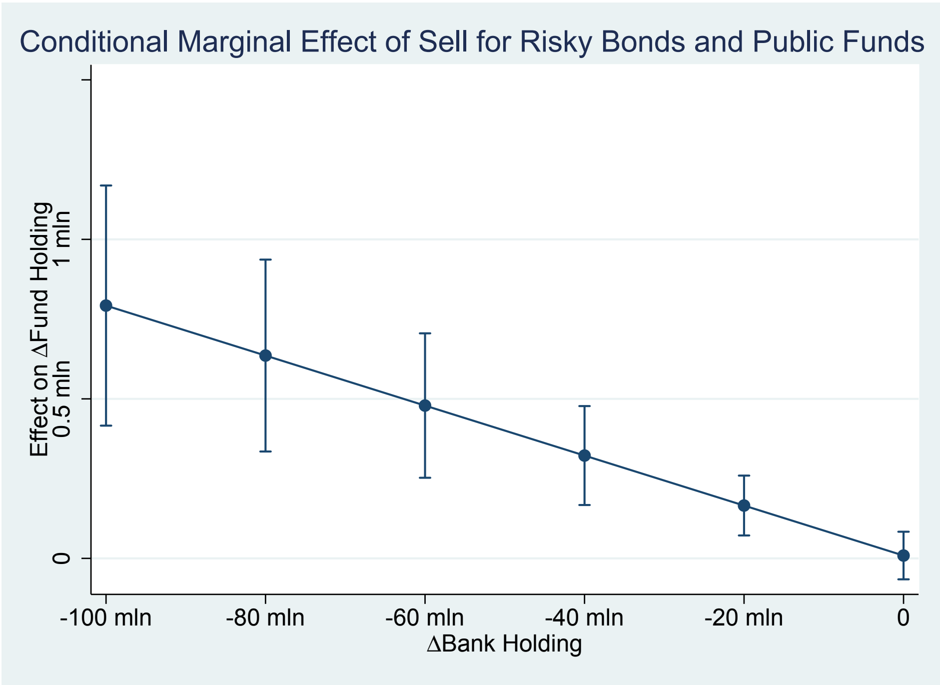
t statistics in parentheses

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

This table reports the coefficient estimates for versions of regression (3). The variable "CDS" is floored at 300 bps. 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 bps; 0 otherwise. The t-statistics reported in parentheses use standard errors clustered at the fund level and at the security level.

The economic significance of this correlation is visualized in Figure 5 via 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 million is associated with a higher increase in the holdings of that bond by a public fund affiliated to that bank by roughly €1 million.

Figure 5: 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.

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. As in the case of mutual funds, 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 300 bps. Column 2 reports the results and shows that this specification confirms our findings. In columns 3 and 4, we saturate the regression with a set of bank-security fixed effects. Results with this highly restrictive estimation are statistically still significant and economically even stronger.

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	78071.3	74273.2	73577.4
	(1.41)	(1.40)	(1.41)	(1.39)
$\Delta BankHolding$	0.000416	0.000698*	0.000118	0.000532
	(0.76)	(1.74)	(0.20)	(1.36)
$\Delta BankHolding \times Sell$	0.000532	-0.000996**	0.00175*	-0.000431
	(1.21)	(-2.11)	(1.69)	(-1.16)
$\Delta BankHolding \times CDS$	0.000000838		0.00000125	
	(1.44)		(1.36)	
$\Delta BankHolding \times CDS \times Sell$	-0.00000486***		-0.00000702**	
	(-5.19)		(-2.55)	
$\Delta BankHolding \times Sell \times Risky$		-0.00135***		-0.00211***
		(-3.87)		(-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

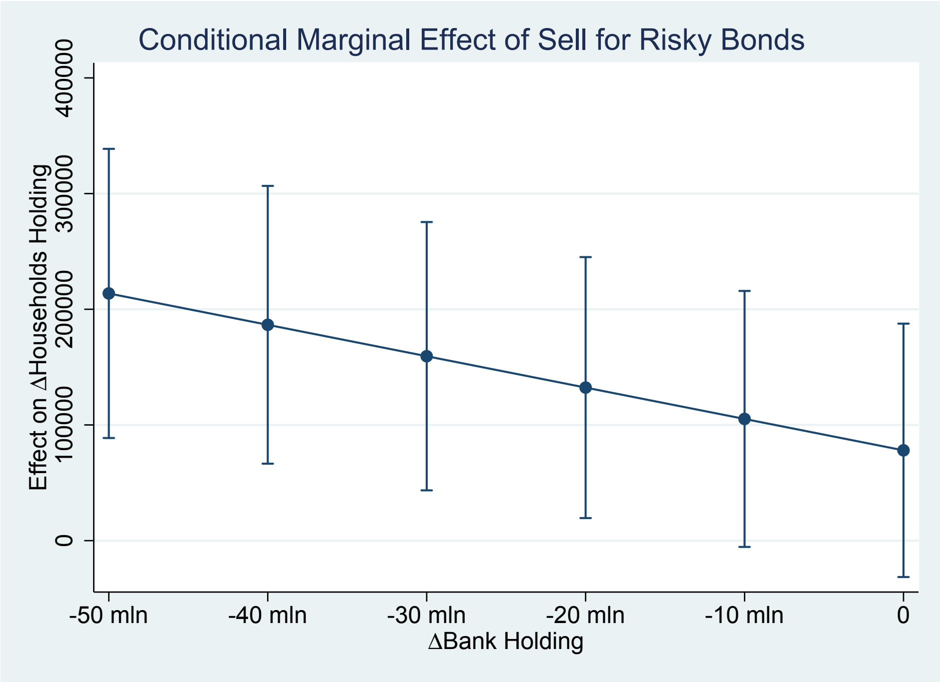
t statistics in parentheses

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

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 300 bps; 0 otherwise. The t-statistics reported in parentheses use standard errors clustered at the bank level and at the security level.

Figure 6 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. The graph shows that a decline in a bank's holding of a risky bond by €50 million is associated with an increase of that bond by approximately €200,000 in the portfolio of the banks' retail customers.

Figure 6: 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.

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.[18] 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 bps (upper 10% of the sample with this ordering). This subsample contains securities issued by all euro-area countries except Malta and Estonia. In 2011 and 2012, at the height of the sovereign debt crisis, there is a peak of holdings of illiquid bonds issued by the GIIPS countries, but also by Austria, Belgium, Germany and France.[19] We define a dummy variable Illiquid_{jt}

[18] 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.

[19] 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 that around half of the observations in the sample are related to German bonds.

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%.

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

	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																	

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 bps (∼10% of the observations). 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.

In order to test whether banks are more likely to sell illiquid bonds from their proprietary trading portfolio to their mutual funds, we reestimate regression (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 seem 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 effects. Only when we additionally include security-fund fixed effects, the coefficient is still negative but loses its significance at conventional levels. However, this does not necessarily invalidate the identification of bank-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. However, what is most interesting is to see whether banks are more likely to sell off risky bonds (that they presumably had to sell off quickly and rather simultaneously) to their affiliated mutual funds when those bonds are also 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 of a particular bond that a bank sells with both the variable *Risky* and the 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.

However, 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 this 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.

Table 13: Funds' and banks' 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 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 fund level and at the security level.

Next, we use the larger (in terms of banks) sample of matched bank-customer sovereign bond holdings to assess whether banks particularly sold illiquid risky sovereign bonds to their customers. We apply the same threshold (30 bps) to define illiquid bonds. 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}.[20] Thus, compared to investment funds sovereign bond holdings, for the bonds in the sample of households holdings, high default risk and illiquidity are remarkably correlated characteristics.

Table 15 reports the results we obtain when reestimating regression (4) with the dummy

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

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 absorbed by security-bank fixed effects, which render them insignificant (column 2).

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

	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																	

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 bps. 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.

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 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.

Table 15: Households' and banks' 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 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.

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 even 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 simultaneously risky *and* illiquid bonds pushed by banks to their funds or their customers to a greater extent.

So, avoiding market impact does not seem to be the main motive why banks supposedly sell their risky sovereign bonds to their affiliated funds or 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.[21]

6.4 Which banks use retail investors particularly as exit channel?

In this section, we investigate which banks have stronger tendency to sell off risky 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-households 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 them 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 its total assets, the size of its bond portfolio relative to total assets and the contemporaneous change in its equity ratio.

Table 16 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 maintain larger security portfolios. But on the contrary, as column 2 indicates, banks with a relatively large bond portfolio are selling to their retail customers a smaller proportion of a bond position that they liquidate.

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 larger decline in its equity ratio will push relatively more of the risky bonds that it sells off to its retail customers. This suggests that banks tend to use their customers more intensely as an exit channel during fire sales the more (and potentially the faster) they need to deleverage. While the coefficients on the two other bank characteristics do not persist when we simultaneously include all bank variables in the regression, even in this specification the effect of banks' deleveraging is at least marginally significant (column 4).

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

Table 16: Households-bank trades of risky bonds: regressions with bank characteristics.

	(1) $\Delta Hou.Hold.$	(2) $\Delta Hou.Hold.$	(3) $\Delta Hou.Hold.$	(4) $\Delta Hou.Hold.$
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
	(-1.23)			(0.52)
$\Delta BankHolding \times Sell \times Risky$	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
	(-3.87)			(0.79)
$\Delta BankHolding \times Sell \times$ 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 300 bps; 0 otherwise. "Bank Size" represents the bank's total assets. "Bond Holdings" are total bond holdings relative to total assets. "ΔEquity Ratio" is the quarter-on-quarter change in the bank's equity ratio. The t-statistics reported in parentheses use standard errors clustered at the bank level and at the security level.

7 The impact of parent banks on funds

7.1 Do parent banks influence funds' sovereign bond portfolio?

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.[22] 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 bps. 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 17 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 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 use the enlarged sample to see whether bank-affiliated mutual funds purchase more of a risky sovereign bond if its parent bank sold that security, compared to both bank-affiliated funds whose parent bank did not sell the bond 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 independent 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 17 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, however, that, if we resort to a specification with the continuous CDS spread (where again we put a floor to the variable

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

at 300 bps), the interaction with $Bank's\ Sell$ turns indeed significant. If the parent bank is selling a non-risky security ($CDS = 300$), the holdings of that security in the portfolio of its funds decrease by approximately €40,000 ($-141,585 + 336.7 \times 300$). However, each 100 bps 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).

Since our previous results showed that banks sold their risky sovereign bonds particularly to their affiliated public funds, in column 4 we restrict our analysis to those funds only. Although the estimated effect is larger, presumably due to the drastically reduced sample size it is not statistically significant.

In column 5 we change the endogenous variable to a dummy variable taking the value one if the fund acquired a particular bond and zero otherwise. Using this more robust measure we find evidence suggesting that whenever the parent bank sold a bond, an affiliated public fund is more likely to purchase the bond the riskier the bond is. These results are also robust to the inclusion of security-fund and security-quarter-fund type fixed effects (not shown).

Table 17: Parent banks' impact on funds' risky holdings.

	(1) Δ Fund Holding	(2) Δ Fund Holding	(3) Δ Fund Holding	(4) Δ Fund Holding	(5) Fund Buy
Has Bank × Risky	151607.7**				
	(1.99)				
Bank's Sell		-38729.9	-141585.3***	-73488.3	-0.0202
		(-1.48)	(-2.71)	(-0.54)	(-1.51)
Bank's Sell × Risky		41281.2			
		(0.64)			
Bank's Sell × CDS			336.7**	399.4	0.0000875**
			(2.43)	(1.26)	(2.25)
Fund-quarter fixed effects	Yes	Yes	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	1381926	1381926	1381926	256831	256831
R^2	0.205	0.205	0.205	0.213	0.573
Sample	Full	Full	Full	Public funds	Public funds

t statistics in parentheses

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

This table reports coefficient estimates of different versions of regression (5). In columns 1-4 the dependent variable is the quarter-on-quarter change in the fund's bond holding; in column 5 it is a binary variable which is equal to 1 if the quarter-on-quarter change is positive, and 0 otherwise. "Has Bank" is a binary variable that is equal to 1 if the fund has a parent bank; 0 otherwise. "Bank's Sell" is a binary variable that is equal to 1 if the fund has a parent bank selling the security in the corresponding quarter; 0 otherwise. "Risky" is a binary variable that is equal to 1 if the CDS spread of the country of issue of the bond, at the end of the corresponding quarter, is above 300 bps; 0 otherwise. The variable "CDS" is floored at 300 bps. Additionally, there is a cap at 1000 bps. The t-statistics reported in parentheses use standard errors clustered at the fund level and at the security level.

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

$$\Delta\text{Portfolio Share}_{ij} = \frac{\text{Fund Holding}_{ijT}}{\text{AUM}_{iT}} - \frac{\text{Fund Holding}_{ijt}}{\text{AUM}_{it}},$$

where $t = 2010Q2$ and $T = 2012Q2$ and AUM represents the fund's assets under management.

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

$$\Delta\text{Portfolio Share}_{ij} = \text{Has Bank}_i \cdot \text{CDS}_j + \gamma_j + \alpha_i, \tag{6}$$

or alternatively with the dummy *Risky*, where *CDS*, *Risky* and *Has Bank* are the respective values for 2012Q2. Here, γ_j and α_i represent respectively security fixed effects and fund fixed effects.

Table 18 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. Extending the crisis period up to 2012Q4 or starting from 2009Q4 – as well as calculating portfolio shares over total sovereign bond holdings instead of assets under management – leaves the result qualitatively and quantitatively unchanged (not reported).

Table 18: Parent banks' impact on funds' portfolio shares of risky bonds.

	(1) Δ Portfolio Share	(2) Δ Portfolio Share
Has Bank × CDS	0.0000382***	
	(5.73)	
Has Bank × Risky		0.0118***
		(10.96)
Fund fixed effects	Yes	Yes
Security fixed effects	Yes	Yes
Observations	64535	64535
R^2	0.502	0.504

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 the change in the fund's portfolio share of a bond between 2010Q2 and 2012Q2. "Has Bank" is a binary variable that is equal to 1 if the fund has a parent bank; 0 otherwise. "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 bps; 0 otherwise. The variable "CDS" is floored at 300 bps. Additionally, there is a cap at 1000 bps. The t-statistics reported in parentheses use standard errors clustered at the fund level and at the security level.

In sum, while our findings in section 6 suggest that banks sell risky bonds that they liquidate 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 riskier than their peers.

7.2 Parent banks' impact on funds' performance

Next we want to find out whether affiliated funds that loaded up risky sovereign bonds underperformed their peers or, rather, enjoyed higher returns offered by these risky investments.

In order to investigate to what extent the performance of affiliated funds is impacted *specifically* by trading risky bonds directly with their mother institutions, we aggregate potential transactions to construct a time-varying proxy for the amount of high default-risk bonds purchased by a fund *from its own parent bank.*

To this end, we exploit again our full sample of investment fund holdings of euro-area sovereign bonds, and construct the variables

$$\text{Amount bought}_{ijt}^{Fund} = \max(\Delta \text{Fund Holding}_{ijt}, 0)$$
$$\text{Amount sold}_{ijt}^{Bank} = \max(-\Delta \text{Bank Holding}_{ijt}, 0)$$

where the latter is zero whenever there exists no matching security j held by the parent bank (if any) of fund i at time t. The lower of these two amounts represents the nominal value exchanged in a potential transaction where fund i purchased bond j during quarter t from its parent bank:

$$\text{Transaction}_{ijt} = \min(\text{Amount bought}_{ijt}^{Fund}, \text{Amount sold}_{ijt}^{Bank}).$$

We then aggregate $Transaction$ across all *risky* securities and scale by fund total assets to obtain a quarter-specific proxy for the flow of risky bonds to a fund from its parent bank:

$$\text{Fund-bank trade}_{it} = \frac{\sum_j \text{Transaction}_{ijt} \cdot \text{Risky}_{jt}}{\text{AUM}_{it}}. \tag{7}$$

To look at how the bank-to-fund flow of risky bonds is correlated to the future fund performance, we run the following regression of the fund return on the *Fund-bank trade* variable:

$$\text{Return}_{i,t\to t+k} = \beta \cdot \text{Fund-bank trade}_{it} + \gamma_i + \alpha_t, \tag{8}$$

where the return is calculated over a horizon of length k from the end of quarter t.[23] The fixed effects at the fund level control for fund-specific investment style (i.e. risk profile and, hence, risk premium) and can account, among other things, for average differences in performance between affiliated and non-affiliated funds (e.g. if affiliated funds consistently deliver worse performance than their non-affiliated peers). Time fixed effects instead control for industry-wide performance (thereby in a way discounting the return of the market portfolio).

Running (8) on the full sample of mutual funds, we find that *Fund-bank trade* is indeed strongly negatively correlated with short-term returns at the monthly, quarterly and semiannual horizons (columns 1, 4 and 7 of Table 19). A potential fund purchase of risky bonds from the bank amounting to 1% of the fund's assets (which is approximately the median value among the non-zero observations) leads to a 13 bps (0.13%) lower return over the next quarter. However, over a period of one year return differences vanish. The coefficient β turns positive and non-significant for the 12 month return (column 10).

This differences in returns are however not surprising: all funds that happened to bet

[23] $\text{Return}_{i,t\to t+k}$ is a logarithmic return. We compute it starting from the monthly returns

$$Return_{\,t\,\to\,t+1\,month} = \ln\left[(P_{t+1\,month} + D_{\,t+1\,month})/P_t\right],$$

where D_t is the per-share dividend paid out in month t and P_t is the average of the fund shares' issue and redemption price at the end of month t.

more heavily on sovereign bonds from GIIPS countries and other stressed countries during the crisis likely incurred losses in the short term, due to increasing yields and falling bond prices, independently of whether they purchased the securities from their parent bank. For this reason, we need to account for the overall risky bond holdings in a fund's portfolio. To do so we construct the variable

$$\text{Risky Sov}_{it} = \frac{\sum_j \text{Fund Holding}_{ijt} \cdot \text{Risky}_{jt}}{\text{AUM}_{it}}$$

to control for funds' portfolio composition and investment strategy.

First, we include the lag of Risky Sov_{it} as control variable in regression (8), to control for the pre-existing level of risky sovereign bonds in the fund's portfolio. Second, we additionally include also the increment of Risky Sov_{it} to account for overall increases in the risky bonds by a fund. If the correlation between the bank-to-fund risky bond flow in quarter t and the subsequent short-term returns were a mere result of these securities' falling market prices, lower returns would be common to all funds that purchased risky bonds on the market, and not specific to affiliated funds.

While the coefficient for lagged *Risky Sov* is significant and positive, the coefficient estimated for Δ*Risky Sov* is negative and significant for the returns up to six months: controlling for their stock of risky bonds, those funds that choose to additionally invest in these assets experience sub-par returns. However, crucially, the coefficient of *Fund-bank trade* is still negative and highly statistically significant, with its magnitude reduced only by between 10% and 27% (columns 3, 6, and 9 of Table 19). In other words, this result indicates that if two funds buy exactly the same amount of risky bonds, both will on average deliver lower returns, but – on top of that – the fund that purchased the securities from its parent bank will have its performance impacted more negatively than the fund that got them on the market.

Importantly, column 12 shows that, on average, funds that loaded up risky sovereign bonds were delivering better returns one year after the trades, likely benefiting from a recovery in bond prices as the sovereign crisis subsided. Conversely, the coefficient of *Fund-bank trade* is close to zero, as the negative effect of trading directly with the bank vanishes.

Table 19: Parent banks' impact on fund performance.

	(1) 1m return	(2) 1m return	(3) 1m return	(4) 3m return	(5) 3m return	(6) 3m return	(7) 6m return	(8) 6m return	(9) 6m return	(10) 12m return	(11) 12m return	(12) 12m return
Fund-bank trade	-0.0642***	-0.0701***	-0.0467***	-0.128***	-0.135***	-0.115***	-0.150***	-0.165***	-0.131***	0.0665	0.0443	0.00907
	(-4.27)	(-4.31)	(-2.87)	(-5.00)	(-5.25)	(-4.30)	(-5.72)	(-6.05)	(-4.50)	(1.44)	(0.88)	(0.17)
Risky Sov (t-1)		0.0146***	0.00959***		0.0152***	0.0110***		0.0410***	0.0337***		0.0735***	0.0812***
		(9.60)	(4.49)		(4.57)	(2.92)		(6.47)	(4.56)		(6.52)	(5.75)
Δ Risky Sov			-0.0127***			-0.0108***			-0.0189***			0.0194**
			(-4.74)			(-2.77)			(-3.04)			(1.98)
Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	79625	79625	79625	80166	80166	80166	75696	75696	75696	66985	66985	66985
R^2	0.370	0.371	0.372	0.388	0.388	0.389	0.450	0.451	0.451	0.565	0.567	0.567

t statistics in parentheses

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

This table reports coefficient estimates from regressions based on specification (8). The sample includes all funds holding euro-area sovereign bonds. The dependent variable is fund's i return over a one-month (columns 1-3), three-month (columns 4-6), six-month (columns 7-9) and twelve-month (columns 10-12) period following quarter t. $Fund - bank\ trade_{it}$ is the amount of risky sovereign bonds potentially purchased by fund i from its parent bank in quarter t, scaled by the fund's total assets. $Risky\ Sov_{it}$ is the amount of risky sovereign bonds held by fund i at time t scaled by total assets. The t-statistics reported in parentheses use standard errors clustered at the fund level.

We repeat the estimation of (8) on the sample of public funds only. Table 20 reports the results which are qualitatively more or less identical. However, the immediate (one-month) negative effect of *Fund-bank trade* on returns in the specification with full controls (column 3) is 36% larger in magnitude.

In sum, the fact that funds that acquired risky sovereign bonds directly from the parent bank were negatively affected over and above comparable funds that acquired similar securities in the market seems to suggest that the latter were on average getting "better deals" – possibly as they exploited fire-sale market prices that affiliated funds were instead foregoing in trading with the bank – thereby limiting the price drawdown. Or put differently, affiliated funds did not get the full liquidity premium that other funds obtained during the crisis when purchasing risky sovereign bonds that banks sold off. At the same time, after one year as most sovereigns' credibility recovered[24], no discernible effect persists on bank-affiliated funds, suggesting that apparent price differentials eventually resolved into a second-order effect.

[24] In fact, the only notable exception is the sovereign default of Greece in 2012.

Table 20: Parent banks' impact on fund performance: public funds.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	1m return	1m return	1m return	3m return	3m return	3m return	6m return	6m return	6m return	12m return	12m return	12m return
Fund-bank trade	-0.0963***	-0.109***	-0.0636**	-0.106***	-0.113***	-0.0741*	-0.176***	-0.192***	-0.137**	-0.0186	-0.0426	-0.0101
	(-3.70)	(-3.92)	(-2.12)	(-2.71)	(-2.88)	(-1.75)	(-3.41)	(-3.72)	(-2.51)	(-0.25)	(-0.56)	(-0.13)
Risky Sov (t-1)		0.0133***	0.00489		0.00746	0.000259		0.0182**	0.00796		0.0308**	0.0246
		(4.86)	(1.28)		(1.58)	(0.05)		(2.27)	(0.91)		(2.29)	(1.54)
Δ Risky Sov			-0.0206***			-0.0176**			-0.0250***			-0.0148
			(-3.48)			(-2.54)			(-2.58)			(-1.39)
Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19721	19721	19721	19839	19839	19839	18712	18712	18712	16466	16466	16466
R^2	0.321	0.321	0.322	0.326	0.326	0.326	0.383	0.383	0.383	0.499	0.499	0.500

t statistics in parentheses

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

This table reports coefficient estimates from regressions based on specification (8). The sample includes all public funds holding euro-area sovereign bonds. The dependent variable is fund's i return over a one-month (columns 1-3), three-month (columns 4-6), six-month (columns 7-9) and twelve-month (columns 10-12) period following quarter t. $Fund - bank\ trade_{it}$ is the amount of risky sovereign bonds potentially purchased by fund i from its parent bank in quarter t, scaled by the fund's total assets. $Risky\ Sov_{it}$ is the amount of risky sovereign bonds held by fund i at time t scaled by total assets. The t-statistics reported in parentheses use standard errors clustered at the fund level.

8 Do affiliated funds facilitate banks' sovereign bond 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 a larger fraction of its risky bond portfolio holdings over the sample period than those without. In order to test this hypothesis, we first calculate for each bank i the change in bond j's portfolio share in quarter t: $\Delta\text{Bank Holding}_{ijt}/\text{TA}_{it}$, where TA_{it} are bank i's total assets in t. We then run the following regression:

$$\Delta\text{Bank Holding}_{ijt}/\text{TA}_{it} = \beta \cdot \text{Has Fund}_i \cdot \text{Risky}_{jt} + \gamma_{jt} + \alpha_{it}. \quad (9)$$

The binary variable Has Fund_i is equal to one for a bank which has affiliated investment funds. We include time-varying security and bank fixed effects.

The results are summarized in Table 21. Column 1 shows that having an affiliated mutual fund allowed banks to reduce their portfolio share of risk sovereign bonds significantly more than banks that do not have an affiliated asset management company. This finding is also robust to alternatively using the continuous variable CDS_{jt} as a measure for a bond's riskiness. Column 2 indicates that a bank with an affiliated mutual fund was able to reduce its portfolio holdings particularly faster for riskier bonds.

For a bank wishing 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 5 bps from $t-1$ to t (which represents approximately the 80th percentile of bid-ask spread increments of the securities in the sample). Column 3 shows that banks with affiliated funds were also able to sell a larger fraction of their portfolio holdings of a bond that suffered from such a market dry-up than banks without affiliated funds.

Overall, 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 portfolio shares at banks with affiliated mutual funds.

Table 21: Regressions from banks' perspective.

	(1) Δ Bank Holding / TA	(2) Δ Bank Holding / TA	(3) Δ Bank Holding / TA
Has Fund × Risky	-0.489***		
	(-3.00)		
Has Fund × CDS		-0.000202***	
		(-3.28)	
Has Fund × Liq. Shock			-0.0922*
			(-1.78)
Bank-quarter fixed effects	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes
Observations	37693	37693	36305
R^2	0.776	0.776	0.761
Sample	Bank sales	Bank sales	Bank sales

t statistics in parentheses

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

This table reports the coefficient estimates for regression (9) on the sample of bank bond sales. The dependent variable is the quarter-on-quarter change in the bank's bond holding, scaled by the bank's end-of-quarter total assets. "Has Fund" is a binary variable that is equal to one if the bank has an associated asset management company. "Risky" is a binary variable that is equal to one if the CDS spread of the country of issue of the bond, at the end of the corresponding quarter, is above 300bps; zero otherwise. The variable "CDS" is floored at 300 bps. Additionally, there is a cap at 1000 bps. "Liq. Shock" is a binary variable that is equal to one if the security's bid-ask spread increased by more than 5 bps (≃80th percentile of bid-ask spread increments of the securities in the sample). The t-statistics reported in parentheses use standard errors clustered at the bank level and at the security level.

9 Robustness tests

In this section, we test the robustness of our results to a series of alternative specifications, involving changing threshold and floor applied to the CDS spread in the definition of our variables for default risk, as well as using an alternative measure based on sovereign credit ratings; excluding from the analysis securities issued by regional governments; excluding bank short sales; and introducing a restrictive set of security-quarter-fund type fixed effects.

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 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 22 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 regression 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.

Another concern with the identification of trade of risky bonds between banks and affiliated funds is that the results might be particularly sensitive to the definition of the bond riskiness measures – for instance, to the choice of the floor for the continuous CDS spread and the threshold for the definition of the dummy *Risky*. Therefore, we first set the floor and the threshold at the 250 bps mark, which corresponds to the 75th percentile of the set of eurozone countries', quarterly sampled CDS (columns 5 and 6 of Table 22). Then, we take the level of 375 bps, which corresponds to the 85th percentile (columns 7 and 8). However, this variation leaves all the results presented above largely unchanged.

In the last test, we make another attempt to detect whether the trading behaviour we identified can be explained by features linked to a specific subset of investment funds. To this end, we exploit an additional attribute reported in the Investment Funds Statistics, which is linked to the fund's portfolio composition. We include in the baseline regression (3) a conservative set of security-quarter-*fund type* fixed effects, to capture purchases of a specific security at a specific time that might be explained by common investment strategies within fund type. According to this partition, most mutual funds in our matched sample are "mixed securities" funds (56.7% of the observations), followed by bond funds (30%) and "mixed" funds (11.8%). A few are equity funds (0.6%), while other types of affiliated funds hardly hold any government bond. Columns 9 and 10 of Table 22 confirm that, in this case too, evidence of idiosyncratic bank-fund trades is unaltered, especially for public funds.

Table 22: Robustness regressions for fund-bank trades of risky bonds.

	(1) No short sales	(2) No short sales	(3) Central govt	(4) Central govt	(5) Floor at 250bps	(6) Threshold at 250bps	(7) Floor at 375bps	(8) Threshold at 375bps	(9) Fund type f.e.	(10) Fund type f.e.
Sell	-113480.8*	-114395.4*	5638.5	4777.5	9473.4	8851.5	9761.8	9380.6	16486.6	16247.4
	(-1.84)	(-1.85)	(0.11)	(0.09)	(0.25)	(0.23)	(0.26)	(0.25)	(0.41)	(0.40)
$\Delta BankHolding$	-0.000229	-0.0000918	0.0000859	0.0000873	0.000136	0.0000952	0.000307	0.0000946	0.000134	0.0000436
	(-0.30)	(-0.19)	(0.16)	(0.26)	(0.29)	(0.29)	(0.45)	(0.29)	(0.17)	(0.11)
$\Delta BankHolding \times Sell$	0.00278***	0.000865	0.00231**	0.000474	0.00183**	0.000421	0.00285**	0.000407	0.00318**	0.000686
	(2.59)	(1.26)	(2.56)	(1.05)	(2.45)	(0.96)	(2.43)	(0.92)	(2.24)	(1.20)
$\Delta BankHolding \times CDS$	0.000000381		-1.43e-08		-0.000000165		-0.000000558		-0.000000310	
	(0.27)		(-0.01)		(-0.14)		(-0.38)		(-0.15)	
$\Delta BankHolding \times CDS \times Sell$	-0.00000652***		-0.00000624**		-0.00000563**		-0.00000652**		-0.00000843**	
	(-2.70)		(-2.48)		(-2.36)		(-2.34)		(-2.09)	
$\Delta BankHolding \times Sell \times Risky \times (1 - Public)$		-0.00361***		-0.00202*		-0.000658		-0.00141		-0.00206
		(-3.62)		(-1.72)		(-0.52)		(-1.10)		(-1.54)
$\Delta BankHolding \times Sell \times Risky \times Public$		-0.00911***		-0.00819***		-0.00677***		-0.00641***		-0.00839***
		(-3.95)		(-4.27)		(-3.77)		(-2.96)		(-4.10)
Fund-quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Security-fund type-quarter fixed effects	No	No	No	No	No	No	No	No	Yes	Yes
Observations	216849	216849	263791	263791	343682	343682	343682	343682	333122	333122
R^2	0.297	0.297	0.268	0.268	0.273	0.273	0.273	0.273	0.317	0.317

t statistics in parentheses

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

This table reports the coefficient estimates for versions of regression (3). In columns 1 and 2, the sample excludes bank short sales; in columns 3 and 4, it excludes bonds issued by regional governments. In columns 5 and 6 the level of 250 bps (75th percentile of CDS spreads in the sample) is used as floor and threshold in the definition of the variables "CDS" and "Risky"; in columns 7 and 8 the level of 375 bps (85th percentile) is used. In columns 9 and 10, a set of security-quarter-fund type fixed effects is included. The t-statistics reported in parentheses use standard errors clustered at the fund level and at the security level.

We then perform the same robustness test on our sample of bank-households bond holdings. Table 23 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 differing result 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, estimated on a larger sample. Finally, columns 5 to 8 show that, also in the case of households holdings, modifying the definition of bond riskiness does not disproportionately affect results.

Table 23: Robustness regressions for households-bank trades of risky bonds.

	(1) No short sales	(2) No short sales	(3) Central government	(4) Central government	(5) Floor at 250bps	(6) Threshold at 250bps	(7) Floor at 375bps	(8) Threshold at 375bps
Sell	75460.5	74533.7	110887.5	110462.4	78525.6	77868.6	78704.5	78154.6
	(1.06)	(1.04)	(1.51)	(1.50)	(1.41)	(1.40)	(1.41)	(1.40)
$\Delta BankHolding$	0.00103**	0.00112***	0.000149	0.000539	0.000477	0.000698*	0.000301	0.000696*
	(2.01)	(2.97)	(0.28)	(1.44)	(0.92)	(1.76)	(0.50)	(1.78)
$\Delta BankHolding \times Sell$	-0.000237	-0.00166***	0.000738	-0.000828	0.000177	-0.000997**	0.00118**	-0.000964**
	(-0.52)	(-3.10)	(1.25)	(-1.65)	(0.42)	(-2.09)	(2.30)	(-2.04)
$\Delta BankHolding \times CDS$	0.000000250		0.00000116*		0.000000764		0.000000976	
	(0.43)		(1.87)		(1.27)		(1.51)	
$\Delta BankHolding \times CDS \times Sell$	-0.00000458***		-0.00000492***		-0.00000442***		-0.00000561***	
	(-5.05)		(-3.34)		(-5.34)		(-4.86)	
$\Delta BankHolding \times Sell \times Risky$		-0.00198***		-0.00112		-0.00126***		-0.00226***
		(-4.57)		(-1.51)		(-4.22)		(-6.77)
Bank-quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	40310	40310	32941	32941	47529	47529	47529	47529
R^2	0.310	0.310	0.275	0.275	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). In columns 1 and 2, the sample excludes bank short sales; in columns 3 and 4, it excludes bonds issued by regional governments. In columns 5 and 6 the level of 250 bps (75th percentile of CDS spreads in the sample) is used as floor and threshold in the definition of the variables "CDS" and "Risky"; in columns 7 and 8 the level of 375 bps (85th percentile) is used. The t-statistics reported in parentheses use standard errors clustered at the bank level and at the security level.

9.2 Robustness of the impact of parent banks on funds

As in the previous subsection, we test whether the differences between affiliated and unaffiliated funds that we detected in section 7.1 as to the amount of risky bond purchases are sensitive to how we defined a bond's riskiness.[25] Table 24 reports the results of the estimation of (5) where threshold and floor in the definition of *Risky* and *CDS* have been varied. Columns 1 and 5 show that the coefficient β in regression (5) is indeed sensitive to changes in the definition of a risky bond. Both for a higher and for a lower CDS threshold, the coefficient is still positive but not statistically significant. On the other hand, columns 2 and 6 show that when we use as explanatory variable the indicator for a parent bank's sell trade of a bond, and not the mere condition of having a parent bank, results are robust to alternative levels of the floor. As in the main estimation, when restricting the sample to public funds a larger effect is estimated, but the coefficient turns non-significant (columns 3 and 7). Finally, slight variations to the CDS variable are not relevant to the results at the extensive margin, where we use a dummy *Fund Buy* as dependent variable (columns 4 and 8).

[25] In unreported regressions, we find that neither restricting the sample to central government bonds, nor excluding the short sales of banks significantly affect the results.

Table 24: Parent banks' impact on funds' risky holdings: robustness regressions.

	(1) Δ Fund Holding	(2) Δ Fund Holding	(3) Δ Fund Holding	(4) Fund Buy	(5) Δ Fund Holding	(6) Δ Fund Holding	(7) Δ Fund Holding	(8) Fund Buy
Has Bank × Risky	82922.6				28711.6			
	(1.26)				(0.23)			
Bank's Sell		-112875.8**	-26152.3	-0.0150		-187112.8***	-148329.7	-0.0260
		(-2.48)	(-0.21)	(-1.35)		(-2.88)	(-0.88)	(-1.45)
Bank's Sell × CDS		287.9**	291.2	0.0000828**		392.7***	521.0	0.0000865**
		(2.16)	(0.96)	(2.28)		(2.58)	(1.42)	(1.98)
Fund-quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1381926	1381926	256831	256831	1381926	1381926	256831	256831
R^2	0.205	0.205	0.213	0.573	0.205	0.205	0.213	0.573
Sample	Full	Full	Public funds	Public funds	Full	Full	Public funds	Public funds
Robust to:	250 bps threshold	250 bps floor	250 bps floor	250 bps floor	375 bps threshold	375 bps floor	375 bps floor	375 bps floor

t statistics in parentheses

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

This table reports coefficient estimates of different versions of regression (5). In columns 1-3 and 5-7 the dependent variable is the quarter-on-quarter change in the fund's bond holding; in columns 4 and 8 it is a binary variable which is equal to 1 if the quarter-on-quarter change is positive, and 0 otherwise. "Has Bank" is a binary variable that is equal to 1 if the fund has a parent bank; 0 otherwise. "Bank's Sell" is a binary variable that is equal to 1 if the fund has a parent bank selling the security in the corresponding quarter; 0 otherwise. Regressions 1 and 5 differ in the threshold used to define the variable "Risky", while regressions 2-4 and 6-8 differ in the floor used to define the variable "CDS". The t-statistics reported in parentheses use standard errors clustered at the fund level and at the security level.

All in all, the tests in Table 24 seem to corroborate our findings that parent banks had a discernible effect on affiliated funds' portfolios of risky bonds. The results in section 7.2 show that correspondingly, at least in the short-term, funds that acquired risky bonds from the parent bank were indeed negatively impacted in terms of performance. As our regression specification inherently benchmarks the returns with those of funds that did not trade with the bank, we test whether changes in the composition of the sample affect the results. In Table 25 we repeat the estimation of (8) on a smaller sample that excludes those funds that held little or no sovereign bonds defined as risky. Specifically, we keep the 25% of funds with the highest average value of Risky Sov_t in the sample (columns 1, 3, 5 and 7) – respectively all public funds with non-zero average Risky Sov_t (columns 2, 4, 6 and 8). The results are comforting as the estimated coefficients, especially with respect to the variable *Fund-bank trade*, are remarkably similar, lending weight to the finding that bank-affiliated funds heavily involved in risky purchases from their parent institution suffered temporary but significant subpar returns.

Table 25: Parent banks' impact on fund performance: robustness regressions with restricted sample.

	(1) 1m return	(2) 1m return	(3) 3m return	(4) 3m return	(5) 6m return	(6) 6m return	(7) 12m return	(8) 12m return
Fund-bank trade	-0.0404**	-0.0596**	-0.113***	-0.0752*	-0.158***	-0.139***	-0.00323	0.0109
	(-2.27)	(-2.01)	(-4.34)	(-1.81)	(-5.39)	(-2.69)	(-0.05)	(0.14)
Risky Sov (t-1)	0.0103***	0.00350	0.00573	-0.00447	0.0243***	0.000446	0.0551***	0.00658
	(4.22)	(0.89)	(1.29)	(-0.87)	(2.78)	(0.05)	(3.42)	(0.40)
Δ Risky Sov	-0.0109***	-0.0205***	-0.00469	-0.0180***	-0.0229***	-0.0323***	0.0170	-0.0204*
	(-3.65)	(-3.37)	(-1.13)	(-2.59)	(-3.26)	(-3.29)	(1.53)	(-1.96)
Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	30128	12493	30258	12549	28894	11956	26157	10766
R^2	0.398	0.342	0.421	0.354	0.464	0.396	0.568	0.508
Sample	All funds	Public funds	All funds	Public funds	All funds	Public funds	All funds	Public funds

t statistics in parentheses

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

This table reports coefficient estimates from regressions based on specification (8). In columns 1, 3, 5 and 7, the funds in the sample correspond to the upper quartile of funds by average risky bond holdings. In columns 2, 4, 6 and 8, all public funds with positive risky bond holdings are included. The dependent variable is fund's i return over a one-month (columns 1-2), three-month (columns 3-4), six-month (columns 5-6) and twelve-month (columns 7-8) period following quarter t. $Fund-bank\ trade_{it}$ is the amount of risky sovereign bonds potentially purchased by fund i from its parent bank in quarter t, scaled by the fund's total assets. $Risky\ Sov_{it}$ is the amount of risky sovereign bonds held by fund i at time t scaled by total assets. The t-statistics reported in parentheses use standard errors clustered at the fund level.

9.3 Robustness of the impact of affiliated funds on banks

In Table 26, we check whether results of regression (9) are qualitatively intact if we slightly vary the sample of risky and illiquid bonds. As in the previous robustness tests, we first set the critical level of the CDS spread to 250 bps (columns 1 and 2); then, we increase it to 375 bps (columns 4 and 5). In all cases, results are very similar to the ones we obtained previously. In columns 3 and 6 we analogously vary the threshold for a liquidity dry-up to, respectively, the 75th and the 85th percentile (from the 80th in the original definition) of the distribution of bid-ask spread increments over the estimation period of all the sovereign bonds in our sample. In this case, both size and statistical significance vary and suggest that the effect is better identified on a smaller number of the most illiquid bonds (85th percentile of liquidity shock distribution).

Table 26: Regressions from banks' perspective: robustness.

	(1) 250 bps threshold	(2) 250 bps floor	(3) 75th pct threshold	(4) 375 bps threshold	(5) 375 bps floor	(6) 85th pct threshold
Has Fund × Risky	-0.480***			-0.525***		
	(-2.91)			(-3.37)		
Has Fund × CDS		-0.000209***			-0.000195***	
		(-3.34)			(-3.21)	
Has Fund × Liq. Shock			-0.0895*			-0.143**
			(-1.68)			(-2.26)
Bank-quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Security-quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	37693	37693	36305	37693	37693	36305
R^2	0.776	0.776	0.761	0.776	0.776	0.761
Sample	Bank sales	Bank sales	Bank sales	Bank sales	Bank sales	Bank sales

t statistics in parentheses

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

This table reports the coefficient estimates for regression (9) on the sample of bank bond sales. The dependent variable is the quarter-on-quarter change in the bank's bond holding, scaled by the bank's end-of-quarter total assets. "Has Fund" is a binary variable that is equal to one if the bank has an associated asset management company. In regressions 1-3 (resp. 4-6) a lower (resp. higher) threshold/floor is used in the definition of "Risky", "CDS" and "Liq. Shock". The t-statistics reported in parentheses use standard errors clustered at the bank level and at the security level.

9.4 Sovereign credit ratings as a 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 27 reports the number of observations in the sample of matched fund-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 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, bonds from the GIIPS, as well as Latvia, Lithuania, Slovenia and Cyprus had a poor rating at some point during the sample period.

In Table 28, 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 spreads, 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 28 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.

Table 27: Bond holdings with average rating BBB or below in the sample of matched fund and bank holdings.

	CY	ES	GR	IE	IT	LT	LV	PT	SI	Total
2009q4	0	0	0	0	0	8	1	0	0	9
2010q1	0	0	0	0	0	9	0	0	0	9
2010q2	0	0	1277	0	0	9	0	0	0	1286
2010q3	0	0	682	0	0	19	0	0	0	701
2010q4	0	0	448	603	0	24	2	0	0	1077
2011q1	0	0	358	413	0	27	1	280	0	1079
2011q2	0	0	268	333	0	31	1	188	0	821
2011q3	5	0	155	268	0	32	2	142	0	604
2011q4	4	0	152	188	0	29	2	45	0	420
2012q1	1	0	0	144	0	35	5	32	0	217
2012q2	1	551	0	109	0	35	5	10	0	711
2012q3	0	514	233	125	883	42	5	10	0	1812
2012q4	0	593	183	138	888	35	2	12	0	1851
2013q1	0	641	38	158	0	30	1	24	0	892
2013q2	0	665	35	169	968	33	1	34	32	1937
2013q3	0	653	35	151	911	22	1	39	23	1835
2013q4	0	811	34	118	885	21	0	35	27	1931
2014q1	0	880	9	116	989	32	10	47	31	2114
2014q2	0	929	6	0	1010	0	0	56	60	2061
2014q3	0	923	6	0	937	0	0	67	56	1989
2014q4	0	970	6	0	995	0	0	54	99	2124
2015q1	0	1094	5	0	1068	0	0	42	101	2310
2015q2	0	1105	0	0	1069	0	0	46	99	2319
2015q3	0	1169	0	0	1081	0	0	39	118	2407
2015q4	0	1132	0	0	1126	0	0	50	119	2427
2016q1	0	1174	0	0	1133	0	0	73	97	2477
Total	11	13804	3930	3033	13943	473	39	1325	862	37420
N	37420									

This table reports, classified by quarter and country, the number of observations in the sample of matched fund-bank holdings for which the credit rating associated to the bond is lower than or equal to BBB. 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 28: 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.

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 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 riskier 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.

Although evidence indicates that funds did not underperform in the long term after piling up sovereign risk, this seemingly opportunistic behavior of banks might in general undermine the efficiency of their clients' investment decisions. On the other hand, 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.

References

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

Ber, H., Y. Yafeh, and O. Yosha (2001). Conflict of interest in universal banking: Bank lending, stock underwriting, and fund management. *Journal of Monetary Economics 47*(1), 189–218.

Boissel, C., F. Derrien, E. Örs, and D. Thesmar (2016). Systemic risk in clearing houses: evidence from the european repo market. *European Systemic Risk Board* (10).

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

Cooper, R. and K. Nikolov (2018). Government debt and banking fragility: The spreading of strategic uncertainty. *International Economic Review* (forthcoming).

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

De Marco, F. (2017). Bank lending and the european sovereign debt crisis. *Journal of Financial and Quantitative Analysis* (forthcoming).

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

Edwards, A. K., L. E. Harris, and M. S. Piwowar (2007). Corporate bond market transaction costs and transparency. *The Journal of Finance 62*(3), 1421–1451.

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., E. Genc, and Y. Karabulut (2018). Liquidity Support in Financial Institutions.

Fecht, F., A. Hackethal, and Y. Karabulut (2018). Is proprietary trading detrimental to retail investors? *Journal of Finance 73*(3), 1323–1361.

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.

Ferreira, M. A., P. Matos, and P. Pires (2018, jul). Asset Management within Commercial Banking Groups: International Evidence. *The Journal of Finance* (0).

Gil-Bazo, J., P. Hoffmann, and S. Mayordomo (2017). Mutual Funding.

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 Z. Rehman (2008). Information flows within financial conglomerates: Evidence from the banks-mutual funds relation. *Journal of Financial Economics 89*(2), 288–306.

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