Journal of Financial Economics 129 (2018) 268–286

Contents lists available at ScienceDirect

Journal of Financial Economics

journal homepage: www.elsevier.com/locate/jfec

# Cyclical investment behavior across financial institutions☆

Yannick Timmer

*Department of Economics, Trinity College Dublin, College Green, Dublin 2, Ireland*

ARTICLE INFO

*Article history:*
Received 30 May 2016
Revised 12 July 2017
Accepted 11 August 2017
Available online 12 May 2018

*JEL classification:*
G11
G15
G12
G21
G22
G23

*Keywords:*
Portfolio allocation
Investment behavior
Financial markets
Debt securities
Balance sheet constraints

ABSTRACT

This paper contrasts the investment behavior of different financial institutions in debt securities as a response to past returns. For identification, I use unique security-level data from the German Microdatabase Securities Holdings Statistics. Banks and investment funds respond in a procyclical manner to past security-specific holding period returns. In contrast, insurance companies and pension funds act countercyclically; they buy when returns have been negative and sell after high returns. The heterogeneous responses can be explained by differences in their balance sheet structure. I exploit within-sector variation in the financial constraint to show that tighter constraints are associated with relatively more procyclical investment behavior.



## 1. Introduction

Do all institutional investors exhibit similar investment behavior? Which institutions act as stabilizers and which act as amplifiers of price dynamics? What drives differences in behavior across financial institutions? To answer these questions, I explore a unique security-by-security holdings data set provided by the Deutsche Bundesbank.

I present evidence that banks and investment funds respond procyclically to past returns, i.e., they buy securities when their returns have been high and sell them when returns have been low. In contrast, insurance companies and pension funds are countercyclical investors, i.e., they buy when returns have been low and sell when returns have been high. In the baseline specification, I regress the percentage change in nominal holdings of the debt security of each sector on the lagged holding period return of these securities, controlling for observed and unobserved time-invariant security characteristics as well as unobserved and observed time-specific factors. I find that a 10% holding period return in the last quarter is associated with a 1.3 and 3.5% increase in the nominal amount held by investment funds and banks, respectively. In contrast, insurance companies and pension funds increase their nominal amount

☆ This version: May 11,2018. I am particularly thankful to Philip Lane for his extremely helpful comments and suggestions. I also gratefully thank Bill Schwert (the editor), Tobias Adrian (the referee), Puriya Abbassi, Markus Brunnermeier, Tim Eisert, Xavier Freixas, Rajkamal Iyer, Nobuhiro Kiyotaki, Erlend Nier, Christoph Memmel, Frieder Mokinski, Stephen Morris, Marco Pagano, José-Luis Peydró, Paul Scanlon, Moritz Stieglitz, Javier Suarez, David Thesmar, Robin Tietz, Motohiro Yogo and participants at Universitat Pompeu Fabra, Central Bank of Ireland, Deutsche Bundesbank, IMF, IGIDR, Princeton, ECMI annual conference 2016, the first annual ECB macroprudential policy and research conference, 6th MoFiR Workshop on Banking and members of the Advisory Scientific Committee of the European Systemic Risk Board for discussions and helpful comments. Katharina Bergant provided excellent research assistance. Financial support from the Grattan Foundation is gratefully acknowledged.

*E-mail address:* timmery@tcd.ie

https://doi.org/10.1016/j.jfineco.2018.04.012
0304-405X/

held by 4.4% in response to a negative holding period return of 10% in the last quarter.

This behavior can be attributed to differences in the fragility of the balance sheet structure of these sectors. This can be confirmed by exploiting within-sector variation in the balance sheet constraints. First, the procyclical investment behavior is stronger for banks that are relatively less capitalized. Second, investment funds that face more outflows act more procyclically relative to other investment funds. Third, the countercyclical investment behavior of insurance companies and pension funds is weaker when their negative duration gap rises.

I also present evidence that banks' and investment funds' balance sheet constraints tighten when they suffer losses on their security holdings. While losses on the security holdings of investment funds lead to outflows, banks' capital constraints tighten when they suffer losses on their security holdings. Since banks and investment funds are averse to tightening constraints and returns exhibit a short-term momentum factor, procyclical investment behavior can be rational. In contrast, the liability side of insurance companies and pension funds is relatively more stable and movements in their balance sheets are relatively orthogonal to economic and financial conditions. This makes insurance companies and pension funds more capable of absorbing losses on a short-term horizon and enables them to act in a countercyclical fashion.

The procyclical investment behavior of investment funds and banks resulted in relatively mild losses on their security holdings during the European sovereign debt crisis. Although insurance companies and pension funds suffered severe losses on their security holdings during the sovereign debt crisis, they outperformed banks and investment funds in the medium term. More generally, while prices fall at short horizons after insurance companies and pension funds have bought these securities, they revert after several quarters, leading to larger capital gains in the medium run. In contrast, prices rise at short horizons after banks and investment funds have acquired them but fall in the medium run.

To shed light on these questions, security-level data are indispensable. In this paper I use unique, confidential security-by-security holdings data provided by the Deutsche Bundesbank (the German central bank) covering the period from 2005 Q4 through 2014 Q4. This study is the first that uses security-level data of the German Microdatabase Securities Holdings Statistics for bank and non-bank financial institutions and their investment behavior in debt securities.[1] The holdings include both foreign and domestic as well as government and corporate securities. I contrast the buying behavior of the three largest groups of institutional investors: banks, investment funds, and insurance companies and pension funds. By examining the three sectors jointly, I can investigate the investment behavior of banks, investment funds, and insurance companies and pension funds in the same security at a given point in time.

Theory yields a variety of predictions about 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 can be forced to sell undervalued assets due to margin calls, non levered institutional investors can stabilize the market by buying up fire-sold assets to benefit from high future returns (Shleifer and Vishny, 1992). In contrast, it might also be rational to speculate on high returns so that prices can be pushed away from fundamentals (DeLong et al., 1990b; Abreu and Brunnermeier, 2003). However, despite its importance for macro-prudential policy and financial stability, empirical evidence on who is buying and selling as a response to past returns has been elusive due to a lack of granular data.

One contribution of this paper is to identify insurance companies and pension funds as countercyclical investors who "lean against the wind" by buying securities when returns have been low and selling them when returns have been high.[2] Due to the market clearing condition, for every procyclical investor there needs to be a countercyclical investor who takes the other side of the trade. Said differently, for every buyer there needs to be a seller, and vice versa. Although the theoretical literature predicts rational arbitrageurs with "deep pockets" to behave countercyclically, empirical studies have failed to identify them.

The closest paper to this one is Abbassi et al. (2016), which shows that banks with trading expertise increased their holdings of debt securities with falling prices during the crisis relatively more than banks without trading expertise. In contrast to their paper, I distinguish the investment behavior of the entire banking sector to non-bank financial institutions, i.e. the investment fund industry and the insurance company and pension fund sector.

In addition, their analysis only sheds light on the relative investment behavior of trading banks versus non trading banks, but remains silent about whether these institutions actually buy when prices fall. In contrast to Abbassi et al. (2016), I show not only whether certain sectors act relatively more countercyclically than do others but also that insurance companies and pension funds actually buy securities when returns have been negative, and they sell securities when returns have been high. In addition, instead of concentrating only on times of stress, I aim to generalize the cyclical investment behavior across time periods, verifying that it is robust during the crisis.[3] While periods of high stress are certainly crucial for financial stability, normal periods are also important to consider, as these are times when systemic risk builds up.

Security holdings of banks have received much attention recently.[4] However, there is little evidence on their trading behavior at the micro level due to a lack of

[1] Abbassi et al. (2016) and Buch et al. (2016) focus on banks' investment behavior in debt securities. Domanski et al. (2017) use aggregate data for German insurance companies and pension funds.

[2] I am not the first who uses the term in this context. Weill (2007) shows theoretically that market makers are "leaning against the wind" by providing liquidity in times of market stress.

[3] The results for the crisis split are available upon request or can be found in the working paper version.

[4] See e.g. Acharya et al., 2014; Acharya and Steffen, 2015; Battistini et al., 2014; Gennaioli et al., 2014 and references therein.

security-level holdings data. Micro-level evidence is crucial due to the heterogeneity in return dynamics of bonds depending on their security-level characteristics, such as the country and sector of issue, the maturity, or the credit rating.[5] In addition to showing that the banking sector as a whole acts procyclically, I also exploit cross-sectional variation and show that the procyclical behavior is stronger for banks that are relatively less capitalized.

This paper also contributes to the investment fund literature. Fund managers may act with a short-term horizon due to agency frictions as they are exposed to injections and redemptions from investors (Chevalier and Ellison, 1997; Morris and Shin, 2015; Chen, Goldstein and Jiang, 2010; Goldstein, Jiang and Ng, 2015). While most papers focus on the relationship between performance and inflows, I investigate the investment behavior of investment funds. Many investment funds are measured on monthly or quarterly performance, which adds pressure to chase the market higher as it moves. Since fund managers may not be able to coordinate their selling behavior and have an incentive to time the market, it can be rational for them to trade procyclically (Abreu and Brunnermeier, 2003). Consistent with this prediction, I provide empirical evidence that investment funds respond procyclically to past returns. I also show that investment funds that face more outflows act relatively more procyclically relative to other investment funds. Brunnermeier and Nagel (2004) similarly show that hedge funds that were not riding the tech bubble underperformed and suffered significant investor redemptions. My findings are also in line with the findings of Feroli et al. (2014) who show that a feedback loop between prices and sales of investment funds managers can emerge.[6] Since the procyclicality seems to be existent in both upswings and downturns, delegated portfolio managers may generally increase market volatility and distort asset prices (Guerrieri and Kondor, 2012).

In contrast to the procyclical investment behavior of banks and investment funds, I find that insurance companies and pension funds act countercyclically with respect to past returns. While this is consistent with the view that long-term investors should stabilize the market by acting in a contrarian way, this has not been shown empirically.[7] Most studies even point to procyclical behavior of insurance companies and pension funds. The reason for that may be that most studies focus on how credit ratings affect the investment behavior of investment funds and fail to specifically ask the question of whether they actually act pro or countercyclically, see Ellul et al. (2011), Ellul et al. (2015), Merrill et al. (2012). Becker and Ivashina (2015) explain that insurance companies buy corporate bonds that are the highest yielding within each rating group as they are reluctant to hold more capital when they hold lower rated bonds.[8] While my results hold in the pre-crisis, crisis and post-crisis period, I find that countercyclical investment behavior is weaker in times when insurance companies' and pension funds' negative duration gap gets larger. This suggests that a low interest rate environment may weaken the countercyclical behavior, as it can result in larger duration gaps for insurance companies and pension funds. In addition, I present evidence that insurance companies and pension funds buy bonds whose excess bond yields rise. This supports the hypothesis that they are buy-and-hold investors and not averse to liquidity risk. In general, my results suggest that the investment behavior of insurance companies and pension funds can be a stabilizing force on the capital markets.

My results are consistent with intermediary asset pricing models. While in standard asset pricing models, households are the marginal investors and determine asset prices, see, e.g., Campbell and Cochrane (1999), my results suggest that financial intermediaries can have asset pricing effects. My results are therefore consistent with frameworks where the marginal investors are financial intermediaries (Adrian and Boyarchenko, 2012; Brunnermeier and Pedersen, 2009; He and Krishnamurthy, 2013). These models have been, for example, tested by Adrian et al. (2011) and Adrian et al. (2010a).

However, my results also suggest that direct empirical tests of intermediary asset pricing models should not only take into account financial constraints of broker dealers but also of other financial intermediaries, such as investment funds and insurance companies and pension funds. For these institutions it is important that it is not necessarily the leverage ratio that determines asset prices. My results suggest that net outflows of investment funds and the duration mismatch of insurance companies and pension funds are potential risk factors that can be used for testing intermediary asset pricing models.

My results are also consistent with leverage cycle theories in the spirit of Adrian and Shin (2010, 2014). In particular, my finding that banks act procyclically and even more so when they are more capital constrained is in line with these leverage cycle theories. When banks suffer losses on their security holdings, this tightens their constraints and induces them to sell securities with low past returns. On the other side, when banks experience gains on their security holdings, their constraints loosen, which makes them buy securities with high past returns. This investment behavior can again have an impact on prices and therefore their constraints.[9]

[5] Again, a notable exception that uses security-level holdings data is Abbassi et al. (2016). While they do not show how the whole banking sector responds to price changes, my findings show that banks generally respond procyclically to past returns. In the working paper version of this paper, I show all the results with lagged price changes.

[6] In addition, Shek et al. (2018) show that investment funds sell more when they face outflows. Raddatz and Schmukler (2012) also show that mutual funds' investment behavior tends to be procyclical and thus not stabilizing; they reduce their exposure to countries in bad times and increase it during good times. Franzoni and Giannetti (2017) and Giannetti and Kahraman (2018) show that investment funds with more stable funding invest more countercyclically in stocks. Cella et al. (2013) show that investors that trade more often, sell more stocks in times of stress.

[7] My findings are consistent with an asset insulator model like in Chodorow-Reich et al. (2016). They show that usually stock prices of insurance companies do not drop when they suffer losses on their security holdings.

[8] Other studies that indicate that insurance companies and pension funds act procyclically are Acharya and Morales (2015), Domanski et al. (2017), Duijm and Steins Bisschop (2015) and Haldane (2014).

[9] The framework by Geanakoplos (2010) is also consistent with my findings.

Lastly, my results are also consistent with models of limits to arbitrage due to capital constraints (Gromb and Vayanos, 2002; Shleifer and Vishny, 1997). My findings are also in line with theories where banks are acting procyclically (Hanson and Stein, 2015) and Shleifer and Vishny (2010). In contrast, my results are at odds with models where banks are risk absorbers, see, for example, Hanson et al. (2015), where banks are modelled as patient fixed-income investors.[10] My findings are also inconsistent with theories that model less levered institutions as stabilizing (Shleifer and Vishny, 1992). I find that that less levered institutions do not necessarily act as a stabilizing force. While even non levered institutions such as mutual funds can exacerbate price dynamics and amplify financial cycle dynamics, insurance companies and pension funds act in a stabilizing fashion.

The paper is structured as follows. In Section 2, I describe the data. Section 3 presents the main empirical findings on the heterogeneous investment responses of financial institutions to past returns. Section 4 shows that a balance sheet channel is at work by showing heterogeneous responses within each sector dependent on the institutions' balance sheet constraints. Section 5 discusses the dynamics of price changes. In Section 6, I conduct additional robustness tests. Section 7 concludes.

## 2. Data

This section first describes the data. Second, it presents summary statistics.

### 2.1. Data description

The Microdatabase Securities Holdings Statistics of the Deutsche Bundesbank's Research Data and Service Centre of the Deutsche Bundesbank provides quarterly security-by-security-level holdings data of all investors based in Germany from 2005 Q4 onward. The data include the raw, nominal, and market value of each security. The institutions report the raw value of the security holdings to the Deutsche Bundesbank, which subsequently calculates the nominal and market value. 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. The market value is the number of securities held multiplied by the price.[11] The price that is used to calculate the market value of the security is gathered from the Centralised Securities Database (CSDB) and reflects the market price of the security at the end of the quarter. I construct the holding period return in the following way:

$$Return_{s,t} = \frac{Price_{s,t} - Price_{s,t-1} + Coupon_s}{Price_{s,t-1}}. \quad (1)$$

[10] However, one difference to Hanson et al. (2015) is that they focus on the holdings of securities by financial institutions, while I investigate their trading behavior.

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

The security is identified with the International Security Identification Number (ISIN). Information about the currency of denomination, the security classification, and the issuing sector of the security is also available. The holdings are further split up by the sector that is holding the security. The largest holding sectors are banks, investment funds, and insurance companies and pension funds, followed by nonfinancial corporates and households. While this data set contains information about the sector that is holding the security, it does not specify which institution within the sector is holding it.

However, I also use the institution-level security-level holdings data and balance sheet information for all banks in Germany for the same time period from the Microdatabase Securities Holdings Statistics and the monthly bank balance sheet statistics, respectively. For investment funds, I use institution-level security-holdings data and balance sheet data from the investment fund statistics of the Deutsche Bundesbank. However, the institution-level security-holdings data are only available from the end of 2009. For insurance companies and pension funds the institution-level security-holdings data are not available. For a detailed data description of the Microdatabase Securities Holdings Statistics see Amann et al. (2012) and Bade et al. (2016).

To harmonize the analysis for all three sectors, I use sector-level data for my main analysis. In addition, I only consider the three largest sectors: banks, investment funds, and insurance companies and pension funds. I also restrict my analysis to debt securities and discard any equity security holdings.

I download additional security-specific characteristics from Bloomberg and Datastream. The yield refers to the yield to maturity. The credit rating is the S&P rating if available and the Fitch rating otherwise. Investment grade rating is defined as a rating better than BB+.

### 2.2. Summary statistics

Table 1 shows the summary statistics of the main variables. The average value of a security held is 22.6 million euros for insurance companies and pension funds, 31.8 million euros for investment funds, and 57.6 million for banks. Insurance companies and pension funds, which hold a significantly smaller quantity of securities, are the smallest group of debt security holders among the three sectors. Insurance companies and pension funds not only hold fewer securities but they also trade less. However, when they do trade, they transact larger volumes than do investment funds. Investment funds are the most active traders among the three; the number of observations for buy and sell outstrip those for banks and insurance companies and pension funds. On average, the amounts they trade are smaller than those of banks and insurance companies and pension funds. This is also true for the percentage changes in their holdings. When investment funds trade, they increase their holdings on average by 22% and reduce their holdings on average by 21%. The numbers for banks and insurance companies and pension funds are larger. Banks increase their holdings on average by 37% and reduce their holdings by 41%. Insurance companies and pension funds

**Table 1**
Summary statistics.

| | Holdings | Buy | Sell | NetBuy | Buy% | Sell% | Return |
|---|---|---|---|---|---|---|---|
| | Panel A: Insurance companies and pension funds | | | | | | |
| Mean | 22.634 | 11.021 | 9.768 | −0.003 | 0.311 | −0.305 | 0.011 |
| Std. | 78.122 | 35.295 | 33.349 | 0.670 | 0.577 | 0.612 | 0.038 |
| Obs. | 136,954 | 14,665 | 15,183 | 29,848 | 14,665 | 15,183 | 907,020 |
| | Panel B: Investment funds | | | | | | |
| Mean | 31.842 | 5.887 | 6.192 | -0.012 | 0.218 | -0.212 | 0.001 |
| Std. | 115.805 | 26.240 | 24.487 | 0.438 | 0.389 | 0.377 | 0.037 |
| Obs. | 383,521 | 107,737 | 124,584 | 232,321 | 107,737 | 124,584 | 907,020 |
| | Panel C: Banks | | | | | | |
| Mean | 57.641 | 12.749 | 15.800 | -0.002 | 0.372 | -0.407 | 0.001 |
| Std. | 167.278 | 47.811 | 58.529 | 0.812 | 0.669 | 0.758 | 0.037 |
| Obs. | 475,782 | 62,553 | 57,783 | 120,336 | 62,553 | 57,783 | 907,020 |

Holdings is the nominal value held if a security is held (in million euros). Buy and sell refers to the amount bought and sold in million euros. NetBuy is the change in the log of the nominal amount held. Buy% (Sell%) is the change in the log of the nominal amount held if positive (negative). Return is the holding period return defined as the quarterly change in the price plus the quarterly coupon divided by the price in the previous quarter. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2004 Q4–2014 Q4; author's calculations.

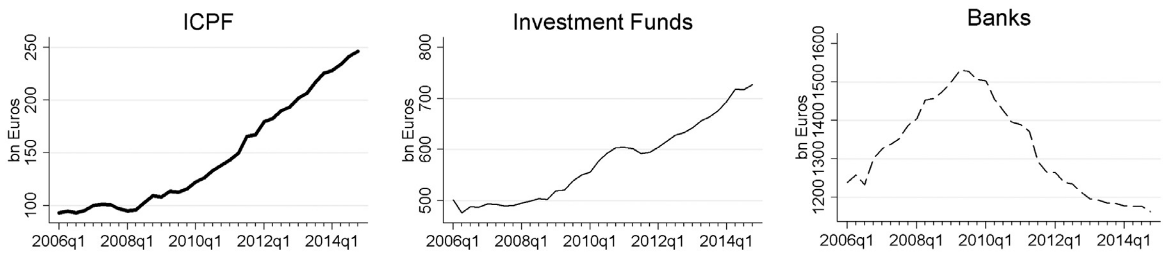


**Fig. 1.** Nominal debt security holdings. The figure shows the nominal value of debt securities held by investment funds, banks, and insurance companies and pension funds (ICPF). Source: author's calculations; Data: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4–2014 Q4.

change their holdings on average by 31%. The standard deviation of the net buy variable also suggests that investment funds transact smaller amounts than do banks and insurance companies and pension funds. The standard deviation is 43% for for investment funds, compared to 67% for insurance companies and pension funds and 81% for banks. Lastly, while the average return is 1.1%, the standard deviation is 3.8%.

Fig. 1 shows the holdings of debt securities of the three sectors over time. Banks are the largest holder of debt securities, followed by investment funds and insurance companies and pension funds. While banks increased their security holdings before the beginning of the financial crisis, they have since reduced their security holdings significantly. In contrast, nonbank financial institutions, such as investment funds and insurance companies, gained more importance in the provision of market-based funding. Although investment funds built up their security holdings over time, they were selling securities during the sovereign debt crisis. In contrast, insurance companies and pension funds were building up debt securities even between 2010 and 2012.[12]

The active selling behavior of banks and investment funds in the crisis paid off in the short run, as can be seen from Fig. 2. The capital gains on their debt security portfolios were positive before dropping into negative territory in mid-2010 but still without major losses. Insurance companies and pension funds, however, suffered severely when their bonds fell in value during the crisis, but their medium-term strategy paid off when prices began to recover. Between mid-2011 and the end of 2014, capital gains on their debt securities have been nearly 30%. They have 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 other two sectors in the medium run. This is in line with the statement by Matteo Renzi, at that time Italy's prime minister, to the Italian Senate on February 17, 2016: "Let me say that if some northern European lenders had kept their Italian government debt in 2011–2012, they would be earning much more." However, holding or even increasing the holdings of securities that have performed poorly can be a risky strategy, as bond returns tend to continue their trend for several quarters before trends reverse, see Cutler et al. (1991),

[12] For the portfolio composition of the three sectors see Table A1.

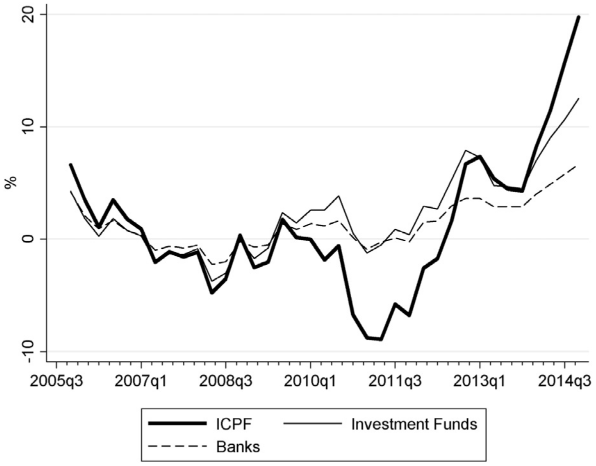


**Fig. 2.** Capital gains on security holdings. The figure shows the capital gains of *Banks*, *Investment Funds*, and Insurance Companies and Pension Funds (*ICPF*). The capital gains are calculated as the difference between the total market value of all securities and the total nominal value of all securities divided by the total nominal value of all securities. Source: author's calculations; data: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4–2014 Q4.

Cutler et al. (1990), Moskowitz et al. (2012). Although the selling behavior that Matteo Renzi stresses has been formally rationalized by DeLong et al. (1990b), not every investor can take the same side of a trade. Due to the adding-up constraint, someone has to buy the securities when their prices fall and others are selling them.[13] The above results suggest that insurance companies and pension funds have been the institutions that tried to "catch the falling knife." However, these simple facts only show simple aggregated numbers that can be influenced by other factors. In the next section, I turn to a security-by-security analysis to test the systematic investment behavior of the different sectors more formally.

## 3. Main results

I attempt to shed light on the question of which institutions act procyclically or countercyclically by investigating how their investment decisions depend on past returns. My regression is in the spirit of Abbassi et al. (2016), but instead of comparing trading banks to non-trading banks, I compare insurance companies and pension funds to banks and investment funds. I treat insurance companies and pension funds as my benchmark and define a dummy *Banks* that equals one for banks, and zero otherwise. The second dummy *Funds* takes a value of one for investment funds, and zero otherwise. I regress the percentage increase in the nominal amount held by each institution on the interaction of the respective dummies with the holding period return in the last quarter. The coefficients on the interaction terms show how much more procyclically banks and investment funds act compared to insurance companies and pension funds. I estimate the following specification:

$$NetBuy_{i,s,t} = \beta_1 Return_{s,t-1} * Funds_i + \beta_2 Return_{s,t-1} * Banks_i + \alpha_{s,t} + \alpha_{i,t} + \alpha_{i,s} + \epsilon_{i,s,t} \quad (2)$$

The results are shown in column (6) of Table 2. Net Buy is the change in the log of the nominal amount held of security *s* at quarter *t* given the institution trades.[14] Return is the quarterly change of the price plus the coupon divided by the price of the security in the past quarter.

I lag *Return* by one quarter to prevent contamination of my results by the possibility that trading decisions have a price impact.[15] In addition, this allows me to rule out the possibility that trading decisions are executed before the institution observes the reported return.[16]

In this specification I also include security*time, sector*time, and security*sector fixed effects. The inclusion of security*time fixed effects controls for all time-variant and time-invariant security-specific characteristics so that a separate security fixed effect is spanned by the security*time fixed effect. This specification allows me to draw conclusions about the investment behavior in one specific security at a given point in time. For instance, a positive correlation between the error term and the return leads to an overestimation of the coefficient on the return. Comparing banks and investment funds to insurance companies and pension funds allows me to control for unobserved and observed time-varying security characteristics. The additional inclusion of sector*time fixed effects controls for time-variant and time-invariant sector-specific characteristics. By controlling for sector*time fixed effects, I can confirm that results hold if I control for the amount invested by the specific sector at a given time. Lastly, I saturate the specification with security*sector fixed effects to control for observed and unobserved preference of the three sectors for specific securities.

Column (6) shows that both banks and investment funds invest more procyclically in response to past returns than do insurance companies and pension funds (Table 2). A return of 10% in the last quarter is associated with a 7.9 percentage point stronger increase by banks and a 3.9 percentage point stronger increase of the nominal position by investment funds relative to insurance companies and pension funds. As can already be seen from the interpretation of the results, the disadvantage of including security*time fixed effects is that I can only make statements about whether the sectors trade more or less pro or

[13] DeLong et al. (1990b) call them passive investors.

[14] The NetBuy measure reflects only buy and sell decisions and no valuation effects. The results are robust to the use of other Net Buy measures. For instance, the results do not change qualitatively whether I use the log of the amount bought minus the log of the amount sold or the amount in Euros. The results are also robust when I use buy and sell separately instead of using a Net Buy measure. The results are also robust when hold decisions are included.

[15] In this case, the return and the decision to buy or sell can be jointly determined.

[16] If I included the contemporaneous return, trading decision could have been executed any time during the quarter *t*, although the return I am using in my regression has not been observed, as it is the holding period return from the end of quarter $t-1$ until the end of quarter *t*. Therefore, unless the trading decision is always executed at the last point of the quarter, the contemporaneous independent variables can be observed only after the decision to transact is taken.

**Table 2**
Heterogeneity in cyclical investment behavior—interactions.

| | Dependent variable: NetBuy | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Return | −0.676*** | −0.826*** | −0.435*** | | | |
| | (0.110) | (0.113) | (0.128) | | | |
| Return * Funds | 0.841*** | 0.927*** | 0.562*** | 0.553*** | 0.815*** | 0.392** |
| | (0.112) | (0.115) | (0.131) | (0.131) | (0.157) | (0.183) |
| Return * Banks | 0.933*** | 1.160*** | 0.787*** | 0.812*** | 1.275*** | 0.792*** |
| | (0.133) | (0.140) | (0.156) | (0.159) | (0.185) | (0.216) |
| *R*-squared | 0.0849 | 0.121 | 0.125 | 0.453 | 0.529 | 0.532 |
| Observations | 387,379 | 383,265 | 383,265 | 147,499 | 147,499 | 147,499 |
| Security FE | Yes | – | – | – | – | – |
| Time FE | Yes | No | – | – | – | – |
| Security*time FE | No | No | No | Yes | Yes | Yes |
| Sector*time FE | No | No | Yes | No | No | Yes |
| Security*sector FE | No | Yes | Yes | No | Yes | Yes |

The dependent variable is the change in the log of the nominal amount held. *Return* is the holding period return defined as the quarterly change in the price plus the quarterly coupon divided by the price in the previous quarter and lagged by one quarter. *Banks* is a dummy that equals one for banks, and zero otherwise. *Funds* is a dummy that equals one for investment funds, and zero otherwise. The benchmark is insurance companies and pension funds. Fixed effects are either included (Yes), not included (No), or spanned by other fixed effects (-). Standard errors are in parentheses. Standard errors are clustered at the security level and robust to heteroskedasticity and autocorrelation. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4-2014 Q4; author's calculations.

countercyclically to past returns relative to insurance companies and pension funds and not whether they actually buy or sell.

Columns (1)–(3) exclude the security*time fixed effects. Excluding security*time from the specification relaxes the restrictions that at least two sectors need to trade the security at a given point in time. The exclusion of the security*time fixed effect implies that the level of the return is identified as it is no longer collinear with the fixed effects. The interpretation of the level of the return coefficient is the response of insurance companies and pension funds to past returns. Column (3) of Table 2 shows that a return of 10% in the last quarter is associated with a 4.4% decrease of the nominal amount held by insurance companies and pension funds. The interaction of the return with the dummy *Funds* shows that investment funds increase their nominal holdings by 5.6 percentage points more, i.e., they increase their holdings by 1.2%. The interaction of the past return with the dummy *Banks* shows that banks increase their holdings by 7.9 percentage points more than insurance companies and pension funds, i.e., they increase their holdings by 3.5%. Column (2) and (3) are equivalent to splitting the sample and estimating the equation separately for banks, investment funds, and insurance companies and pension funds. This also allows testing the null hypothesis whether institutions do not respond to past returns against the alternative hypothesis that they change their holdings in response to past returns. This is in contrast to Table 2, where I test whether institutions change their holdings differentially in response to past returns.

Therefore, the following specification can be estimated:

$$NetBuy^X_{s,t} = \beta_1 \Delta Return_{s,t-1} + \alpha_s + \alpha_t + \epsilon_{s,t}. \quad (3)$$

$X$ represents investment funds, banks or insurance companies and pension funds. Columns (1) and (2) show the results for when $X$ equals investment funds, columns (2) and (3) are for insurance companies and pension funds, columns (5) and (6) show the results for banks. Again, $\alpha_s$ is a security fixed effect that controls for security-specific characteristics that are timeinvariant. The inclusion of security fixed effects controls for the fact that different securities have different time-invariant characteristics, such as the expiration date or the coupon. It also enables me to analyze the investment behavior in a specific security over time, which circumvents the issue that the number of securities outstanding in the economy can change.[17] $\alpha_t$ is a time fixed effect that controls for market-wide development. As I split the equation into three parts, the security fixed effect, as well as the time fixed effects, are sector specific. This is equivalent to the sector*time and sector*security fixed effect in Table 2.

Table 3 shows the estimation of E. (2) sector by sector. Investment funds and banks buy securities whose returns have been high and sell securities whose returns have been low, i.e., they have an upward sloping demand curve. In contrast, insurance companies and pension funds buy when returns have been low and sell when returns have been high.[18] The inclusion of time fixed effects implies that aggregate time-specific characteristics that affect the investment behavior are discarded. For instance, when banks sell securities in times when returns have been low, time fixed effects would absorb this effect. On the other side, when insurance companies and pension funds increase their holdings in general in times after returns have been low, this would not be captured in a specification with time fixed effects. Therefore, including time fixed ef-

[17] See online Internet appendix for details.

[18] In the working paper version of the paper, I show the response of the various institutions to macro-financial variables, see Timmer (2016).

**Table 3**
Heterogeneity in cyclical investment behavior—sample split.

| | Dependent variable: NetBuy | | | | | |
|---|---|---|---|---|---|---|
| | Funds | | ICPF | | Banks | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Return | 0.101*** | 0.127*** | −0.826*** | −0.435*** | 0.334*** | 0.352*** |
| | (0.023) | (0.026) | (0.113) | (0.128) | (0.083) | (0.087) |
| *R*-squared | 0.120 | 0.126 | 0.161 | 0.173 | 0.114 | 0.116 |
| Observations | 232,464 | 232,464 | 29,860 | 29,860 | 120,941 | 120,941 |
| Security FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Time FE | No | Yes | No | Yes | No | Yes |

The dependent variable is the change in the log of the nominal amount held. *Return* is the holding period return defined as the quarterly change in the price plus the quarterly coupon divided by the price in the previous quarter and lagged by one quarter. Columns (1) and (2) estimate the specification for the investment fund sector. Columns (3) and (4) estimate the specification for the insurance companies and pension fund sector. Columns (5) and (6) estimate the specification for the banking sector. Fixed effects are either included (Yes), not included (No), or spanned by other fixed effects (-). Standard errors are in parentheses. Standard errors are clustered at the security level and robust to heteroskedasticity and autocorrelation. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4–2014 Q4; author's calculations.

fects might overcontrol some of the effects one is interested in. Instead of showing how much insurance companies and pension funds actually buy when prices have fallen and returns are negative, it rather shows how much is bought of securities whose returns have been relatively lower compared to other securities.

Table 3 also shows the results without time fixed effects. The effects are again statistically and economically highly significant. A two standard deviation in the past return (7.4%) is associated with a 2.47% increase in the nominal holdings for banks, 0.75% for investment funds, and a 6.11% decrease for insurance companies and pension funds. These magnitudes add up to an increase of 1.42 million euros for banks, 0.24 million for investment funds and 1.38 million decrease for insurance companies and pension funds.[19] The countercyclical investment behavior of insurance companies and pension funds offsets almost completely the procyclical investment behavior of banks and investment funds, although the security holdings of banks and investment funds are significantly larger than those of insurance companies and pension funds.

## 4. Balance sheet constraints

The results above indicate that banks and investment funds act like positive feedback investors who "buy securities when prices rise and sell when prices fall" (DeLong et al., 1990b). Since insurance companies and pension funds have deep pockets they may be able to trade against them (DeLong et al., 1990a).[20] The investment behavior of banks and investment funds might be rational for several reasons. In this section, I empirically investigate one potential channel that could generate these findings: a balance sheet channel.

### 4.1. Balance sheets and investment behavior

The procyclical investment behavior of banks and investment funds could be explained by their unstable balance sheet composition. I test this channel by exploiting cross-sectional heterogeneity within the banking and investment fund sector. This within-sector heterogeneity confirms that institutions with tighter constraints act in a more procyclical way to past returns. In articular, banks with tighter capital constraints and investment funds with more outflows act relatively more procyclically. The constraints of banks and investment funds also tighten when the institutions suffer losses on their security holdings. Since bond returns exhibit a momentum factor at short horizons, and banks and investment funds are averse to short-term losses, the procyclical investment behavior of banks and investment funds can be rational.

In contrast, insurance companies and pension funds have long-term liabilities so that they are not exposed to redemption pressure. While insurance companies and pension funds act relatively less countercyclically in times when their negative duration gap rises, the duration gap does not seem to be related to losses on their security holdings.[21] The benefit of a more stable balance sheet can explain why insurance companies and pension funds are acting in a countercyclical manner and can benefit from buying securities whose values have fallen.

Before I empirically link the institution's balance sheet constraints to their investment behavior, I lay out the balance sheet structure of the institutions under investigation and discuss the balance sheet channel hypothesis in greater detail.[22]

[19] It is important to stress that these numbers are for a single security. Given that the institutions hold several thousands of securities, the results sum up to even larger aggregate numbers.

[20] Insurance companies' and pension funds' investment behavior is consistent with passive investors in DeLong et al. (1990b).

[21] Chodorow-Reich et al. (2016) show that stock prices of insurance companies in the US are usually not sensitive to losses on their security holdings.

[22] See also Hanson et al. (2015) for a discussion of the balance sheets of various financial intermediaries.

#### 4.1.1. Banks

The aggregated balance sheet of banks in Germany amounted to 7.85 trillion euros in 2014, which is around 270% of Germany's gross domestic product (2.9 trillion euros in 2014). The liability side mainly consists of retail and wholesale deposits. Only 382 billion euros, approximately 5%, are equity capital. Both retail and interbank borrowing are short-term liabilities that can be withdrawn without an extended period of notice.[23]

When creditors refuse to roll over their debt or actively withdraw their funds, the asset side needs to be reduced to service the liabilities. The asset side of banks mainly consists of longer-term assets, such as debt securities and loans. When funding liquidity dries up, banks start by reducing their most liquid assets, such as cash and excess reserves at the central bank. 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 dry up is systemic and nonspecific to a single 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.

The small amount of equity capital exacerbates their unstable balance sheet structure. The poorer capitalized a bank is, the more leverage increases when the value of the assets declines. To keep leverage constant, banks need to sell securities that can lead to a spiral between lower asset prices and weaker balance sheets (Adrian and Shin, 2010; 2014; Brunnermeier, 2009; Brunnermeier and Pedersen, 2009; Greenwood, Landier and Thesmar, 2015).[24]

The ability of banks to take on additional exposure is therefore limited by their capital cushion (Danielsson, Shin and Zigrand, 2012). In particular, a better capitalized bank could act in a countercyclical fashion, a strategy that pays off only at longer horizons, as it is relatively less sensitive to losses on their security holdings in the short run.[25] In contrast, a bank with a lower capital ratio is more sensitive to losses on their securities. Therefore, it can be rational for these banks to act procyclically, as this is a relatively less risky strategy due to the short-term momentum component of bond returns.[26] To shed light on the question of whether a balance sheet channel is actually at work, I test whether there is heterogeneity in the cyclical investment behavior across banks depending on their degree of capitalization.

Hypothesis 1. Banks with tighter capital constraints act relatively more procyclically.

To test Hypothesis 1, I obtain data on bank-level security holdings. The data set covers every bank in Germany and their security holdings from 2005 Q4 through 2014 Q4. For all 1954 banks in my sample, I define the capital ratio of the bank as the ratio of equity to total assets. I fix the capital ratio at the beginning of the sample to assure that changes in the capital ratio are not driven by active balance sheet management, see, e.g., Adrian and Shin (2010).[27] The empirical strategy uses the bank's capital ratio and interacts it with the past return of the security. I expect a negative coefficient for the interaction term of the return with the capitalization measure, i.e., poorer capitalized banks act relatively more procyclically.

The empirical specification for column (4) in Table 4 is as follows:

$$NetBuy_{i,s,t} = \beta_1 \Delta Return_{s,t-1} * Capital_i + \alpha_{s,t} + \alpha_{i,t} + \epsilon_{i,s,t} \quad (4)$$

This is the most conservative specification and includes security*time fixed effects and institution*time fixed effects. This allows me to control for all unobserved time-varying institution and security-specific characteristics. The separate inclusion of security fixed effects, time fixed effects, and institution fixed effects is not possible, as they are spanned by the inclusion of security*time and institution*time fixed effects. In addition, the inclusion of the level of the return and the capital ratio is not possible due to collinearity with the fixed effects. Standard errors are double clustered at the security and institution-level to account for serial correlation between observations of the same security and institution across time.[28]

A one percentage point lower capital ratio is associated with a 2 percentage point more procyclical investment behavior for a return of 10% in the previous quarter. This result provides evidence in support of Hypothesis 1. Since the return is collinear with the security*time fixed effect, the return coefficient is not identified in Eq. (3). Columns (1) and (2) relax this restriction so that the level of the return can be included in the regression specification. The results also hold when I exclude institution*time fixed effects and security*time fixed effects. For instance, column (2) shows the specification with security and institution*time fixed effects separately. Since the capital ratio is demeaned by the sample average, the level coefficient can be interpreted as a response of a bank with an average capital ratio, which is approximately 5%. A bank with a capital ratio of 5% increases the nominal holdings by 4.6% in response to a 10% return in the last quarter. For every one percentage point lower capital ratio, the response is 1.4 percentage points stronger. For instance, a

[23] See Fig. A1 for the composition of assets and liabilities for the German banking sector.

[24] This is not only the case for banks that mark-to-market. Geanakoplos (2003) and Fostel and Geanakoplos (2008) stress the importance of collateral constraints for balance sheet dynamics. For instance, a higher levered bank is more sensitive to price changes, as it alters the collateral value a bank can borrow against. This is independent whether the bank marks-to-market their security holdings. In addition, lower capitalized banks are more vulnerable, as they mechanically have a larger share of unstable funding. Adrian et al. (2015) also point out that accounting rules are unlikely the reason for balance sheet dynamics. Laux and Leuz (2010), Allen and Carletti (2008), and Plantin et al. (2008) describe the mark-to-market behavior of banks in more detail.

[25] See Abbassi et al. (2016).

[26] While I pose the assumption here that procyclical investment behavior is relatively less risky at short horizons than countercyclical investment behavior, I test this more formally in Section 5.

[27] In this regression, I am only interested in the cross-sectional variation of the cyclical investment behavior across banks. If I used the contemporaneous capital ratio instead, the coefficient could be driven by both changes in the capital ratio over time and the cross-sectional component. The capital is the book value and not the market value of equity.

[28] The results are even stronger when I cluster either on the security, on the institution, or on the security-institution level. The results also hold when I include security*institution fixed effects.

**Table 4**
Bank heterogeneity.

| | Dependent variable: NetBuy | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Return | 0.385*** | 0.463*** | | |
| | (0.069) | (0.076) | | |
| Return*Capital | −8.823** | −14.41*** | −15.33*** | −19.73*** |
| | (3.504) | (4.000) | (4.936) | (5.766) |
| *R*-squared | 0.117 | 0.127 | 0.238 | 0.249 |
| Observations | 1653727 | 1653727 | 1653727 | 1653727 |
| Security FE | Yes | Yes | – | – |
| Institution FE | Yes | – | Yes | – |
| Time FE | Yes | – | – | – |
| Institution*Time FE | No | Yes | No | Yes |
| Security*time FE | No | No | Yes | Yes |

The dependent variable is the change in the log of the nominal amount held for banks on the institution level. *Return* is the holding period return defined as the quarterly change in the price plus the quarterly coupon divided by the price in the previous quarter and lagged by one quarter. *Capital* is equity as a ratio of its total assets at the beginning of the period. *Capital* is demeaned by the average across banks. Fixed effects are either included (Yes), not included (No), or spanned by other fixed effects (-). Standard errors are in parentheses. Standard errors are double clustered at the security and institution level and robust to heteroskedasticity and autocorrelation. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, monthly bank balance sheet statistics, 2005 Q4–2014 Q4; author's calculations.

**Table 5**
Bank heterogeneity across time.

| | Dependent variable: NetBuy | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Return * Capital | −20.59 | −25.63** | −14.70 | 4.628 |
| | (22.108) | (12.520) | (32.860) | (34.524) |
| *R*-squared | 0.218 | 0.263 | 0.284 | 0.288 |
| Observations | 441,778 | 748,569 | 149,868 | 313,512 |
| Institution*Time FE | Yes | Yes | Yes | Yes |
| Security*time FE | Yes | Yes | Yes | Yes |
| Sample | Precrisis | Crisis | Postcrisis | Postreg. reform |

The dependent variable is the change in the log of the nominal amount held for banks on the institution level. *Return* is the holding period return defined as the quarterly change in the price plus the quarterly coupon divided by the price in the previous quarter and lagged by one quarter. *Capital* is equity as a ratio of its total assets at the beginning of the period. *Capital* is demeaned by the average across banks. Fixed effects are either included (Yes), not included (No), or spanned by other fixed effects (-). *Precrisis* refers to the period 2006 Q1:2008 Q1, *Crisis* refers to 2008 Q2:2012 Q3, *Postcrisis* refers to 2012 Q4:2013 Q4 and *Postreg. Reform* refers to 2014 Q1:2014 Q4. Standard errors are in parentheses. Standard errors are double clustered at the security and institution level and robust to heteroskedasticity and autocorrelation. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, monthly bank balance sheet statistics, 2005 Q4–2014 Q4; author's calculations.

bank with a capital ratio of 4% increases its holdings by 6% instead of 4.6%.

Table 5 splits the sample into a precrisis, crisis, postcrisis, and a postregulatory reform implementation period. This follows the difference-in-difference approach in Adrian et al. (2017), who investigate the impact of dealer balance sheets on bond liquidity provision and show that while bonds traded by more levered institutions have been more liquid prior to the crisis, this relation reverses postcrisis. The impact of the capital ratio on the cyclical investment behavior should become stronger when overall constraints are tighter if a causal mechanism between the tightness of the capital constraint and the procyclical investment behavior is at work. When banks' capital ratios rise, they are pushed away from their financial constraint, which should weaken the impact of the capital ratio on the procyclical investment behavior.

Table 5 indeed shows that the coefficient is strongest in the crisis period when banks suffered losses and capital constraints became tighter. The impact is also relatively strong in the pre-crisis period, at the peak of the leverage cycle, when capital constraints were close to being binding.[29] When security prices started to recover after Draghi's announcement to do "whatever it takes to preserve the euro," capital positions of banks improved again. This distanced banks from their financial constraint, which arguably led to the weakening of the impact of capital ratios on the procyclical investment behavior in the post-crisis period.[30] Lastly, in 2014 new capital requirement for banks were introduced (Commission, 2013). The results show that the impact of the capital ratio on the procyclical investment behavior is weakest in the post-regulatory reform implementation period, and if anything, the relation reversed. This result suggests that that the implementation of regulatory reforms had a mitigating effect on the procyclical investment behavior of banks.[31]

#### 4.1.2. Investment funds

The investment fund industry in Germany is a significant sector, with an aggregate balance sheet of 1.7 trillion euros in 2014 (more than 50% of Germany's GDP). In Germany, the sector consists almost exclusively of open-end mutual funds, such as bond and mixed funds.[32] The leverage of these investment funds is limited. Only 2% of their liability side consists of loans (Fig. A2). At first glance, the fact that investment funds are not vulnerable to runs on their debt liabilities can raise doubts about their contribution to systemic risk. As their investors provide equity capital, this suggests that investment funds can be seen as benign with respect to financial stability.

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, 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, as the redemptions of investors are usually not orthogonal to the performance of the investment fund.[33] In particular, losses on security holdings are associated with investor redemptions; since investment funds are averse to redemptions from investors, they can have incentives to limit short-term losses. This is particularly strong when investment funds already suffered outflows, as higher outflows make them more vulnerable to low returns.[34] From this the following hypothesis arises:

Hypothesis 2. Investment funds with more net outflows act relatively more procyclically.

To test Hypothesis 2, I use data on all investment funds and their security-level holdings. However, in contrast to the bank-level security-level holdings data, the data on investment funds is only available from 2009 Q4 onwards. First, I define the net outflow of a fund as

$$NetOutflow_{i,t} = -\left(\frac{Shares_{i,t} - Shares_{i,t-1}}{NAV_{i,t-1}}\right). \quad (5)$$

*Shares* are the investment fund's shares outstanding at face value to control for outflows to be driven mechanically by the price of the investment fund. *NAV* is the net asset value, used to scale for how large the outflows are relative to the size of the investment fund.

I estimate the following specification to test whether investment funds that suffered more outflows indeed rebalance their portfolio toward securities that have been risen versus those that have been fallen:

$$NetBuy_{i,s,t} = \beta_1 \Delta Return_{s,t-1} * NetOutflow_{i,t-1} + \alpha_{s,t} + \alpha_{i,t} + \epsilon_{i,s,t} \quad (6)$$

Column (4) of Table 6 shows the results with double clustered standard errors at the security and institution level to account for serial correlation between observations of the same security and institution across time.[35] A 10% net outflow is associated with a 1.2 percentage point stronger procyclical investment behavior for a 10% return in the past period. Column (2) shows the results without security*time fixed effects but with institution*time and security fixed effects so that the return coefficient is identified. The results can be interpreted as follows: an investment funds without outflows increases its security holdings by 2.4% in response to a return of 10% in the previous quarter, while a fund that suffers 10% net outflows increases the amount by 3.2%.[36]

#### 4.1.3. 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 (more than 80% of Germany's GDP). On the asset side, cash and deposit holdings are much larger than for banks and contribute 21% to total assets, while almost 60% are securities (Fig. A3). The leverage ratio of insurance companies is much smaller compared to banks. The lion's share of liabilities is represented by insurance technical reserves; these are net equity of households in life insurance

[29] The results are economically large but not statistically significant due to larger standard errors compared to the baseline specification. One potential explanation is that the short time period for which the cyclical investment behavior is measured leads to more imprecisely estimated coefficients.

[30] See Acharya et al. (2017) for the real effects of the "whatever it takes" announcement.

[31] Note that in this table, the past return coefficient, as well as the capital coefficient, are absorbed by the security*time fixed effect as well as the institution*time fixed effect, respectively. Table A2 shows that the difference between the pre-crisis and crisis period coefficient and the post-regulatory reform period coefficient is statistically significant.

[32] In 2014 there have been 5923 investment funds in Germany of which 57.2% are mixed mutual funds and 15% are bond mutual funds. Only 0.5% are hedge funds.

[33] See e.g. Chevalier and Ellison (1997) and Chen et al. (2010) for the relationship between fund outflows and performance.

[34] See also Goldstein et al. (2015), Feroli et al. (2014), and Morris and Shin (2015) for empirical and theoretical evidence on this channel.

[35] The results are even stronger when I cluster either on the security, on the institution, or on the security-institution level. The results also hold when I include security*institution fixed effects.

[36] Although the return coefficient is economically large and significant, it is not statistically significant. The standard error suggests that there is large heterogeneity in the cyclical investment behavior across investment funds that is exploited by the interaction with the net outflow variable. However, other kinds of heterogeneities are worth exploring in future research.

**Table 6**
Investment fund heterogeneity.

| | Dependent variable: NetBuy | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Return | 0.115 | 0.237 | | |
| | (0.242) | (0.219) | | |
| Return*Net outflow | 1.023*** | 0.747** | 1.343*** | 1.208*** |
| | (0.267) | (0.319) | (0.262) | (0.308) |
| *R*-squared | 0.341 | 0.436 | 0.423 | 0.508 |
| Observations | 2,576,061 | 2,576,061 | 2,576,061 | 2,576,061 |
| Security FE | Yes | Yes | – | – |
| Time FE | Yes | – | Yes | – |
| Institution FE | Yes | – | – | – |
| Institution*Time FE | No | Yes | No | Yes |
| Sector*time FE | No | No | Yes | Yes |

The dependent variable is the change in the log of the nominal amount held for investment funds on the institution level. *Return* is the holding period return defined as the quarterly change in the price plus the quarterly coupon divided by the price in the previous quarter. *Net outflow* is the negative of the change in the face value of shares outstanding as a ratio of the lagged net asset value. The level of *Net outflow* is included in the specification whenever not collinear with the fixed effects. All independent variables are lagged by one quarter. Fixed effects are either included (Yes), not included (No), or spanned by other fixed effects (-). Standard errors are in parentheses. Standard errors are double clustered at the security and institution level and robust to heteroskedasticity and autocorrelation. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, investment fund statistics, 2009 Q4–2014 Q4; author's calculations.

**Table 7**
ICPF heterogeneity

| | Dependent variable: NetBuy | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Return | -0.816*** | -0.429*** | -0.930*** | -0.930*** | -0.631*** |
| | (0.112) | (0.129) | (0.135) | (0.135) | (0.156) |
| Return*ΔMismatch | 27.57*** | 28.37*** | 32.03*** | 32.03*** | 28.08*** |
| | (6.534) | (8.061) | (8.633) | (8.633) | (9.662) |
| *R*-squared | 0.162 | 0.174 | 0.168 | 0.168 | 0.174 |
| Observations | 29860 | 29860 | 29860 | 29860 | 29860 |
| Security FE | Yes | Yes | Yes | Yes | Yes |
| Time FE | No | Yes | No | No | Yes |
| Macro controls | No | - | Yes | Yes | - |
| Macro interactions | No | No | No | Yes | Yes |

The dependent variable is the change in the log of the nominal amount held for insurance companies and pension funds. *Return* is the holding period return defined as the quarterly change in the price plus the quarterly coupon divided by the price in the previous quarter. Δ*Mismatch* is the change in the ratio of long-term liabilities to long-term assets of insurance companies and pension funds. The level of Δ*Mismatch* is included in the specification whenever not collinear with the fixed effects. Macro controls include the German GDP growth, inflation, the ten-year government bond yield, the Eonia and the VIX. Macro interaction are the respective interaction of the macro controls with the price change. All independent variables are lagged by one quarter. Fixed effects are either included (Yes), not included (No), or spanned by other fixed effects (-). Standard errors are in parentheses. Standard errors are clustered at the security level and robust to heteroskedasticity and autocorrelation. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, Deutsche Bundesbank, time series database, banks and other financial institutions, insurance corporations and pension funds, 2005 Q4-2014 Q4; author's calculations.

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 overall financial conditions. This predictable liability structure can give insurance companies and pension funds more autonomy in their portfolio choice as compared to banks or investment funds. For instance, an accident with an insured car, a damage to an insured building, or a death of a person are events that could be covered by insurance companies and cause payouts. As the structure of the liability side of insurance companies' and pension funds' balance sheet is relatively persistent, this keeps their funding and rollover risk relatively moderate and leaves them with more “skin in the game.”[37] In addition, insurance companies and pension funds in Germany did not have to mark-to-market their security holdings during my sample period (Fabozzi, 2012).[38] This can enable deep pocket investors, such as insurance companies and pension funds, to buy securities when returns have been low when other actors, such as banks and investment funds, can sell these securities. When returns have been low, insurance companies and pension funds can benefit from a reversal of the price if they hold on to the security. Therefore, insurance companies and pension funds can act countercyclically due to their more stable balance sheet as compared to those of banks and investment funds.

However, while insurance companies and pension funds are less sensitive to losses on their security holdings than banks and investment funds, they are unlikely to be totally unconstrained investors. While their long-term liabilities relative to their assets are usually an advantage, the duration mismatch of assets and liabilities can also become problematic. Insurance companies and pension funds discount their liabilities with the risk-free rate. When the risk-free rate falls, insurance companies' and pension funds' liabilities increase relatively more due to their negative duration gap. To prevent having a duration mismatch that is too large, insurance companies and pension funds can buy long-term bonds, independent of the past return. While it is usually the case that insurance companies and pension funds buy securities whose value dropped most, this can change when the duration mismatch increases. When interest rates fall, the prices of long-term bonds rise and the duration mismatch of insurance companies and pension funds increases. To investigate whether the duration mismatch is indeed a balance sheet constraint that affects the investment behavior of insurance companies and pension funds, I test the following hypothesis:

Hypothesis 3. Insurance companies and pension funds act relatively less countercyclically when their duration mismatch increases.

Security holdings data are not available on the institution level for insurance companies and pension funds. To test the hypothesis, I instead use balance sheet data for the insurance company and pension fund sector in Germany provided by the Deutsche Bundesbank, and proxy the duration mismatch by constructing a maturity mismatch measure by dividing insurance companies' and pension funds' long-term liabilities by their long-term assets. A higher ratio of long-term liabilities to long-term assets is associated with a higher on-balance-sheet maturity mismatch. Since the duration of an asset is closely linked to its maturity, the maturity mismatch can be seen as a proxy for the duration mismatch.[39]

To test this hypothesis, I estimate the following specification:

$$NetBuy_{s,t} = \beta_1 \Delta Return_{s,t-1} + \beta_2 \Delta Mismatch_{t-1} * \Delta Return_{s,t-1} + \alpha_t + \alpha_s + \epsilon_{s,t} \quad (7)$$

The results are shown in column (2) of Table 7. The specification includes security fixed effects to control for time-invariant security-specific characteristics. Time fixed effects control for observed and unobserved time-specific characteristics. As this regression is on the sector level, all sector-specific time trends are also controlled for. If Hypothesis 3 is true, I would expect a positive sign for the interaction of the change in the maturity mismatch and the past return. The larger the mismatch, the more procyclically (less countercyclically) insurance companies and pension funds act on the capital markets with respect to past returns.[40]

Column (2) of Table 7 shows that a one percentage point increase in the mismatch ratio is indeed associated with a 2.8 percentage point weaker countercyclical investment behavior for a 10% holding period return in the last quarter. Column (1) shows that this pattern holds when time fixed effects are not included in the regression. In this case countercyclical investment behavior is even stronger, as insurance companies and pension funds seem to buy more in general when prices fall. This also holds when I include macroeconomic controls in the regression instead of using time fixed effects, seen in column (4). Column (5) is the most conservative specification. To rule out that the duration mismatch is correlated with other macroeconomic variables and that the mismatch only picks up this correlation, I control for the interaction between several macroeconomic variables, such as German GDP growth, inflation, the ten-year government bond yield, the Euro OverNight Index Average (Eonia) and the Chicago Board Options Exchange Volatility Index (VIX) and the past return. Even controlling for these other interaction terms, the interaction of the past return with the mismatch ratio is still highly significant.

After having shown that insurance companies and pension funds act relatively less countercyclically in times when the duration mismatch increases, this still poses the question of what drives the aggregate pattern of Section 2, i.e., that insurance companies and pension funds act countercyclically on average. One mechanism that could explain these findings is the correlation of the tightness of their constraints with gains and losses on the portfolio holdings. In contrast to investment funds and banks, whose constraints tighten when they suffer losses on their security holdings, the duration mismatch of insurance companies and pension funds should, if anything, decrease when prices fall due to their negative duration gap.[41] Therefore, insurance companies and pension funds can use this comparative advantage to act countercyclically. I test the link

[37] Acharya et al. (2011) discuss the systemic importance of insurance companies for the global economy in more detail. Manconi et al. (2016) show their selling behavior when they face a large outflow.

[38] With the introduction of Solvency II in January 2016, insurance companies and pension have to mark-to-market their security holdings.

[39] Of course, insurance companies and pension funds can use interest swaps to hedge their interest rate exposure. However, since hedging is expensive, insurance companies and pension funds may not fully hedge their exposure.

[40] In recent work Domanski et al. (2017) provide a theoretical framework for this behavior. They also provide consistent evidence with aggregate data.

[41] When interest rates fall and security prices rise, assets of insurance companies and pension funds may rise relatively less than their liabilities due to their larger sensitivity to interest rate changes.

**Table 8**
Capital gains and balance sheet constraints.

| | Dependent variable: | | | | |
|---|---|---|---|---|---|
| | Δ Mismatch | Capital | | Net Outflows | |
| | (1) | (2) | (3) | (4) | (5) |
| Net capital gains | 0.0542 | 0.0937*** | 0.257*** | −0.217*** | −0.0822*** |
| | (0.054) | (0.034) | (0.008) | (0.072) | (0.007) |
| *R*-squared | 0.0292 | 0.186 | 0.807 | 0.303 | 0.335 |
| Observations | 36 | 36 | 59,563 | 36 | 92,870 |
| Time FE | – | – | Yes | – | Yes |
| Institution FE | – | – | Yes | – | Yes |

The dependent variable Δ*Mismatch* is the change in the ratio of long-term liabilities to long-term assets of insurance companies and pension funds; *Capital* is equity as a ratio of its total assets with assets being fixed at the beginning of the period; *Net Outflow* is the negative of the change in the face value of shares outstanding as a ratio of the lagged net asset value. *Net capital gains* are sector or institution specific net capital gains on security holdings and lagged by one quarter. Columns (1), (2), and (4) are on the sector level. Columns (3) and (5) are on the institution level. Fixed effects are either included (Yes), not included (No), or cannot be included (-). Robust standard errors are in parentheses. Standard errors are clustered at the institution level and robust to heteroskedasticity and autocorrelation in columns (3) and (5). * $p<0.1$, ** $p<0.05$, *** $p<0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, Deutsche Bundesbank, time series database, banks and other financial institutions, investment fund statistics, monthly balance sheet statistics, 2005 Q4–2014 Q4; author's calculations.

between capital gains and the tightness of the balance sheet constraint more formally in the next section.

### 4.2. Balance sheet constraints and capital gains

The above hypotheses and results suggest that there is a link between capital gains and losses on their portfolio holdings of different investor types and the tightness of their constraints. As shown in the previous section, poorer capitalized banks and investment funds with more outflows act relatively more procyclically. When insurance companies' and pension funds' duration mismatch increases, they also tend to act relatively less countercyclically.

To align the findings of Section 2 with the overall pattern that insurance companies and pension act countercyclically and the banking and investment fund sector acts procyclically, I test whether losses on portfolio holdings are affecting the constraints of the various institutions. When prices fall and losses on their security holdings lead to tighter constraints, institutions can (i) be forced to sell securities or (ii) sell securities to avoid further price falls tightening constraints even more. This may be the case because procyclical investment behavior is profitable in the short run. To test whether the tightness of the constraint is related to the losses on the security holdings, I estimate the following specification:

$$Constraint_t^X = \alpha + \beta_1 Netgains_{t-1} + \epsilon_t. \tag{8}$$

where $X$ is either (i) investment funds, (ii) banks, or (iii) insurance companies and pension funds. For investment funds, I again use net outflows of a fund as defined in the last section as a constraint; for banks I use capital over total assets at the beginning of the sample, and for insurance companies and pension funds I use the change in the maturity mismatch.[42] These simple correlations in column (1), (2), and (4) of Table 8 confirm that banks' and investment funds' constraints tighten when they suffer losses on their security holdings and insurance companies' and pension funds' constraints, if anything, loosen.

To test this correlation more structurally, I can use institution-level data for banks and investment funds to estimate the following equation:

$$Constraint_{i,t}^X = \beta_1 Netgains_{i,t-1} + \alpha_i + \alpha_t + \epsilon_{i,t}. \tag{9}$$

where $X$ can be either investment funds or banks. The specification includes institution fixed effects to control for unobserved and observed time-invariant heterogeneity in the cross-section of investment funds or banks, e.g., some banks can be structurally better capitalized than others. The specification also includes time fixed effects to control for institution-invariant time trends. The results from the simple correlation can be confirmed in columns (3) and (5) of Table 8. When banks suffer losses on their security holdings, it tightens their constraints by reducing their capital. Losses on investment funds' balance sheets are associated with redemptions from investors.

## 5. Price dynamics

In this section, I first investigate how the investment behavior relates to price changes of securities in the future. Second, I test whether returns exhibit a momentum and reversal component.

### 5.1. Investment behavior and future price changes

To test how prices of securities move after various institutions have bought them, I regress the difference of the

[42] I fix total assets at the beginning of the period to prevent the capital ratio to be driven by active balance sheet management. However, here I am interested in the changes in capital over time. Therefore, I only fix total assets at the beginning of the period so that changes in the capital ratio are only driven by mark-to-market activities as well as equity issuance.

**Table 9**
Future price changes.

| | Dependent variable: $Price_{t+k}$-$Price_t$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $k$=1 | $k$=2 | $k$=3 | $k$=4 | $k$=6 | $k$=8 | $k$=10 | $k$=12 |
| Panel A: Investment funds | | | | | | | | |
| $NetBuy_{Funds}$ | 0.201*** | 0.209 | −0.0514 | −0.0321 | −0.893*** | −1.363*** | −1.570*** | −0.392 |
| | (0.067) | (0.132) | (0.163) | (0.216) | (0.307) | (0.363) | (0.425) | (0.408) |
| $R$-squared | 0.0253 | 0.0265 | 0.0267 | 0.0314 | 0.0356 | 0.0389 | 0.0471 | 0.0534 |
| Panel B: Banks | | | | | | | | |
| $NetBuy_{Banks}$ | 0.123*** | −0.0182 | −0.319*** | −0.353*** | −0.257** | −0.251* | −0.227 | −0.736*** |
| | (0.036) | (0.053) | (0.082) | (0.090) | (0.106) | (0.130) | (0.167) | (0.175) |
| $R$-squared | 0.0253 | 0.0265 | 0.0268 | 0.0315 | 0.0355 | 0.0388 | 0.0469 | 0.0536 |
| Panel C: Insurance companies and pension funds | | | | | | | | |
| $NetBuy_{ICPF}$ | 0.0714 | −0.213** | −0.233* | −0.188 | −0.497** | −0.277 | 0.761*** | 1.753*** |
| | (0.056) | (0.097) | (0.126) | (0.169) | (0.243) | (0.255) | (0.260) | (0.268) |
| $R$-squared | 0.0253 | 0.0265 | 0.0267 | 0.0314 | 0.0355 | 0.0387 | 0.0470 | 0.0536 |
| Observations | 508,645 | 458,306 | 413,195 | 371,909 | 303,699 | 243,732 | 195,595 | 154,294 |
| Time FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

The dependent variable is the change in the log of the price between quarter t+k and t. $NetBuy_{Funds}$ is the change in the log of the nominal amount held of investment funds. $NetBuy_{Banks}$ is the change in the log of the nominal amount held of banks. $NetBuy_{ICPF}$ is the change in the log of the nominal amount held of insurance companies and pension funds. Standard errors are in parentheses. Standard errors are clustered at the security level and robust to heteroskedasticity and autocorrelation. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, 2005 Q4-2014 Q4; author's calculations.

$k$ period ahead log of the price and the current log of the price, $\Delta Price_{s,t+k}$, on the net buy variable for each institution type X for security $s$ as follows:

$$\Delta Price_{s,t+k} = \beta_1 NetBuy^X_{s,t} + \alpha_t + \epsilon_{s,t+k}. \quad (10)$$

where

$$\Delta Price_{s,t+k} = Price_{s,t+k} - Price_{s,t}. \quad (11)$$

and the price is expressed in logs and time fixed effects, $\alpha_t$, control for market-wide developments. Column (1) of Table 9 reports results for $k = 1$. The results show that the price of a security increases after banks and investment funds have acquired the security. These results are in line with Adrian et al. (2010a, 2010b, 2011) who show that the investment behavior of banks can predict price changes and can even stimulate the economy. A doubling in the nominal amount held is associated with a 0.12% increase in the bond price in the next quarter for banks and 0.2% for investment funds.

In contrast to the prices of securities that have been bought by banks and investment funds, the prices of securities that have been bought by insurance companies and pension funds do not increase significantly. Columns (2) and (3) of Panel C of Table 9 show that prices decrease two and three quarters after insurance companies and pension funds have bought them. A doubling in the amount bought by insurance companies and pension funds result on average in 0.2% lower bond prices after two and three quarters. However, after ten quarters, the results are reversed. For $k$=10, the prices of bonds have increased after insurance companies and pension funds have bought them and decreased when banks and investment funds have bought them. After 12 quarters, bond prices are 1.7% higher when insurance companies and pension funds have doubled their position. These findings are consistent with the impression given by Fig. 2 that the countercyclical strategy of insurance companies and pension funds is not profitable at short horizons but outperforms procyclical investment behavior in the medium run.

### 5.2. Momentum and reversal of returns

Prior evidence suggests that returns are positively autocorrelated at short horizons but negatively correlated at longer horizons, see Cutler et al. (1990), Cutler et al. (1991), Moskowitz et al. (2012).[43] This would support the results of Section 5.1 that procyclical investment behavior is profitable at short horizons, while countercyclical investment behavior pays off at longer horizons. According to Cutler et al. (1990), price changes reflect a fundamental and a transitory component. While the fundamental component follows a random walk, the transitory component follows a first-order autoregressive process that is likely driven by a dominance of noise traders who overreact to fundamental news. In the absence of noise traders, investors are not expected to change their security holdings as a response to past returns (Milgrom and Stokey, 1982). After rejecting this hypothesis in Section 3, this section delivers complementary evidence on the possible channel. Positive feedback investing can be rational when the investment horizon is short and one has a strong loss aversion at short horizons. In this case, it may be rational to have a positive demand elasticity to price changes. In contrast, countercyclical investors, who have a negative demand elasticity

[43] Vayanos and Woolley (2013) propose a model of momentum and reversal.

**Table 10**
Momentum and reversal in returns.

| | Dependent variable: $Return_{t+k}$-$Return_t$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $k$=1 | $k$=2 | $k$=3 | $k$=4 | $k$=6 | $k$=8 | $k$=10 | $k$=12 |
| Return | 0.0467*** | 0.0237*** | −0.0282*** | −0.0292*** | −0.0153** | −0.0606*** | −0.153*** | −0.118*** |
| | (0.002) | (0.003) | (0.006) | (0.007) | (0.008) | (0.010) | (0.01) | (0.02) |
| $R$-squared | 0.171 | 0.172 | 0.171 | 0.168 | 0.156 | 0.121 | 0.0736 | 0.0549 |
| Observations | 512,932 | 453,145 | 403,243 | 361,917 | 288,271 | 226,968 | 176,779 | 135,744 |

*Return* is the holding period return defined as the quarterly change in the price plus the quarterly coupon divided by the price in the previous quarter. The dependent variable is the change between the k quarter ahead price and the current price plus the coupon divided by the current price. 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.

to price changes, can have a low short-term loss aversion but instead aim to maximize their profits at long horizons.

Although the positive autocorrelation at short horizons and the negative autocorrelation at longer horizons has been pointed out by previous papers, I study whether the same pattern also holds in my data. Therefore, I estimate the following specification:

$$Return_{s,t+k} = \alpha_{t+k} + \beta_1 Return_{s,t} + \epsilon_{i,t+k}. \qquad (12)$$

Table 10 shows that banks and investment funds can indeed avoid short-term losses by acting procyclically, as returns are positively autocorrelated at short horizons. In contrast, as insurance companies' and pension funds' constraints do not tighten when they suffer losses on their security holdings, this can enable them to step in when bonds are cheap. That this countercyclical investment strategy can be profitable when prices revert can be seen in Table 10. Given that insurance companies and pension funds act on longer horizons, one would expect them to buy potentially undervalued securities, as they have the comparative advantage to wait until the prices revert. I turn to this topic in the next section.

## 6. Additional tests

In this section, I first contrast the investment across financial institutions with respect to excess bond yields. Second, I show additional robustness tests.

### 6.1. Investment behavior and excess bond yields

As shown above, banks and investment funds act in a procyclical manner to past returns. This behavior can be profitable in the short run but is less profitable than the investment behavior of insurance companies and pension funds in the medium run. Since banks and investment funds trade on shorter horizons than do insurance companies and pension funds, they might be more averse to liquidity risk. I define an excess bond yield, the yield spread of a security that cannot be justified by credit risk, to test this hypothesis. An increase in the excess bond yield reflects an increase in returns without an increase in credit risk. The excess bond yield increases might be due to lower liquidity, which may not be part of the fundamental value. Therefore, changes in the excess bond yield could arguably be interpreted as variation of the nonfundamental component of the bond.

My approach is similar to the one of Gilchrist and Zakrajšek (2012). First, I define a risk-free yield for five maturity buckets, i.e., for 1–3 years, 3–5 years, 5–7 years, 10–20 years, and above 20 years.[44] I define the risk-free yield as the yield of a German government security in each benchmark. To define an excess bond yield, I regress the security-specific yield to maturity on the risk-free yield of its maturity bucket which is a categorial credit rating variable and a security fixed effect to control for time-invariant security-specific characteristics, such as exchange rate risk, if the security is denominated in foreign currency. I estimate the following regression:

$$Yield_{s,t} = \beta_1 Yield^{rf}_{m,t} + \gamma' Rating_{s,t} + \alpha_s + \epsilon_{s,t}. \qquad (13)$$

where Rating is a vector of dummies for each rating category. I take the residual of this regression and define:

$$ExcessBondYield = \epsilon_{s,t}. \qquad (14)$$

Yields can be higher for bonds that are more difficult to sell, especially in times of market turmoil. Illiquidity is only a risk for short-term investors that need to sell securities at short horizons. Investors that hold securities until maturity should not be reluctant to hold these securities. In contrast, these investors should even buy these securities when the liquidity premium goes up as these also yield higher expected future returns.

Therefore, I investigate which investors are buying and selling bonds whose excess bond yields rise as follows:

$$NetBuy^X_{s,t} = \beta_1 \Delta ExcessBondYield_{s,t} + \alpha_s + \alpha_t + \epsilon_{s,t}. \qquad (15)$$

Table 11 shows the results of a regression of the net buy variable on the excess bond yield.[45] Insurance companies and pension funds buy securities whose excess bond yields increase and sell them when the excess bond yield decreases. In particular, column (3) shows that a one percentage point increase in the excess bond yield is associated with a 2.3% increase in the nominal amount held. This might be the case because insurance companies and pension funds often hold bonds until maturity and do not have to sell at short notice. In contrast, banks and investment funds buy when the excess bond yield falls and sell when the excess bond yield increases.

[44] I follow Ellul et al. (2011) for the choice of the maturity groups.

[45] Since the variable excess bond yield is estimated, I bootstrap the standard errors.

**Table 11**
Excess bond yield.

| | Dependent variable: NetBuy | | | | | |
|---|---|---|---|---|---|---|
| | Funds | | ICPF | | Banks | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| ΔExcess yield | −0.00225* | −0.00259* | 0.0225*** | 0.0110* | −0.0222*** | −0.0205*** |
| | (0.001) | (0.001) | (0.005) | (0.007) | (0.004) | (0.003) |
| *R*-squared | 0.160 | 0.165 | 0.336 | 0.346 | 0.201 | 0.203 |
| Observations | 190,824 | 190,824 | 24,882 | 24,882 | 90,967 | 90,967 |
| Security FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Time FE | No | Yes | No | Yes | No | Yes |

The dependent variable is the change in the log of the nominal amount held. Δ *Excess yield* is the lagged change in the residual of a regression of the yield to maturity on the risk-free yield within its maturity bucket, an indicator variable for the credit rating and a security fixed effect. Columns (1) and (2) estimate the specification for the investment fund sector. Columns (3) and (4) estimate the specification for the insurance companies and pension fund sector. Column (5) and (6) estimate the specification for the banking sector. Fixed effects are either included (Yes), not included (No), or spanned by other fixed effects (-). Standard errors are in parentheses. Bootstrapped standard errors are clustered at the security level and robust to heteroskedasticity and autocorrelation. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Research Data and Service Centre of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, Bloomberg, Datastream, 2005 Q4-2014 Q4; author's calculations.

If changes in the excess bond yield are interpreted as changes away from their fundamental value, these results suggest that banks and investment funds are pushing away prices from fundamentals, and insurance companies and pension funds stabilize prices and push them toward fundamentals. Since banks and investment funds trade more frequently than do insurance companies and pension funds, it can be rational for them to consciously buy securities that are overvalued. Speculating on further price rises indicates that investors attempt to ride the bubble and time the market by selling the security when the price is at the inflection point (Brunnermeier and Nagel, 2004). The behavior of banks to buy securities whose excess bond yield falls is consistent with the model of Shleifer and Vishny (2010) who show that if banks believe that security prices will increase further, they lever up and buy securities.[46] However, once prices start to fall, banks cannot roll over funding and may have to sell securities to de-lever again. Alternatively, banks and investment funds can sell securities that trade below their fundamental value if they expect the downward trend to continue further at short horizons, as shown in Table 10.

In contrast, return-oriented investors who have a long-term investment horizon and potentially hold securities until maturity can be buying up troubled assets when they believe the security is undervalued to benefit from future price increases (Hanson and Stein, 2015). In line with the typical behavior of return-oriented investors, insurance companies and pension funds, who can be more risk tolerant due to their long-term liabilities, buy assets whose excess bond yield has risen.[47] This behavior can act as a stabilizing force in bad times and prevent prices from falling by as much as they would otherwise. Selling securities whose excess bond yields are falling and whose prices are potentially rising above their fundamental value on the other side can also prevent bubbles from growing. These types of investors have received rather less attention but are certainly important actors who can prevent the buildup of systemic risk that could materialize in a crisis (Brunnermeier and Sannikov, 2014).

### 6.2. Additional robustness tests

Table A3 tests whether the cyclical investment behavior is different across rating categories. The return coefficient is still highly significant even after controlling for the rating category. This allows me to rule out the possibility that past returns due to rating category changes are driving the results.[48] Second, cyclical investment behavior is robust across rating types. For instance, while for insurance companies and pension funds the cyclical investment behavior is different in magnitude for investment grade bonds and non-investment grade bonds, insurance companies and pension funds act countercyclically both with respect to investment grade bonds and noninvestment grade bonds. On the other side, banks and investment funds act procyclically for both types of categories.

Table A4 shows that the results hold for both domestic currency and foreign currency bonds. The results are, if anything, stronger for foreign currency bonds. This finding underlines the results by Cerutti et al. (2015). They find that emerging markets that rely on investment funds and banks as their main creditors exhibit relatively higher volatility of their capital inflows. They argue that it is important for emerging markets to monitor their investor base. My results support their hypothesis and do not only apply to cross-border inflows into emerging market countries but also more generally to both domestic and foreign investors as well as corporates and governments.[49]

While the above measures focus on credit and foreign exchange rate risk, I have thus far neglected the interac-

[46] This behavior is also consistent with models that predict myopic behavior due to short-term incentives (Stein, 1989).

[47] In the working paper version of this paper, I also show that insurance companies and pension funds buy securities that are trading at discount (Timmer, 2016). Buying these securities guarantees nominal gains when the security is held until maturity unless it defaults.

[48] See, e.g., Ellul et al. (2011), Ellul et al. (2015), and Merrill et al. (2012)

[49] Table A6 shows the results for German and foreign bonds.

tion between market risk and the past returns. One caveat of this approach is that the riskiness of the securities can itself be endogenous to the leverage cycle. Before the crisis, at the peak of the leverage cycle, volatility and perceived risk of securities have been low. However, when financial conditions deteriorated and financial institutions delevered, risk aversion increased, security prices dropped, volatility spiked, and perceived risk of securities increased. Hence, it is challenging to disentangle the effect of the leverage cycle from the riskiness of the securities. For instance, when a certain group of institutions starts to act more procyclically with respect to riskier securities, this in itself makes the securities even more risky. It is therefore possible that the coefficient for security specific riskiness reflects the leverage cycle, rather than idiosyncratic risk.

First, I study the interaction between market risk and the investment behavior by defining a $\beta_{dax}$ in relation to the German stock market index. A positive and large $\beta_{dax}$ indicates high systematic risk with respect to the stock market. A coefficient of one reflects that the security moves in tandem with the stock market, on average. An investor whose benchmark portfolio is on average highly correlated with the German stock market can buy securities with a low or even negative $\beta_{dax}$ to hedge exposure to the stock market. Table A5 shows whether the cyclical investment behavior of the various institutions differs depending on the beta of the security in question. For this, I interact the $\beta_{dax}$ with the past return of the security. A positive coefficient on the interaction term shows that institutions act relatively more procyclically or less countercyclically with respect to bonds that reflect a higher systematic risk with respect to the stock market. Column (4) shows that insurance companies and pension funds act relatively more countercyclically with respect to bonds that have a larger beta. In contrast, banks act relatively more procyclically with respect to these bonds.[50]

Table A10 shows that banks seem to act relatively more procyclically with respect to less volatile bonds. To test whether the cyclical behavior of financial institutions intensifies in volatile times, I interact the VIX with the change in the price. Column (1) of Table 11 shows that as soon as the VIX increases, investment funds exacerbate the procyclicality, which is in favor of the hypothesis that investment funds act relatively more procyclically in times when asset prices are down. However, once time fixed effects are included, the result diminishes. When the market in general is more volatile, measured by a high VIX, investment funds and insurance companies and pension funds act relatively less countercyclically (Table A11). However, even large movements in the VIX, e.g., a 100% increase in the VIX, does not make insurance companies and pension funds act procyclically. In addition, the result also diminishes when time fixed effects are included. This suggests that the results are not driven by specific time periods.

[50] Table A7 show the results when the covariance instead of the $\beta_{dax}$ is used. Table A8 shows the same analysis but instead of using the $\beta$ of the security with the stock market index, I use the security-specific yield and the risk-free yield (rf) to define $\beta_{rf}$. Table A8 shows that the beta with respect to the risk-free yield does not seem to be important in determining the cyclical investment behavior. Table A9 shows the results for the covariance instead of the beta.

## 7. Conclusion

This paper analyzes the cyclical investment behavior of investment funds, banks and insurance companies and pension funds. I show that banks and investment funds are procyclical investors with respect to past returns. In contrast, insurance companies and pension funds respond countercyclically to past returns: they buy when returns have been low and sell when past returns have been high.

One channel that could generate the heterogeneity in the cyclical investment behavior is based on the investors' balance sheet dynamics. I provide evidence that is consistent with this channel by exploiting cross-sectional heterogeneity between institutions for banks and investment funds. The procyclical investment behavior is stronger for banks that are relatively weaker capitalized and investment funds that face relatively more outflows. Although investment funds use almost no leverage, both investment funds and banks are sensitive to short-term losses on their security holdings. To avoid these losses, they act procyclically, as returns exhibit a short-term momentum factor. Since insurance companies' and pension funds' balance sheets are more resilient to short-term losses, they can act in a countercyclical manner.

The procyclical investment behavior of investment funds and banks resulted in relatively mild losses during the European sovereign debt crisis. Although insurance companies and pension funds suffered severe losses during the crisis, they outperformed banks and investment funds in the medium run.

The results suggest that the investment behavior of insurance companies and pension funds can be a stabilizing force on capital markets. In contrast, the investment behavior of banks and investment funds can exacerbate price dynamics and lead to excessive volatility in capital markets. These results underline the findings of Cerutti et al. (2015) who argue that it can be hazardous for countries to rely on investment funds and banks as their main investors.

## References


Abbassi, P., Iyer, R., Peydró, J., Tous, F., 2016. Securities trading by banks and credit supply: micro-evidence from the crisis. J. Financ. Econ. 121, 569–594.

Abreu, D., Brunnermeier, M., 2003. Bubbles and crashes. Econometrica 71, 173–204.

Acharya, S., Morales, A., 2015. Asset Price Effects of Peer Benchmarking: Evidence From a Natural Experiment. FRB of New York Staff Report 727.

Acharya, V., Cooley, T., Richardson, M., Walter, I. (Eds.), 2011. The Dodd-Frank Act and the New Architecture of Global Finance, Wiley, Hoboken. 241–301

Acharya, V., Drechsler, I., Schnabl, P., 2014. A pyrrhic victory? Bank bailouts and sovereign credit risk. J. Financ. 69, 2689–2739.

Acharya, V., Eisert, T., Eufinger, C., Hirsch, C., 2017. Whatever it Takes: The Real Effects of Unconventional Monetary Policy. Sustainable Architecture for Finance in Europe. Unpublished Working Paper.

Acharya, V., Steffen, S., 2015. The "greatest" carry trade ever? Understanding eurozone bank risks. J. Financ. Econ. 115, 215–236.

Adrian, T., Boyarchenko, N., 2012. Intermediary Leverage Cycles and Financial Stability. FRB of New York Staff Reports 567.

Adrian, T., Boyarchenko, N., Shachar, O., 2017. Dealer balance sheets and bond liquidity provision. J. Monet. Econ. 89, 92–109.

Adrian, T., Boyarchenko, N., Shin, H., 2015. On the Scale of Financial Intermediaries. FRB of New York Staff Reports 743.
Adrian, T., Etula, E., Muir, T., 2011. Financial intermediaries and the cross–section of asset returns. J. Financ. 69, 2557–2596.
Adrian, T., Moench, E., Shin, H., 2010a. Financial Intermediation, Asset Prices and Macroeconomic Dynamics. FRB of New York Staff Reports 422.
Adrian, T., Moench, E., Shin, H., 2010b. Macro risk premium and intermediary balance sheet quantities. Rev. Financ. Stud. 26, 1607–1648.
Adrian, T., Shin, H., 2010. Liquidity and leverage. J. Financ. Intermed. 19, 418–437.
Adrian, T., Shin, H., 2014. Procyclical leverage and value-at-risk. Rev. Financ. Stud. 27, 373–403.
Allen, F., Carletti, E., 2008. Mark-to-market accounting and liquidity pricing. J. Account. Econ. 45, 358–378.
Amann, M., Baltzer, M., Schrape, M., 2012. Microdatabase: securities holdings statistics. Technical Documentation. Deutsche Bundesbank.
Bade, M., Flory, J., Schönberg, T., 2016. Micro Database: Securities Holdings Statistics-Base 200512 – 201603 Data Report. Research Data and Service Centre. Deutsche Bundesbank.
Battistini, N., Pagano, M., Simonelli, S., 2014. Systemic risk, sovereign yields and bank exposures in the euro crisis. Econ. Policy 29, 203–251.
Becker, B., Ivashina, V., 2015. Reaching for yield in the bond market. J. Financ. 70, 1863–1901.
Brunnermeier, M., 2009. Deciphering the liquidity and credit crunch 2007–2008. J. Econ. Perspect. 23, 77–100.
Brunnermeier, M., Nagel, S., 2004. Hedge funds and the technology bubble.. J. Financ. 59, 2013–2040.
Brunnermeier, M., Pedersen, L., 2009. Market liquidity and funding liquidity. Rev. Financ. Stud. 22, 2201–2238.
Brunnermeier, M., Sannikov, Y., 2014. A macroeconomic model with a financial sector. Am. Econ. Rev. 104, 379–421.
Buch, C., Koetter, M., Ohls, J., 2016. Banks and sovereign risk: a granular view. J. Financ. Stab. 25, 1–15.
Campbell, J., Cochrane, J., 1999. By force of habit: a consumption-based explanation of aggregate stock market behavior. J. Polit. Econ. 107, 205–251.
Cella, C., Ellul, A., Giannetti, M., 2013. Investors' horizons and the amplification of market shocks. Rev. Financ. Stud. 26, 1607–1648.
Cerutti, E., Claessens, S., Puy, D., 2015. Push Factors and Capital Flows to Emerging Markets: Why Knowing Your Lender Matters More Than Fundamentals. Unpublished working paper. International Monetary Fund.
Chen, Q., Goldstein, I., Jiang, W., 2010. Payoff complementarities and financial fragility: evidence from mutual fund outflows. J. Financ. Econ. 97, 239–262.
Chevalier, J., Ellison, G., 1997. Risk taking by mutual funds as a response to incentives. J. Polit. Econ. 105, 1167–1200.
Chodorow-Reich, G., Ghent, A., Haddad, V., 2016. Asset Insulators. Unpublished working paper. Harvard University.
Commission, E., 2013. Regulation (EU) no 575/2013 of the European Parliament and of the Council of 26 June 2013 on Prudential Requirements for Credit Institutions and Investment Firms and Amending Regulation (EU). Technical report. European Commission.
Cutler, D., Poterba, J., Summers, L., 1990. Speculative dynamics and the role of feedback traders. Am. Econ. Rev. 80, 63–68.
Cutler, D., Poterba, J., Summers, L., 1991. Speculative dynamics. Rev. Econ. Stud. 58, 529–546.
Danielsson, J., Shin, H., Zigrand, J., 2012. Procyclical Leverage and Endogenous Risk. Unpublished working paper. London School of Economics.
DeLong, B., Shleifer, A., Summers, L., Waldmann, R., 1990a. Noise trader risk in financial markets. J. Polit. Econ. 703–738.
DeLong, B., Shleifer, A., Summers, L., Waldmann, R., 1990b. Positive feedback investment strategies and destabilizing rational speculation. J. Financ. 45, 379–395.
Domanski, D., Shin, H., Sushko, V., 2017. The hunt for duration: not waving but drowning? IMF Econ. Rev. 65, 113–153.
Duijm, P., Steins Bisschop, S., 2015. Short-Termism of Long-Term Investors? The Investment Behaviour of Dutch Insurance Companies and Pension Funds. Unpublished working paper. De Nederlandsche Bank Working Paper.
Ellul, A., Jotikasthira, C., Lundblad, C., 2011. Regulatory pressure and fire sales in the corporate bond market. J. Financ. Econ. 101, 596–620.
Ellul, A., Jotikasthira, C., Lundblad, C., Wang, Y., 2015. Is historical cost accounting a panacea? market stress, incentive distortions, and gains trading. J. Financ. 70, 2489–2538.
Fabozzi, F., 2012. The Handbook of Fixed Income Securities. McGraw Hill Education, New York City.
Fama, E., 1965. The behavior of stock-market prices. J. Bus. 45, 34–105.
Feroli, M., Kashyap, A., Schoenholtz, K., Shin, H., 2014. Market Tantrums and Monetary Policy. Research paper. Chicago Booth School of Business.
Fostel, A., Geanakoplos, J., 2008. Leverage cycles and the anxious economy. Am. Econ. Rev. 98, 1211–1244.
Franzoni, F., Giannetti, M., 2017. Financial Conglomerate Affiliated Hedge Funds: Risk Taking Behavior and Liquidity Provision. Unpublished working paper. Stockholm School of Economics.
Friedman, M., 1953. The methodology of positive economics. In: Friedman, M. (Ed.), Essays in Positive Economics. University of Chicago Press, Chicago, pp. 3–43.
Geanakoplos, J., 2003. Liquidity, Default, and Crashes Endogenous Contracts in General Equilibrium. Cambridge University Press, Cambridge, pp. 170–205.
Geanakoplos, J., 2010. The leverage cycle. NBER Macroecon. Annu. 24, 1–66.
Gennaioli, N., Martin, A., Rossi, S., 2014. Banks, Government Bonds, and Default: What do the Data Say? Unpublished working paper. International Monetary Fund.
Giannetti, M., Kahraman, B., 2018. Open-end organizational structures and limits to arbitrage. Rev. Financ. Stud. 31, 773–810.
Gilchrist, S., Zakrajšek, E., 2012. Credit spreads and business cycle fluctuations. Am. Econ. Rev. 102, 1692–1720.
Goldstein, I., Jiang, H., Ng, D., 2015. Investor flows and fragility in corporate bond funds. J. Financ. Econ. 126, 592–613.
Greenwood, R., Landier, A., Thesmar, D., 2015. Vulnerable banks. J. Financ. Econ. 115, 471–485.
Gromb, D., Vayanos, D., 2002. Equilibrium and welfare in markets with financially constrained arbitrageurs. J. Financ. Econ. 66, 361–407.
Guerrieri, V., Kondor, P., 2012. Fund managers, career concerns, and asset price volatility. Am. Econ. Rev. 102, 1986–2017.
Haldane, A., 2014. Procyclicality and Structural Trends in Investment Allocation by Insurance Companies and Pension Funds. Discussion paper. Bank of England and the Procyclicality Working Group.
Hanson, S., Shleifer, A., Stein, J., Vishny, R., 2015. Banks as patient fixed-income investors. J. Financ. Econ. 117, 449–469.
Hanson, S., Stein, J., 2015. Monetary policy and long-term real rates. J. Financ. Econ. 115, 429–448.
He, Z., Krishnamurthy, A., 2013. Intermediary asset pricing. Am. Econ. Rev. 103, 732–770.
Laux, C., Leuz, C., 2010. Did fair-value accounting contribute to the financial crisis? J. Econ. Perspect. 24, 93–118.
Manconi, A., Massa, M., Zhang, L., 2016. Bondholder concentration and credit risk: evidence from a natural experiment. Rev. Financ. 20, 127–159.
Merrill, C., Nadauld, T., Stulz, R., Sherlund, S., 2012. Did Capital Requirements and Fair Value Accounting Spark Fire Sales in Distressed Mortgage-Backed Securities? Unpublished working paper. NBER.
Milgrom, P., Stokey, N., 1982. Information, trade and common knowledge. J. Econ. Theory 26, 17–27.
Morris, S., Shin, H., 2015. Risk-Taking Channel of Monetary Policy: a Global Game Approach. Princeton University. Unpublished working paper.
Moskowitz, T., Ooi, Y., Pedersen, L., 2012. Time series momentum. J. Financ. Econ. 104, 228–250.
Plantin, G., Sapra, H., Shin, H., 2008. Marking-to-market: panacea or Pandora's box? J. Account. Res. 46, 435–460.
Raddatz, C., Schmukler, S., 2012. On the international transmission of shocks: micro-evidence from mutual fund portfolios. J. Int. Econ. 88, 357–374.
Shek, J., Shim, I., Shin, H., 2018. Investor redemptions and fund manager sales of emerging market bonds: how are they related? Rev. Financ. 22, 207–241.
Shleifer, A., Vishny, R., 1992. Liquidation values and debt capacity: a market equilibrium approach. J. Financ. 47, 1343–1366.
Shleifer, A., Vishny, R., 1997. The limits of arbitrage. J. Financ. 52, 35–55.
Shleifer, A., Vishny, R., 2010. Unstable banking. J. Financ. Econ. 97, 306–318.
Stein, J., 1989. Efficient capital markets, inefficient firms: a model of myopic corporate behavior. Q. J. Econ. 655–669.
Timmer, Y., 2016. Cyclical Investment Behavior Across Financial Institutions. Deutsche Bundesbank. Discussion paper.
Vayanos, D., Woolley, P., 2013. An institutional theory of momentum and reversal. Rev. Financ. Stud. 26, 1087–1145.
Weill, P.O., 2007. Leaning against the wind. Rev. Econ. Stud. 74, 1329–1354.