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## Cyclical investment behavior across financial institutions

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# Non-technical summary

### Research Question

It is still an open question which financial institutions act in a stabilizing and destabilizing manner on the capital markets. Institutional investors that respond pro-cyclically to price changes can exacerbate price dynamics. Institutions that buy when prices drop and sell when prices rise may stabilize the market and push prices back to fundamentals. While many studies highlight pro-cyclical institutions, studies that identify counter-cyclical investors are few and far between.

### Contribution

This paper analyses the investment behavior in debt securities using confidential and unique security level data provided by the Deutsche Bundesbank. That allows us to compare the investment behavior of the three largest groups of institutional investors in Germany: insurance companies and pension funds; investment funds; and banks. The granular data also enables us to analyze the investment behavior at the security level. One contribution to the literature is to answer the open question of which sectors respond pro-cyclically and counter-cyclically to price changes. This also sheds light on the question of whether the investor base of securities is critical for borrowers and enables us to draw some inferences about the determinants of episodes of large capital flows.

### Results

Insurance companies and pension funds may stabilize the market by responding counter-cyclically to price changes. They also buy debt securities that are trading at a discount and sell securities that are trading at a premium. Investment funds and banks buy securities after their price has increased and sell securities after a drop in prices. While the investment behavior of insurance companies and pension funds may stabilize the market, investment funds and banks may exacerbate price dynamics. It is of crucial importance for financial stability to monitor the investor base of a security.

# Nichttechnische Zusammenfassung

### Fragestellung

In der akademischen Literatur ist es eine ungeklärte Frage, welche Finanzinstitute eine eher stabilisierende und welche Institute eine eher destabilisierende Wirkung an den Kapitalmärkten haben. Institutionelle Anleger, die Wertpapiere verkaufen, wenn diese im Kurs gefallen sind (prozyklisches Verhalten), können Preisdynamiken verstärken. Im Gegensatz dazu können Anleger, die antizyklisch handeln, Kurse näher an Fundamentalwerte bringen, wenn diese davon entfernt liegen. Während viele bisherige Studien zeigen, dass Finanzinstitute prozyklisch handeln, gibt es nur wenige Studien, die antizyklisch agierende Anleger empirisch nachweisen.

### Beitrag

Diese Studie analysiert das Investitionsverhalten auf dem Anleihenmarkt und untersucht dieses für die drei größten Anleger in Deutschland: Versicherungsunternehmen und Pensionsfonds, Investmentfonds sowie Banken. Die Daten, die von der Deutschen Bundesbank bereitgestellt wurden, ermöglichen, das Investitionsverhalten auf Wertpapierebene zu untersuchen und Anleihen-spezifische Charakteristiken in die Analyse einzubeziehen. Dadurch kann ein Beitrag zu der Literature geleistet werden, indem die Frage beantwortet wird, welcher Anlagesektor prozyklisch und welche antizyklisch auf Kursveränderungen reagiert.

### Ergebnisse

Die Ergebnisse zeigen, dass Versicherungsunternehmen und Pensionsfonds den Markt durch ihr antizyklisches Kaufverhalten in Bezug auf Kursveränderungen stabilisieren können. Da diese Institutionen Anleihen kaufen (verkaufen), die mit einem Abschlag (Aufschlag) gehandelt werden, kann ihr Investitionsverhalten den Kurs von Anleihen zum Nennwert. Im Gegensatz dazu agieren Investmentfonds und Banken prozyklisch auf Kursveränderungen. Sie kaufen Anleihen, nachdem die Preise gestiegen sind, und sie verkaufen Anleihen, nachdem die Kurse gefallen sind. Während das Investitionsverhalten der Versicherungsunternehmen und Pensionsfonds eine stabilisierende Wirkung auf den Markt haben dürfte, können Investmentfonds und Banken Preisdynamiken verstärken. Daraus kann geschlossen werden, dass es aus Sicht der Finanzstabilität unerlässlich ist, die Art der investierenden Institutionen zu überwachen.

Bundesbank Discussion Paper No 08/2016

# Cyclical Investment Behavior across Financial Institutions*

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**Abstract**

This paper examines the investment behavior in debt securities across financial institutions with a particular focus on how they respond to price changes. For identification, we use security-level data from the German Microdatabase Securities Holdings Statistics. Our results suggest that banks and investment funds may destabilize the market by responding in a pro-cyclical manner to price changes. For investment funds, this effect was even stronger during the crisis and periods of high uncertainty. Insurance companies and pension funds buy securities after a drop in prices. They also buy securities that are trading at a discount and sell securities that are trading at premium. This counter-cyclical behavior may stabilize markets whenever prices have been pushed away from fundamentals. Since our results suggest that institutions with impermanent balance sheet characteristics may exacerbate price dynamics, it is of crucial importance for financial stability to monitor the investor base as well as the balance sheets of both levered and non-levered investors.

**Keywords:** Cyclicality, Portfolio Allocation, Financial Stability, Debt Capital Flows

**JEL classification:** F32, G11, G15, G20.

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# 1 Introduction

Theory yields a variety of predictions on the buying behavior of capital market participants. The standard efficient market hypothesis claims that asset prices must reflect all available information due to the existence of arbitrageurs (Fama, 1965; Friedman, 1953). While banks may be forced to sell undervalued assets due to margin calls, non-levered institutional investors may stabilize the market by buying up fire-sold assets in order to benefit from future price gains (Shleifer and Vishny, 1992). DeLong, Shleifer, Summers, and Waldmann (1990) show that it may be rational to buy when prices rise and sell when prices fall so that prices can be pushed away from fundamental values. Despite its importance for macro-prudential policy and financial stability, empirical evidence on who buys when prices are falling has been elusive due to the lack of granular data.

In recent years policymakers have increasingly monitored leverage of financial intermediaries in order to make judgments about financial stability.[1] However, if the investor base of debt securities consists mainly of destabilizing short-term investors, who withdraw their assets once at the slightest sign of instability, borrowers are not insulated even if they have strong balance sheets (Cerutti, Claessens, and Puy, 2015).

In order to shed more light on the question of how various institutional investors respond to price changes, security-level data is indispensable. For the identification, we use confidential security-by-security holdings data provided by the Deutsche Bundesbank (the German central bank) covering the period from 2005 Q4 until 2014 Q4. For every single security that is held in Germany we have data on the amount held by each sector. For instance, we know that banks in Germany hold X amount of security Z in quarter t. To the best of my knowledge, this sector-level data has not been used before. The holdings include both foreign and domestic as well as government and corporate securities. Foreign debt security holdings are consistent with portfolio debt on an ultimate risk base. For the purpose of this study, we focus on the buying behavior of the three largest groups of institutional investors: banks; investment funds; and insurance companies and pension funds.[2]

The availability of security-level data allows us to make comparisons between securities within the same asset class and to observe idiosyncratic price movements. By including security fixed effects, we also control for time-invariant security-specific characteristics and can make judgments about the investment behavior of a specific security over time. Using security∗time fixed effects, we compare the investment behavior by insurance companies and pension funds relative to banks as well as investment funds for a given security at a given point in time. This within security comparison fully absorbs unobserved and observed time-variant security-specific characteristics such as the risk or the liquidity of the security. Hence, the estimated difference of the buying behavior can be attributed to heterogeneity in their response to price changes. Not controlling for these characteristics can lead to biases in the coefficient of the variable of interest when it is correlated

[1] For example, the Federal Open Market Committee concluded in December 2013 that "Participants also reviewed indicators of financial vulnerabilities that could pose risks to financial stability and the broader economy. These indicators generally suggested that such risks were moderate, in part because of the reduction in leverage and maturity transformation that has occurred in the financial sector since the onset of the financial crisis."

[2] For a more detailed data description, see the Appendix.

with the error term. In addition, grouping securities of specific asset classes together ignores idiosyncratic security characteristics and may lead to misleading results due to compositional effects.

We find evidence that banks as well as investment funds respond pro-cyclically to price changes. In contrast, insurance companies and pension funds are contrarian investors, i.e. they buy when prices fall and sell when prices rise. We also present evidence that insurance companies and pension funds have a preference for bonds that are trading at a discount, while banks buy more bonds that are trading at a premium.

Market participants that, on average, buy when prices rise and sell when prices fall can destabilize the market (Friedman, 1953). This suggests that pro-cyclical investors may exacerbate price dynamics, while counter-cyclical investment behavior pushes prices back towards fundamentals. To the best of my knowledge, this is the first study that compares the investment behavior across sectors and shows who may stabilize the market by acting counter-cyclically.

The empirical approach is to regress the percentage change in the nominal holdings of the debt security of each sector on the lagged percent price change of these securities, controlling for time-invariant security characteristics as well as macroeconomic factors. We find that a ten percent price increase in the last quarter is associated with a 1.7 percent buildup in the nominal value held for both investment funds and banks. If the price of a security drops by ten percent in the previous quarter, insurance companies and pension funds *raise* their nominal amount held by 6.5 percent.

The heterogeneous responses may be explained by differences in their liability structure. Banks and investment funds are vulnerable to runs on their liabilities. This is even the case for mutual funds with small leverage due to the impermanent structure of their equity capital. In addition, their asset side may be relatively illiquid. The liability side of insurance companies and pension funds is more stable and movements in their balance sheets are relatively orthogonal to economic and financial conditions.

The approach brings together two literatures. First, the financial economics literature that focus on the return of these investment strategies neglects financial stability issues. Other studies that focuses predominantly on a single sector, fail to address the counterparts of pro-cyclical investors. For actual buys and sales, there needs to be someone who offsets the pro-cyclical investment behavior, as opposed to order flows, for which there can be a one-sided market of potential buyers and sellers. Easily said, for every buyer there needs to be a seller, and vice versa.

While Abbassi, Iyer, Peydró, and Tous (2016) show that banks with trading expertise increased their investment in debt securities during the crisis relatively more than banks without trading expertise, it is still an open question as to how the sectoral allocation of securities shifts when prices move. Acharya and Steffen (2015) show that banks in the Euro Area periphery bought government bonds of Euro Area periphery countries in the first half of 2012 when their yields were high, which indicates counter-cyclical investment behavior. However, it is not clear whether banks started buying when prices were already rising or whether they did so when prices were rock-bottom. In order to clarify this, we delve deeper into the question of whether the banking sector increases its exposure to bonds that have fallen in order to "catch the falling knife" in the hope of mean reversion or if they have jumped on the bandwagon as prices had already started to increase.

We find evidence that banks respond pro-cyclically to price changes. Banks also tend

to buy securities that trade at a premium. They increase their holdings more strongly when the price has gone up in the previous quarter and the bond is trading at a premium. This indicates that they are speculating that the price will appreciate further and will sell the security aggressively once it starts decreasing in value.

There is a growing literature investigating the cyclical investment behavior of investment funds. Fund managers may act with a very short-term horizon when exposed to investor injections and redemptions (Shek, Shim, and Shin, 2015; Goldstein, Jiang, and Ng, 2015). They may also invest pro-cyclically because many are measured on monthly or quarterly performance, adding pressure to chase the market higher as it moves (Feroli, Kashyap, Schoenholtz, and Shin, 2014; Shin and Morris, 2015; Abreu and Brunnermeier, 2003). Brunnermeier and Nagel (2004) confirm this finding by investigating the buying behavior of big hedge funds around the dot-com bubble. Hedge funds that were *not* riding the tech bubble underperformed and suffered significant investor redemptions. Raddatz and Schmukler (2012) show that mutual funds' investment behavior tends to be pro-cyclical and thus not stabilizing; they reduce their exposure in bad times and increase it during good times. Since the pro-cyclicality seems to be existent in both upswings and downturns, delegated portfolio managers may increase market volatility and distort asset prices in general (Guerrieri and Kondor, 2012).

Our results confirm that investment funds may destabilize the market by acting in a pro-cyclical manner. Although the direction of the cyclical investment behavior has not changed during the crisis, we present evidence that pro-cyclical investment behavior is stronger during the crisis as well as when the implied stock market volatility of the S&P 500 (VIX) is high. A high VIX can be seen as a period of elevated uncertainty and illiquid markets.

There is limited evidence on the cyclical investment behavior of insurance companies and pension funds. Becker and Ivashina (2015) explain that insurance companies buy corporate bonds that are the highest yielding within each rating group due to their reluctance to hold more capital when they hold worse-rated bonds. In contrast, some authors have also pointed to the pro-cyclical behavior of insurance companies and pension funds (Haldane, 2014; Acharya and Morales, 2015).

While there is mixed evidence on the buying behavior of insurance companies and pension funds, we show that they buy securities when their prices have dropped. We also present evidence that insurance companies and pension funds have a preference for buying bonds that are trading at a discount. This supports the hypothesis that they are buy-and-hold investors and that their investment behavior can stabilize the market. Both buying at a discount and selling at a premium may push the price towards its face value as, for a given amount of securities issued, a higher demand should push up prices.

Second, this paper also contributes to the international economics literature that studies the determinants of portfolio flows. This literature does not differentiate between the holding sector and issuing sector of the securities. In addition, the literature neglects security-specific characteristics, such as price movements but concentrates on country-specific characteristics and global factors (see for example Broner, Didier, Erce, and Schmukler (2013); Forbes and Warnock (2012)). These push and pull factors neglect the investor base of the flows.

First empirical evidence that sensitivity of capital flows can be attributed to the investor base is shown by Cerutti et al. (2015). They demonstrate that capital flows to

emerging market countries that rely more on international funds and global banks are more sensitive to global factors. However, they use the correlation of debt capital flows reported by two different data providers as a proxy for the share of bank and investment funds responsible for the capital movements. In contrast, we can distinguish cleanly between the individual holding sectors of securities and thus absorbing compositional effects.

Due to the lack of bilateral data on the sectoral-level link, evidence on heterogenous responses across investors has been rare. By presenting evidence on the cyclical behavior of different sectors, we aim to fill this gap in the literature. Our results indicate that sudden stops and surges of capital flows may be determined by the composition of the investor base. By distinguishing between insurance companies and pension funds, banks and investment funds, we find significantly heterogeneous responses to country-specific economic and financial characteristics. Grouping all holding sectors together, the effects may neutralize each other and lead to misleading results. In addition, the granular data allows us to distinguish not only the link between the holding sector and the issuing sector, but also the link at the security level. This information enables us to make statements about security-specific characteristics, absorbing compositional effects. For instance, while it is not possible using aggregated data to establish whether bond investors respond to country-specific or security-specific characteristics, we show that both factors play a vital role. Our results indicate that monitoring the investor base of a security is key to identifying financial vulnerabilities. Relying on pro-cyclical investors such as investment funds and banks can drive prices away from fundamentals and may also lead to sudden stops and surges of capital flows.

The paper is structured as follows. In section 2, we lay out the balance sheet dynamics of the three different sectors. Section 3 describes the data. In section 4, we present some stylized facts. Section 5 shows the regression results. In section 6, we present robustness tests. Section 7 concludes.

# 2 Institutional Background

In order to understand the rationale behind the buying behavior of different financial institution, it is important to understand their balance sheet dynamics.

## 2.1 Banks

Much attention has been paid to the liability side of banks, as the high leverage of global banks can jeopardize the stability of the global financial system. Figure 1 shows different categories of the aggregated balance sheet of German banks proportionally. The total size of the balance sheets amounted to 7.85 trillion Euros in 2014, which is around 270 per cent of Germany's GDP (2.9 trillion Euros in 2014). The liability side consists mainly of retail and wholesale deposits. Only 382 billion Euros, approximately 5 per cent, are equity capital. Both retail and interbank borrowing are short-term liabilities that can be withdrawn without an extended period of notice.[3]

[3]While in the banking crisis as described in Diamond and Dybvig (1983) retail deposits were withdrawn, the most recent financial crisis was characterized by a withdrawal of wholesale funding and money

Figure 1: Balance Sheet of Banks in Germany


*Source: Author's calculations; Data: Deutsche Bundesbank* [4]

When creditors refuse to roll over their debt or actively withdraw their funds, the asset side needs to be reduced in order to service the liabilities. The asset side of banks mainly consists of long-term assets, such as debt securities and loans. When funding liquidity dries up, banks start reducing their most liquid assets, such as cash and excess reserves at the central bank, first. As these contribute only a small amount to the aggregate balance sheet and banks are unable to call in loans, debt securities need to be sold. If the liquidity dryup is systemic and not only specific to one bank, banks may have trouble finding a buyer for the securities, forcing them to sell them below their fundamental value, what is known as a "fire sale". This process can be even exacerbated if banks need to write their assets down to their fair value. If security prices plunge and banks need to mark them to market, this reduces banks' equity positions. In order to satisfy capital requirements, they shrink their balance sheets by selling more debt securities, which depresses their prices even further. This can lead to a spiral between lower asset prices and weaker balance sheets (Adrian and Shin, 2010).[5]

market fund shares.

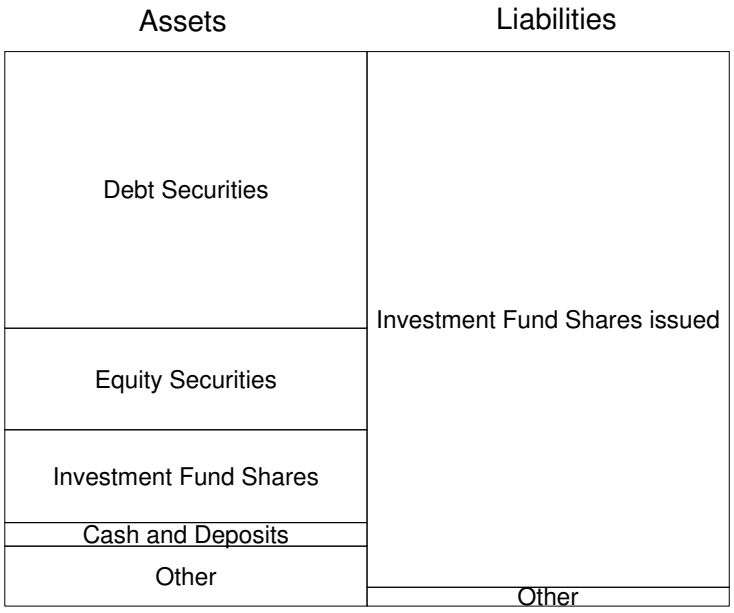
[4] Assets (in EUR billions, share of total assets): Loans to Non-Banks (3127, 40%), Loans to Banks (1950, 25%), Debt Securities (1176, 15%), Others (1599, 20%); Liabilities (in EUR billions, share of total liabilities): Equity (382, 5%), Retail Deposits (3299, 42%), Interbank Borrowing (1717, 22%), Debt Securities issued (1115, 14%), Other (1341, 17%); Total: EUR 7853 billion

[5] Laux and Leuz (2010) describe the mark-to-market behavior of banks in more detail. Allen and Carletti (2008) demonstrate a link between mark-to-market behavior and asset prices.

## 2.2 Investment Funds

The investment fund industry in Germany is a significant sector, with an aggregate balance sheet of 1.7 trillion Euros in 2014. In Germany, the sector consists almost exclusively of open-end mutual funds, such as bond and mixed funds. The leverage of these investment funds is very limited. Figure 2 shows that only two percent of their liability side consists of loans. At first glance, the fact that investment funds are not vulnerable to runs on their debt liabilities may raise doubts about their importance to systemic risk. As their investors provide equity capital, this suggests that investment funds can be seen as benign with respect to financial stability.

Figure 2: Balance Sheet of Investment Funds in Germany




*Source: Author's calculations; Data: Deutsche Bundesbank* [6]

However, investors in open-end mutual funds can draw down their capital quickly. This changes the assets under management of the fund, which is the fund's equity capital. In other words, investment funds' capital is not permanent, unlike the equity capital of non-financial corporations. As investment fund shares issued make up the lion's share of investment funds' liabilities, looking at simple metrics like the total assets to equity ratio can lead to misleading conclusions when it comes to identifying financial vulnerabilities. Once investors start redeeming assets, a feedback loop between redemptions by investors and sales of portfolio managers can emerge. The redemptions of investors are usually not orthogonal to the state of the real economy. They withdraw capital in times when the

[6] Assets (in EUR billions, share of total assets): Debt Securities (825, 50%), Equity Securities (303, 18%), Investment Fund Shares (277, 17%), Cash and Deposits (70, 4%), Other (179, 11%); Liabilities (in EUR billions, share of total liabilities): Investment Fund Shares issued (1597, 97%), Other (56, 3%); Total: EUR 1653 billion

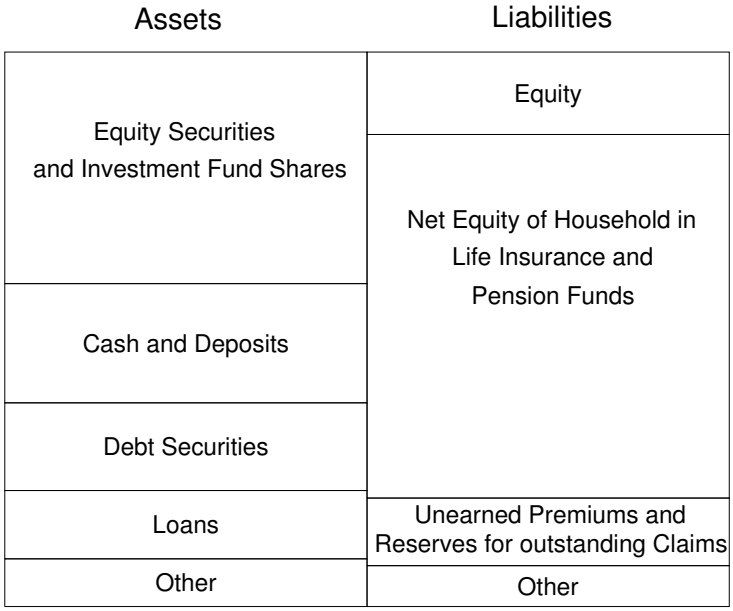
economy is doing badly in order to smooth consumption. Portfolio managers' fire sales can drive down prices further, affecting both the economy and investors' balance sheets adversely. Accordingly, this may trigger more redemptions of investors.

## 2.3 Insurance Companies and Pension Funds

The total size of the insurance companies and pension funds balance sheet in Germany in 2014 was 2.4 trillion Euros. On the asset side, cash and deposit holdings are much bigger than for banks and contribute 21 per cent to total assets, while almost 60 per cent are securities (Figure 3). The leverage ratio of insurance companies is much smaller than that of banks. The lion's share of the liabilities is represented by insurance technical reserves; these are net equity of households in life insurance and pension fund reserves or prepayments of insurance premiums and reserves for outstanding claims. These long-term liabilities are mostly contingent and their payouts are relatively independent of the state of the real economy and of overall financial conditions. This predictable liability structure may give insurance companies and pension funds more autonomy in their portfolio choice during bad times compared to banks or investment funds. For instance, an accident with an insured car or a damage to an insured building are events that would be covered under the insurance and cause payouts. As the structure of the liability side of insurance companies and pension funds is relatively persistent, this keeps their funding and rollover risk relatively moderate and leaves them with more "skin in the game".[7] This enables "deep pocket investors", such as insurance companies and pension funds, to take more risk during bad times when other actors, such as banks and investment funds, may be forced to sell.

[7] Acharya, Biggs, Le, Richardson, Ryan, Cooley, and Walter (2011) discuss the systemic importance of insurance companies for the global economy in more detail. Manconi, Massa, and Zhang (2016) document their selling behavior when they face a large outflow.

Figure 3: Balance Sheet of Insurance Companies and Pension Funds in Germany




*Source: Author's calculations; Data: Deutsche Bundesbank* [8]

# 3 Data

The Microdatabase Securities Holding Statistics of the Deutsche Bundesbank's Research Data and Service Centre of the Deutsche Bundesbank provides data on the holdings of all sectors in Germany separately at the security-by-security level from 2005 Q4 onwards. For instance, we know that the banking sector in Germany holds a specific amount of a specific security in a given quarter. The security is identified with the International Security Identification Number (ISIN). We also have information about the currency of denomination, the security classification and the issuing sector. For a detailed data description see, Amann, Baltzer, and Schrape (2012).[9]

We only consider the three holding sectors: insurance companies and pension funds; investment funds; and bank and their respective holdings of *debt* securities. The raw, nominal and market values are known for debt securities held. The raw value is the nominal value held in the currency of denomination. The nominal value is the notional amount of security holdings and does not reflect price movements.[10] The market value is

[8] Assets (in EUR billions, share of total assets): Investment Fund Shares and Equity Securities (1014, 42%), Cash and Deposits (384, 21%), Debt Securities (384, 16%), Loans (299, 12%), Other (209, 9%); Liabilities (in EUR billions, share of total liabilities): Equity (361, 15%), Net Equity of Household in Life Insurance and Pension Funds (1592, 66%), Unearned Premiums and Reserves for outstanding Claims (296, 12%), Other (90, 3%) Total: EUR 2428 billion

[9] Unfortunately, information on security-specific characteristics from the Centralised Security Database is not available.

[10] The nominal value needs to be adjusted to reflect only investment decisions (see Appendix).

the number of securities held, multiplied by the price.

The data provided by the Deutsche Bundesbank is merged with publicly available data. The country-specific 10-year generic government bond yield, the consumer price index and GDP are from the IMF. We obtain the GDP growth and the inflation rate by taking the natural log change of the GDP and the consumer price index. If the GDP is not available quarterly, we interpolate the annual value linearly. The VIX is from the Chicago Board Options Exchange and downloaded through Datastream. The EONIA is from the ECB.[11] The country-specific variables are merged with the first two characters of the ISIN code. This is consistent with the nationality and not the residence principle and accounts for offshore issuance of securities.[12]

# 4 Stylized Facts

In this section, we show summary statistics of the investment behavior across the financial institutions and their gains. Table 1 shows the summary statistics of our main variables. The average value of a security held is 56 million Euros for banks, 24 million Euros for investment funds and 23 million Euros for insurance companies and pension funds. Insurance companies and pension funds, which hold a significantly smaller quantity of securities, are therefore the smallest holders of debt securities among the three sectors. Insurance companies and pension funds not only hold fewer securities, they also trade less. When they do trade, they transact larger volumes than investment funds. Investment funds are the most active traders among the three. On average, the amounts they trade are smaller than those of banks and insurance companies and pension funds. They also sell more often than they buy, but if they buy, their purchases far outstrip their sales.

Figure 4 compares the holdings of debt securities of the three sectors over time. We can see that banks are the largest holder of debt securities, followed by investment funds and insurance companies and pension funds. These three sectors are the three largest holders of debt securities in Germany. At the beginning of the crisis banks started decreasing their holdings of debt securities while investment funds and insurance companies and pension funds were still accumulating securities. While investment funds started selling in 2010, insurance companies and pension funds have kept building up debt securities.

The active selling behavior of banks and investment funds paid off in the short run, as we can see from Figure 5. Their unrealized gains on their debt security portfolio were positive before they dropped into negative territory in mid-2010, but still with no big losses compared to the pre-crisis period. Insurance companies and pension funds, however, suffered severely when their bonds fell in value during the crisis, but their long-term strategy paid off when prices started to recover. Between mid-2011 and the end of 2014 their unrealized gains on their debt securities was nearly 30 per cent. They outperformed banks and investment funds not only since mid-2010, but also since the beginning of the financial crisis. While insurance companies and pension funds kept buying securities during the crisis, temporarily suffering losses, they outperformed the

[11] All variables are trimmed on a 0.5 percent level.

[12] For instance, if Petrobas Global Finance issues a bond in the Netherlands, we assign the country-specific conditions to Brazil and not to the Netherlands, as the ultimate risk is located in Brazil.

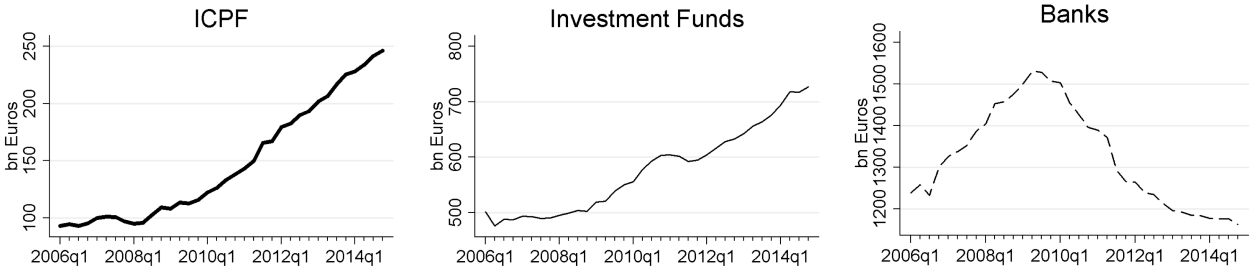
[13] The three panels show the nominal value held by insurance companies and pension funds (ICPF), investment funds and banks.

Table 1: Summary Statistics

| Variable | Mean | Std. Dev. | N |
|---|---|---|---|
| Nominal Value IF | 24.48 | 102.10 | 562978 |
| Nominal Value ICPF | 23.22 | 447.00 | 165670 |
| Nominal Value B | 56.13 | 262.95 | 608263 |
| Buy IF | 8.372 | 35.41 | 110587 |
| Buy ICPF | 12.39 | 35.53 | 19955 |
| Buy B | 16.32 | 100.89 | 91278 |
| Sell IF | 7.54 | 30.64 | 125753 |
| Sell ICPF | 11.57 | 34.62 | 16868 |
| Sell B | 19.51 | 147.90 | 85845 |

Buy and sell refers to the amount bought and sold in million Euros. The nominal value is the nominal value held if a security is held in million Euros. IF, ICPF and B refers to investment funds (IF), insurance companies and pension funds (ICPF) and banks (B) respectively. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2004 Q4 - 2014 Q4; author's calculations.

Figure 4: Nominal Debt Security Holdings




*Source: Author's calculations; Data: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4 - 2014 Q4.*[13]

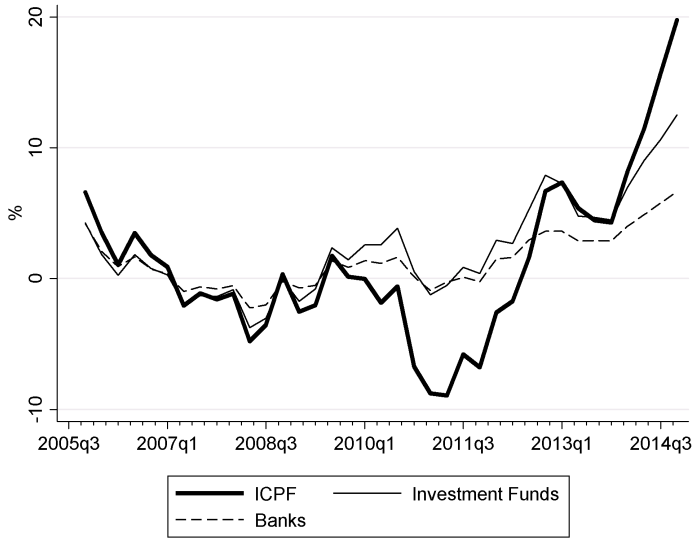
other two sectors in the medium run. The investment behavior of banks, reducing their security holdings even more than investment funds, underperformed both the strategies of investment funds and insurance companies and pension funds.

This raises the question whether the insurance company and pension funds sector systematically steps in when other sectors are selling their securities and prices drop. Buying when prices have fallen is one type of search for yield, as yields rise when prices fall. Insurance companies and pension funds could have been incentivized by the minimum guarantee on their liabilities that forces them to seek yield. However, even if it is well known among potential investors that prices mean revert to their fundamentals, it is a risky decision to "catch the falling knife," especially if they are measured on their short-term performance.

The stylized facts presented in this section only show simple aggregate numbers that can be influenced by other factors in a number of ways. In order to find out more about the systematic investment behavior of the different sectors, conditional on other

characteristics, we need to regress the buying behavior on security-specific, macroeconomic and financial factors. This is done in a regression analysis in the following section.

Figure 5: Cumulative Valuation Effects of Security Holdings




*Source: Author's calculations; Data: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4 - 2014 Q4.*[14]

[14]The cumulative gains are calculated as the difference between the total market value of all securities and the total nominal value of all securities divided by the total nominal value of all securities.

# 5 Results

In this section we empirically investigate the cyclicality of the investment behavior of the following three sectors: insurance companies and pension funds; investment funds; and banks. We attempt to shed light on the question as to whether institutional investors respond pro-cyclically or counter-cyclically to price changes.

By running the following regression, we aim to shed more light on this question:

$$Netbuy_{s,t} = \beta \Delta Price_{s,t-1} + \gamma' X_{j,t-1} + \phi' Z_{t-1} + \alpha_s + \epsilon_{s,t} \tag{1}$$

Netbuy is the log change in the nominal amount held of security s at quarter t if this amount changes.[15] ΔPrice is the log change in the price of the security. The vector X includes the variables $Gov\_Bond\_Yield$, $\pi$, and $\Delta\ GDP$, which are the 10-year country-specific government bond yield, the quarterly inflation rate, and the log change in GDP of issuing country j, respectively. The vector Z includes the $VIX$ and the EONIA, which do not vary by security but over time. The VIX is the log of the end of period implied volatility of the S&P 500 and the EONIA is the Euro OverNight Index Average. $\alpha_s$ is a security fixed effect that controls for security-specific characteristics that are time invariant, like the expiration date or the coupon but also the amount of new securities issued.

Our main variable of interest is the lagged change in the price. The questions is whether a sector increases its nominal holdings in a specific quarter t if the price has surged in the previous quarter. Counter-cyclical investors have a negative sign and vice versa. The coefficient on the government bond yield shows how sensitive the three sectors are to country risk. A positive sign shows that sectors buy debt securities of countries that are riskier. Inflation and GDP growth rate control for macroeconomic conditions of the country of issue. Low inflation and high GDP growth rate may indicate that bond prices will appreciate in the future, as high inflation distorts the real return of the bond and high GDP growth suggests that countries are going to have lower corporate and government bond spreads, and thus higher prices, in the future. The EONIA shows whether institutional investors prefer building up securities during easy funding conditions.

Table 2 shows the estimation of equation (1) sector by sector. Investment funds and banks buy securities whose prices have risen and sell securities that have lost value, i.e. they have an upward sloping demand curve. In contrast, insurance companies and pension funds buy when prices have fallen and sell when prices have risen.

In terms of economic magnitude, if the price has increased by 10 percent in the previous quarter, both the banking and investment fund sector increases their nominal amount held of this security, on average, by 1.7 per cent. The insurance company and pension fund sector increases its amount held of this security, on average, by 6.5 per cent if the price has *dropped* by 10 per cent in the previous quarter. These effects are statistically and economically highly significant. A 1.7 per cent increase in the holding of the security equals, on average, a EUR 954,210 increase in the holding of this security for banks and

[15] The netbuy measure reflects only buy and sell decisions and no valuation effects. The results are robust to the use of other netbuy measures. For instance, the results do not change qualitatively whether we use the log of the amount bought minus the log of the amount sold or the amount in Euros.

Table 2: Baseline

| | (1) Netbuy IF | (2) Netbuy ICPF | (3) Netbuy B |
|---|---|---|---|
| $\Delta$ Price | 0.174*** | -0.650*** | 0.169*** |
| | (0.02) | (0.12) | (0.06) |
| Gov Bond Yield | -0.144 | 4.633*** | 0.807** |
| | (0.18) | (0.86) | (0.40) |
| $\pi$ | -0.846*** | 1.983* | 0.035 |
| | (0.23) | (1.14) | (0.57) |
| VIX | 0.003 | 0.070*** | -0.005 |
| | (0.00) | (0.02) | (0.01) |
| $\Delta$ GDP | 1.440*** | 4.013*** | 0.483 |
| | (0.25) | (0.87) | (0.41) |
| EONIA | 0.967*** | -1.164** | 0.181 |
| | (0.12) | (0.52) | (0.22) |
| $R^2$ | 0.139 | 0.178 | 0.120 |
| N | 263612 | 28096 | 134005 |
| Security FE | Yes | Yes | Yes |

The dependent variable is the log change in the nominal amount held by investment funds (IF), insurance companies and pension funds (ICPF) and banks (B) if this amount changes. All independent variables are lagged by one quarter. $\Delta$ Price is the percentage change in the price. Gov Bond Yield is the 10-year generic government bond yield. $\pi$ is the quarterly inflation rate. VIX is the log of the implied volatility for S&P 500 stock options. $\Delta$ GDP is the quarterly GDP growth. EONIA is the Euro Overnight Index Average. Standard errors are in parentheses and clustered at the security level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4 - 2014 Q4; author's calculations.

EUR 416,160 for investment funds. For insurance companies and pension funds, a 6.5 per cent increase equals EUR 1,509,300. This counter-cyclical behavior more than offsets the pro-cyclical behavior of banks and investment funds.

The pro-cyclical investment behavior of banks and investment funds can be explained by their unstable balance sheet composition. While most investment firms are delegated by investors and have performance pressure so that they have to sell bonds when investors redeem shares, banks need to sell assets when they face a funding squeeze. The effects can be amplified through the asset side of the balance sheet, resulting in a feedback loop between lower prices and sales if creditors are inclined to withdraw their assets when prices are falling. In contrast, insurance companies and pension funds do not have to sell when prices drop, as they are not exposed to redemption pressure and benefit from a more stable balance sheet structure. In addition, insurance companies and pension funds may also not mark-to-market as frequently (Fabozzi, 2012). These "deep pocket investors" can buy securities with high yields to maturity when prices have dropped, and they can benefit from price increases when the bonds have been traded at a discount and they hold them until maturity. This form of yield-seeking behavior of insurance companies is also documented by Becker and Ivashina (2015). This search for yield is benign as long as it does not lead to capital misallocation.

From a financial stability perspective, these results are highly important for all types of issuers. If the investor base of the security is skewed towards short-term investors that act pro-cyclically, debtors needs to be aware of sharp price drops and heightened volatility of their bonds that can worsen their funding conditions or prevent them from access to capital market funding in the first place. These stops and surges of capital flows can have severe consequences for the real economy (Forbes and Warnock, 2012; Lane and McQuade, 2014). A recent prominent example of this is Greece during its sovereign debt crisis that started in 2010, when banks held a significant amount of the debt outstanding and sold it aggressively once conditions worsened.

In addition to the lagged price change, it is also important to include global and country-specific variables, as the investment behavior is driven not only by security-specific characteristics but also by macroeconomic factors. While the VIX and the EONIA are the same for every security in a given quarter, the government bond yield, the inflation rate and the GDP growth rate are assigned according to the nationality of the issuer of the debt security. If these factors are correlated with the price change, and we exclude them from the regression, this can lead to a biased coefficient on the price change.[16] The VIX and the generic government bond yield of a country generally rise when prices drop and vice versa. Similarly, since inflation erodes the purchasing power of a standard debt security, we would expect prices to drop when inflation rises. A higher GDP growth is usually associated with higher prices in the bond market. As a lower EONIA intends to ease the financing conditions for the whole economy, institutional investors are expected to buy more due to easier financing conditions.

All the three sectors tend buy more debt securities from issuers originating from countries that have recently experienced higher GDP growth. The intended effect of a low EONIA, to push down market interest rates, is taken over by insurance companies and pension funds, but not by banks and investment funds. The EONIA can also be seen as a proxy for how strong the ECB expects the Euro Area economy to be in the future, i.e.

[16] In Table 3 we confirm that the results hold if we do not control for these factors.

if it raises rates, it expects the economy to do well. The positive association between the EONIA and buying behavior of investment funds and banks may indicate that investment funds and banks believe the ECB's negative outlook when the EONIA is lower, and they are hesitant to buy. Surprisingly, there is no significant negative correlation with the VIX for banks and investment funds. Insurance companies and pension funds even increase their holdings when the VIX is high. The reaction of investment funds with respect to government bond yields, which proxy a country risk factor, is consistent with Raddatz and Schmukler (2012) who show that mutual funds retrench from countries in bad times. We can also confirm the finding by Buch, Koetter, and Ohls (2013) who show that German banks hold more sovereign bonds in high-yield and low-inflation countries. Banks that increase their holdings of securities in risky countries could be a case of "gambling for resurrection", when investors are willing to take high risk, hoping for a good outcome (Acharya, Drechsler, and Schnabl, 2014; Battistini, Pagano, and Simonelli, 2014; Bolton and Jeanne, 2011). The risk-taking behavior of insurance companies and pension funds with respect to country risk is broadly consistent with Becker and Ivashina (2015) who show that insurance companies and pension funds buy the highest-yielding assets within each rating group.

To test the sensitivity of the price change coefficient to the inclusion of further controls, Table 3 shows a summary of the lagged price change coefficients for various specifications. Controlling for more unobserved and observed characteristics also indicates whether the sectors respond to relative price changes of the debt securities or whether the investment decision is driven by broad market valuations. Creating a more coherent sample across the sectors sheds light on the question as to whether the coefficients are driven by a sample selection bias. The coefficient is consistently positive for investment funds and banks and negative for insurance companies and pension. Row (1) is the result of a simple regression of the netbuy variable on the lagged price change excluding macroeconomic factors as well as security fixed effects. It explains not only the time-series variation but also the cross-sectional variation. Including security fixed effects controls for all time-invariant security-specific characteristics, such as the coupon or the maturity date, but of course also for the issuing country of the security. The approach using security fixed effects focuses on one specific security and attempts to explain the buying and selling behavior over time. Both regressions indicate that, unconditional and conditional on time invariant security characteristics, banks and investment funds respond pro-cyclically to price changes, while insurance companies and pension funds act counter-cyclically. While row (3) shows the estimates of the baseline regression, row (4) also absorbs observed and unobserved country-specific time-varying characteristics.[17] In order to examine how financial institutions invest in specific securities compared to other securities that were issued in the same sector of the same country, the specification is saturated with sector∗country∗time fixed effects. This controls for unobserved and observed time-varying heterogeneity, such as the time-varying common component of a specific asset class. In particular, it adds the issuing sector dimension for banks, other financial corporations, non-financial corporations, and governments in their capacity as issuing sectors. Hence, for each issuing sector of a given country we control for the average amount bought or sold at a given point in time, which allows us to control for broad market valuations of this index. Even within this benchmark banks and investment funds buy securities that have increased in value. However, while

[17]The results of row (3) differ slightly from Table 2 due to a more restricted sample in Table 3.

for investment funds and banks the coefficients are even higher than in specification (4) the coefficient for insurance companies and pension funds is not significant anymore. This indicates that insurance companies and pension funds tend to buy securities that are included in a falling index. In contrast, banks' and investment funds' pro-cyclical investment behavior is also driven by idiosyncratic movements of the security compared to its benchmark.[18] These results also shed some light on the investment strategies the three sectors follow. A negative sign identifies contrarian investors that follow a value investing strategy by buying cheap and selling high, speculating on mean reversion. In contrast, momentum investors buy securities that have performed well recently (see for example Moskowitz, Ooi, and Pedersen (2012) and references therein). Hence, our results suggest that banks and investment funds follow a momentum strategy. However, since there can be much heterogeneity within each sector, institutional-level data is needed to shed more light on this question.

To make the sample of securities held more comparable, row (6) restricts the security sample to all securities that have been held by insurance companies and pension funds at least once throughout the sample. The sample of row (7) includes securities that have been held at least once by all sectors.[19]

Until now, we cannot rule out that our results are driven by time-varying security characteristics. For instance, a positive correlation between the error term and the change in the price leads to an overestimation of the price change coefficient. Grouping the three sectors together and comparing them against a benchmark sector allows use to control for unobserved and observed time-varying security characteristics as well as sector-specific characteristics that do and do not vary over time. While estimating the sectors separately allows us to draw inferences about whether sectors trade pro or counter-cyclically with respect to price changes, in a specification with security∗time fixed effects we can only make statements about whether the sectors trade more or less pro or counter-cyclically to price changes relative to other sectors. However, this specification allows to draw conclusions about the investment behavior of one specific security at a given point in time.

Both banks and investment funds invest more pro-cyclically than the benchmark insurance companies and pension funds when all time-varying characteristics of the securities are taken into account (Table 4). By controlling for sector∗time fixed effects, we can confirm that this is even the case if we control for the amount invested of the specific sector at a given time. This holds for the sample of all securities and only the securities that are traded by all three sectors at a given point in time. The latter indicates that insurance companies buy securities from banks and investment funds when their prices have dropped and vice versa. However, reliable conclusions about who trades with whom are not possible without bilateral trade data.

Since we are more interested in how financial institution respond to price changes, unconditional on benchmark indices, allowing for some macro-financial inferences, we relax the number of restrictions again and return to our baseline equation that includes

[18]These results can be confirmed in Table A1, where the price change is decomposed into a broad market valuation of the issuing sector-country index and an idiosyncratic part.

[19]While in Table 3 the number of observations are consistent for each sector in rows (1)-(5), Table A2 presents evidence that the results also hold for a balanced panel where the observations are also the same across the holding sectors.

Table 3: Summary of Price Change Coefficients

| Security FE | Other Characteristics | IF | ICPF | B |
|---|---|---|---|---|
| (1) No | | 0.178*** | -0.280** | 0.160*** |
| | - | (0.02) | (0.12) | (0.06) |
| (2) Yes | - | 0.124*** | -0.767*** | 0.155** |
| | | (0.02) | (0.12) | (0.06) |
| (3) Yes | Macro Controls | 0.175*** | -0.680*** | 0.179*** |
| | | (0.02) | (0.12) | (0.06) |
| (4) Yes | Country∗Time FE | 0.159*** | -0.365*** | 0.154** |
| | | (0.02) | (0.14) | (0.07) |
| (5) Yes | Country∗Issuing Sector∗ | 0.178*** | -0.233 | 0.188*** |
| | Time FE | (0.02) | (0.15) | (0.07) |
| (6) Yes | Sample of securities | 0.106** | -0.672*** | 0.199* |
| | once held by ICPF | (0.04) | (0.10) | (0.11) |
| (7) Yes | Sample of securities | 0.084* | -0.536*** | 0.254** |
| | once held by all sectors | (0.04) | (0.11) | (0.11) |

The dependent variable is the log change in the nominal amount held by investment funds (IF), insurance companies and pension funds (ICPF) and banks (B) if this amount changes. The coefficients are the estimated effect of a price change in the previous quarter. Macro Controls include the 10-year generic government bond yield, the quarterly inflation rate, the log of the VIX, the quarterly GDP growth and the EONIA. Standard errors in parentheses and clustered at the security level for specifications (2)-(7). For each sector the number of observations is the same in specifications (1)-(5). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4 - 2014 Q4; author's calculations.

Table 4: Time-Varying Security Heterogeneity

| | (1) Netbuy | (2) Netbuy | (3) Netbuy | (4) Netbuy | (5) Netbuy | (6) Netbuy |
|---|---|---|---|---|---|---|
| Δ Price∗Bank | 0.0421*** | 0.0424*** | 0.0497*** | 0.684*** | 0.732*** | 0.928*** |
| | (0.01) | (0.01) | (0.01) | (0.18) | (0.18) | (0.20) |
| Δ Price∗IF | 0.0924*** | 0.0937*** | 0.0779*** | 0.333*** | 0.382*** | 0.424*** |
| | (0.01) | (0.01) | (0.01) | (0.13) | (0.13) | (0.13) |
| $R^2$ | 0.333 | 0.333 | 0.385 | 0.339 | 0.340 | 0.432 |
| N | 2437611 | 2437611 | 2437611 | 50751 | 50751 | 50751 |
| Security*Time FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Sector FE | No | Yes | No | No | Yes | No |
| Sector*Time FE | No | No | Yes | No | No | Yes |
| Sample | All | All | All | If Traded | If Traded | If Traded |

The dependent variable is the log change in the nominal amount held. In specifications (1)-(3) the netbuy variable is zero for sectors that do not trade this security. Specifications (4)-(6) only includes observations when the security is traded by all sectors. Δ Price is the percentage change in the price and is lagged by one quarter. Bank is a dummy that equals one if the holding sector is banks and zero otherwise. IF is a dummy that equals one if the holding sector is investment funds and zero otherwise. The benchmark is insurance companies and pension funds. Standard errors are in parentheses. Standard errors are clustered at the security level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4 - 2014 Q4; author's calculations.

a parsimonious set of macro and financial variables.

As outlined above, we know that insurance companies and pension funds are long-term investors. Whereas banks and investment funds trade more frequently it might be worthwhile for them to buy securities that trade at a premium and sell them again when prices have gone up further. They also may sell securities that trade below their fundamental value if they expect the downward trend to continue further. The typical buy and hold investor would buy securities when they trade at a discount or below their fundamental value to gain when prices revert to their par value. In order to shed more light on the role of who buys at a premium and at a discount, we create a dummy that equals one if the security trades above its par value and 0 otherwise. Whether a bond trades at a premium or not does not necessarily reflect whether the security is trading above its fundamental value. If market interest rates are currently lower than when the bond was issued, investors may be willing to pay more for a bond to earn the additional interest. Hence, a reduction in the interest rate can lead to bonds trading at a premium. Banks may also have a preference for these bonds due to their higher collateral value compared to other bonds that do not trade at a premium.

$$Premium = \begin{cases} 1 \text{ if Price} > \text{Par Value} \\ 0 \text{ if Price} \leq \text{Par Value} \end{cases}$$

Columns (1)-(3) of Table 5 show the results of a regression of the netbuy variable on the dummy *Premium*. Insurance companies and pension funds buy securities that are trading at a discount and sell them when they are trading at a at premium. This also tends to be the case for investment funds. In contrast, banks buy when the price of the

security is above its par value and sell if it is trading at a discount.[20]

In specifications (4-6) we add the dummy to our baseline specification shown in equation (1). Holding constant the price change in the previous quarter and other important variables that affect the buying behavior, we can see that insurance companies and pension funds prefer securities that are trading at a discount. In contrast, banks tend to buy securities that are trading at a premium, regardless of whether they have gone up in the previous quarter or not. Adding an interaction term between the lagged price change and the dummy *premium* sheds light on the question of whether this buying behavior is stronger if the price has gained in value. Column (9) shows that it is indeed true that banks buy securities that are trading at a premium, especially if the price went up in the previous quarter. When the security is trading at a premium and went down in the previous quarter, e.g. if a bubble has burst, banks also sell more aggressively. For investment funds, the pro-cyclicality is stronger for bonds that are trading at a discount. These results suggest that the pro-cyclicality of investment funds is stronger when bond prices are down compared to banks that act more pro-cyclically, when bond prices are up.

Table 5: Bonds that are Trading at a Premium

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| | Netbuy IF | Netbuy ICPF | Netbuy B | Netbuy IF | Netbuy ICPF | Netbuy B | Netbuy IF | Netbuy ICPF | Netbuy B |
| *Premium* | -0.004** | -0.052*** | 0.009** | 0.004 | -0.064*** | 0.028*** | 0.005 | -0.065*** | 0.024*** |
| | (0.00) | (0.01) | (0.00) | (0.00) | (0.02) | (0.01) | (0.00) | (0.02) | ( 0.01) |
| Δ Price∗ | | | | | | | | | |
| *Premium* | | | | | | | -0.109** | 0.122 | 0.646*** |
| | | | | | | | (0.05) | (0.25) | ( 0.16) |
| Δ Price | | | | 0.171*** | -0.560*** | 0.153** | 0.208*** | -0.605*** | -0.004 |
| $R^2$ | 0.000 | 0.001 | 0.000 | 0.139 | 0.178 | 0.120 | 0.139 | 0.178 | 0.121 |
| N | 327026 | 37320 | 169472 | 263612 | 28096 | 134005 | 263612 | 28096 | 134005 |
| Security FE | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| Macro Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

The dependent variable is the log change in the nominal amount held by investment funds (IF), insurance companies and pension funds (ICPF) and banks (B) if this amount changes. All independent variables are lagged by one quarter in colums (4)-(9). Δ Price is the percentage change in the price. The dummy *Premium* equals one if the security trades above its par value and zero otherwise. Macro Controls include the 10-year generic government bond yield, the quarterly inflation rate, the log of the VIX, the quarterly GDP growth and the EONIA. Standard errors are in parentheses. Standard errors are clustered at the security level for specifications (4)-(9). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4 - 2014 Q4; author's calculations.

In order to investigate further whether the cyclical investment behavior changes over the financial cyclical, we look at times of a high VIX in the next step. When market liquidity is low, pro-cyclical buying behavior can lead to strong market distortions and investors may be forced to sell at fire-sale prices because they have to meet margin calls or they cannot roll over their liabilities. If prices fall and investors act pro-cyclically during volatile times, their redemption can trigger a spiral of market and funding liquidity (Brunnermeier and Pedersen, 2009). In order to test whether the cyclical behavior of financial institutions intensified in volatile times, we interact the VIX with the change in the price. When the VIX is at its mean, insurance companies and pension funds still act counter-cyclically and investment funds and banks still act pro-cyclically (Table 6).

However, as soon as the VIX increases above its mean, investment funds exacerbate the pro-cyclicality, which is in favor of the hypothesis that investment funds act more pro-cyclically in times when asset prices are down. This indicates that in times of high uncertainty and illiquid markets they are reluctant to search for yield by buying bonds

[20]This heterogeneity can be confirmed when we control for all time-varying security characteristics (Table A3).

Table 6: Interaction with the VIX

| | (1) Netbuy IF | (2) Netbuy ICPF | (3) Netbuy B |
|---|---|---|---|
| Δ Price∗VIX | 0.166*** | 0.797*** | -0.057 |
| | (0.06) | (0.28) | (0.15) |
| Δ Price | 0.134*** | -0.806*** | 0.183** |
| | (0.03) | (0.14) | (0.08) |
| $R^2$ | 0.139 | 0.178 | 0.120 |
| N | 263612 | 28096 | 134005 |
| Security FE | Yes | Yes | Yes |
| Macro Controls | Yes | Yes | Yes |

The dependent variable is the log change in the nominal amount held by investment funds (IF), insurance companies and pension funds (ICPF) and banks (B) if this amount changes. VIX is the demeaned log of the implied volatility for S&P 500 stock options. Δ Price is the percentage change in the price. All independent variables are lagged by one quarter. Macro Controls include the 10-year generic government bond yield, the quarterly inflation rate, the log of the VIX, the quarterly GDP growth and the EONIA. Standard errors are in parentheses and clustered at the security level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4 - 2014 Q4; author's calculations.

that have lost value.[21] This is consistent with the theory of Amihud, Mendelson, and Pedersen (2006) and Amihud and Mendelson (1986), who show that short-term investors avoid illiquid securities in times of high expected volatility. The probability that illiquid assets will have to be sold at fire-sale prices increases when volatility increases. Hence, funds with daily reception notice should not hold illiquid assets in volatile times if they want to avoid selling off assets at fire-sale prices. In contrast, long-term investors can benefit from a liquidity premium as short-term investors avoid illiquid securities in times of high expected volatility.

# 6 Robustness

Until now we have assumed that the coefficient is the same for all kinds of bonds over the whole sample period. In the following tables, we relax this assumption by splitting by time periods and the types of bonds. Table 7 shows differential effects by issuing sector. In general, we can confirm our previous findings. The highest quantitative responses to price changes are with respect to non-financial corporate bonds, which are our benchmark. A 10 percent increase in the price is associated with a 2.4 percent and 8.6 percent increase in the amount bought for investment funds and banks, respectively, but a 21 per cent increase in the amount *sold* by insurance companies and pension funds. While the sign of the coefficients is still in line with the benchmark model, the cyclicality is least pronounced for bonds issued by other-financial corporations and governments.

In Table 8 we divide the sample into three subsamples: pre-crisis (2006 Q1:2007 Q4),

[21] Investment funds also act more pro-cyclically with respect to short-term bonds than to long-term bonds. The pro-cyclicality is also more pronounced when prices rise than when prices fall (Table A4).

Table 7: Issuing Sector Heterogeneity

| | (1) Netbuy IF | (2) Netbuy ICPF | (3) Netbuy B |
|---|---|---|---|
| Δ Price | 0.244*** | -2.129*** | 0.861*** |
| | (0.04) | (0.60) | (0.23) |
| Δ Price∗Banks | -0.001 | 1.868*** | -0.649** |
| | (0.07) | (0.65) | (0.25) |
| Δ Price∗Gov | -0.225*** | 1.452** | -0.776*** |
| | (0.07) | (0.62) | (0.26) |
| Δ Price∗OFC | -0.121** | 1.817*** | -0.828*** |
| | (0.05) | (0.65) | (0.24) |
| $R^2$ | 0.134 | 0.177 | 0.120 |
| N | 260420 | 27845 | 132621 |
| Security FE | Yes | Yes | Yes |
| Macro Controls | Yes | Yes | Yes |

The dependent variable is the log change in the nominal amount held by investment funds (IF), insurance companies and pension funds (ICPF) and banks (B) if this amount changes. All independent variables are lagged by one quarter. Δ Price is the percentage change in the price. Banks, Gov, OFC are dummies that equal one if the issuing sector is banks, the government or other financial corporations, respectively, and zero otherwise. The benchmark is securities issued by non-financial corporations. Macro Controls include the 10-year generic government bond yield, the quarterly inflation rate, the log of the VIX, the quarterly GDP growth and the EONIA. Standard errors are in parentheses and clustered at the security level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4 - 2014 Q4; author's calculations.

Table 8: Split by Time Periods

| | (1) Netbuy IF | (2) Netbuy ICPF | (3) Netbuy B | (4) Netbuy IF | (5) Netbuy ICPF | (6) Netbuy B | (7) Netbuy IF | (8) Netbuy ICPF | (9) Netbuy B |
|---|---|---|---|---|---|---|---|---|---|
| Δ Price | 0.090 | -3.418*** | 0.083 | 0.146*** | -0.352** | 0.113 | 0.254*** | -0.334 | 0.467** |
| | (0.11) | (0.55) | (0.32) | (0.03) | (0.16) | (0.07) | (0.05) | (0.26) | (0.18) |
| $R^2$ | 0.267 | 0.314 | 0.182 | 0.184 | 0.192 | 0.152 | 0.190 | 0.240 | 0.168 |
| N | 37545 | 6140 | 24698 | 115635 | 12861 | 65164 | 106086 | 8104 | 40603 |
| Sample | Pre-crisis | Pre-crisis | Pre-crisis | Crisis | Crisis | Crisis | Post-crisis | Post-crisis | Post-crisis |
| Security FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Macro Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

The dependent variable is the log change in the nominal amount held by investment funds (IF), insurance companies and pension funds (ICPF) and banks (B) if this amount changes. All independent variables are lagged by one quarter. Δ Price is the percentage change in the price. Macro Controls include the 10-year generic government bond yield, the quarterly inflation rate, the log of the VIX, the quarterly GDP growth and the EONIA. Pre-crisis (2006 Q1: 2007 Q4), Crisis (2008 Q1: 2012 Q2), and Post-crisis (2012 Q3:2014 Q4). Standard errors are in parentheses and clustered at the security level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4 - 2014 Q4; author's calculations.

crisis (2008 Q1:2012Q2), and post-crisis (2012 Q3:2014 Q4). The results confirm that the pro-cyclicality of investment firms has increased since the crisis. Before 2008, investment firms acted only insignificantly pro-cyclically, but in the crisis their reluctance to buy illiquid securities that have dropped in prices could have turned them into pro-cyclical investors.

Table 9: Foreign and Domestic Bonds

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Netbuy IF | Netbuy ICPF | Netbuy B | Netbuy IF | Netbuy ICPF | Netbuy B |
| Δ Price | 0.180*** | -0.738*** | 0.142* | 0.083 | -0.516*** | 0.218* |
| | (0.02) | (0.19) | (0.07) | (0.08) | (0.15) | (0.12) |
| Gov Bond Yield | -0.787*** | 3.027*** | -1.008* | 6.027*** | 7.398*** | 5.148*** |
| | (0.19) | (1.16) | (0.55) | (0.57) | (1.32) | (0.62) |
| $\pi$ | -0.536** | 4.923*** | 0.612 | -3.249*** | -6.056*** | -0.230 |
| | (0.23) | (1.37) | (0.69) | (1.03) | (2.04) | (1.06) |
| VIX | 0.002 | 0.121*** | -0.013 | -0.008 | 0.021 | 0.001 |
| | (0.00) | (0.03) | (0.01) | (0.01) | (0.02) | (0.01) |
| Δ GDP | 1.566*** | 8.740*** | 2.242*** | 0.634 | 2.255** | -1.161** |
| | (0.29) | (1.65) | (0.70) | (0.50) | (1.10) | (0.52) |
| EONIA | 0.977*** | -1.480* | 0.721** | -0.619* | -1.856*** | -2.006*** |
| | (0.12) | (0.86) | (0.30) | (0.34) | (0.69) | (0.38) |
| $R^2$ | 0.134 | 0.180 | 0.123 | 0.181 | 0.176 | 0.115 |
| N | 235025 | 15061 | 67801 | 28587 | 13035 | 66204 |
| Sample | Foreign | Foreign | Foreign | Domestic | Domestic | Domestic |
| Security FE | Yes | Yes | Yes | Yes | Yes | Yes |

The dependent variable is the log change in the nominal amount held by investment funds (IF), insurance companies and pension funds (ICPF) and banks (B) if this amount changes. All independent variables are lagged by one quarter. Δ Price is the percentage change in the price. Gov Bond Yield is the 10-year generic government bond yield. $\pi$ is the quarterly inflation rate. VIX is the log of the implied volatility for S&P 500 stock options. Δ GDP is the quarterly GDP growth. EONIA is the Euro Overnight Index Average. Sample refers to the issuing country of the bond. Foreign refers to foreign bonds and Domestic refers only to German bonds. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4 - 2014 Q4; author's calculations.

Table 9 shows the difference between German and foreign bonds. The pattern described holds for both types of bonds. German institutions seem to consistently respond positively to increases in German bond yields. Relatively higher German bond yields are usually associated with less concern about the stability of the global financial system. Yields of riskier countries and the yield on the German Bund are usually negatively correlated as Germany can be seen a safe haven. Buying German bonds when the German Bund yield is high can serve as a hedge against losses on riskier debt securities in more volatile times. In episodes of high market turmoil the sectors can benefit from holding German bonds once a flight to safety triggers an appreciation of these bonds. The negative association with the EONIA can be interpreted as a flight to safety during low interest rates which is not the intended effect of a lower Euro Area policy rate. The EONIA may reflect a forward-looking element of the medium-term financial and economic conditions in the Euro Area and should not be interpreted causally. During periods of low interest rates, only insurance companies and pension funds increase their holdings of foreign se-

curities. They also tend to shift their funds to countries with higher yielding government bonds, as we can see in column (2). Insurance companies and pension funds also increase their holdings of foreign debt securities when the VIX is high, indicating their higher risk bearing capacity.

As an additional robustness test, Table A5 shows results for a split between Euro and US dollar denominated debt securities. The pattern described above not only exists for Euro-denominated securities but is even stronger for US dollar denominated debt securities. In order to test whether the results are asymmetric between buying and selling, Table A6 splits the sample between observations when the sector only buys and only sells. When the relationship between buy and the lagged price change is negative, this indicates counter-cyclical buying behavior, i.e. increase holdings if the price dropped. For specifications (4)-(6) a positive coefficient represents a counter-cyclical behavior, as a sector decreases its amount held when the price rises. The results confirm our baseline specification in Table 2. A statistically important driver of the cyclical investment behavior is the sales by investment funds and banks when prices dropped.

# 7 Conclusion

This paper has analyzed the cyclical investment behavior of investment funds, banks and insurance companies and pension funds. The results suggest that investment funds and banks may exacerbate price dynamics by buying when the price of the security has gone up and selling when the price has fallen. In contrast, insurance companies and pension funds act counter-cyclically. For investment funds, this pro-cyclical investment behavior was even stronger during the crisis. We also present evidence that this behavior is stronger in periods when the VIX is high, indicating that, in times of uncertainty, portfolio managers are afraid to search for yield through price drops due to heightened uncertainty and an increase in expected volatility on the financial markets. This does not confirm that *all* non-levered institutions act counter-cyclically. One explanation that could generate the heterogeneity in the cyclical investment behavior is based on the investors' balance sheet dynamics. Although investment funds use almost no leverage, both investment funds and banks can suffer runs on their short-term liabilities. The effect can be amplified through the asset side whenever price changes trigger a spiral between balance sheets and asset prices (Adrian and Shin, 2010). This is not only true for banks but also for investment funds, as investors delegate their portfolio managers and withdraw their funds both when the portfolio managers under-perform and when economic conditions are unfavorable, which reduces the funds' equity capital. A reduction in the net asset value may cause the asset manager to sell off assets which again depresses asset prices with adverse effects on their performance and the economy. Banks also seem to buy securities that trade at a premium and sell securities that trade at a discount. They act even more pro-cyclically for bonds that trade at a premium. This indicates that they speculate on further price dynamics and may "ride the bubble".

Insurance companies and pension funds respond counter-cyclically to price changes: they buy when prices haven fallen and sell when prices have gone up. Insurance companies and pension funds also tend to buy securities at discount prices and sell them once they trade at a premium. This counter-cyclical buying behavior of insurance companies and pension funds may push prices back to their face value and may stabilize the market when prices are pushed away from fundamentals. In their role as contrarian investors, insurance companies and pension funds suffered severe losses in the short-run but outperformed pro-cyclical investors in the long-run. This long-term investment strategy may be explained by their higher risk-taking capacity due to their more stable balance sheet composition. Their risk-taking can even contribute significantly to the stability of the global financial system if their investment behavior does not lead to capital misallocation.

These results have important implications for macro-prudential policy. While financial regulation has mainly focused on the banking sector, risk transfer to other financial institutions since the financial crisis calls for an application of macro-prudential tools to the shadow-banking sector, too. Since the heterogeneity in the cyclical investment behavior may be explained by differences in the composition of their balance sheets, it would be desirable to attain a more stable balance sheet structure not only for banks but also for open-end investment funds.

Our results also show that security-specific characteristics are not the only factors which matter for the investment behavior of financial institutions: country risk is also relevant. From a borrower's perspective it is thus important not to feel sheltered if the

security-specific characteristics are favorable. Whenever country-specific characteristics change, this can affect buying behavior. Since institutional investors react heterogeneously to changes in financial and economic conditions, it is of great importance to be aware of the investor base of the security. At a country level, Cerutti et al. (2015) have pointed out that countries which rely heavily on banks and investment funds as an investor base are vulnerable to global factors. We can confirm that relying on investment funds and banks can be hazardous. If the composition is tilted towards banks and investment funds, securities are vulnerable to strong price dynamics. It is in this regard that stops and surges of capital flows may occur more likely if the investor base consists of short-term investors.

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# Appendix

The nominal value is

$$NominalValue = RawValue * e * Poolfactor \tag{2}$$

where $e$ is the domestic price of foreign currency. The pool factor adjusts the nominal value of the specific security by partial or special redemptions. If no redemption has occurred, the poolfactor is one. It gives the amount that is left to be distributed.

In order to obtain a nominal value that moves only when a security is actually bought or sold, the nominal value needs to be adjusted by exchange rate changes and the pool factor.

$$AdjustedNominalValue_t = \frac{NominalValue_t}{Poolfactor_t} * \frac{e_{t-1}}{e_t} \tag{3}$$

$\frac{e_{t-1}}{e_t} - 1$ is the percentage appreciation of the Euro. If the Euro appreciates and the foreign currencies depreciate, this reduces the nominal value of securities in Euros if these securities are denominated in foreign currency and these movements do not reflect buy decisions. By multiplying by the poolfactor, we adjust for partial or special redemptions. In the text, we always refer to the adjusted nominal value in order to adjust for the movements that do not reflect investment decisions. The netbuy variable is obtained by taking the natural log change of the adjusted nominal value if this amount changes.

Table A1: Broad vs. Relative Market Valuation

| | (1) Netbuy IF | (2) Netbuy ICPF | (3) Netbuy B | (4) Netbuy IF | (5) Netbuy ICPF | (6) Netbuy B |
|---|---|---|---|---|---|---|
| $\Delta$ Price $_{broad}$ | 0.175*** | -0.432*** | 0.140** | 0.146*** | -0.764*** | 0.0875 |
| | (0.03) | (0.11) | (0.07) | (0.03) | (0.11) | (0.13) |
| $\Delta$ Price $_{relative}$ | 0.201*** | -0.238** | 0.167*** | 0.135*** | -0.596*** | 0.166** |
| | (0.02) | (0.10) | (0.05) | (0.02) | (0.11) | (0.07) |
| $R^2$ | 0.000415 | 0.000603 | 0.0000661 | 0.135 | 0.164 | 0.117 |
| N | 282471 | 32573 | 144323 | 282471 | 32573 | 144323 |
| Security FE | No | No | No | Yes | Yes | Yes |

The dependent variable is the log change in the nominal amount held by investment funds (IF), insurance companies and pension funds (ICPF) and banks (B) if this amount changes. $\Delta$ Price $_{broad}$ is the price change of the index for the issuing sector in the specific country. $\Delta$ Price $_{relative}$ is the deviation of the security-specific price change from the price change of the country-issuing sector index. All independent variables are lagged by one quarter. Standard errors are in parentheses and clustered at the security level for specifications (4)-(6). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4 - 2014 Q4; author's calculations.

Table A2: Summary of Price Change Coefficients Including Zeros

| Security FE | Other Characteristics | IF | ICPF | B |
|---|---|---|---|---|
| (1) No | - | 0.078*** | -0.011*** | 0.029*** |
| | | (0.01) | (0.00) | (0.01) |
| (2) Yes | - | 0.057*** | -0.019*** | 0.029*** |
| | | (0.01) | (0.00) | (0.01) |
| (3) Yes | Macro Controls | 0.070*** | -0.019*** | 0.030*** |
| | | (0.01) | (0.00) | (0.01) |
| (4) Yes | Country∗Time FE | 0.071*** | -0.007* | 0.024** |
| | | (0.01) | (0.00) | (0.01) |
| (5) Yes | Country∗Issuing Sector∗ | 0.077*** | -0.004 | 0.030*** |
| | Time FE | (0.01) | (0.00) | (0.01) |
| (6) Yes | Sample of securities | 0.054*** | -0.113*** | 0.061* |
| | once held by ICPF | (0.02) | (0.02) | (0.03) |
| (7) Yes | Sample of securities | 0.066** | -0.096*** | 0.119** |
| | once held by all sectors | (0.03) | (0.03) | (0.05) |

The dependent variable is the log change in the nominal amount held by investment funds (IF), insurance companies and pension funds (ICPF) and banks (B) if this amount changes. The coefficients are the estimated effect of a price change in the previous quarter. The number of observations are the same in specifications (1)-(5). For specifications (6) and (7) the observations are the same across the holding sectors. Macro Controls include the 10-year generic government bond yield, the quarterly inflation rate, the log of the VIX, the quarterly GDP growth and the EONIA. Standard errors in parentheses and clustered at the security level for specifications (2)-(7). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4 - 2014 Q4; author's calculations.

Table A3: Time-Varying Security Heterogeneity for Premium Bonds

| | (1) Netbuy | (2) Netbuy | (3) Netbuy | (4) Netbuy | (5) Netbuy | (6) Netbuy |
|---|---|---|---|---|---|---|
| Δ Price∗Bank | 0.0391*** | 0.0329*** | 0.0424*** | 0.686*** | 0.581*** | 0.701*** |
| | (0.01) | (0.01) | (0.01) | (0.19) | (0.19) | (0.20) |
| Δ Price∗IF | 0.0976*** | 0.0924*** | 0.0782*** | 0.408*** | 0.364*** | 0.350*** |
| | (0.01) | (0.01) | (0.01) | (0.13) | (0.13) | (0.13) |
| *Premium*∗Banks | 0.00182*** | 0.00654*** | 0.00653*** | -0.000642 | 0.0887*** | 0.135*** |
| | (0.00) | (0.00) | (0.00) | (0.01) | (0.01) | (0.02) |
| *Premium*∗IF | -0.00309*** | 0.000877 | -0.000263 | -0.0274*** | 0.0106 | 0.0438*** |
| | (0.00) | (0.00) | (0.00) | (0.01) | (0.01) | (0.01) |
| $R^2$ | 0.333 | 0.333 | 0.385 | 0.339 | 0.341 | 0.433 |
| N | 2437611 | 2437611 | 2437611 | 50751 | 50751 | 50751 |
| Security*Time FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Sector FE | No | Yes | No | No | Yes | No |
| Sector*Time FE | No | No | Yes | No | No | Yes |
| Sample | All | All | All | If Traded | If Traded | If Traded |

The dependent variable is the log change in the nominal amount held. In specifications (1)-(3) the netbuy variable is zero for sectors that do not trade this security. Specifications (4)-(6) only includes observations when the security is traded by all sectors. Δ Price is the percentage change in the price. Bank is a dummy that equals one if the holding sector isbanks and zero otherwise. IF is a dummy that equals one if the holding sector is investment funds and zero otherwise. The benchmark is insurance companies and pension funds. The dummy *Premium* equals one if the security trades above its par value and zero otherwise. All independent variables are lagged by one quarter. Standard errors are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4 - 2014 Q4; author's calculations.

Table A4: Heterogeneity Between Price Rises vs. Price Falls and Short vs. Long Term

| | (1) Netbuy IF | (2) Netbuy ICPF | (3) Netbuy B | (4) Netbuy IF | (5) Netbuy ICPF | (6) Netbuy B |
|---|---|---|---|---|---|---|
| Δ Price | 0.112*** | -0.930*** | 0.162 | 0.168*** | -0.656*** | 0.168*** |
| | (0.04) | (0.27) | (0.10) | (0.02) | (0.12) | (0.06) |
| Δ Price∗Price Rise | 0.125* | 0.650 | -0.108 | | | |
| | (0.07) | (0.41) | (0.17) | | | |
| Δ Price∗Short-Term Bond | | | | 0.462** | 0.876*** | 0.541 |
| | | | | (0.23) | (0.34) | (0.51) |
| $R^2$ | 0.139 | 0.177 | 0.125 | 0.139 | 0.178 | 0.120 |
| N | 250294 | 26515 | 120220 | 263612 | 28096 | 134005 |
| Security FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Macro Controls | Yes | Yes | Yes | Yes | Yes | Yes |

The dependent variable is the log change in the nominal amount held by investment funds (IF), insurance companies and pension funds (ICPF) and banks (B) if this amount changes. Independent variables are lagged by one quarter in colums (4)-(9). Δ Price is the percentage change in the price. Macro Controls include the 10-year generic government bond yield, the quarterly inflation rate, the log of the VIX, the quarterly GDP growth and the EONIA. The Price Rise equals one if the price of the security has gone up and zero if the price decreased. The dummy Short-Term equals one if the Security is a debt security with a maturity until 1 year and zero otherwise. Standard errors are clustered at the security level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4 - 2014 Q4; author's calculations.

Table A5: Split by Currency Denomination

| | (1) Netbuy IF | (2) Netbuy ICPF | (3) Netbuy B | (4) Netbuy IF | (5) Netbuy ICPF | (6) Netbuy B |
|---|---|---|---|---|---|---|
| Δ Price | 0.179*** | -0.319** | 0.093 | 0.192*** | -1.960*** | 0.275*** |
| | (0.05) | (0.15) | (0.09) | (0.03) | (0.35) | (0.09) |
| $R^2$ | 0.173 | 0.153 | 0.115 | 0.121 | 0.310 | 0.129 |
| N | 59865 | 19579 | 96203 | 187832 | 5104 | 29823 |
| Currency | EUR | EUR | EUR | USD | USD | USD |
| Security FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Macro Controls | Yes | Yes | Yes | Yes | Yes | Yes |

The dependent variable is the log change in the nominal amount held by investment funds (IF), insurance companies and pension funds (ICPF) and banks (B) if this amount changes. All independent variables are lagged by one quarter. Δ Price is the percentage change in the price. Macro Controls include the 10-year generic government bond yield, the quarterly inflation rate, the log of the VIX, the quarterly GDP growth and the EONIA. Currency refers to the currency denomination of the bond. EUR refers to Euro-denominated bond. USD refers to US dollar-denominated bonds. Standard errors are in parentheses and clustered at the security level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4 - 2014 Q4; author's calculations.

Table A6: Asymmetric Buy and Sell Responses

| | (1) Buy IF | (2) Buy ICPF | (3) Buy B | (4) Sell IF | (5) Sell ICPF | (6) Sell B |
|---|---|---|---|---|---|---|
| Δ Price | 0.190 | -0.186 | 0.084 | -0.315*** | 1.122 | -0.437** |
| | (0.13) | (0.62) | (0.21) | (0.11) | (0.83) | (0.19) |
| $R^2$ | 0.625 | 0.556 | 0.714 | 0.680 | 0.592 | 0.668 |
| N | 71818 | 9891 | 58422 | 90208 | 9014 | 55872 |
| Security FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Macro Controls | Yes | Yes | Yes | Yes | Yes | Yes |

The dependent variable is the log of the amount bought (Buy) or the log of the amount sold (Sell) by investment funds (IF), insurance companies and pension funds (ICPF) and banks (B) if this amount changes. All independent variables are lagged by one quarter. Δ Price is the percentage change in the price. Macro Controls include the 10-year generic government bond yield, the quarterly inflation rate, the log of the VIX, the quarterly GDP growth and the EONIA. Standard errors are in parentheses and clustered at the security level.* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4 - 2014 Q4; author's calculations.