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The effects of monetary policy on banks and non-banks in times of stress

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Challenges for Monetary Policy Transmission in a Changing World Network (ChaMP)

This paper contains research conducted within the network “Challenges for Monetary Policy Transmission in a Changing World Network” (ChaMP). It consists of economists from the European Central Bank (ECB) and the national central banks (NCBs) of the European System of Central Banks (ESCB).

ChaMP is coordinated by a team chaired by Philipp Hartmann (ECB), and consisting of Diana Bonfim (Banco de Portugal), Margherita Bottero (Banca d’Italia), Emmanuel Dhyne (Nationale Bank van België/Banque Nationale de Belgique) and Maria T. Valderrama (Oesterreichische Nationalbank), who are supported by Melina Papoutsi and Gonzalo Paz-Pardo (both ECB), 7 central bank advisers and 8 academic consultants.

ChaMP seeks to revisit our knowledge of monetary transmission channels in the euro area in the context of unprecedented shocks, multiple ongoing structural changes and the extension of the monetary policy toolkit over the last decade and a half as well as the recent steep inflation wave and its reversal. More information is provided on its website.

Abstract

This paper investigates the effects of monetary policy on banks and non-bank financial institutions (NBFIs), with particular attention to the role of financial stress. We use high-frequency identified monetary policy shocks and state-dependent local projections to capture non-linear responses across financial sectors. Drawing on aggregated balance sheet data, including total assets, debt securities, and loans, we find that monetary tightening leads to broad-based contractions in total assets and debt holdings, with particularly pronounced effects for banks and investment funds. Loan responses are more heterogeneous, but money market funds and pension funds exhibit notable declines in loan exposures, especially under high-stress conditions. Importantly, we find that financial stress significantly amplifies the contractionary effects of monetary policy across all sectors and asset classes. Our results highlight the differentiated roles and vulnerabilities of financial intermediaries in the transmission of monetary policy and underline the importance of financial conditions in determining its overall effectiveness.

Keywords: Non-bank financial intermediaries, non-bank lending activities, monetary policy identification, state-dependent local projections

JEL classification: E52, G23

1 Non-technical summary

The existing literature examining the effects of monetary policy on the banking sector is relatively extensive and largely conclusive. It is well-documented, for instance, that monetary policy tightening typically results in a contraction of bank lending. However, in the aftermath of the global financial crisis, there has been a significant expansion in the role of non-bank financial intermediaries, such as investment funds, money market funds, pension funds, and insurance companies, collectively referred to as non-banks. Despite this development, empirical research on the effects of monetary policy on non-banks, particularly within the euro area, remains limited.

Some studies suggest that the prolonged low interest rate environment has encouraged yield-seeking behaviour among non-banks, contributing to their growth. Nevertheless, the mechanisms through which monetary policy is transmitted to non-bank entities are still not fully understood and remain an active area of research. In particular, there is a lack of comprehensive evidence regarding the joint response of both banks and non-banks to changes in monetary policy.

This study seeks to fill this gap by providing empirical evidence on the effects of monetary policy on both banks and non-banks, with a specific emphasis on the role of financial stress. We explore the transmission of monetary policy through non-bank financial intermediaries and assess how periods of financial stress influence these dynamics. The inclusion of financial stress is motivated by the hypothesis that financial institutions adjust their behaviour under stress, potentially becoming more risk-averse, which could in turn reduce their lending activities.

A key contribution of this study is the incorporation of disaggregated balance sheet data for both, banks and non-banks, enabling the identification of heterogeneity across different segments of the financial sector. One of our central findings is that while monetary tightening typically leads banks to reduce lending, certain non-bank institutions may concurrently increase their lending activities. Furthermore, we examine the interconnections between banks and non-banks, such as banks' holdings of money market fund shares, to better understand the broader systemic implications of monetary policy.

This interconnection analysis represents a novel contribution to the literature, as it allows us to investigate how monetary policy and financial stress jointly influence the dynamic relationships between banks and non-banks. Methodologically, we employ state-of-the-art non-linear local projection techniques to estimate causal effects. Our identification strategy makes use of high-quality monetary policy shocks, which facilitates a clear and interpretable analysis of the transmission mechanisms.

In summary, this study contributes to the literature in several important ways. First, it advances the understanding of the non-bank transmission channel of mon-

etary policy. Second, it highlights heterogeneity within the financial system by incorporating detailed balance sheet data. Third, it quantifies the role of financial stress in impacting monetary policy transmission. Finally, by analyzing interconnections between banks and non-banks, it provides a more comprehensive view of the financial sector's response to monetary policy interventions.

2 Introduction

The impact of monetary policy on the banking sector has been extensively examined in the literature (e.g., Kashyap and Stein [2000]; Ehrmann et al. [2002]; Altunbas et al. [2009]). Empirical evidence broadly supports the view that tighter monetary policy conditions adversely affect lending behavior and credit supply within the banking system. However, comparatively less attention has been devoted to understanding how monetary policy influences the broader financial system, i.e. the non-bank financial intermediation (NBFI) sector, which includes investment funds, money market funds, insurance companies, and pension funds. Our work aims to contribute to this research gap by offering an analysis of the different responses of banks and non-bank financial institutions to monetary policy shocks. We argue that this analysis is not only of academic interest but also of considerable practical importance for policymakers and supervisory authorities. Moreover, by including different levels of financial stress into our analysis, we aim to understand in depth the role of financial market conditions in influencing the transmission of monetary policy. Our central hypothesis is that the effects of monetary policy are likely heterogeneous across financial sectors, particularly in times of high(er) financial stress. For example, in the case of investment funds, an accommodative monetary policy stance is generally associated with an expansion in total assets, both in terms of valuation and transaction volumes. However, during periods of heightened financial stress, investor behavior may shift in line with flight-to-safety dynamics, which may in turn lead to a reallocation of funds towards safer asset classes, such as bond funds, or even a retreat to the relative security of bank deposits. This study is built by three key assumptions. First, we anticipate that banks and non-banks show distinct responses to monetary policy shocks, mainly due to their divergent business models and operational structures. Second, we assume that specific balance sheet components, for example lending, will show varying degrees of sensitivity to monetary policy, with banking sector lending likely responding more negatively than that of non-bank intermediaries. These different responses may also give rise to substitution effects across sectors. Third, we expect that financial stress reflects a critical factor in the transmission mechanism of monetary policy. For instance, entities such as investment funds and

money market funds may show immediate reactions to financial stress, whereas insurance companies and pension funds may demonstrate more delayed, long-term adjustments. Through this analytical framework, we aim to deepen the understanding of how monetary policy interacts with diverse segments of the financial system, especially under different states of financial stress.

This paper is structured as follows. In chapter three, we provide a literature review putting our work into overall context. Chapter four and five introduce and explain the data and econometric approach we use. Baseline results, as well as state-dependent results are presented in chapters six and seven. Chapter 8 presents additional results for interconnections between banks and non-banks. Robustness will be presented in chapter 9. Finally, chapter 10 concludes.

3 Related literature

The literature on the effects of monetary policy on the banking sector is well established. Over the past decade, a growing body of research has examined how changes in monetary policy influence banking activity. Elliott et al. [2019] provide evidence that monetary tightening reduces bank lending, while lending by non-bank financial institutions increases. Similarly, Cucic and Gorea [2024] find that monetary contractions are associated with rising credit provision by non-bank entities.

The effects of monetary policy on non-bank financial intermediaries are less settled but have attracted increasing attention. Tillmann and Tiza Mimun [2023] examine the response of investment funds, i.e. equity, bond, hedge, and real estate funds, to monetary policy shocks. Using high-frequency identified shocks and local projection methods, they show that accommodative policy tends to expand investment fund activity, with significant variation across fund types. In a related study, Holm-Hadulla et al. [2023] analyze how monetary policy differentially affects banks and non-banks. Their findings, based on similar methods, suggest that monetary tightening leads to reductions in investment fund flows. Kaufmann [2023], employing a structural Bayesian VAR model, investigates the response of European investment funds to U.S. monetary policy shocks. He finds that looser U.S. monetary policy is associated with increased inflows, particularly into equity and bond

funds. Giuzio et al. [2021] analyze euro area investment funds using a comparable VAR framework, finding that expansionary monetary policy shocks correspond with higher inflows, especially in bond, equity, and money market funds.

The insurance sector has also been considered in this context. Pelizzon and Sottocornola [2018] document a positive relationship between accommodative monetary policy and the stock prices of insurance companies. Kubitza et al. [2022] explore how monetary policy influences surrender rates, finding that tighter policy results in higher surrender activity. Kaufmann et al. [2024] study the impact of monetary conditions on insurers' balance sheets, presenting evidence that expansionary policy generally supports balance sheet growth.

Research on pension funds suggests that monetary policy affects asset allocation and risk-taking behavior. Boubaker et al. [2018], using a structural VAR approach, find that unconventional U.S. monetary policy is associated with increased allocations to equities and greater risk-taking, particularly under low interest rate environments. Lu et al. [2019], using a theoretical framework, identify mechanisms through which low risk-free rates and funding ratios lead to elevated risk-taking among pension funds.

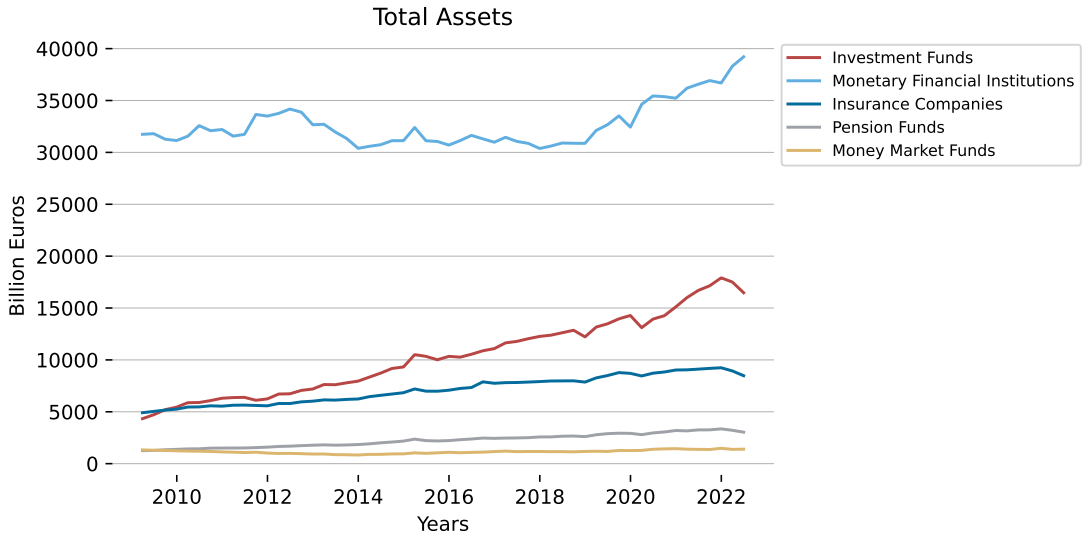
Studies on money market funds (MMFs) yield mixed findings. Bua and Dunne [2019] report that easing monetary policy is linked to outflows from MMFs. In contrast, Aldasoro et al. [2024] find that assets in prime MMFs tend to increase following monetary tightening.

This paper contributes to the existing literature in several ways. First, it offers a joint analysis of multiple financial sectors and their responses to changes in monetary policy. By incorporating various balance sheet components, it seeks to deepen the understanding of how different asset classes across financial intermediaries are affected by monetary developments. Additionally, the analysis introduces nonlinear elements by accounting for financial stress. It is posited that the response of financial sectors may depend on prevailing stress levels, and that the behavior of financial intermediaries' clients like depositors, borrowers, and investors may adjust accordingly. This approach aims to provide a more comprehensive perspective on the interaction between monetary policy, financial sector dynamics, and systemic stress.

4 Data

We split the financial system in the euro area into its two main parts: banks and non-bank financial intermediaries (NBFIs), where we follow the ESA 2010 definition, and therefore include investment funds (IF), money market funds (MMF), pension funds (PF), and insurance companies (IC) representing the NBFI universe into our estimation. The data we use for our analysis is obtained by the Data Portal of the ECB [1] and includes aggregated data for different balance sheet positions for banks and non-banks on a monthly and quarterly level. Concretely, we aim to study the cross-sectional relation of banks and non-banks, and therefore, identify three balance sheet positions, i.e. total assets, debt securities, and loans. Our sample covers the time horizon between January 2009 and October 2022. Across all estimations, we make use of quarterly data. Therefore, we aggregate the monthly data for banks and investment funds to end-of-quarter observations. Further, the reference area of the data we use is Euro area. In addition, we do not do any further aggregation or data cleaning since each specific balance sheet position is available on the data portal.

Figure 1: Total assets of banks and non-banks



[1] We provide the specific sources in the appendix.

Figures (1), (2), and (3) present an overview of the aggregated balance sheet positions we include in our analysis for banks and non-bank financial intermediaries between 2009 and 2022, focusing on total assets, total debt securities, and total loans. Concretely, Figure (1) shows the total assets of banks and non-bank entities, including investment funds, monetary financial institutions, insurance companies, pension funds, and money market funds. The data indicate a continuous increase in total assets over the period, with banks holding the largest share. Investment funds also show a substantial rise in total assets, particularly after 2015. Pension funds, insurance companies, and money market funds display comparatively lower asset volumes, with minor fluctuations observed over time.

Figure 2: Total debt securities of banks and non-banks

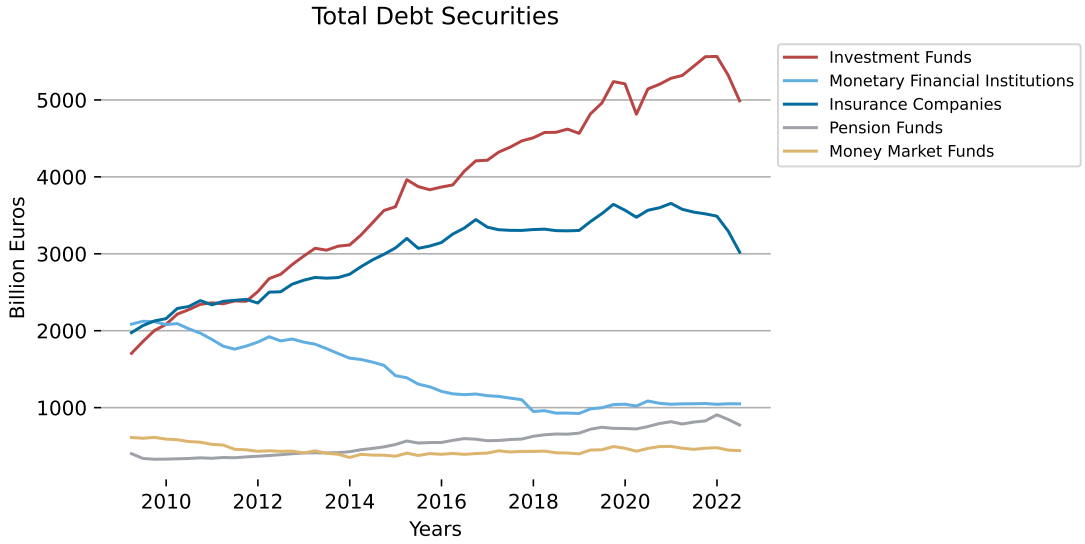


Figure (2) illustrates the total debt securities held by banks and non-bank entities. Investment funds and insurance companies exhibit the highest levels of debt securities, while the holdings of pension funds and money market funds remain at lower levels throughout the period. Banks, in addition, display a gradual decrease over time. The overall trend shows a gradual increase in total debt securities, with some fluctuations occurring between years.

Figure 3: Total loans of banks and non-banks

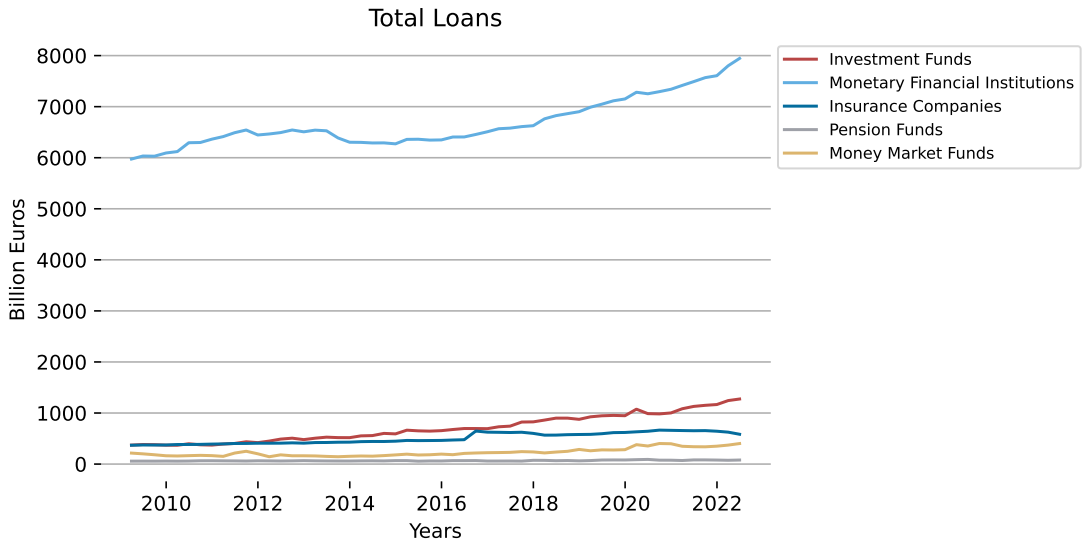


Figure (3) depicts the total loans issued by banks and non-bank entities from 2009 to 2022. Banks hold the largest share of total loans throughout the period, with a consistent upward trend. However, investment funds also exhibit an increase in total loans, albeit at a significantly lower scale. Insurance companies, pension funds, and money market funds maintain relatively lower levels of loan issuance with fluctuations visible at certain points.

Figures (4) through (8) provide an overview of the aggregated balance sheets of specific financial institutions, illustrating the composition of assets over time. Concretely, Figure (4) presents the aggregated balance sheet of banks and includes total assets, loans to households (HH), loans to other financial institutions (OFI), loans to insurance corporations and pension funds (ICPF), debt securities of monetary financial institutions (MFIs), and money market fund (MMF) shares. The data shows an overall increase in total assets, with loans to households and financial institutions forming a significant portion. Debt securities and money market fund shares are also present in the balance sheet composition.

Figure 4: Aggregated balance sheet of banks

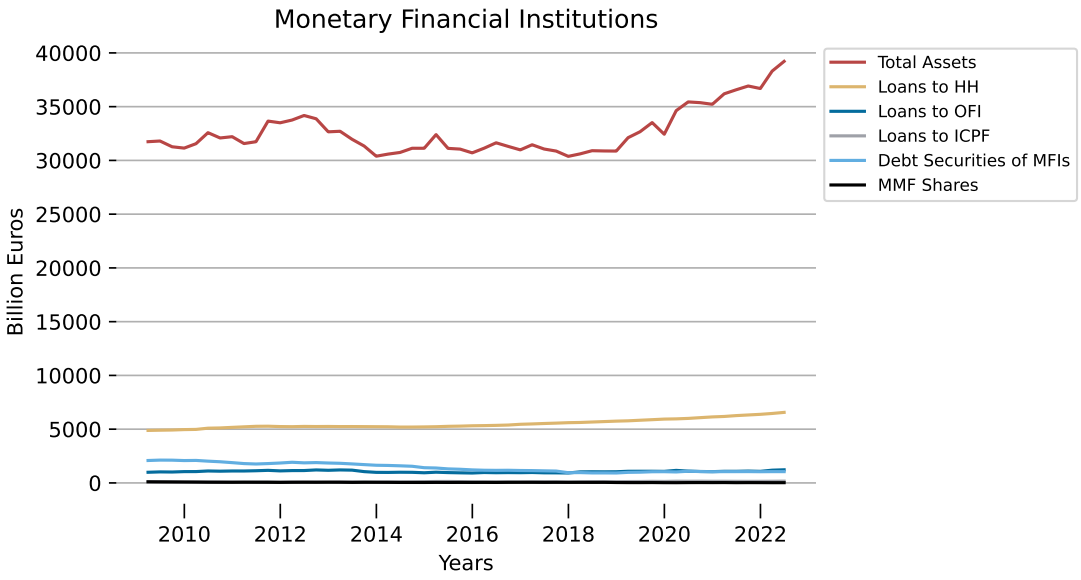


Figure 5: Aggregated balance sheet of investment funds

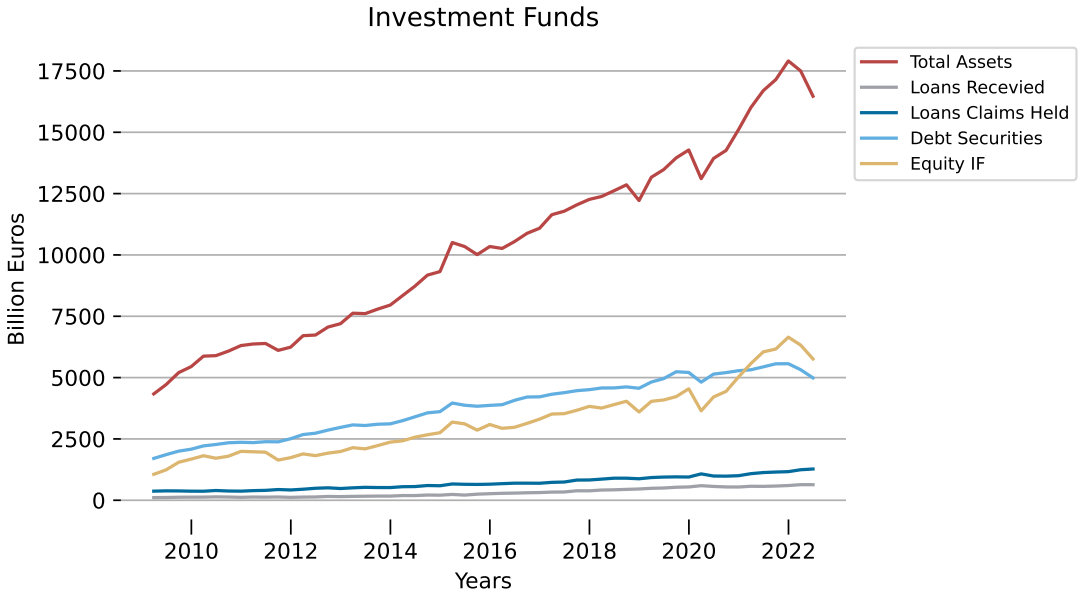


Figure (5) displays the aggregated balance sheet of investment funds, showing total assets, loans received, loan claims held, debt securities, and equity investments

in investment funds. The data indicate an increase in total assets over the period. Debt securities and equity holdings represent major components of the balance sheet, while loan claims held and loans received are also included.

Figure (6) illustrates the aggregated balance sheet of money market funds, including total assets, debt securities, loans to money market funds (MMFs), loans to banks (MFIs), and debt securities issued by banks (MFIs) and insurance companies and pension funds (ICPFs). The data shows that money market funds hold a lower level of total assets compared to other financial entities. Debt securities represent a significant proportion of money market funds balance sheets, with loans to banks (MFIs) and other money market funds also being relatively high.

Figure 6: Aggregated balance sheet of money market funds

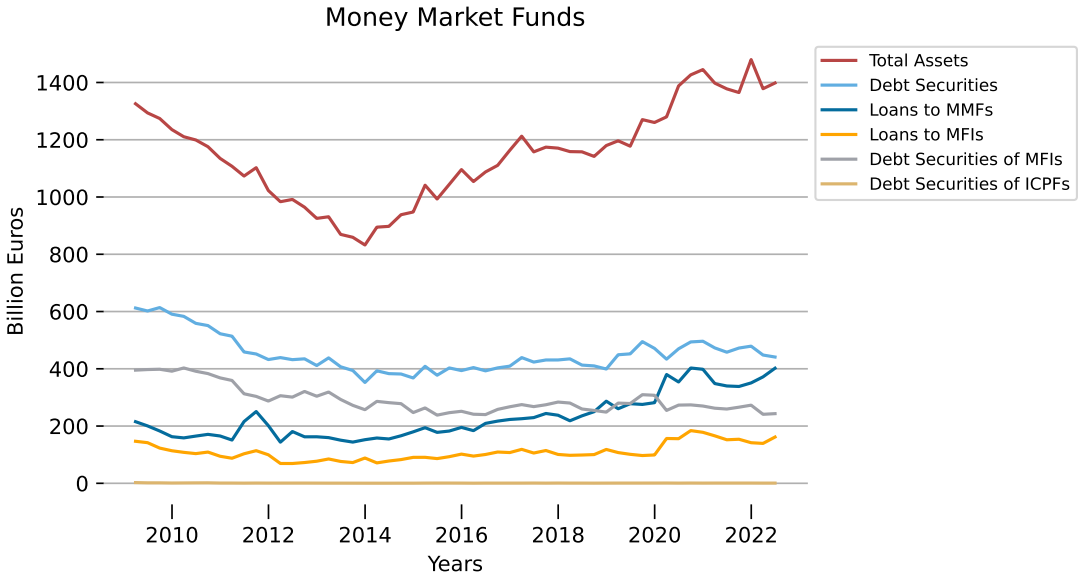


Figure 7: Aggregated balance sheet of insurance companies

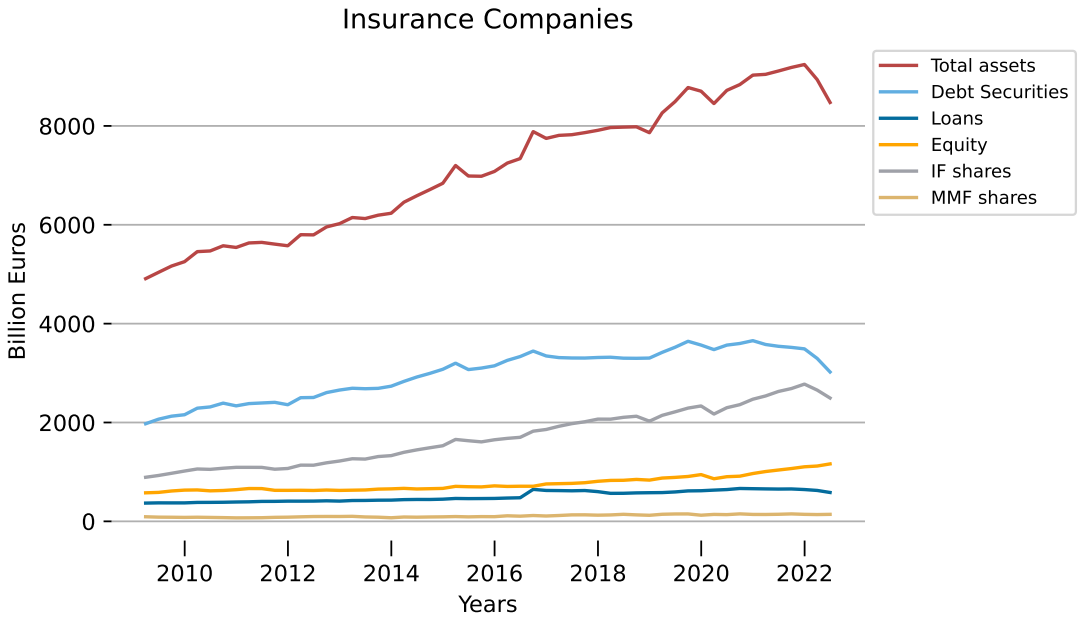
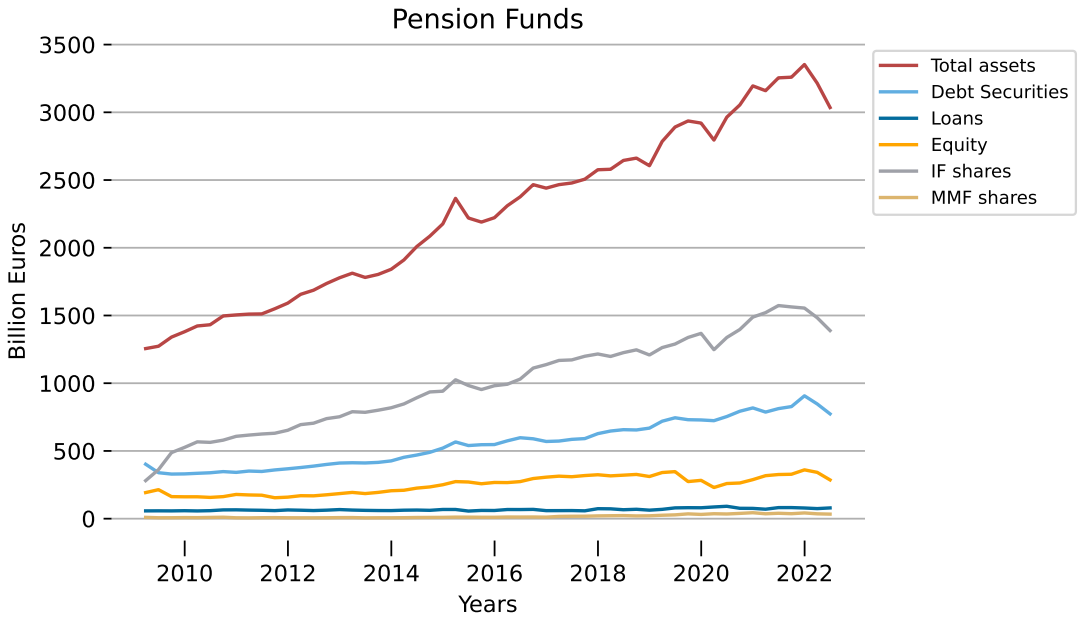


Figure (7) presents the aggregated balance sheet of insurance companies, showing total assets, debt securities, loans, equity, investment fund shares, and money market fund shares. The data indicates an increase in total assets over the period. Debt securities form a significant part of the balance sheet, while holdings of equity, loans, and investment fund shares are also present.

Finally, Figure (8) provides the aggregated balance sheet of pension funds, including total assets, debt securities, loans, equity, investment fund shares, and money market fund shares. The data indicates that total assets have increased over time. Further, debt securities account for a substantial portion of the balance sheet. Investment fund shares, money market funds (MMF) shares, loans, and equity are also included.

Figure 8: Aggregated balance sheet of pension funds



Finally, the data we use additionally for our analysis include euro area industrial production (IP), euro area harmonized index for consumer prices (HICP), and stock market volatility measured by the Vstoxx. As monetary policy shocks, we make use of the Euro Area Monetary Policy Database (EA-MPD) provided by Altavilla et al. [2019]. This dataset provides the intra-day changes of asset prices around the ECB's Governing Council press conferences. We will provide more details on the monetary policy shock identification and its underlying narrative in the next section.

5 Econometric methodology and identification

This section introduces the empirical methodology we apply to analyze the effects of monetary policy. We follow Jordà [2005] using local projections and identify monetary policy with high-frequency identified monetary policy shocks. In local projections, we regress a dependent variable y_{t+h} at different horizons $t+h$ for $h = 0, 1, \ldots, H$ on a driving variable dated t conditional on a set of control variables.

Formally, the equation takes the following form:

$$y_{t+h} = \alpha_h + \beta_h shock_t + \gamma_h X_t + e_{t+h}, \tag{1}$$

where y_{t+h} includes our variable of interest, $\beta_h shock_t$ is the monetary policy shock, and X_t includes our control variables, i.e. industrial production (in logs), consumer prices measured by the Harmonized Index of Consumer Prices (in logs), and stock market volatility measured by the Vstoxx.

For our state-dependent analysis, we further follow Tenreyro and Thwaites [2016] and employ state-dependent local projections. The advantage of this approach is that we can estimate the effects of monetary policy in different states of the economy. In this paper, we include different states of financial stress. Concretely, we include the CISS indicator reflecting different states of financial stress into our estimations.

Hence, our state-dependent analysis takes the following form:

$$y_{t+h} = F(z_t)(\beta_s^h \epsilon_t + \gamma_s' x_t) + (1 - F(z_t))(\beta_c^h \epsilon_t + \gamma_c' x_t) + u_t \tag{2}$$

where y_t is our variable of interest, $F(z_t)$ reflects the different regimes, i.e. stress (s) and calm (c) both reflected by the CISS index, x_t is a vector of control variables, and u_t is the policy shock. The coefficients β_j^h measure the average effect of a shock as a function of the state of the economy when the shock hits, and therefore encompasses the average effect of the shock on the future change in the economy's state.

In particular, $F(z_t)$ is a smooth increasing function of an indicator of the state of the economy z_t. Following Granger and Terasvirta [1993], we employ the following logistic function:

$$F(z_t) = \frac{exp(\theta \frac{z_t - c}{\sigma_z})}{1 + exp(\theta \frac{z_t - c}{\sigma_z})} \ , \tag{3}$$

where c is a parameter that controls for what proportion of the sample the economy spends in either state and σ_z is the standard deviation of the state variable z. The parameter θ determines how violently the economy switches from one regime to the other when z_t changes. In our estimation, we assign the value of 3 for θ. The parameter c is set to 0.5, essentially capturing (very) high and (very) low levels of financial stress. [2]

Our identification of monetary policy shocks follows the approach introduced by Altavilla et al. [2019]. Concretely, we use the surprise series for the German 10Y asset for our estimations. The main idea of this approach consists of capturing the surprise component in the change of the monetary policy stance, and including the resulting identified monetary policy shocks into our estimation. Concretely, we build a surprise time series including the change of the yield of a specific asset around the ECB's press conference. Therefore, we assign to each month the surprise change, and in each month where the Governing Council did not take any decision, the value of zero, respectively. Since our estimations include quarterly data, we transform further the time series in a way that we sum up the monthly changes around the actual Governing Council meetings.
Technically, our times series is built in the following way:

$$shock_t = \begin{cases} surp_{t,d} & \text{if Governing Council meeting in quarter } t \\ 0 & \text{if no Governing Council meeting in quarter } t \end{cases}$$

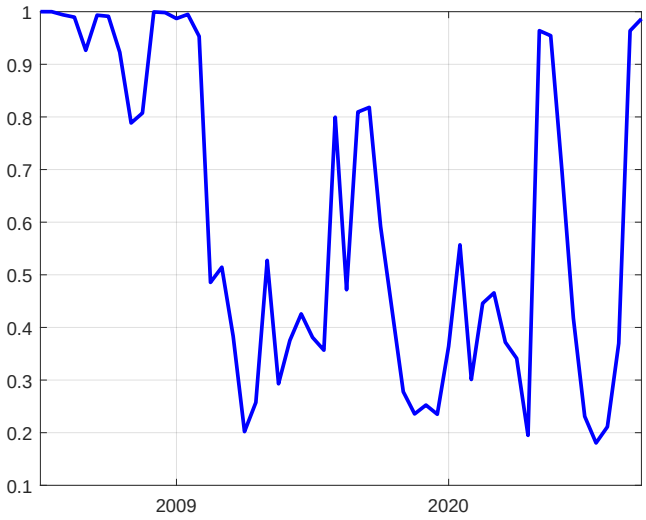
[2] We estimate the model using ordinary least squares, and impulse response functions are constructed by plotting the estimated coefficients along with 68 percent confidence intervals over a five-quarter period. An advantage of the local projection (LP) approach is that it allows for straightforward computation of confidence intervals without relying on Monte Carlo simulations or asymptotic approximations. However, a known limitation of the LP method is that the confidence bands tend to widen at longer horizons. Consistent with the framework described by Cevik and Jalles [2024], we rely on 68 percent confidence bands which offer a more informative and precise view of the true underlying uncertainty.

where t and d indicate the quarter and the day of the press conference following meetings of the Governing Council.

Finally, we choose financial stress as our state variable for several reasons. First, we argue that in times of financial stress, financial markets participants, and therefore financial sectors, do behave differently. It follows that our study would not provide a full overview and in-depth understanding of the effects of monetary policy on banks and non-banks, without including different financial stress regimes. In other words, the effects of monetary policy could be and likely are heterogeneous in the presence of financial stress because of the nature of different financial sectors. Taking investment funds as an example, we would anticipate that loose monetary policy can be associated with an increase in total assets, in both value and inflows. However, in times of higher financial stress, investors might in accordance with a flight-to-safety behavior either only invest (or re-invest) in relatively safer investment funds' types, such as bond funds, or keep their investments as deposits in the banking sector. Second, according to a recently published speech by ECB Board Member Isabel Schnabel [3] (unconventional) monetary policy does indeed have a particularly powerful impact on the financial system in periods of stress. It is argued that the effects of asset purchases particularly work well through a liquidity channel in times of financial stress in the NBFI sector. Hence, it is reasonable for us to study the concrete role of financial stress for the overall transmission of monetary policy to the whole financial system. Third, in order to capture potential financial stability threats, it is reasonable to not only study the effects of monetary policy on non-bank sectors, such as insurance companies or pension funds, but also to include financial stress into this perspective in order to anticipate potential sources of instability, e.g. liquidity mismatches or maturity mismatches. Finally, the CISS index includes all relevant dimensions of the euro area's financial sector contribution to systemic stress. Therefore, it is an adequate candidate to help us study not only the underlying uncertainty displayed by various volatility indices, but also the (potential) build-up of systemic stress.

[3] https://www.ecb.europa.eu/press/key/date/2024/html/ecb.sp240528 a4f151497d.en.html

Figure 9: Transition function $F(z_t)$



Notes: The figure shows the estimated transition function $F(z_t)$ of the CISS indicator.

Figure (9) displays the transition function $F(z_t)$. We can observe that prior to the global financial crisis, i.e. right before 2009, financial stress levels were highly elevated. Also in the context of euro area sovereign crisis, in the years 2012-2014, financial stress was relatively high. Finally, we can also observe very high levels of financial stress after the beginning of the COVID-19 pandemic.

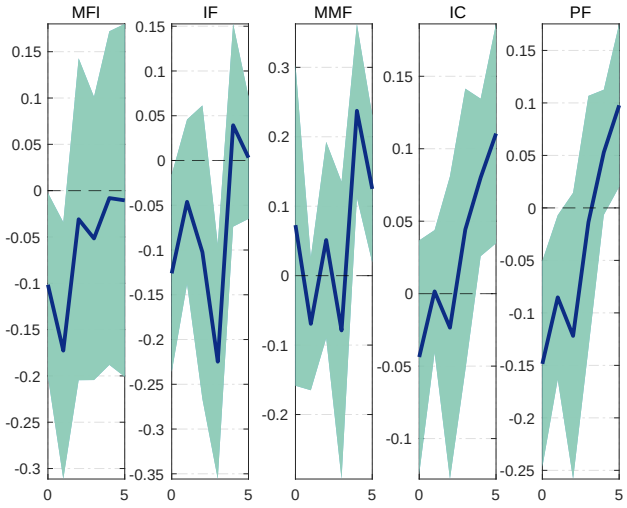
6 Baseline results

This section presents our baseline results. As stated above, we estimate the responses of different balance sheet positions of banks and non-banks to a monetary

policy shock. [4]

Figure (10) shows the responses of total assets of banks and non-banks to a high-frequency identified monetary policy shock, respectively. We observe that a tightening shock leads to a negative response of all our variables of interest, except for money market funds. Interestingly, the magnitudes of banks, investment funds, and pension funds are relatively similar, while insurance companies display a relatively small decline. Further, the path of the response of insurance companies and pension funds looks very similar, while banks and investment funds, although both reacting negatively on impact, show results with the opposite direction. Although banks and investment funds both initially respond negatively, their longer-term responses diverge, which may reflect differences in their operational strategies or regulatory constraints. In contrast, the similar response patterns of insurance companies and pension funds suggest comparable strategic or asset composition characteristics.

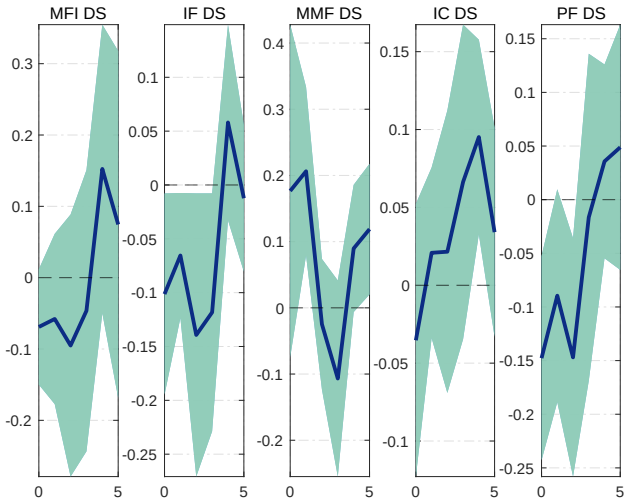
Figure 10: Impulse response functions of total assets



Notes: The figure shows the estimated β_h coefficients within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

[4]The baseline impulse response functions of the aggregated balance sheets positions of each sector can be found in the appendix.

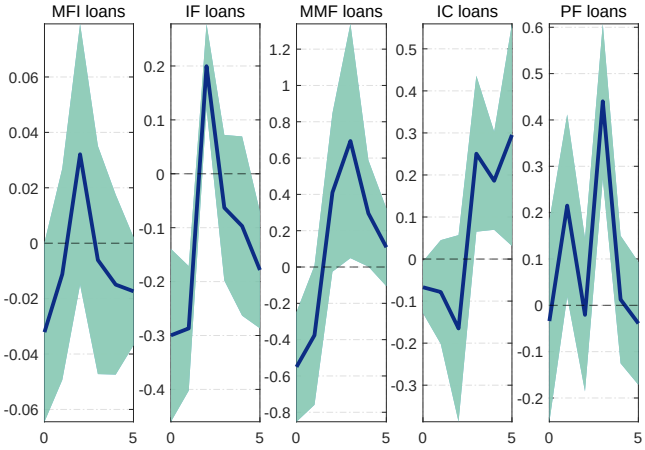
Figure 11: Impulse response functions of debt securities



Notes: The figure shows the estimated β_h coefficients within 68% confidence bands.The x-axis displays quarters, and the y-axis represents percentage points.

Taking a look at the responses of debt securities of banks and non-banks (Figure (11)), we also observe a negative response to a tightening monetary policy shock. As in the case of total assets, the responses of banks, investment funds, insurance companies, and pension funds display a similar pattern and magnitude. This suggests that higher interest rates or reduced liquidity lead to a decline in the value or issuance of debt securities. Consistent with the total assets response, banks, investment funds, and pension funds exhibit similar patterns and magnitudes in their reactions, indicating that these institutions may have comparable sensitivities to interest rate changes and similar strategies for managing their debt portfolios under tightening conditions.

Figure 12: Impulse response functions of loans



Notes: The figure shows the estimated β_h coefficients within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

Figure (12) shows the responses of total loans [5] of our variables of interest, respectively. As expected, loans of banks react negatively on impact. In addition, loans of investment funds react also negatively on impact, but increase relatively strongly after one quarter, reaching a peak of about 0.2%. Money market funds also react negatively on impact following a tightening monetary policy shock, but continue to strongly increase afterwards. In terms of magnitude, their response shows a relatively strong increase, which remains positive within our projection window of five quarters. Similarly, insurance companies also react slightly negative on impact, but approximately after two quarters, they increase their lending. Finally, pension funds increase their lending activities and reach a peak of about 0.45% after approximately four quarters. The observed dynamics suggest that banks' loan contraction reflects the immediate effects of higher borrowing costs and tighter credit conditions inherent in a tightening monetary policy. Investment funds, after an initial downturn, may have adjusted their strategies to leverage opportunities or shifts in demand, leading to a subsequent increase in loan activity. The overall positive response of money market funds may highlight their role as a

[5] In the appendix, we also provide a granular baseline response of different loan types of MFIs, IFs, and MMFs.

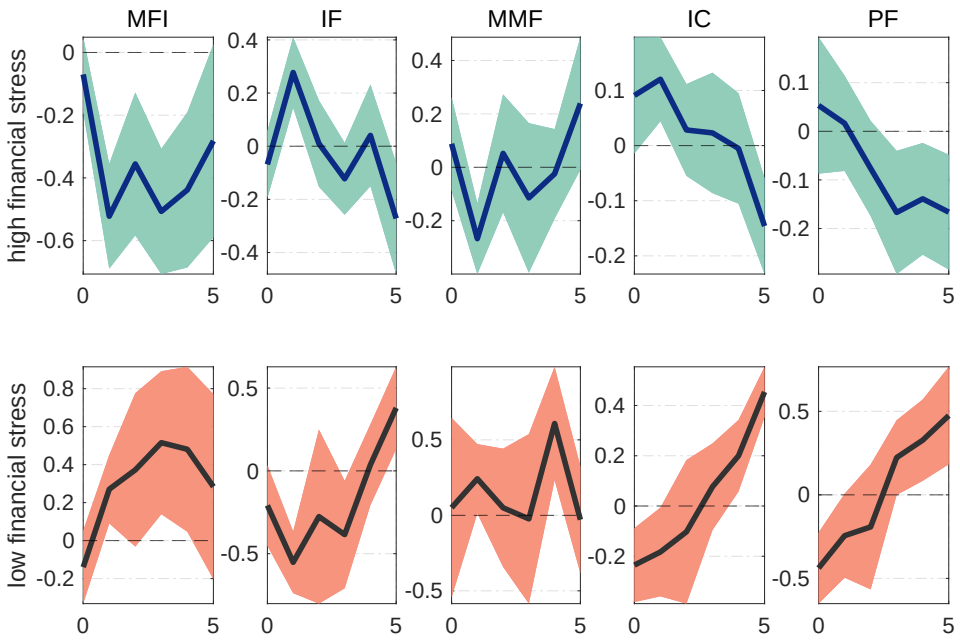
haven for liquidity-seeking investors during periods of monetary tightening. It may underscore their attractiveness due to short-term, lower-risk investment profiles.

7 State dependent results

This section presents our results including different states of financial stress. Generally, we try to identify the responses of different variables representing banks and non-banks to identified monetary policy shocks. In addition, we differentiate between two different financial stress states in order to understand the effectiveness of monetary policy across those different states.

Figure (13) shows the impulse responses to a monetary policy shock including states of high levels of financial stress and low levels of financial stress, respectively. First of all, and most importantly, we observe a strong heterogeneity of our variables of interest, indicating that financial stress has a varying degree of impact for different parts of the financial system. For instance, total assets of banks experience a strong decline on impact, showing they are quite vulnerable to tighter monetary conditions, especially when stress levels are high. Investment funds react in the exact opposite direction following a monetary policy tightening shock (see the first two figures before) suggesting they can adjust or even take advantage of the situation. Furthermore, in times of heightening financial stress, a monetary policy tightening shock leads total assets of insurance companies as well as those of pension funds to decrease over time, reflecting their sensitivity to tough market conditions. As expected, the responses of all variables in our estimation react in an opposite direction in the state of low financial stress, indicating that, for example, total assets of investment funds decrease following a tightening monetary policy shock.

Figure 13: Impulse response functions of total assets

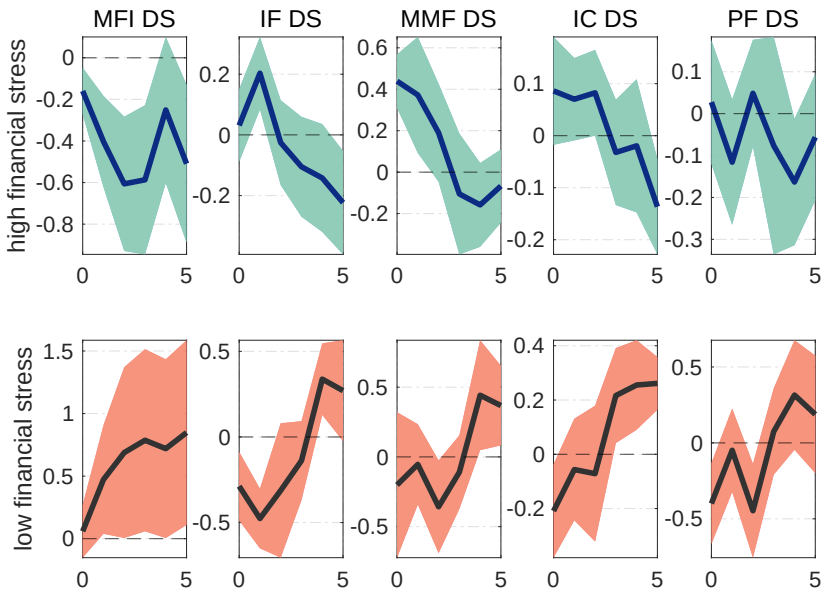


Notes: The figure shows the estimated β_h coefficients of a 1pp shock within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

Figure (14) shows the response of debt securities of banks and non-banks to a monetary policy shock. Here, we observe again a relatively strong heterogeneity across banks and non-banks, and some similarities to the estimation including total assets as dependent variable. Concretely, we observe debt securities of banks to react negatively on impact, and continue to further decrease for at least three quarters. Investment funds, on the other hand, react slightly positive on impact, and further increase for the first two quarters in the state of high financial stress. The opposite is the case in a regime including low financial stress. This observation is interesting in several ways. First, financial stress seems to have a significant influence on the behavior of investment funds. Second, the impulse response of debt securities to a monetary policy shock in times of stress shows that, in contrast to our baseline estimation, i.e. without distinguishing between different financial stress

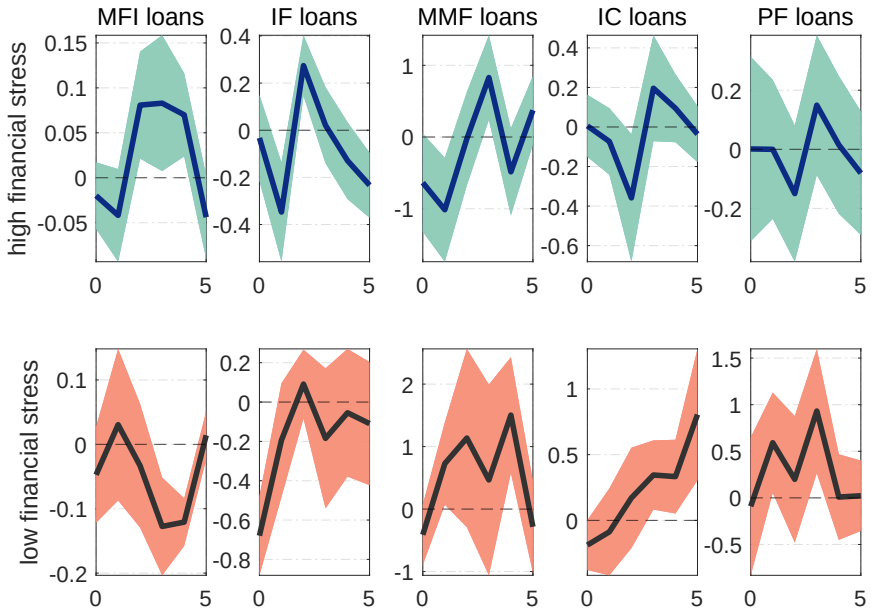
levels, a tightening stance of monetary policy actually *increases* debt securities. Money market funds, in addition, show the strongest positive reaction on impact in terms of magnitude, but decrease constantly over time. This suggests that while they may initially benefit from a shift towards safer, short-term investments, their appeal diminishes as stress persists. Interestingly, insurance companies as well as pension funds do not show a significant reaction to a monetary policy shock when financial stress is present. But on the other hand, when financial stress is relatively low, both sectors react negatively on impact. This indicates that these sectors might be more stable or less reactive under stress, but they adjust more when conditions are calmer.

Figure 14: Impulse response functions of debt securities



Notes: The figure shows the estimated β_h coefficients of a 1pp shock within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

Figure 15: Impulse response functions of loans



Notes: The figure shows the estimated β_h coefficients of a 1pp shock within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

Figure (15) shows the responses of total loans [6] of our variables of interest to a monetary policy shock. Again as expected, banks' loans decrease following a monetary policy shock. In addition, money market funds also show a negative reaction on impact but increase relatively strongly afterwards. We can observe a similar response of investment funds. They barely react on impact, reduce their lending in the first quarter and increase their lending relatively strongly in the subsequent quarters. This result is particularly interesting since it suggests that in times of stress and following a tightening shock, investment funds and money market funds may step in and provide (likely) short-term loans when banks potentially reduce their lending. Finally, insurance companies and pension funds again do not show a significant response to a monetary policy shock in times of financial

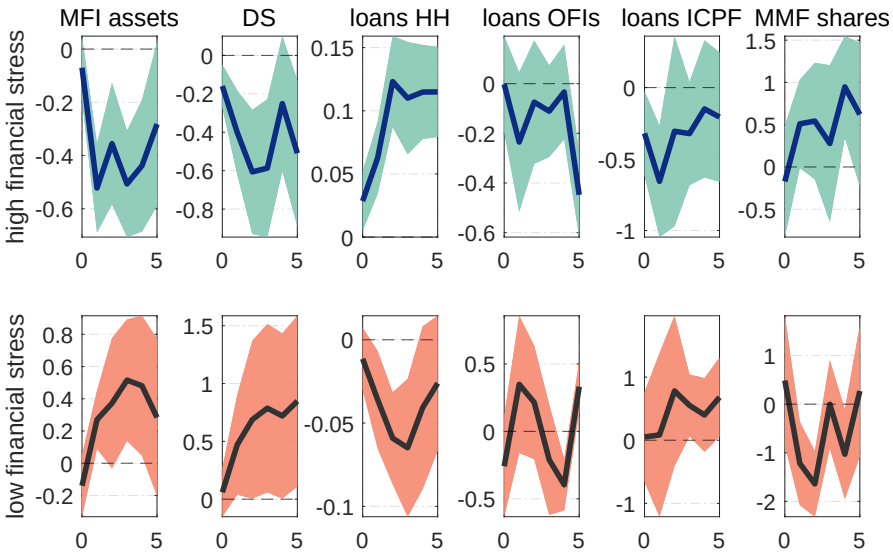
[6] In the appendix, we also provide a granular response of different loan types of MFIs, IFs, and MMFs.

stress. However, loans of insurance companies in the state of low financial stress do react negative on impact but increase relatively strongly afterwards.

8 State dependent results for interconnections

In this chapter, we try to understand better the effects of monetary policy on different balance sheet positions for *each* financial sector. Also, we show how banks and non-banks are interconnected with each other, for example by lending activities.

Figure 16: Impulse response functions of Monetary Financial Institutions

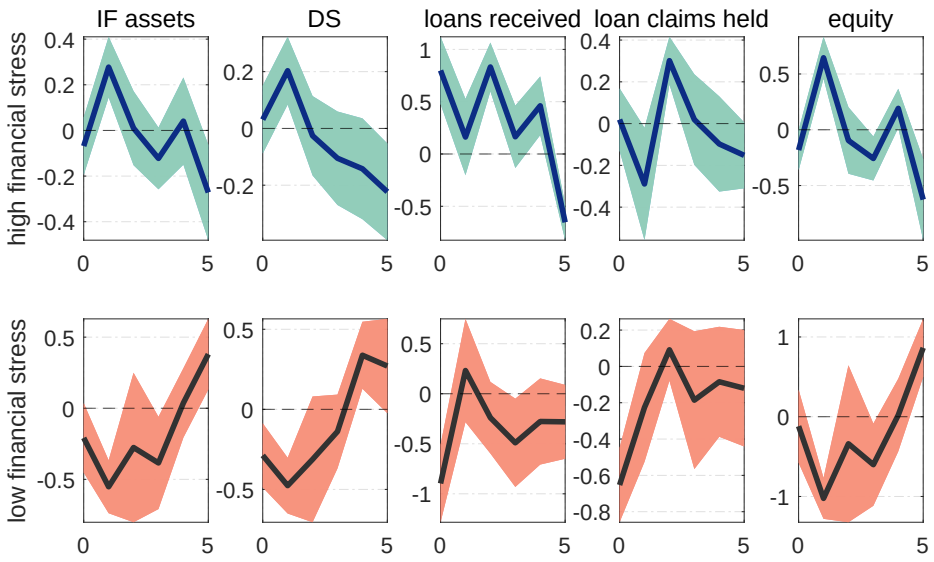


Notes: The figure shows the estimated β_h coefficients of a 1pp shock within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

Figure (16) includes, for example, the loans issued by euro area banks to households (HH), other financial intermediaries (OFIs), and insurance companies and

pension funds (ICPF), respectively. These impulse responses deliver an interesting insight. In times of relatively high financial stress, loans to households respond positively and further increase in the first two quarters approximately, while loans to other financial intermediaries and to insurance companies and pension funds react negatively on impact and continue to decrease over time. Interestingly, the results for the state including low financial stress, the opposite can be observed. These results allow the conclusion that bank lending activities are potentially also driven by financial stress. Moreover, financial stress concretely leads to an increase of loans to households, while loans to non-bank financial intermediaries overall are being reduced.

Figure 17: Impulse response functions of Investment Funds



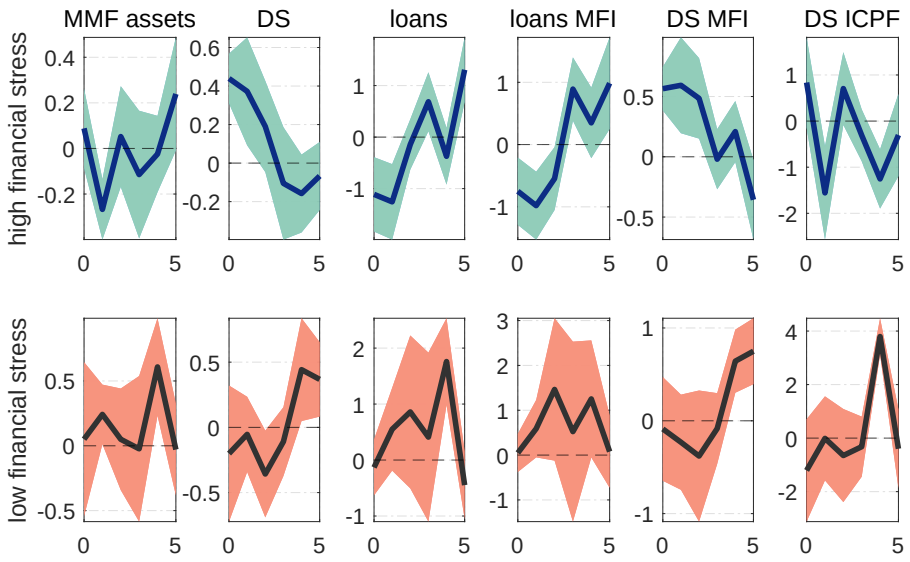
Notes: The figure shows the estimated β_h coefficients to a 1pp tightening shock within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

Figure (17) shows the responses of the aggregated balance sheet positions of invest-

ment funds included in our analysis. We observe, for instance, that they accept more loans in times of stress, but apparently, they reduce the loans claims they hold. Equity hold, in addition, increases strongly within the first two quarters.

Figure (18) displays the impulse responses of all available balance sheet positions of money market funds. We obtain the impulse response of loans issued to banks (MFIs), and debt securities hold of banks and of insurance companies and pension funds (ICPFs), respectively. We learn from these impulse responses that in times of high financial stress, loans to banks react negatively on impact but increase after roughly one quarter strongly, reaching a peak at 1%. Regarding the debt securities of banks, we observe a positive reaction on impact but a gradual decrease afterwards. Finally, debt securities of insurance companies and pension funds experience a strongly emphasized volatility. First, they react positively on impact but experience a gradually strong decline afterwards. After one quarter approximately, the reaction is reversed.

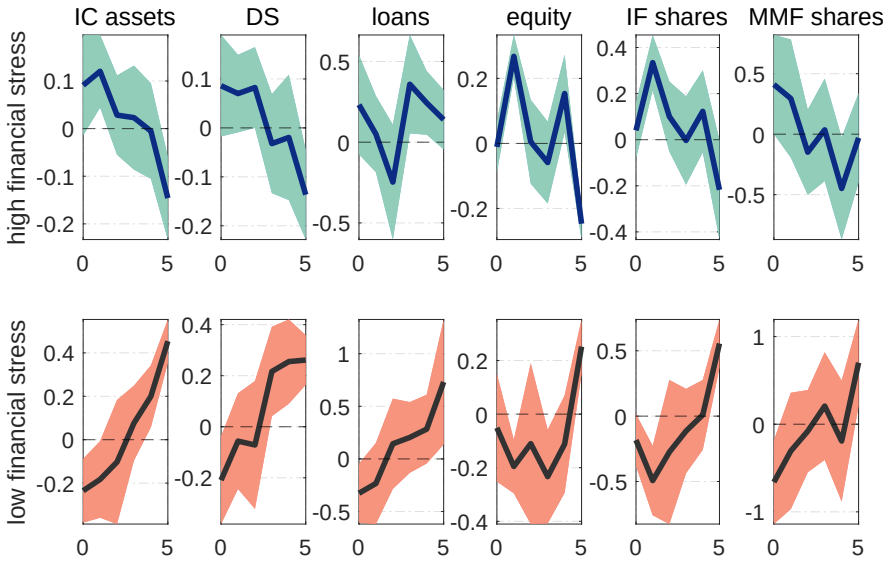
Figure 18: Impulse response functions of Money Market Funds



Notes: The figure shows the estimated β_h coefficients of a 1pp shock within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

Figure (19) shows mainly the interconnections between insurance companies, investment funds, and money market funds. Concretely, we obtain the response of investment funds shares' holdings and holdings of money market funds shares. We observe that both balance sheet positions increase after a tightening monetary policy shock. However, money market funds shares hold decrease over time.

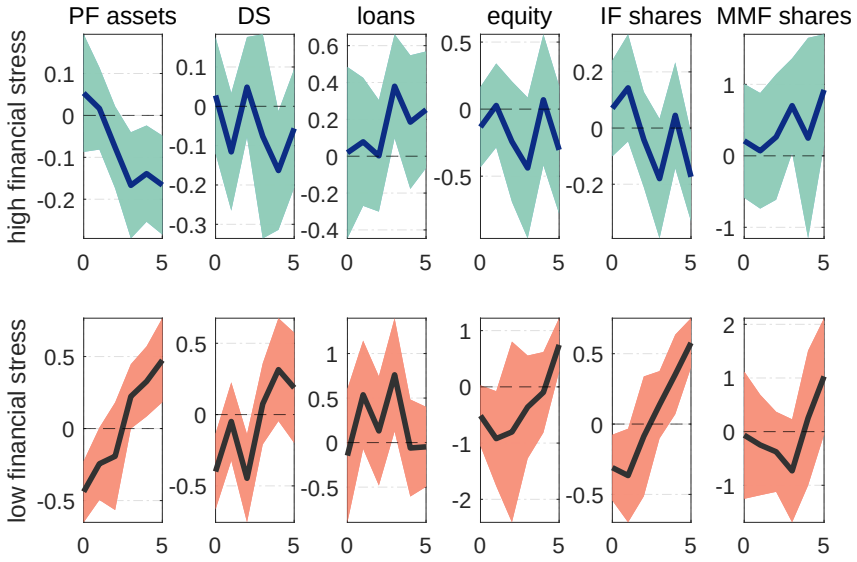
Figure 19: Impulse response functions of Insurance Companies



Notes: The figure shows the estimated β_h coefficients of a 1pp shock within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

Figure (20) sheds light on the interconnections between pension funds, investment funds, and money market funds. Similar to insurance companies (19), both positions react positively. But, in contrast, money market funds shares hold continue to increase over time.

Figure 20: Impulse response functions of Pension Funds



Notes: The figure shows the estimated β_h coefficients of a 1pp shock within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

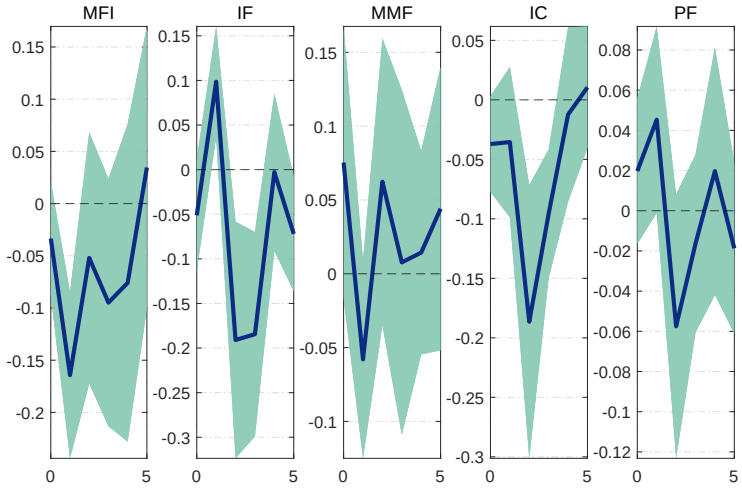
9 Robustness

This section presents our robustness checks. In order to test whether our results hold, we employ the same estimation approach, but with an alternative monetary policy shock. Concretely, we employ a monetary policy shock at the shorter end of the yield curve, measured by the high-frequency identified surprise change in OIS 2 years asset price. Our motivation to include a monetary policy shock capturing the short end of the yield curve is reflected in the findings, for example of Holm-Hadulla et al. [2023] and Tillmann and Tiza Mimun [2023] who show that, for example investment funds react differently to monetary policy shocks targeting the short and the long end of the yield curve.

Figure (21) presents the impulse responses of total assets for monetary financial institutions (MFIs), investment funds (IFs), money market funds (MMFs), insurance companies (ICs), and pension funds (PFs). The responses exhibit notable heterogeneity across sectors. For instance, monetary financial institutions experience a marked and immediate decline, whereas investment funds display an initial negative response followed by a pronounced rebound. Similarly, money market funds react positively on impact but undergo a substantial decline shortly thereafter. When comparing these dynamics to the baseline results, banks and money market funds exhibit broadly consistent patterns, both in terms of direction and magnitude. In contrast, the response of investment funds deviates from the baseline, which may reflect their distinct sensitivities to interest rate changes across the yield curve, namely, at both the short and long ends.

9.1 Baseline results

Figure 21: Impulse response functions of total assets

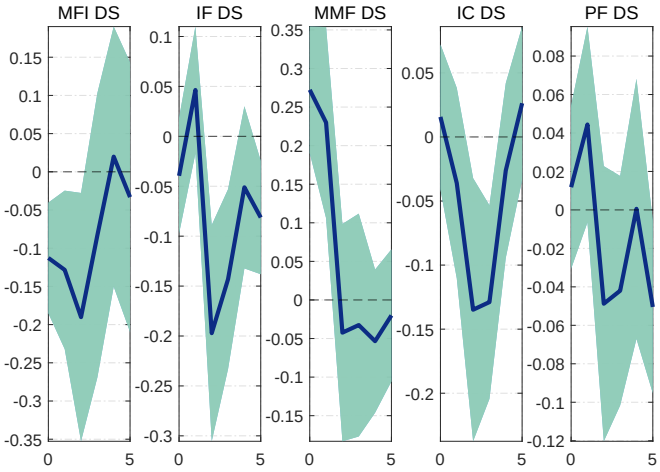


Notes: The figure shows the estimated β_h coefficients of a 1pp shock within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

Figure (22) displays the impulse responses of debt securities holdings across the same institutional sectors. The results reveal substantial heterogeneity in responses, particularly when comparing monetary financial institutions with money market funds. Once again, a comparison with the baseline estimation indicates that both banks and money market funds exhibit highly similar response patterns.

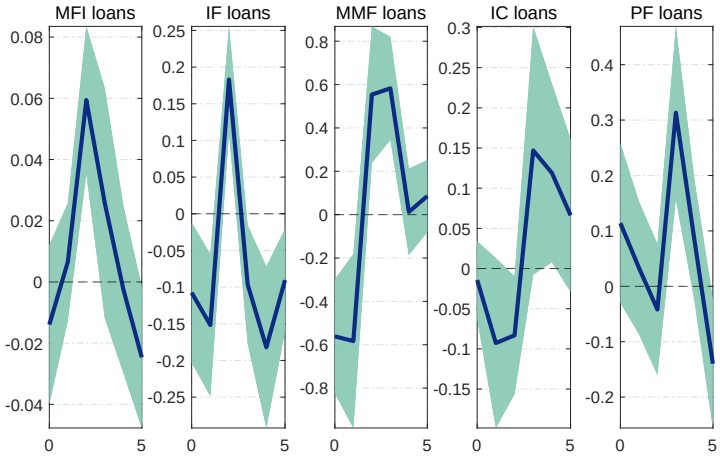
Furthermore, Figure (23) presents the impulse responses of loans. Across most sectors, loans respond negatively to a monetary policy shock. Notably, money market funds exhibit a sharp initial decline, potentially reflecting heightened sensitivity to market conditions or funding constraints. However, this is followed by a pronounced increase after approximately one quarter. Investment fund loans also decline on impact, albeit to a lesser extent, and subsequently display a relatively strong rebound. The magnitude of responses varies considerably across sectors, with the most pronounced peaks observed for investment funds, money market funds, and insurance companies. Importantly, these results closely mirror the patterns observed in the baseline estimation.

Figure 22: Impulse response functions of debt securities



Notes: The figure shows the estimated β_h coefficients of a 1pp shock within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

Figure 23: Impulse response functions of loans

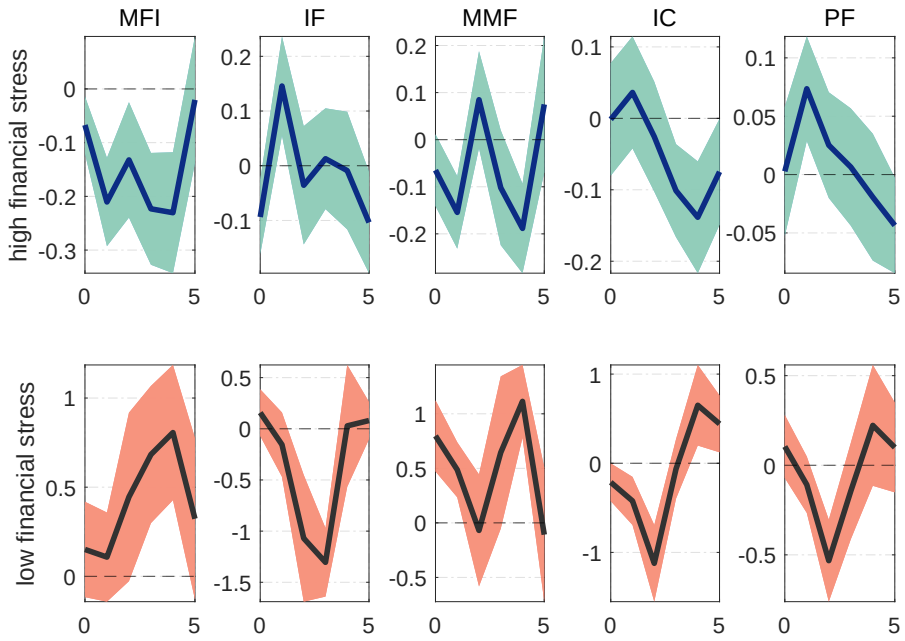


Notes: The figure shows the estimated β_h coefficients of a 1pp shock within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

9.2 State dependent results

Figure (24) illustrates the responses of total assets under conditions of high versus low financial stress. Under high-stress conditions, contractions in asset holdings are more pronounced, particularly for monetary financial institutions and money market funds. These results closely replicate the patterns observed in the baseline estimation for the high financial stress regime.

Figure 24: Impulse response functions of total assets

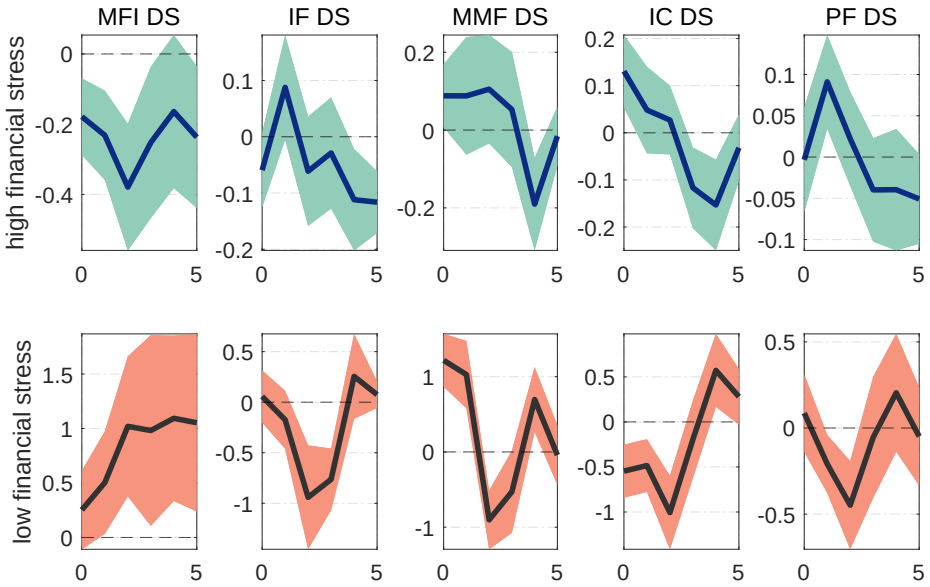


Notes: The figure shows the estimated β_h coefficients of a 1pp shock within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

Analogous to Figure (24), but focusing on debt securities, Figure (25) presents the corresponding responses across institutional sectors. The results again highlight the heterogeneous reactions of banks and non-banks to monetary tightening under conditions of financial stress. For instance, monetary financial institutions exhibit substantial negative responses in stressed regimes, which largely vanish or even

reverse under low-stress conditions. In contrast, debt securities held by non-bank institutions respond predominantly positively. These findings are fully consistent with the results obtained in the baseline estimation.

Figure 25: Impulse response functions of debt securities

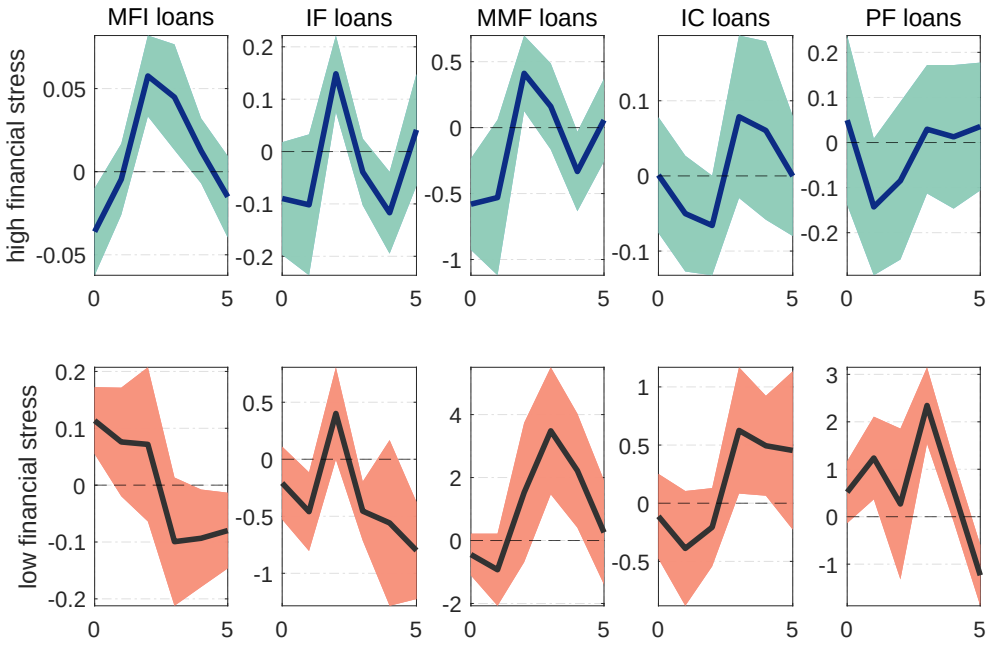


Notes: The figure shows the estimated β_h coefficients of a 1pp shock within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

As shown in Figure (26), loan responses also exhibit stronger contractions under high financial stress, with particularly pronounced declines observed for monetary financial institutions and money market funds. Interestingly, certain sectors, such as investment fund loans, display a positive reaction on impact. Moreover, although money market funds loans initially decline, they subsequently increase in the following quarters. This figure underscores the heightened sensitivity of short-term lending and funding to monetary tightening during periods of financial turbulence. It also confirms the robustness of our estimation, as the baseline re-

sults closely align with these findings.

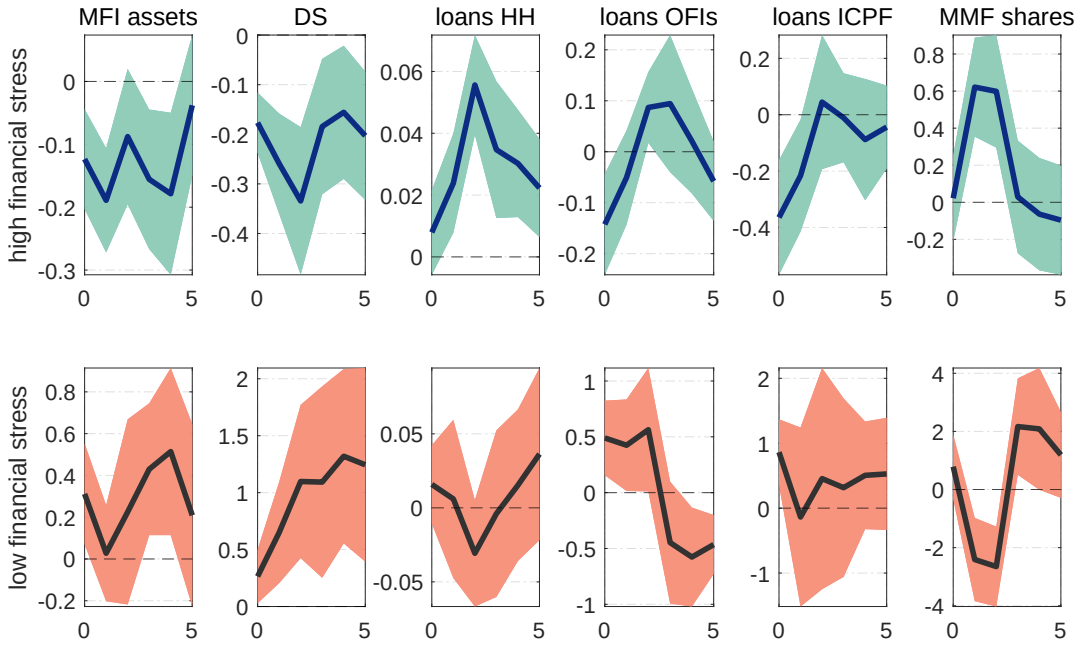
Figure 26: Impulse response functions of loans



Notes: The figure shows the estimated β_h coefficients of a 1pp shock within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

9.3 State dependent results for interconnections

Figure 27: Impulse response functions of Monetary Financial Institutions

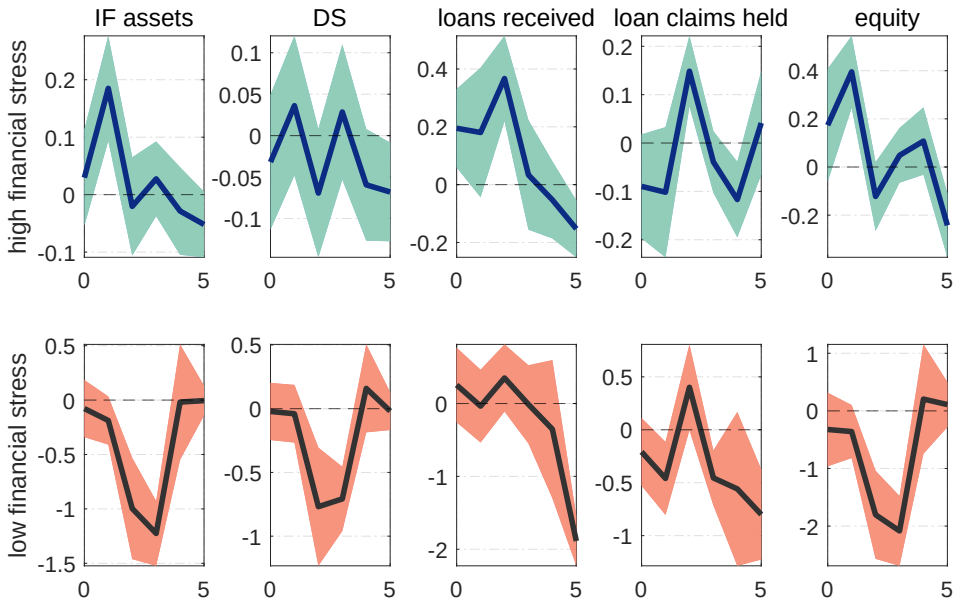


Notes: The figure shows the estimated β_h coefficients of a 1pp shock within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

Figure (27) disaggregates the responses of monetary financial institutions into several components. The most pronounced negative responses are observed in loans to insurance corporations and pension funds as well as in debt securities holdings. Additionally, a notable increase in loans to households is observed under high-stress conditions, whereas loans to other financial institutions and to insurance corporations and pension funds decline. Furthermore, money market fund shares exhibit a substantial rise during periods of financial stress. These results closely resemble those obtained in the baseline estimation, with the key exception that, in the aftermath, loans to other financial institutions and insurance corporations and pension funds increase rather than decline.

Figure (28) shows that investment funds experience declines across most asset categories in response to a monetary tightening shock. Total assets and debt securities contract more sharply under high financial stress. Notably, investment funds reduce their loan claims while simultaneously increasing borrowing, indicating stress-induced liquidity needs. A comparison with the baseline results reveals that investment funds total assets and equity exhibit almost identical responses, whereas debt securities appear considerably more volatile in this specification.

Figure 28: Impulse response functions of Investment Funds

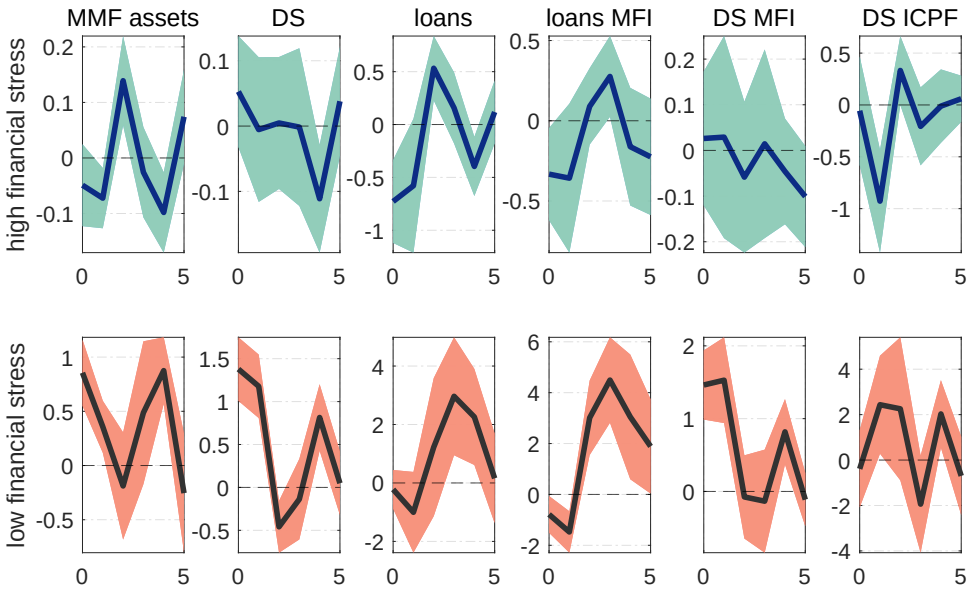


Notes: The figure shows the estimated β_h coefficients of a 1pp shock within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

Figure (29) indicates that money market funds undergo significant reductions in assets and loans in response to monetary tightening, particularly under high financial stress. Money market funds also scale back lending to monetary financial institutions and reduce their holdings of banks-issued debt securities. This be-

havior reinforces the narrative of liquidity hoarding and reflects money market funds' pronounced sensitivity to short-term market fluctuations. Moreover, these responses are largely consistent with the baseline specification across most balance sheet positions.

Figure 29: Impulse response functions of Money Market Funds

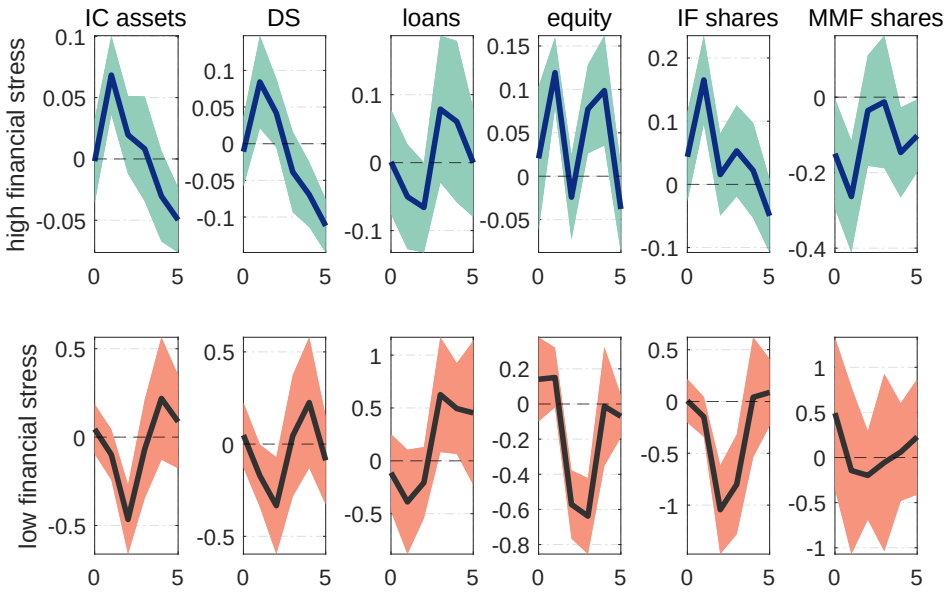


Notes: The figure shows the estimated β_h coefficients of a 1pp shock within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

In contrast, Figure (30) shows that insurance companies reduce their holdings of assets, debt securities, and equity following a monetary policy shock, with effects being more pronounced under high financial stress. Additionally, insurance companies decrease their holdings of investment fund shares, indicating a risk-averse portfolio reallocation. Although the magnitudes of these responses are smaller compared to those of money market funds or investment funds, the observed trends are consistent with a broader sector-wide contraction. These responses also exhibit

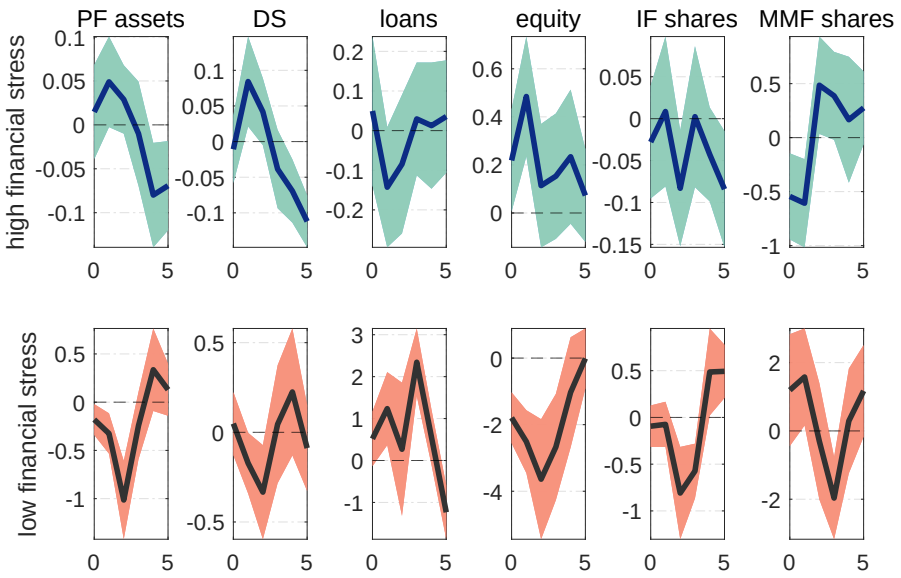
similar directional patterns to those observed in the baseline estimation.

Figure 30: Impulse response functions of Insurance Companies



Notes: The figure shows the estimated β_h coefficients of a 1pp shock within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

Figure 31: Impulse response functions of Pension Funds



Notes: The figure shows the estimated β_h coefficients of a 1pp shock within 68% confidence bands. The x-axis displays quarters, and the y-axis represents percentage points.

Finally, Figure (31) illustrates that pension funds exhibit moderate negative responses in total assets and debt securities under conditions of high financial stress. The most pronounced declines occur in their holdings of money market fund shares and in loans. These patterns likely reflect a combination of valuation effects and potential de-risking behavior. When comparing these results to the baseline specification, we observe differing response patterns except for investment funds shares and money market funds shares, which remain consistent. This divergence may be attributed to the typical investment strategies of pension funds, which predominantly hold long-term assets and thus may respond differently to fluctuations primarily affecting the short end of the yield curve.

10 Conclusions

This paper examines the effects of monetary policy on the balance sheets of both banks and non-bank financial institutions (NBFIs), with particular emphasis on how financial stress conditions alter these dynamics. Focusing on aggregated balance sheet categories, i.e. total assets, debt securities, and loans, we provide new evidence on the joint and sector-specific responses of monetary financial institutions, investment funds, money market funds, insurance companies, and pension funds to monetary policy shocks. Our results show that monetary financial institutions and investment funds consistently exhibit the strongest and most persistent contractions across total assets and debt securities following a monetary policy tightening. These contractions are broad-based, emerge quickly, and intensify over time. Money market funds also display pronounced reductions, particularly in debt securities, with effects materializing within a few months. Insurance companies and pension funds, while generally more stable, show delayed and more moderate responses, consistent with their long-term asset-liability structures and lower sensitivity to short-term funding pressures. Loan dynamics reveal more pronounced heterogeneity. While monetary financial institutions exhibit only temporary contractions in loan holdings, pension funds and money market funds experience significant and persistent reductions, particularly during periods of elevated financial stress. Interestingly, some IF segments increase lending following tightening shocks, suggesting that certain non-bank entities may reallocate assets toward credit provision in response to changing market conditions. These offsetting effects point to the potential for NBFIs to play a stabilizing or amplifying role in the credit transmission channel, depending on prevailing financial conditions. Moreover, the role of financial stress emerges as a key amplifier of monetary policy transmission. We find that across all sectors and asset classes, balance sheet contractions are substantially more severe during periods of high financial stress. This is particularly evident for monetary financial institutions, investment funds, and money market funds, which are more sensitive to liquidity constraints and investor flows. Sector-specific analyses reinforce this pattern, with stronger and more synchronized contractions in high-stress environments. Insurance companies and pension funds are less affected by stress amplification, suggesting a more passive

or counter-cyclical role during adverse conditions. Robustness checks, including alternative shock identification, confirm the consistency of our results. We also document active within-sector asset reallocations, particularly among investment funds and money market funds, indicating dynamic balance sheet management in response to policy changes.

In sum, our findings include three key insights. First, monetary tightening leads to widespread balance sheet contractions across financial institutions, with clear sectoral differentiation in timing and magnitude. Second, financial stress acts as a powerful amplifier of these effects, particularly for institutions reliant on short-term funding or subject to liquidity pressures. Third, NBFIs demonstrate active portfolio and lending responses that can either cushion or magnify the effects of monetary policy. These results suggest that the effectiveness of monetary policy is increasingly influenced by the evolving structure and behavior of the non-bank financial sector.

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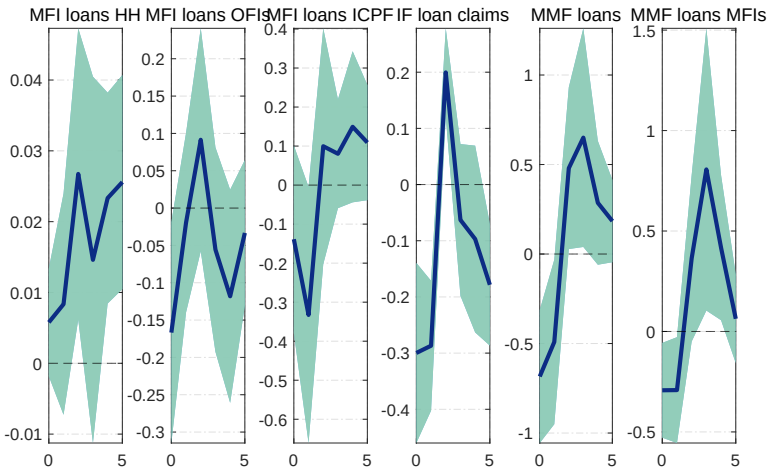
Appendix A: Additional results for loan responses

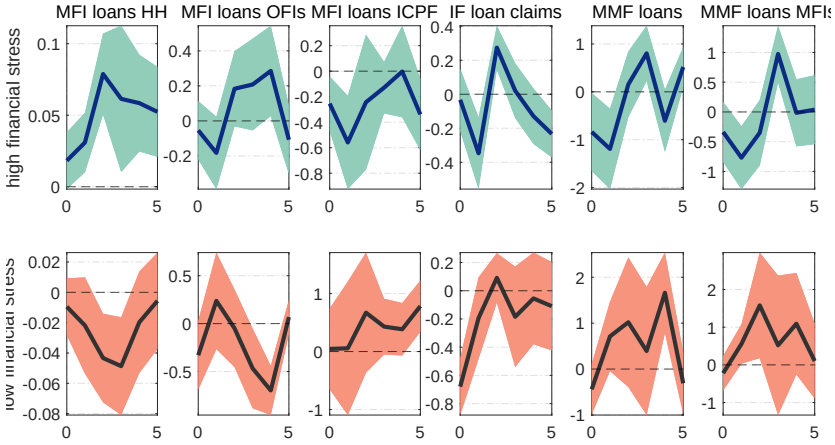
Here we present additional results of loans as in our baseline and state-dependent estimations with granular loan types. Figure (32) compared with Figure (12) shows that the mainly negative response of loans appears to be mainly driven by loans to other financial institutions and insurance companies and pension funds. In contrast, when explicitly estimating the response of loans to households, we observe a slight positive reaction and increasing pattern. Regarding the loans of money market funds, we see that both types of loans, i.e. loans to monetary financial institutions as well as all other types of loans, react negative on impact but increase afterwards relatively strongly.

Figure 32: Impulse response functions of loans (detailed)



Further, Figure (33) compared with Figure (15) shows a similar picture. In times of high financial stress, loans to households react slightly positive and continue to increase, while loans to other financial institutions and insurance companies and pension funds both react in a negative way. This is consistent with the response in Figure (15), implying that in times of high financial stress, money market funds react negative on impact but continue to increase their lending activities to banks and other financial intermediaries.

Figure 33: Impulse response functions of loans (detailed)



Appendix A: Additional results

Figure 34: Impulse response functions of Monetary Financial Institutions (baseline)

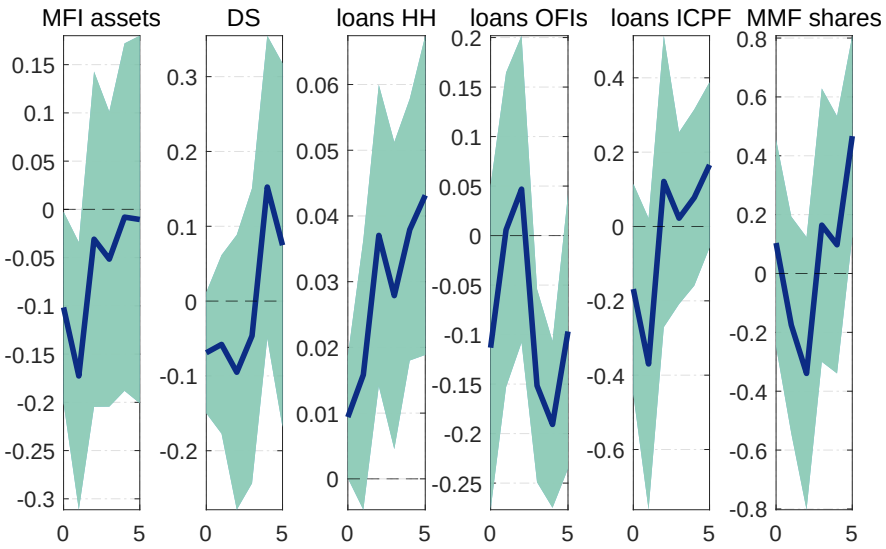


Figure 35: Impulse response functions of Investment Funds (baseline)

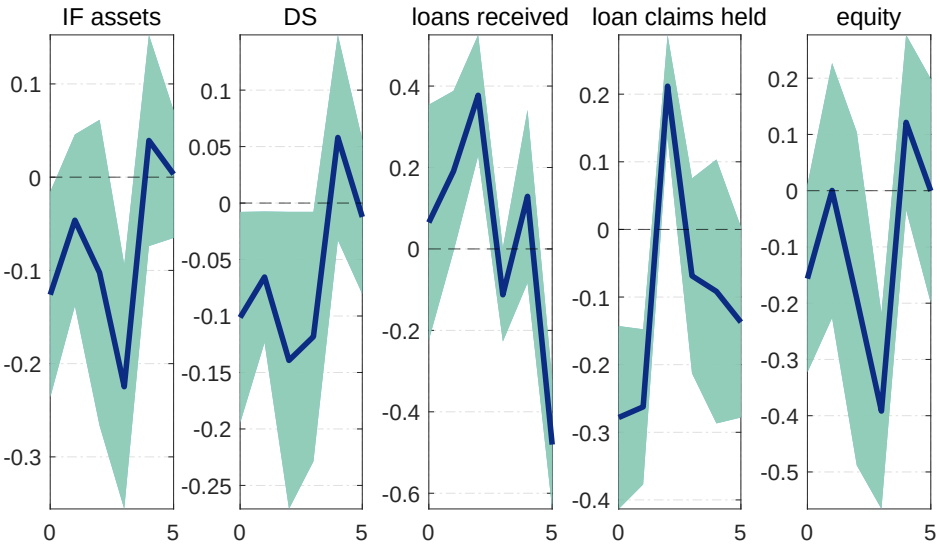


Figure 36: Impulse response functions of Money Market Funds (baseline)

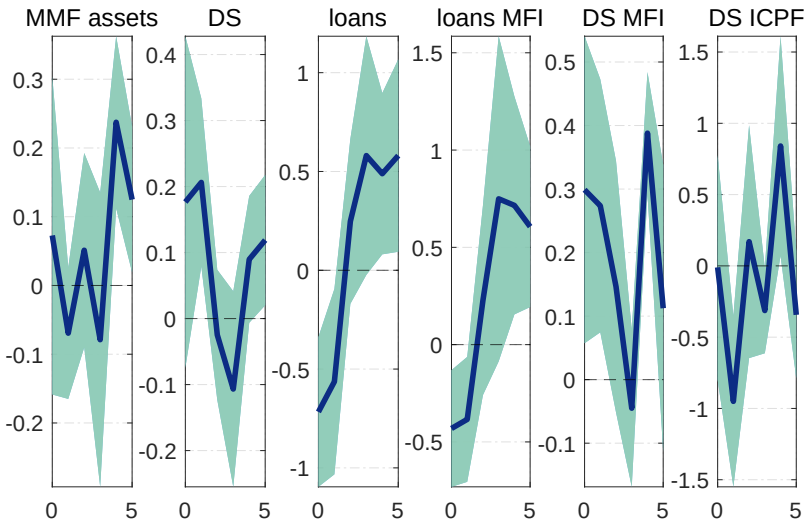


Figure 37: Impulse response functions of Insurance Companies (baseline)

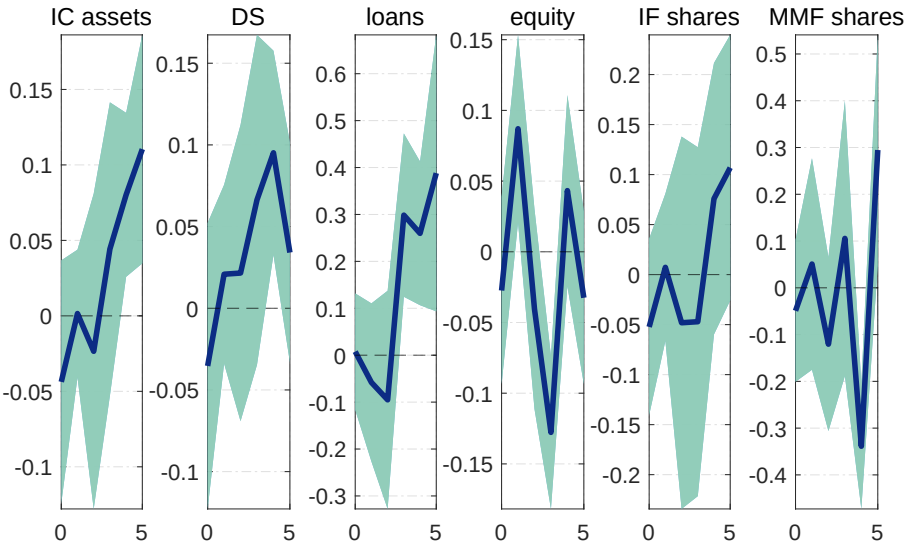


Figure 38: Impulse response functions of Pension Funds (baseline)

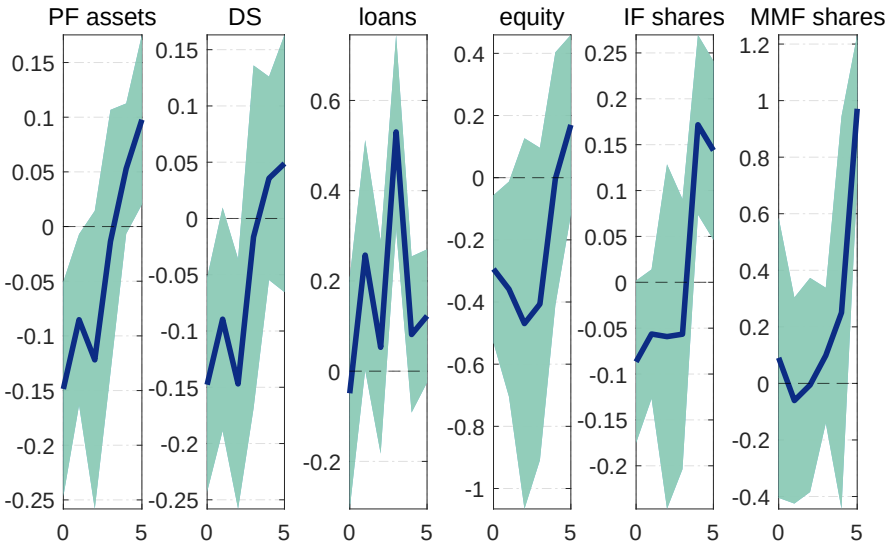


Figure 39: Impulse response functions of Monetary Financial Institutions (robustness)

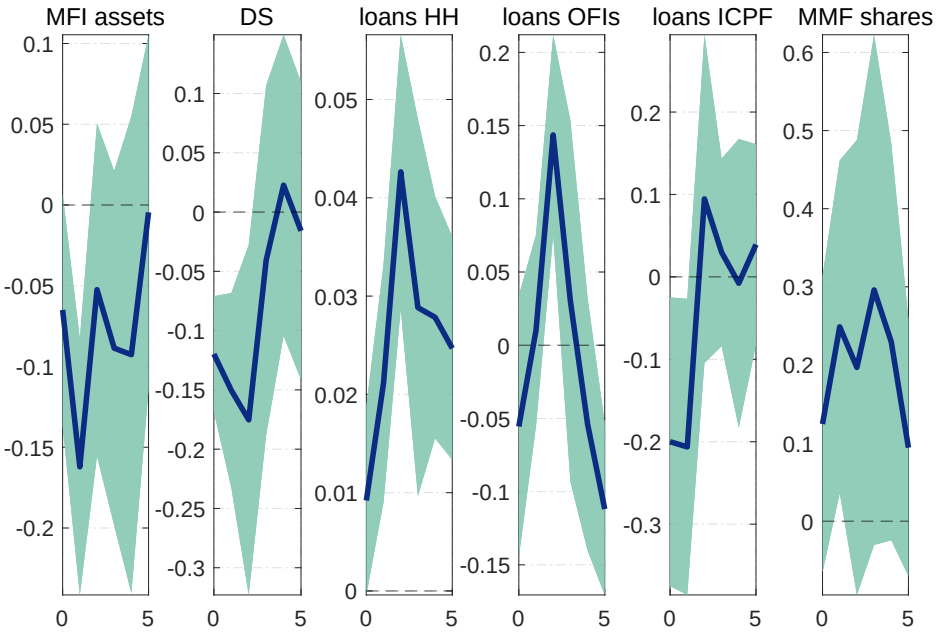


Figure 40: Impulse response functions of Investment Funds (robustness)

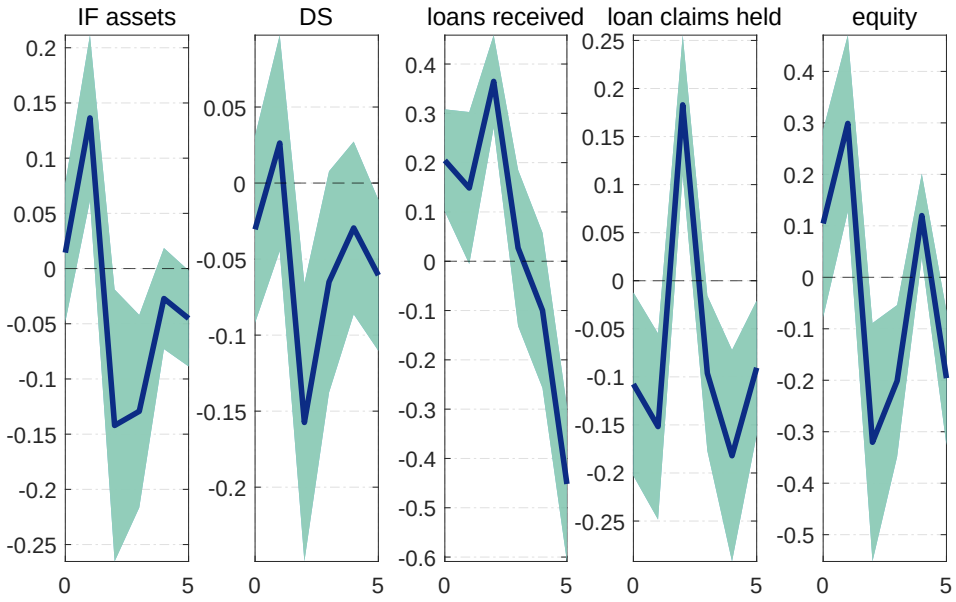


Figure 41: Impulse response functions of Money Market Funds (robustness)

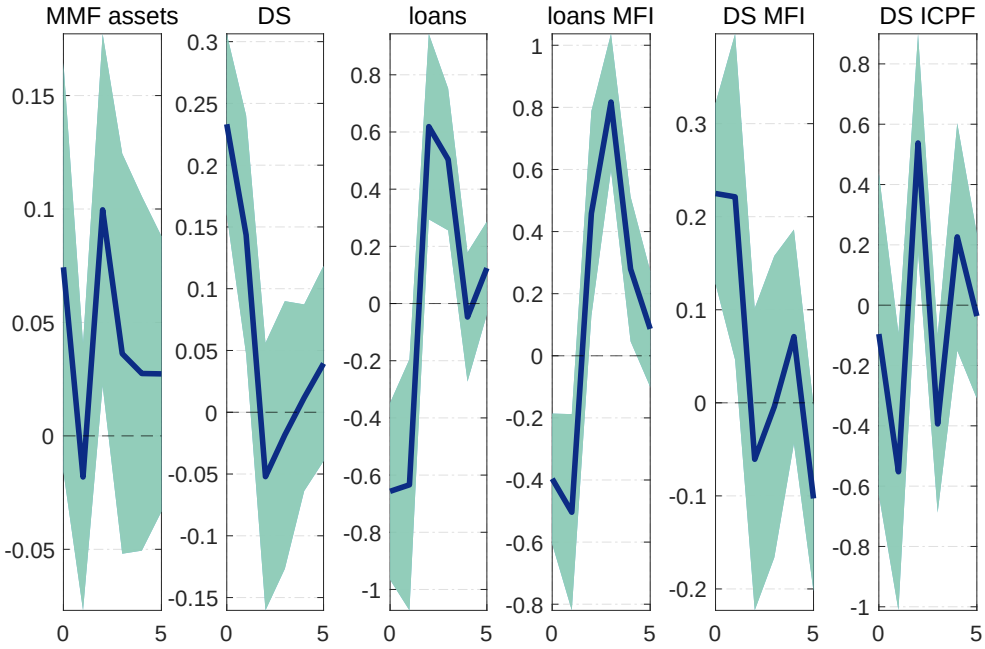


Figure 42: Impulse response functions of Insurance Companies (robustness)

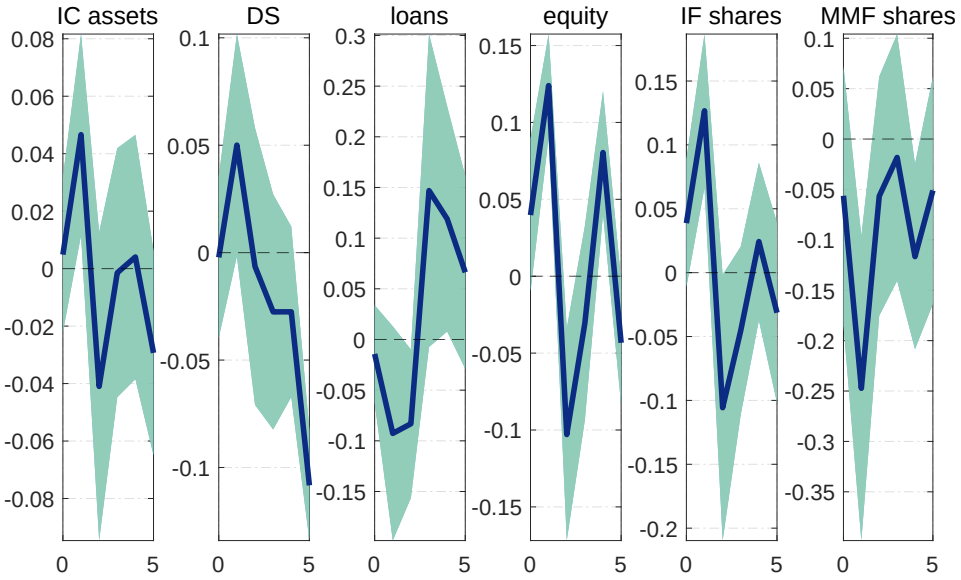
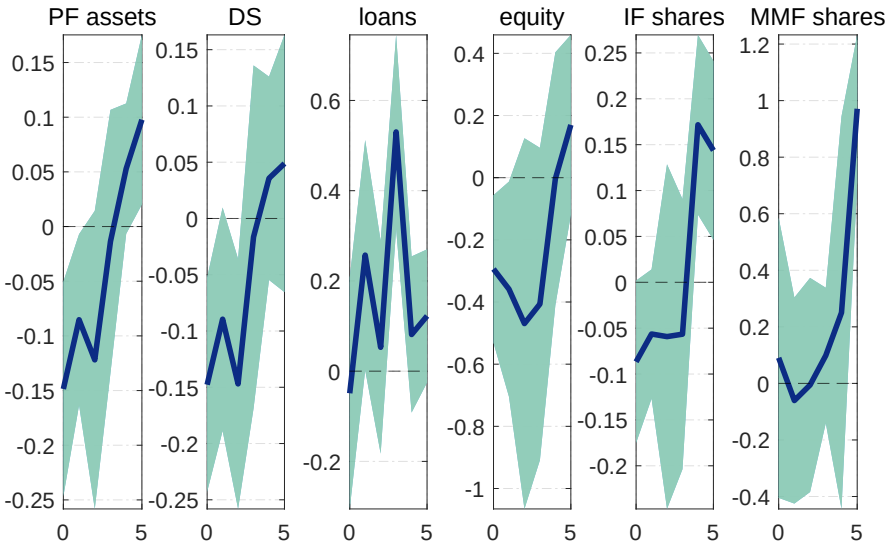


Figure 43: Impulse response functions of Pension Funds (robustness)



Appendix B: Data Sources

For our estimations, we make use of the aggregated and balance-sheet based data for banks and non-banks available at the Data Portal of the ECB. Concretely, we use total assets, total debt securities, and total loans [7]

The following overview provides the series key for each financial sector:

1. Monetary Financial Institutions: BSI.M.U2.N.A.T00.A.1.Z5.0000.Z01.E
2. Investment Funds: IVF.Q.U2.N.T0.T00.A.1.Z5.0000.Z01.E
3. Money market funds: BSI/BSI.Q.U2.N.F.T00.A.1.Z5.0000.Z01.E
4. Insurance Companies: ICB.Q.U2.X.S128.T00.T.1.W0.S1._T.EUR
5. Pension Funds: PFBR.Q.U2.S.S129.A00.T.1.W0.S1._T.EUR

[7] In this analysis, we are primarily interested in the interconnections between banks and non-banks, therefore, we do not include bank loans to other banks, but focus on loans to non-bank entities and households. However, since we are interested in understanding better the non-bank lending channel, for non-banks, we do include all available loans granted, including to banks.

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We thank David Finck for sharing his MATLAB toolbox for the estimation of state-dependent local projections. We thank Peter Tillmann for his helpful comments. We thank the ECB's DG-MF seminar series participants and participants of the ChaMP Workshop in Dublin for their helpful feedback. We thank Alexander Schifrin for his helpful assistance.

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