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Investment funds, monetary policy, and the global financial cycle

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Abstract

This paper studies the role of international investment funds in the transmission of global financial conditions to the euro area using structural Bayesian vector auto regressions. While cross-border banking sector capital flows receded significantly in the aftermath of the global financial crisis, portfolio flows of investors actively searching for yield on financial markets world-wide gained importance during the post-crisis "second phase of global liquidity" (Shin, 2013). The analysis presented in this paper shows that a loosening of US monetary policy leads to higher investment fund inflows to equities and debt globally. Focussing on the euro area, these inflows do not only imply elevated asset prices, but also coincide with increased debt and equity issuance. The findings demonstrate the growing importance of non-bank financial intermediation over the last decade and have important policy implications for monetary and financial stability.

JEL classification: F32; F42; G15; G23

Key words: Monetary policy; international spillovers; capital flows; non-bank financial intermediation

1 Introduction

Fostered by the progress in financial integration since the 1990s, a global financial cycle emerged that has led to an increased synchronisation in the movements of risky asset prices, capital flows, and leverage across borders (Rey, 2015). This development can imply improved international risk sharing via financial markets, but also leads to a faster and widespread contagion of economic and financial shocks globally. Monetary policy of the United States (US), as the most important centre of the global financial system, is regarded as one of the main drivers of the global financial cycle and the balance sheets of global banks are identified as the main transmitter of US financial conditions to the rest of the world – at least up to the global financial crisis of 2007 (Bruno and Shin, 2015a; Bruno and Shin, 2015b; Miranda-Agrippino and Rey, 2020b; Rey, 2016).

As highlighted by Shin (2013), the relevance of the banking sector for spreading global liquidity across borders receded significantly in the aftermath of the global financial crisis. Instead, portfolio flows of global investors actively searching for yields on bond and equity markets world-wide gained importance during this “second phase of global liquidity.”

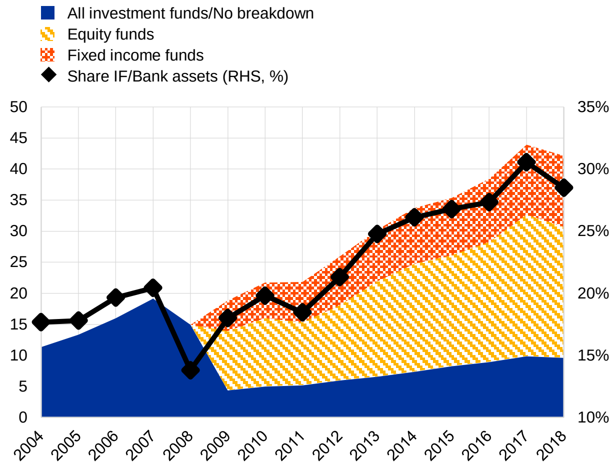

Figure 1: Total assets under management of investment funds globally

Notes: Left axis unit: USD trillion. Right axis unit: percentages. Black diamond line shows percentage ratio of total assets of investment funds relative to banks worldwide. *Data source:* Financial Stability Board (2020)

Figure 1 shows that the assets under management of the investment fund sector globally almost tripled between 2008 and 2019 to more than USD 42 trillion. Also, the importance of investment fund relative to bank financing increased steadily post-crisis from a low point of 14% in 2008 to 28% in the beginning of 2019.[1] Given their internationally diversified asset holdings, the investment fund sector by now accounts for more than a half of all global debt and equity portfolio flows (see Figure 2, left panel). In the euro area (EA), for example, the relative size of debt portfolio inflows to other investment

[1] As shown regularly, for example by Financial Stability Board (2020), the investment fund sector constitutes the largest sub-sector of the growing field of non-bank financial intermediation (NBFI) in the post financial crisis episode.

flows, which can be mainly attributed to banks, increased from on average 65% before 2008 to 175% after the global financial crisis (see Figure 2, right panel).[2]

This paper sheds light on the role of the investment fund sector for the transmission of global financial conditions in the post-financial crisis episode using a structural Bayesian Vector Auto Regression (BVAR) approach. Focussing in particular on the euro area, the paper addresses the following research questions: Do investment fund flows respond systematically to changes in global liquidity, as measured by US monetary policy shocks? If yes, are these flows directed to particularly risky segments of bond and equity markets? And to what extent do these portfolio flows lead to changes in financial conditions for firms and real activity?

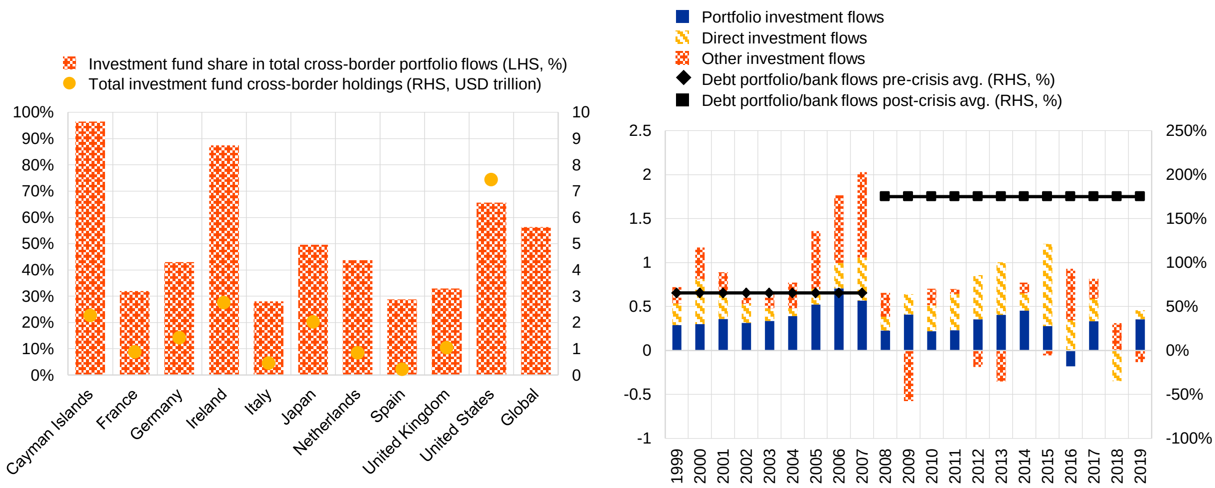

Figure 2: The role of investment funds for international portfolio flows

Notes: Left panel: Data shown for end of 2018. 'Global' represents weighted average of countries shown, covering approximately 80% of global investment funds' assets under management. Right panel: Left axis unit: EUR trillion. Bars show categories of capital inflows to the euro area. Right axis unit: Black lines show ratios of average debt portfolio inflows to 'Other investment flows', which mainly contain bank sector inflows. Diamond (squared) lines denote averages from 1999 to 2007 (pre-crisis) and from 2008 to 2019 (post-crisis). *Data sources:* IMF Coordinated Portfolio Investment Survey and ECB Balance of Payments Statistics.

As discussed extensively, for example by Rey (2016), the international transmission of US monetary policy before the global financial crisis worked via global banks through the credit and the risk-taking channel of monetary policy (Borio and Zhu, 2012). According to these channels monetary policy affects net worth, risk-taking, leverage constraints, and hence loan origination of globally-active financial intermediaries that do not only refinance themselves in US Dollars, but also lend in Dollars even to non-US borrowers.

In the post-crisis era, global investment funds transmit US monetary policy through to the following main channels: international risk-taking, searching for yield, and pro-cyclical flow-performance behaviour.

Via its effect on global risk appetite (Bekaert et al., 2013; Bruno and Shin, 2015a),

[2]These aggregate developments reflect Shin's (2013) discussion about the diminishing role of banks in the transmission of global financial conditions. In fact, Bruno and Shin (2015a) note that the bank-based global transmission of US monetary policy was only relevant up to the global financial crisis, mainly because of the structural change in the dynamics of global banking sector leverage at this time.

looser US monetary policy affects the risk-taking behaviour of global financial investors. This can imply additional inflows to the investment fund sector generally and also a re-balancing of investors' portfolios towards riskier asset classes.

By means of a search-for-yield channel, global investors reallocate their portfolios towards assets that are associated with a higher comparative expected return. This can involve fund investors to rebalance towards higher yielding, but riskier assets. This type of behaviour is well-documented especially during the post-crisis low yield environment (Choi and Kronlund, 2017; Di Maggio and Kacperczyk, 2017; Becker and Ivashina, 2015). Searching for yield also has an international dimension. For example, the relatively higher interest rate differential between international and US securities after a monetary expansion by the Federal Reserve can trigger investor flows away from US assets and towards international and EA assets (Ammer et al., 2018, 2019; Fratzscher et al., 2018; Kroencke et al., 2015).

At the same time, a reduction of US interest rates can have positive asset valuation effects globally, which may trigger momentum in the returns of investment funds (Feroli et al., 2014). Due to pro-cyclical flow-performance behaviour of ultimate investors (Goldstein et al., 2017; Timmer, 2018), investment funds may experience further inflows as a result.

For a transmission to the real economy it is relevant to what extent these portfolio adjustments and capital flows only lead to asset price inflation and share buybacks (Acharya and Plantin, 2018) or also to improved financing conditions for non-financial corporations (NFC), leading to increased equity and debt issuance and, ultimately, higher real activity and inflation.

While questions on market-based sources of financing are widely discussed in policy circles, systematic empirical evidence on the role and the effects of non-bank finance for the transmission of shocks to financial and real economic activity is still limited.[3] The present paper contributes in this respect by analysing the international dimension of non-bank financial intermediation for the EA.

The empirical analysis is based on 12 years of monthly data between April 2007 and March 2019. It studies the dynamic interactions between US monetary policy and macro-financial variables at the global level, in the US, and in the EA, focussing in particular on international investment fund flows.

I find evidence for significant spill-overs of US monetary policy to bond and equity markets via the investment fund sector. After accommodative monetary policy action by the Federal Reserve, inflows to investment funds increase on a global level. The estimates from the model imply additional inflows of USD 200 billion globally after a 25 basis point US monetary policy shock. Looking specifically at funds investing into European assets,

[3]Recent publications from policy institutions on this topic, such as Financial Stability Board (2020), European Central Bank (2019), and Adrian and Jones (2018), give an overview of the growing importance and potential risks emanating from this sector.

cross-border flows towards the euro area increase as well. Moreover, even investment funds domiciled within the euro area receive significantly higher inflows after a monetary loosening in the US. Inflows are particularly strong to the riskier segments of financial markets, such as high-yield corporate bonds and equities with a small market capitalisation. Global money market funds experience outflows instead. My results confirm that a global financial cycle in risky asset prices continues to exist after the global financial crisis, while the related literature mainly analyses pre-crisis data. Specifically, I find that various global financial risk and uncertainty measures, such as the VIX and the Habib and Venditti (2019) global risk index decline, while US and EA bond and equity market indices rise after a loosening of US monetary policy. These financial market effects are transmitted to the euro area firm sector, which increases its issuance of debt and equity securities. The model implies an additional debt securities issuance of about USD 16 billion, corresponding to 1% of NFC debt outstanding, after a 25 basis point shock. Industrial production, as a measure for real economic activity, and inflation increase in both currency areas. The results continue to hold when controlling for changes in bank lending in the US and EA.

These findings have potentially important policy implications for monetary and financial stability. The observation that an international loosening of financial conditions leads to inflows to riskier market segments potentially raises financial stability concerns. This calls for diligent oversight of the globally active investment fund industry and possibly the introduction of additional macroprudential policy tools to control risks in this sector.[4] To the extent that the additional issuance of debt and equity by firms also leads to increased real economic activity and inflation in the EA, these international spill-overs would also be relevant for monetary stability.

In terms of methods, the applied BVAR framework has the well-known advantage of avoiding problems like overfitting, to which VAR-models estimated using a frequentist approach are prone to. Importantly, it allows for reliable parameter estimation even in the relatively small sample that is available for this study.

The monetary policy shocks are identified using the method proposed by Jarociński and Karadi (2020), which is based on a combination of high-frequency identification, as proposed by Gertler and Karadi (2015) in conventional VARs, and sign restrictions methods, as introduced by Arias et al. (2018).[5] This combined method allows disentangling pure monetary policy shocks, defined as a negative co-movement between the high-frequency change of a monetary policy indicator and a stock market index around Federal Open Market Committee (FOMC) monetary policy announcements, from central bank information shocks, defined as positive co-movements between those two variables. These information shocks are related to the concept expressed in Nakamura and Steinsson

[4]See, for example, Portes et al. (2020) and Cominetta et al. (2018) for a discussion of possible risks and policy tools.

[5]Caldara and Herbst (2019) propose an alternative approach to implement high-frequency identified monetary policy shocks in a BVAR framework.

(2018). Jarociński and Karadi (2020) show that the responses of macroeconomic and financial market variables can differ decisively under these two types of shocks. Throughout the paper, I will focus on the analysis of the genuine (negative co-movement) monetary policy shocks.

Instead of using short-term innovations of US monetary policy, such as changes in 3-months federal funds rate futures as done by Jarociński and Karadi (2020), I construct a measure that captures changes of monetary policy also in the longer end of the yield curve. I generate a US monetary policy term structure shock using the method by Gürkaynak et al. (2005). In this way, I disentangle a monetary policy 'target factor' from a 'term structure factor', using the latter one as my measure of US monetary policy shocks. The reason for this approach is the following. As the federal funds rate was set (close) to its zero lower bound for an extended period of time after the global financial crisis, which is the sample under study, the shock variation at the short-end of the yield curve is very limited compared to earlier decades. Most of the monetary policy adjustments post-crisis implied changes in the longer end of the term structure, though – for example, by means of central bank asset purchases or forward guidance. As I will show, the term structure monetary policy shock captures these post-crisis policy changes much better.

All main results are, notably, highly robust to using other identification methods, such as a conventional Cholesky decomposition and using the shadow federal funds rate by Wu and Xia (2016) instead of the term structure shock. A distinct advantage of using high-frequency identification compared to causal ordering is that the former allows for simultaneous responses of all variables to the monetary policy shock. This is of particular importance given the focus of the paper on fast moving financial variables, like investment fund flows and asset prices.

The rest of the paper is structured as follows. Section 2 reviews the related literature. Section 3 gives an overview of the data and the estimation methods used to study the second phase of global liquidity. All results are presented in Section 4, where Section 4.1 focusses on the reaction of investment fund flows and securities issuance, while Section 4.2 provides results for various macro-financial variables to further analyse the transmission mechanisms in place. The sensitivity of the results with respect to various changes, including alternative identification methods, is analysed in Section 5. A conclusion is given in Section 6.

2 Related literature

Closest to this paper in terms of approach and methods is the paper by Miranda-Agrippino and Rey (2020b), who analyse the effects of US monetary policy on US and EA macro-financial variables in a BVAR. They focus on the transmission via global banks and their sample ends in 2010, which does not allow to study the more market-based second phase of global liquidity, which is the focus of my paper. In parallel to my work, Miranda-Agrippino and Rey (2020a), which I discovered only recently, confirm that their earlier findings on a global financial cycle in asset prices continue to hold after the global financial crisis. Gerko and Rey (2017) perform VAR analyses of US and United Kingdom monetary policy spillovers to the rest of the world. Bruno and Shin (2015b) formulate a model of the global banking system, where an appreciation of the US Dollar is associated with deleveraging of global banks and an overall tightening of international financial conditions. In turn, Bruno and Shin (2015a) provide evidence for the predictions of this model in a small-scale VAR, linking US monetary policy to risk aversion, bank leverage and banking-sector capital flows. Compared to these papers, I explicitly consider the role and behaviour of non-bank financial intermediaries for transmitting financial conditions internationally after the global financial crisis.

Several papers analyse the effects of monetary policy and global factors on debt and equity portfolio flows. Habib and Venditti (2019) construct a measure of global risk based on stock market return data. They demonstrate that US monetary policy and more general financial shocks are indeed the main drivers of global capital flow cycles. Scheubel et al. (2019) also build a measure of the global financial cycle, which is not only based on prices but also on quantities data, such as global bank leverage and credit volumes. They find a consistent link between their measure and extreme shifts in capital flows, such as sudden stops. Davis et al. (2019) show that two global factors, an asset price and a commodity price factor, explain about one half of gross capital flows in advanced economies.

Focussing on emerging markets, Converse et al. (2020) provide evidence that the growing presence of exchange-traded funds increased the sensitivity of capital flows to the global financial cycle. The analysis is based on micro data for equity and bond mutual funds. Kalemli-Özcan (2019) shows that changes in US monetary policy has strong effects on capital flows, in particular for emerging market economies. These effects are not only driven the direct changes in interest rate differentials to the US, but more so by the effect of US monetary policy on the risk perceptions of global investors.

Fratzscher et al. (2018) find that US quantitative easing induced significant international portfolio reallocations by global investors, while Fratzscher et al. (2016) do not observe significant portfolio rebalancing in response to early unconventional monetary policy by the ECB between 2007 and 2012. Bubeck et al. (2018) study the effect of ECB monetary policy announcements on the portfolio allocation of EA investment funds. They find that portfolios of these funds are mainly affected by valuation effects from asset prices and less by active asset reallocation decisions.

A synopsising study by the International Monetary Fund (2016) examines the links between monetary policy and non-bank financial intermediation. The analysis finds some evidence that the increasing importance of non-bank financial intermediation increased monetary policy transmission in the recent past. Both banks and non-banks tend to contract their balance sheets after monetary tightening. The authors can link this behaviour to a risk-taking channel, which they find to be particularly strong for the investment fund sector.

Using data for the EA, Hau and Lai (2016) run country-level fund flow regressions on a country-specific measure of short-term real interest rate changes as a measure for monetary policy. They also find evidence for a risk-shifting channel, according to which investors rebalance their portfolios out of money market funds and towards equity funds in response to a reduction in country-specific real interest rates. Feroli et al. (2014) argue that in a search-for-yield environment flows into an asset class can induce momentum in returns that leads to further return-chasing behaviour. Based on data for fixed-income mutual funds, they provide evidence that changes in the monetary policy stance can reverse this return-chasing behaviour rapidly, thereby inducing strong fund in- and out-flows.

Using micro data from Turkey, Baskaya et al. (2017) show that capital inflows increase wholesale (non-deposit) funding of domestic banks, in turn also leading to higher lending. Niepmann and Schmidt-Eisenlohr (2018) document that an appreciation of the Dollar is associated with a reduction in US credit supply due to the behaviour of global mutual funds on US secondary syndicated loan markets. Lo Duca et al. (2016) find that US quantitative easing policies had a significant impact on corporate bond issuance across advanced and emerging economies. Holm-Hadulla and Thürwächter (2020) analyse the role of the aggregate corporate debt structure for the transmission of monetary policy for a panel of EA countries. They find that the overall response of bank lending to monetary policy shocks is weaker in countries with a higher ratio of bond to bank financing.

3 Analysing the second phase of global liquidity

To study the transmission of global financial conditions in a BVAR framework, I set up a baseline model of five variables that includes the nominal flows of global investment funds, the VIX volatility index as a measure of global risk aversion that has a high co-movement with the global financial cycle (Rey, 2015), the S&P 500 stock market index, the USD/EUR nominal exchange rate, and the US 10-year Treasury rate as a measure for US monetary policy. This selection of variables is akin to the model used by Bruno and Shin (2015a), who focus on a measure for the leverage of global banks instead of the investment fund flows. As in Jarociński and Karadi (2020), I add two further high-frequency variables for changes in monetary policy and in the S&P 500 stock market index on FOMC dates to the model.

Using a marginal approach, this baseline model is subsequently augmented by further macroeconomic and financial variables for the US, the EA, and the global level, in order to analyse the risk-taking behaviour of investors, aspects of the transmission mechanism, and the effects on the real economy.

The remainder of this section provides a description of the data set, the estimation methods, and the identification of the monetary policy shocks.

3.1 The data set

The available sample consists of 12 years of monthly data between April 2007 and March 2019, which yields 144 observations. The beginning of the sample is restricted by the availability of data for bond funds. The sample, nevertheless, fully covers the episode of growing international importance of investment funds and market-based finance.

The data on investment funds is at the heart of this analysis and is taken from the private data provider EPFR Global. Aggregated investment funds data is available in this source by fund type (i.e., equities, bonds, mixed, money market), by regional investment focus (e.g., global, US, Western Europe), and by domicile country. EPFR decomposes the evolution of total net assets over time into nominal flows and into valuation changes. The response of the nominal flows to global liquidity shocks is the focus of this paper. As the domicile country of a fund is generally regarded to be a good proxy for the origin of its investors because of regulatory reasons, the data set allows for the construction of, e.g., the cross-border flows of non-EA investors to bond and equity funds with an investment focus on Europe.

The main advantages of the EPFR data compared to official investment fund statistics or balance-of-payments data are the global coverage of investment funds data in one single source, the detailed breakdowns in different asset classes and the possibility to decompose changes of investment funds' assets into nominal and valuation changes. Moreover, public statistics on cross-border portfolio debt and equity flows are not restricted to investment funds, but do also include cross-border securities transactions of other sectors including banks, which would complicate the identification of the response of the funds sector to global financial shocks.

I use investment fund flows for different domicile/investment focus combinations. The main results are based on global-to-global investment fund flows, which are based on aggregate data for all investment foci and all domiciles. Further results are based on euro area domiciled investment funds investing in European assets (hereafter also EA-to-EA flows) and globally (non-EA) domiciled funds investing in European assets (global-to-EA).[6]

Additional breakdowns are available for the different fund types. In case of bond funds, I can distinguish between funds investing in corporate or sovereign bonds, and in high-yield versus investment-grade assets. For equity funds, I use a decomposition in terms of the market capitalisation of the underlying corporations. These breakdowns enable to see whether in- and outflows are directed to more or less risky market segments, such as corporate and high-yield bonds or small cap equities.

The data from EPFR does not cover the full market capitalisation of equites and bonds. Yet, for cross-border portfolio flows, Miao and Pant (2012) and Fratzscher (2012) show

[6] In order to have a consistent data definition and to ensure a comprehensive coverage, the euro area domiciled investment funds always refer to the EA-12. This country group consistently covers more than 99% of total assets of the investment fund sector in the EA over the whole sample.

Table 1: Investment fund assets under management in EPFR and official statistics

Asset type (USD trillion)	Bond	Equity	Mixed/ No breakdown	Total
2009:				
FSB	4.91	9.59	4.35	18.84
EPFR	2.14	5.71	3.83	11.67
Sample coverage	44%	59%	88%	62%
2018:				
FSB	11.46	21.09	9.59	42.14
EPFR	7.57	16.44	7.23	31.24
Sample coverage	66%	78%	75%	74%

Notes: Table shows investment fund assets under management at global level from official governmental statistics as provided by Financial Stability Board (2020) and from the sample available in EPFR Global. Numbers are in USD trillion. 'Sample coverage' gives the share of the total investment fund asset universe that is available in EPFR. 'Mixed/No breakdown' refers to the category 'Other funds' in FSB data and includes mixed funds and money market funds in the EPFR data.

that this source provides a relatively representative sample with aggregate portfolio flows from EPFR matching the patterns of those from official balance-of-payments statistics closely. Table 1 compares the investment fund assets under management at the global level from official governmental statistics, as provided by Financial Stability Board (2020), with the sample available from EPFR Global. The comparison is shown for 2009 and 2018, which are the earliest and latest available breakdowns that allow for a comparison. The sample coverage in EPFR increased over time from on average 62% in 2009 to 74% in 2018, where the data set includes USD 31 trillion of the USD 42 trillion given in official statistics. The coverage is generally somewhat better for equity than for bond funds with 78% versus 66% in 2018. These observations give confidence that the analysis in this paper covers the relevant developments in the fund sector in a comprehensive way.

The focus of this paper lies on the analysis of the nominal flows instead of the evolution of assets under management, which also include valuation changes. Changes in flows reflect direct buying and selling decisions of investors, while valuation changes also affect existing portfolios. Analysing flows, therefore, allows studying the actual response of investors to changes in global financial conditions.

Figures 16 and 17 in Appendix A.2 depict the evolution of the cumulative flows for all asset classes available since the starting point of the sample in April 2007. Over the whole sample period, bond funds saw by far the strongest cumulative inflows of over USD 2.64 trillion, while cumulative flows into equity funds ended up close to the level from the beginning of the sample. The strong growth of assets under management in equity funds, which is also visible in Figure 1 and Table 1, is accordingly mainly driven by increases in stock valuations.

In the regression models of Section 4, I use the cumulative flows in percent of lagged assets under management. Time series for the different asset class breakdowns of the global investment fund series, as used in the BVAR models, can be found in Figures 18 and 19 of Appendix A.2. The construction of these series follows the methodology by EPFR Global, which allows for a straightforward interpretation in percentage terms.

All other data used in this paper are relatively standard financial and macroeconomic time series from various private and public data providers as well as from other academic works. An overview of all variables used in the analysis together with their sources and applied transformations is given in Appendix A.1.

3.2 Estimation method and identification

The model is estimated as a Bayesian VAR with four lags and a constant term for each variable using the Independent Normal-Wishart prior.[7] Unless stated otherwise, I use the following hyperparameter values that are standard in the related literature.

As a prior belief about the regression coefficients, I assume that each endogenous variable follows a unit root process in its own first lag and has zero coefficient values for all further own and cross-variable lags. The overall tightness parameter for this prior belief is assumed to be $\lambda_1 = 0.1$. The cross-variable weighting parameter that determines the tightness of the prior belief for cross-variable lags is set to $\lambda_2 = 0.5$. The lag decay parameter, determining the speed at which the lag coefficients converge to 0 with greater certainty, reads $\lambda_3 = 2$. For the constant term, a diffuse prior is implemented by setting the exogenous variable tightness to $\lambda_4 = 100$.

The total number of iterations is set to 2000 with 1000 burn-in iterations. The number of lags is set on the basis of comparing model marginal likelihoods. The results continue to hold with a higher number of lags. The results are robust to using other priors, including the Litterman (1986) "Minnesota" prior and a conventional Normal-Wishart prior. I ensure that all estimated models are stationary, which is not a necessary requirement for valid inference when using Bayesian methods. In practise, credibility intervals are, however, often very wide in models where not all roots of the characteristic polynomial lie inside the unit circle.

The monetary policy shocks are identified using the approach introduced by Jarociński and Karadi (2020), which is based on a combination of high-frequency identification and sign restrictions methods. Jarociński and Karadi (2020) show that surprise changes of federal funds rate futures in a 30-minutes window around FOMC announcements do not always coincide with stock market movements in the opposite direction. Such a negative co-movement between a monetary policy indicator and stock markets is, however, the expected result of a monetary policy shock in conventional economic theory. The approach by Jarociński and Karadi (2020) allows disentangling these pure negative co-movement monetary policy shocks from positive co-movement shocks, which the authors interpret as central bank information shocks, where the central bank conveys additional

[7] For the estimation I use the BEAR toolbox Version 4.2 by Dieppe et al. (2016).

information to market participants. For example, an increase in equity markets after a monetary policy tightening could be the result when the central bank reveals information that the tightening of monetary conditions was required to prevent the economy from overheating, which can be interpreted as positive economic news by financial markets. The authors show that the responses of macroeconomic and financial market variables can differ decisively under these two types of shocks.

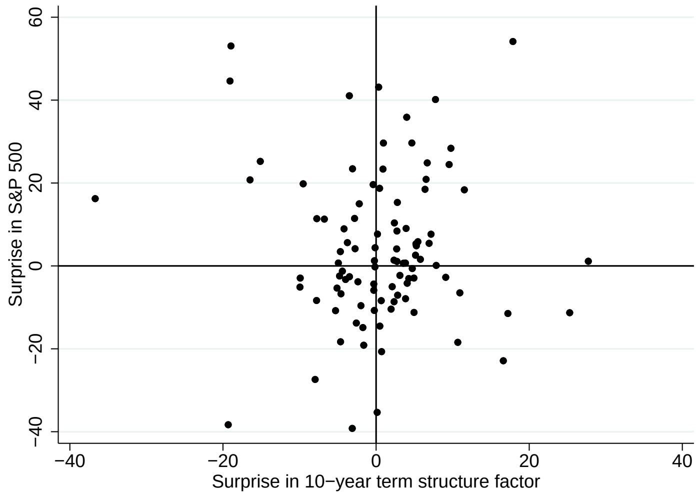

Figure 3: Term structure factor and stock price surprises at FOMC announcements

Notes: Horizontal axis in basis points, vertical axis in index points. Each dot represents one FOMC announcement between April 2007 and March 2019.

Table 2: Comparison of US monetary policy shock alternatives

	Mean	Std. Dev.	Nr. of obs. with negative co-movement	Nr. of obs. with positive co-movement
Term structure factor	0.55	8.81	41	56
Target factor	0.97	4.68	50	47
3-month FFR future	-0.30	2.96	24	22

Notes: The table shows summary statistics on US monetary policy shock measures at the 97 FOMC announcments between April 2007 and March 2019. An increase of the term structure (target) factor by one unit reflects a 100bps increase of the 10-year US Treasury (current month federal funds) rate. Mean and standard deviations (std. dev.) are given in bps. The third and forth column count the observations with negative and positive correlation with the change in the S&P 500 stock market index. The change of the 3-month federal funds rate (FFR) is zero for 51 observations.

The method is implemented in a VAR framework by aggregating the daily observations of monetary policy and stock market changes on FOMC announcement dates to monthly frequency. These two shock time series are then added alongside to the other variables in the VAR model. The negative and positive co-movement shocks are then disentangled by means of sign restrictions as shown in Table 3 in Appendix A.3.

While Jarociński and Karadi (2020) use changes of 3-month federal funds rate futures around the FOMC announcments, I construct a shock measure that captures changes of the monetary policy stance also in the longer end of the yield curve. I generate this monetary policy term structure shock using the method by Gürkaynak et al. (2005). To this end, I use end-of-day data on federal funds rate futures with maturities of up to 4 months and eurodollar futures with maturities of 6, 9, and 12 months. To also capture effects of monetary policy at the longer end of the yield curve, I add US Treasury rates with maturities of 2, 5, and 10 years to this set. Following the procedure by Gürkaynak et al. (2005), I calculate the first two principal components of this data set. After suitable transformations, these can be interpreted as a monetary policy 'target factor', capturing changes in the current monetary policy stance, and as a 'term structure factor', which captures monetary policy induced movements throughout the yield curve. I normalise the term structure factor such that an increase of the factor by one unit is equivalent to an increase of the 10-year Treasury rate by 100 basis points (bps). The resulting variable constitutes my measure of US monetary policy shocks for the analysis in Section 4.

Figure 3 plots the surprise changes of the term structure factor and stock prices at FOMC announcements. Table 2 provides summary statistics on the shock as well as a comparison between term structure factor, target factor, and the 3-month federal funds rate future. There are in total 97 FOMC announcements over the sample between April 2007 and March 2019, of which 41 are events with a negative co-movement with the stock market (to be found in the upper left and lower right quadrants of Figure 3), while 56 events feature a positive co-movement (lower left and upper right quadrants).

Comparing the standard deviations for the different shocks also exemplifies the importance of making use of changes over the whole term structure. As the federal funds rate was kept (close) to zero for an extended period time after the global financial crisis, the shock variation at the short-end of the yield curve is very limited compared to earlier decades. Most of the monetary policy adjustments post-crisis implied changes in the longer end of the term structure, though – for example, by means of central bank asset purchases or forward guidance. As a result, the standard deviation of the term structure factor is almost twice as high as for the target factor and almost three-times as high as for the 3-month federal funds rate future (Table 2).[8] In fact, at more than 50% (51 out of 97) of the FOMC announcements in this post financial crisis sample, the surprise changes of the 3-month federal funds rate are zero. Using this variable as a shock would, therefore, make it very difficult to identify effects of monetary policy. This highlights the importance using monetary policy surprise changes over the whole term structure. Since I am interested in the effects of a genuine monetary policy on global financial conditions in this paper, I will focus on those shocks with a negative co-movement between the monetary policy surprise and equity markets throughout the rest of the analysis.

[8] See also Figures 22 and 23 in Appendix A.3 for scatter plots of the target factor and the 3-month federal funds rate future against stock market changes.

4 Results

In this section, I show impulse response functions to the US monetary policy shock, identified as in Jarociński and Karadi (2020). After discussing the baseline model that is used throughout the whole analysis, Section 4.1 describes the reaction of investment fund flows for different asset classes and domicile/investment focus combinations. The flows are analysed at the global and the euro area level. Section 4.2, in turn, shows impulse responses for several financial and macroeconomic variables. The results provide evidence that US monetary policy shocks continue to be an important driver of global asset prices after the global financial crisis. The results also link the findings on investment fund flows to the transmission channels discussed in the introduction. The responses for all variables shown behave intuitively and in line with economic theory. This gives further confidence in the reliability of the identification scheme.

4.1 Investment fund flows and securities issuance

Figure 4 presents impulse responses of the variables in the baseline model to study the transmission of a loosening in global financial conditions, induced by US monetary policy, through the investment fund sector. The blue lines always give the median response of the variables' posterior distribution. The blue-shaded areas show the 68% credibility intervals and the grey-shaded areas display 90% credibility bands. The responses of all variables are given in percent, except for those of the VIX index that is used in levels. The surprise changes of the term structure and the S&P index are given in basis points and index points, respectively. The x-axis denotes the number of months after the shock.

The surprises in the US term structure and in the S&P 500 are the high-frequency measures that identify a US monetary policy shock as a negative co-movement between the two variables. As a result of the monetary shock, the US term structure factor decreases by about 4 bps, which translates into a reduction of the monthly US 10-year Treasury rate by about 5 bps on impact. At the same time, the high-frequency S&P 500 increases by 10 index points, translating into a 0.8% increase of the monthly S&P 500 series.

This expansionary monetary shock leads to increased risk appetite of global financial investors, as proxied by the VIX (Rey, 2015). After a short-lived initial increase for one month, risk aversion declines persistently and statistically significantly.

The loosening of US monetary policy leads to an immediate depreciation of the US Dollar relative to the Euro, which lasts about one year. This is in line with the results in Miranda-Agrippino and Rey (2020b). The result does not display a "delayed overshooting" of the exchange rate, which is often found in recursively identified VAR models, for example by Bruno and Shin (2015a).

In line with the discussed transmission channels, the nominal flows of international investors to global investment funds increase significantly and persistently. In response

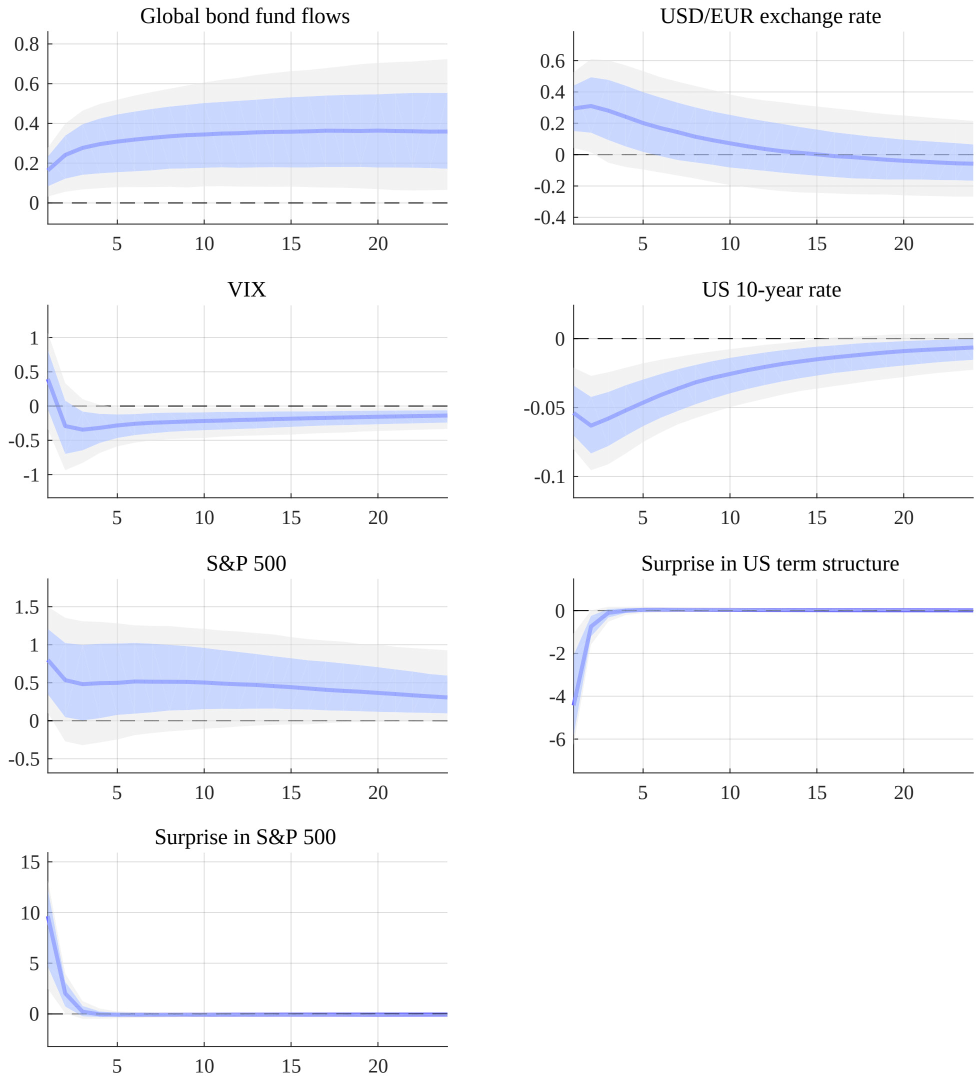

Figure 4: Impulse responses in baseline model with global bond fund flows

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 5 bps decrease of the ten-year US treasury rate (blue lines) with 68% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with high-frequency sign restriction identification.

to the about 5 bps reduction of the US 10-year rate, the flows to bond funds increase by up to 0.4%, with the maximum effect arising after 12 months. This finding provides the first line of evidence that the investment fund sector responds systematically at the international level to changes in US monetary policy, thereby transmitting this change in financial conditions globally.

Figure 5 shows results for breakdowns of investment fund flows in a wide range of different asset classes. While the response of the bond fund flows is repeated in the upper left panel to facilitate comparison, all other variables shown in the figure are added one by one to the baseline model of Figure 4 instead of the bond fund flows.[9]

The further responses show that the investor flows to global corporate (Panel 2) and

[9]The responses of the other variables in the baseline model that are not shown again are very close to those displayed in Figure 4 and are available upon request.

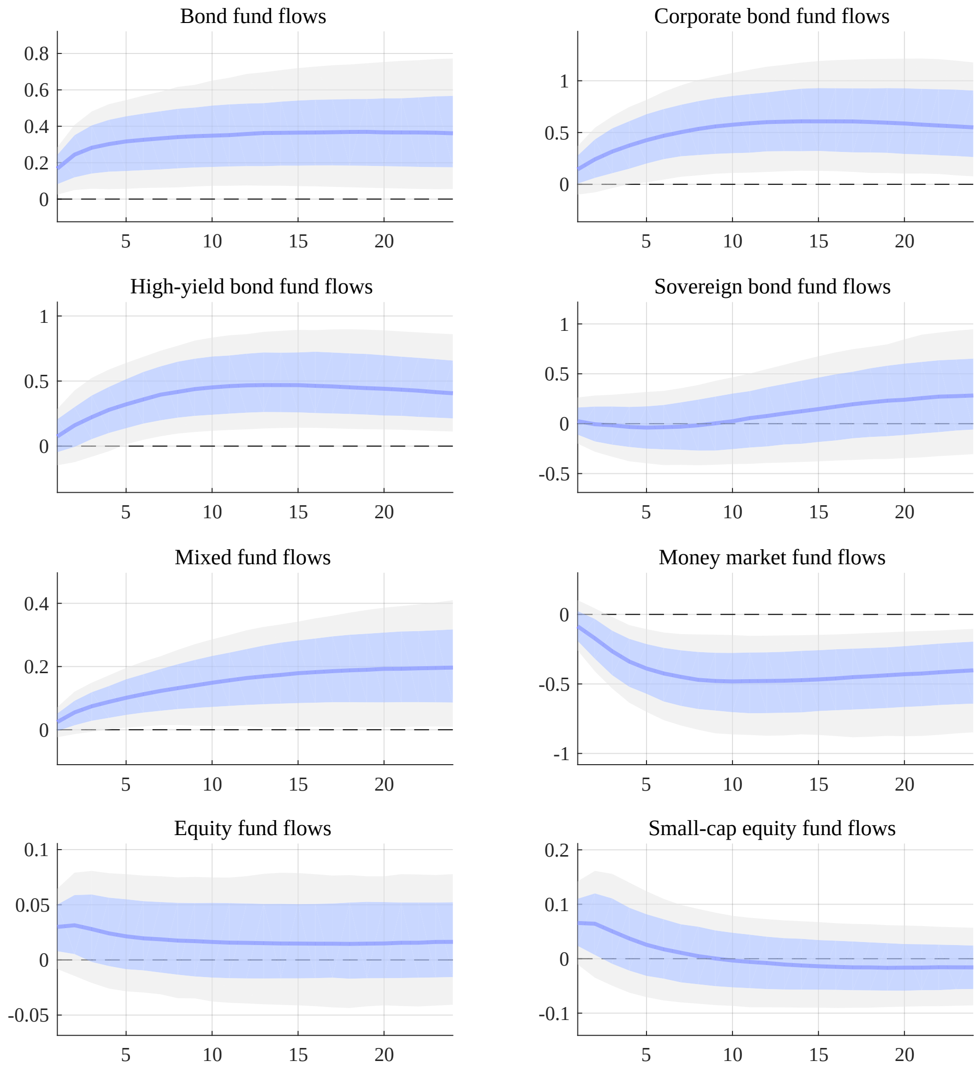

Figure 5: Impulse responses of global investment fund flows

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 5 bps decrease of the ten-year US treasury rate (blue lines) with 68% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with high-frequency sign restriction identification. Each variable added separately to the baseline model in Figure 4.

high-yield (Panel 3) bond funds also increase after the expansionary shock. In fact, flows to both categories increase by more than the overall global bond fund flows. The peak responses of these two asset classes read 0.6% and 0.5%, respectively, compared to 0.4% for the overall flows. By contrast, flows to sovereign bond funds (Panel 4) are insignificant, while money market funds (Panel 6) experience significant outflows at the global level. These findings are well aligned with the international risk-taking and search-for-yield channels as well as the observation of increased global risk appetite in Figure 4. Accordingly, investors increase their investments in global bond markets and they rebalance from less risky sovereign and money market funds to more risky corporate and high-yield bond funds.

The economic significance of these results can be gauged when the percentage flows are transformed to USD flows. According to the data by the Financial Stability Board (2020) shown in Figure 1, bond funds had about USD 11.5 trillion assets under management globally in 2018. Using the median coefficient of 0.4% for bond funds from the model and scaling the monetary policy shock up to 25 bps implies that global investor flows into bond funds increase persistently by about USD 200 billion.

Looking at further asset classes beyond bonds, mixed funds (Panel 5), which invest both in equity and debt securities, also see significant inflows after the shock. Inflows to equity funds (Panel 7) are positive. The impact effect 0.03% is relatively small and turns insignificant after a few months. Next to the response of the overall equity fund flows, I show the response for flows to equities issued by firms with a relatively small market capitalisation between USD 300 million and 2 billion (Panel 8). This market segment is considered to be riskier than the "large cap" segment. Price and return volatility of small caps are usually found to be larger than for large caps. The percentage increase of small caps is significantly more pronounced than the overall increase of equity flows. This finding is again indicative of a rebalancing to riskier segments of financial markets after a global monetary loosening.

Comparing the percentage coefficient to the assets under management of equity funds globally, which stood at USD 21 trillion in 2018, implies that equity funds experience inflows of about USD 33 billion in response to a 25 bps loosening of US monetary policy.[10]

As it is a special focus of the paper to analyse the transmission of global financial conditions to the euro area, I study the flows of global (i.e., non-domestic) investors towards funds that invest in European assets in Figure 6. Overall, these results are in line with those presented in Figure 5 before. Global funds investing in European assets experience significant inflows after a global monetary loosening.

Again there is evidence for a re-balancing towards riskier asset classes, such as corporate bonds, while flows to European money market funds decline.[11] Mixed funds are found to obtain inflows after the shock. While the flow response of global investors to European equity funds is insignificant, the relatively riskier small cap equity funds have strong significant inflows.

The results of Figure 6 make clear that European firms can obtain additional funding from international investment funds after a loosening of global financial conditions. These funds can therefore play an important role in transmitting the global financial cycle to the euro area.

In order to assess the transmission of global financial conditions to the euro area completely, it is also important to study the behaviour of investors that are domiciled within the euro area. EA-domiciled investment funds hold about 30% of the total investment

[10] The relatively smaller absolute response of equity funds compared to bond funds is hardly surprising when looking at the underlying raw data. As Figure 16, Appendix A.2 shows, cumulative flows to bond funds were much higher and fluctuated more widely than those for equity funds over the sample period.

[11] Assets under management and flows of internationally-domiciled sovereign and high-yield bond funds with a European investment focus are very small in the EPFR data. Results are therefore not shown for these two categories, but are broadly consistent with the findings in Figure 5.

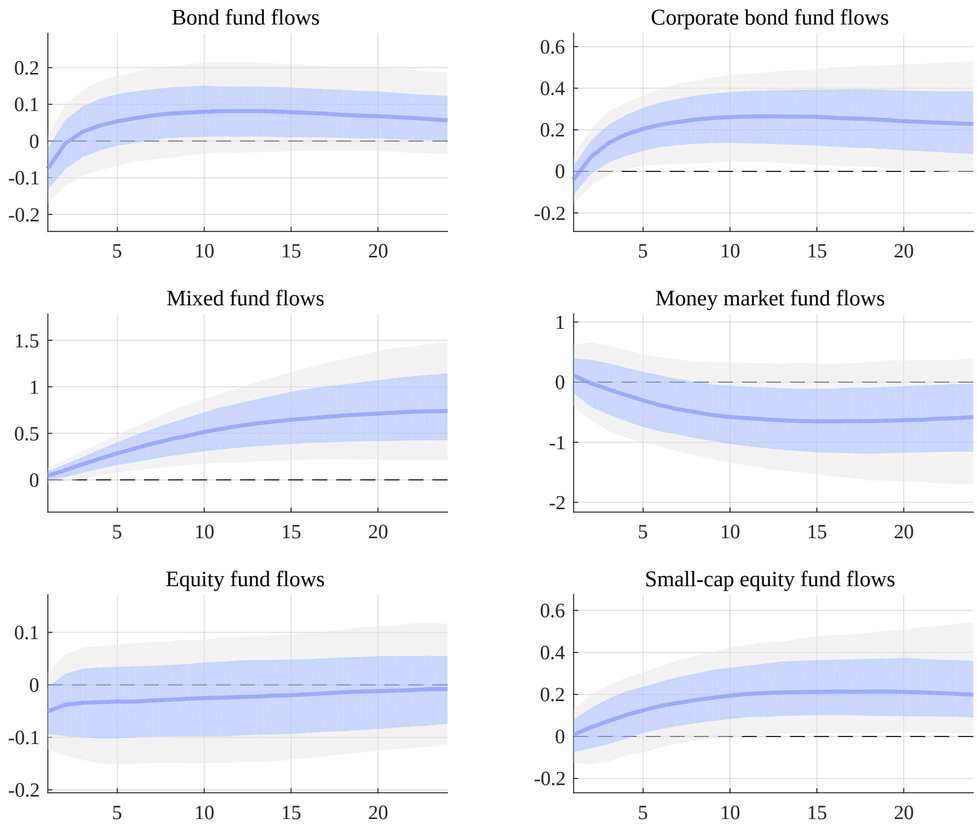

Figure 6: Impulse responses of global-to-EA investment fund flows

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 5 bps decrease of the ten-year US treasury rate (blue lines) with 68% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with high-frequency sign restriction identification. Each variable added separately to the baseline model in Figure 24.

fund sector assets globally.[12]

Figure 7 shows flow responses of EA-domiciled investors to funds investing in European assets. To take into account that these fund flows stem from domestic investors, I add a BBB-bond spread to the underlying model instead of the of the exchange rate (see Figure 25, Appendix B). Jarociński and Karadi (2020) use this variable as a measure for financial frictions in the euro area and find that it is important to explain macroeconomic dynamics after monetary shocks. Figure 7 shows that EA investors increase their flows to funds with European investment focus significantly across all asset classes. European corporate and high-yield bond funds obtain persistently higher inflows of more than 0.7% and 1% respectively, while flows to mixed funds increase by about 0.5%. Flows to equity funds increase by about 0.1%. The riskier small-cap equity category obtains additional inflows of 0.5%.

These findings can again be seen as evidence for an international risk-taking channel. Domestic euro area investors increase their exposures to riskier asset classes in their home markets in response to a loosening of financial conditions abroad. The results can also be

[12]See Figure 20, Appendix A.2 for an overview of the growth of the euro area investment fund sector since the global financial crisis.

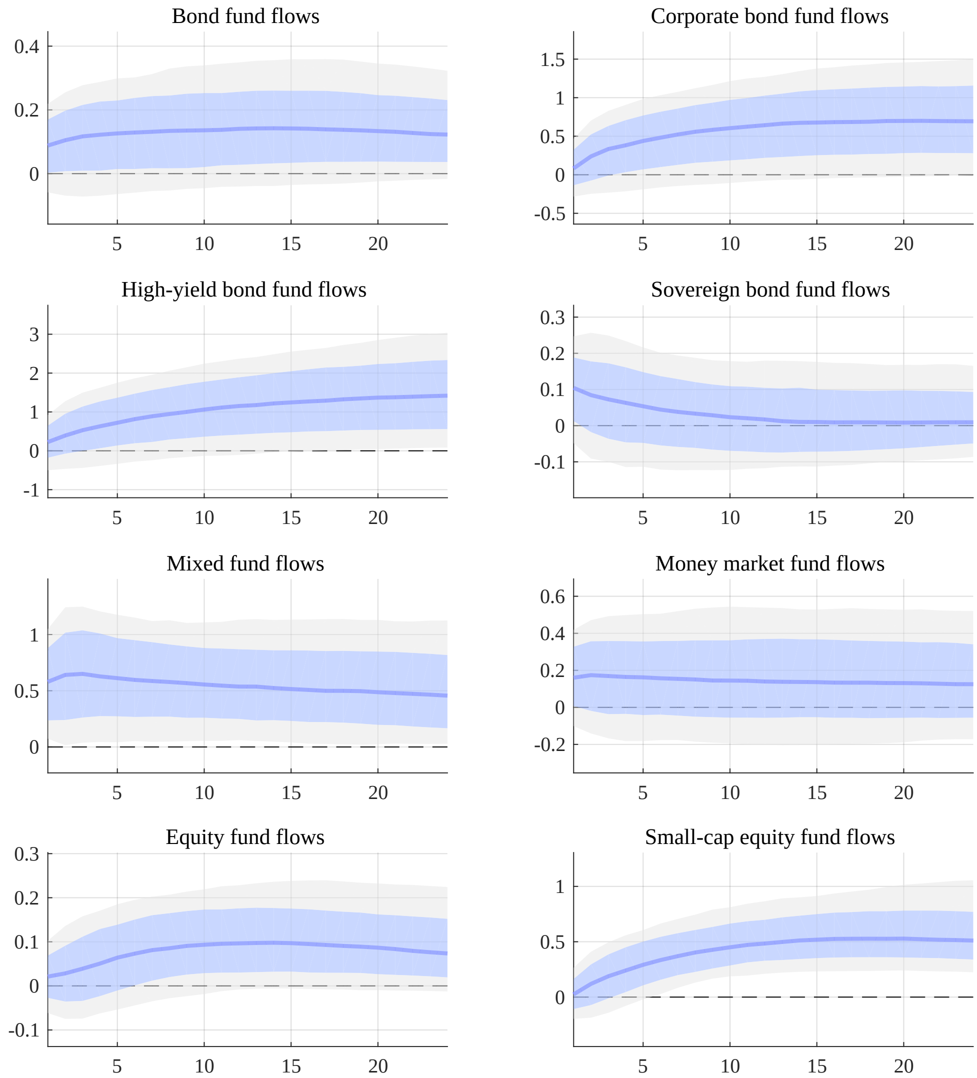

Figure 7: Impulse responses of EA-to-EA investment fund flows

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 5 bps decrease of the ten-year US treasury rate (blue lines) with 68% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with high-frequency sign restriction identification. Each variable added separately to the baseline model in Figure 25.

interpreted as searching for yield behaviour of euro area investors, since European assets could offer relatively more attractive returns than US (or more broadly international) assets after the US monetary accommodation.

As opposed to global investors, EA investors also increase their flows to the less risky sovereign bond and money market funds. Both responses in Figure 7 are only statistically significant at the 68% credibility band for the first few months, but the median responses stay positive for about one year for sovereign bond and for longer than two years for the money market funds. This behaviour can also be rationalised by searching for yield motives amidst the reduction of risk-free rates in the US. EA investors that aim to invest a certain share of their portfolios in safe assets might be incentivised to reduce their holdings of safe international assets, such as US Treasuries, and move to European sovereign bonds, which offer a relatively higher return. Section 4.2 provides some evidence that supports this reasoning.

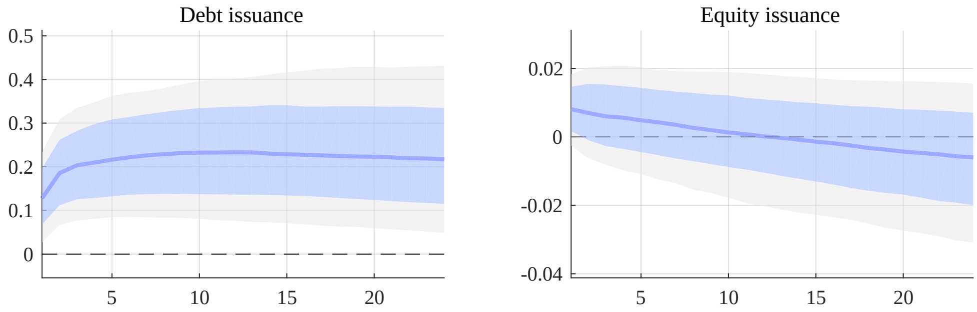

Figure 8: Impulse responses of EA securities issuance

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 5 bps decrease of the ten-year US treasury rate (blue lines) with 68% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with high-frequency sign restriction identification. Each variable added separately to the baseline model in Figure 4.

The analysis so far focussed on the investment fund flows and, hence, the demand-side reaction of securities markets after a global financial loosening. To assess to what extent these flows do not only lead to higher asset prices or share buybacks (Acharya and Plantin, 2018), it is important to also study the supply side of debt and equity markets. Figure 8 shows the responses of the outstanding amounts of debt and equity of euro area non-financial corporations.

The issuance of debt securities increases significantly by about 0.2%. Given the total amount outstanding of euro area NFC debt of EUR 1.4 trillion in 2019, this implies an increase of about EUR 14 billion after a 25 bps monetary policy shock. Parallel to the much smaller inflows to equity funds, listed shares outstanding increase by 0.01% only, corresponding to about EUR 3 billion. Compared to the effect of debt outstanding, this impulse is relatively short-lived and it turns insignificant after two months.

According to the ECB Securities Holding Statistics, domestic and foreign investment funds held up to 50% of debt securities issued by euro area NFCs in 2019, while euro area banks only held about 8%.[13] Although investment funds are, therefore, not the sole driver of the increased debt issuance, they are likely to contribute the single most to the improving financing conditions for EA firms after a global monetary loosening by absorbing a large share of any newly issued debt. In this way, firms will be relatively less constrained to finance new investments and to expand their operations. The increased investment fund flows can, hence, also affect real macroeconomic activity, which will be analysed in the next section. This nexus constitutes another important finding of this paper.

[13]See Figure 21, Appendix A.2 for an overview of the investor base of debt issued by euro area NFCs. Euro area NBFIs in total held about 70% of euro area NFC debt, of which investment and money market funds were the largest individual sector, responsible for about one third of the total. Foreign (non-euro area) investors held another 17%, which, as argued earlier, also mainly consist of investment funds (see Figure 2).

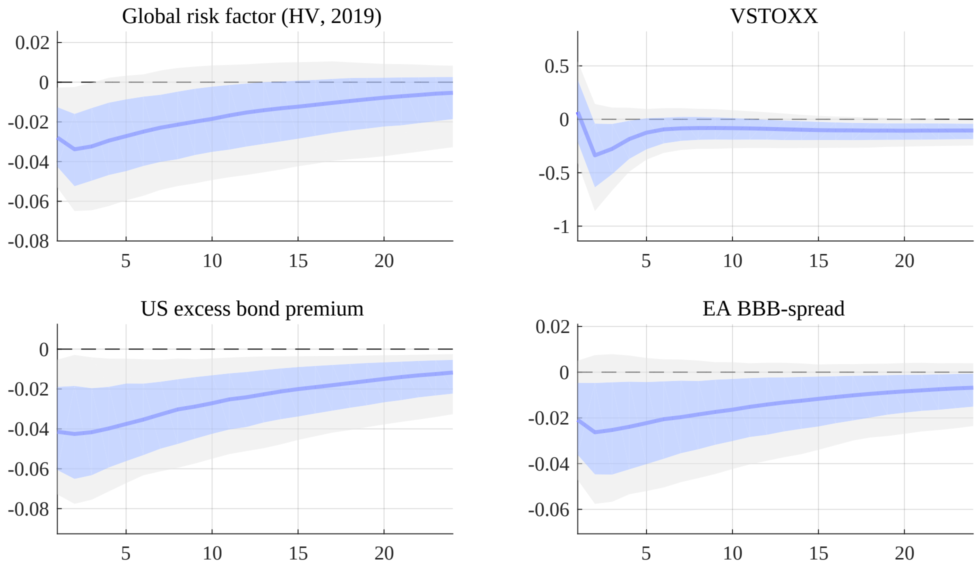

Figure 9: Impulse responses of global risk and uncertainty

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 5 bps decrease of the ten-year US treasury rate (blue lines) with 68% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with high-frequency sign restriction identification. Each variable added separately to the baseline model in Figure 4. HV, 2019 denotes global risk factor by Habib and Venditti (2019). US excess bond premium is taken from Gilchrist and Zakrajšek (2012).

4.2 Financial transmission and macroeconomic effects

This section presents evidence that the investment fund flow responses can be rationalised with the transmission channels discussed in the introduction – the international risk-taking channel, the search-for-yield channel, and pro-cyclical flow-performance relations. It also analyses to what extent these financial effects spill-over to the macroeconomy and the banking sector of the US and the EA in the post global financial crisis episode. Again, all variables shown are added one by one using the marginal approach to the baseline model presented in Figure 4.

Figure 9 analyses the effects of the US monetary policy shock on global risk sentiment, financial uncertainty and frictions. The baseline model showed that the VIX as a measure for investor risk sentiment declines after the loosening of US monetary policy. This finding is corroborated by the global risk factor of Habib and Venditti (2019), which also declines significantly and persistently on impact. This index represents the global component of expected stock returns and provides a further concise measure for the global financial cycle. A decline of the variable indicates less global financial risk. The figure shows next that also the VSTOXX, the volatility index for the Euro Stoxx 50, declines in response to the US monetary easing, indicating that expected market volatility and risk aversion also decline in the euro area. In sum, these responses provide a clear indication for increased global risk appetite of investors after a loosening of monetary policy in the US. In line with an international risk-taking channel of monetary policy, this is one explanation for the higher investment fund flows – particularly to the riskier market segments – that were discussed in the previous section.

While the volatility indices and the global risk factor focus on equity markets, I analyse credit spread variables to study changing conditions in US and EA bond markets as well. For the US, I use the excess bond premium by Gilchrist and Zakrajšek (2012), which is an average corporate bond spread from which default risk is removed. Gertler and Karadi (2015) argue it can, therefore, be interpreted as a measure for financial frictions in the economy. Moreover, the excess bond premium is shown to have excellent properties in forecasting economic activity. Caldara and Herbst (2019) show that it improves the reliability and forecasting performance of macro VAR models significantly for this reason. For the EA, I follow Jarociński and Karadi (2020) in using the spread between BBB-rated bonds of non-financial corporations and the Bund yield, where the latter serves as the measure for the euro area risk-free rate. The impulse responses in Figure 9 show that the bond risk spreads decrease significantly in both regions. The US excess bond premium reacts relatively stronger by -4 bps on impact, while the EA BBB-spread declines by 2 bps. Financial frictions and financing conditions for NFCs in both regions, accordingly, ease after the monetary shock.

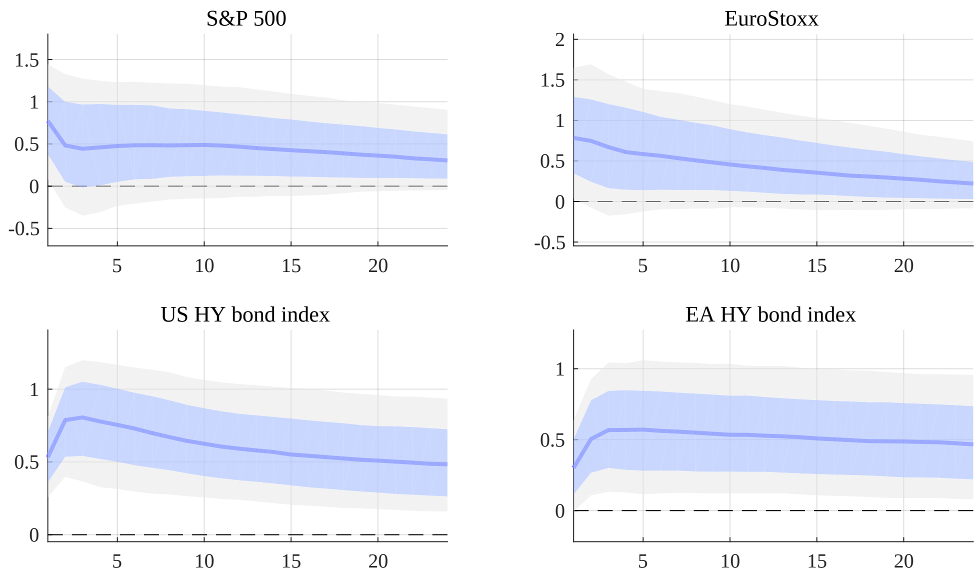

Figure 10: Impulse responses of equity and bond market indices

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 5 bps decrease of the ten-year US treasury rate (blue lines) with 68% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with high-frequency sign restriction identification. Each variable added separately to the baseline model in Figure 4.

Related to Figure 9, I study the reaction and international co-movement of risky asset prices in the US and the EA in Figure 10 in greater detail. The figure shows the impulse responses of the Standard & Poors 500 and the EuroStoxx 50 equity indices as well as indices for the high-yield segments of EA and US bond markets. In both regions, all measures increase persistently after the interest rate decline. This implies more attractive conditions for firms who seek for additional funding on bond and equity markets. As they also imply higher investment returns, the higher asset prices may also reinforce the investor flows visible in Section 4.1 due to pro-cyclical flow-performance behaviour (Timmer, 2018; Goldstein et al., 2017; Feroli et al., 2014). Overall, the findings in Figure 9 and 10 are consistent with the observation of the literature initiated by Rey (2015) on a global financial cycle in risky asset prices. While this literature so far mainly analysed the episode before the global financial crisis, I confirm that these findings also extend to the post-crisis time.

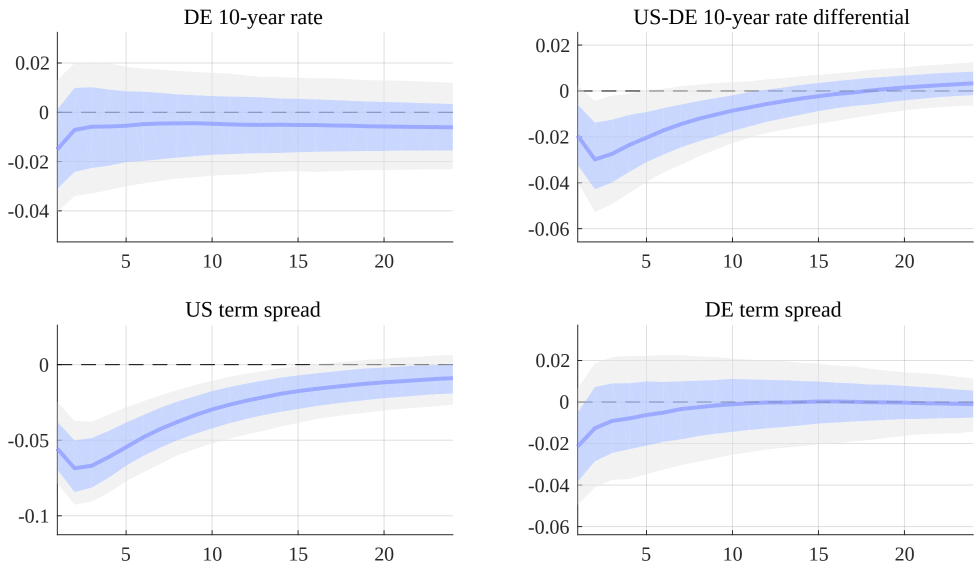

Figure 11: Impulse responses of interest rate differentials

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 5 bps decrease of the ten-year US treasury rate (blue lines) with 68% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with high-frequency sign restriction identification. Each variable added separately to the baseline model in Figure 4. Term spreads calculated as difference between 10- and 1-year US Treasury and German Bund (DE) rates, respectively.

Figure 11 analyses the transmission channel via interest rate differentials between the two currency areas in combination with globally active investors that search for yield. The figure shows that a monetary expansion in the US is not followed by a statistically significant loosening of the EA monetary policy stance, as measured by the 10-year German Bund rate. This finding differs from Miranda-Agrippino and Rey (2020b), who find that the ECB adjusts its policy systematically after US monetary policy changes in their pre-crisis sample – be it for reasons related to a "fear of floating" or due to endogenous economic developments in the euro area. As a consequence, the interest rate differential between the 10-year US and EA interest rates (the latter again proxied by the German Bund rate) decreases significantly. This observation is, hence, supportive of the hypothesis that global investors adjust their portfolios towards relatively higher yielding international and in particular European assets after the shock (Ammer et al., 2019), as shown in Figures 5 and 6.

Figure 11 also shows that the term spread in the US, measured as the difference between the 10- and the 1-year Treasury rate declines significantly by about 5 bps and thus by the same amount as the 10-year rate itself. The shock accordingly implies a flattening of the yield curve. This provides a consistency check of the construction of the shock, which aims to capture monetary policy effects in the longer end of the term structure. It is also in line with the fact that monetary policy for the largest part of my sample predominantly aimed to control the steepness of the yield curve, while its short end remained at relatively low levels. Consistent with the small insignificant response of the German 10-year rate, the Bund term spread only reacts mildly as well. The yield curve flattens by 2 bps on impact, but the response turns statistically insignificant after two months already.

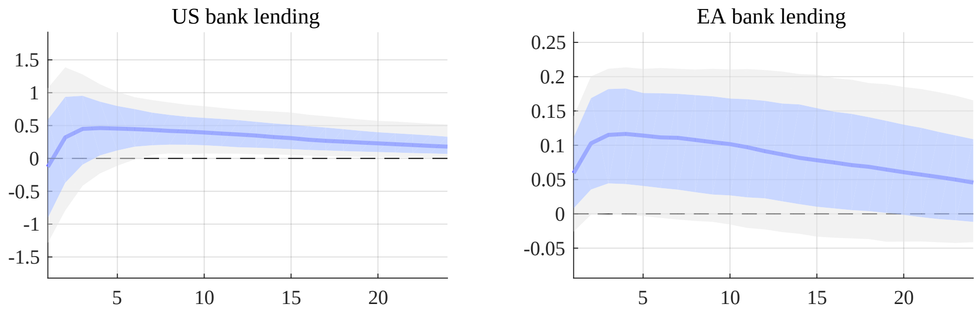

Figure 12: Impulse responses of bank lending

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 5 bps decrease of the ten-year US treasury rate (blue lines) with 68% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with high-frequency sign restriction identification. Each variable added separately to the baseline model in Figure 4. Model with US (EA) bank lending additionally includes the excess bond premium (BBB-spread).

The response of bank lending in both regions is explored in Figure 12. The estimated models additionally include the excess bond premium (BBB-spread) when US (EA) lending is added. In line with standard bank lending and credit channels of monetary policy, US banks increase their loan origination significantly with a peak response of 0.5%, which is reached four months after the shock. Interestingly, and in line with the observed easing in global financial conditions, EA banks also increase their lending operations. The effect is much smaller than in the US with a peak response of about 0.1% and it stays significant at the 68% credibility level for one and a half years.

Finally, the question whether the observed financial spill-overs also have an impact on EA macroeconomic indicators is explored in Figure 13. As a reference, the figure also shows results for US variables. The US and EA variables are again added jointly with the excess bond premium or the BBB-spread, respectively.

Industrial production increases in both regions after the US monetary shock, which is line with the findings by Miranda-Agrippino and Rey (2020b). The response of US industrial production turns significant after seven months and reaches a peak of almost 0.2% after about one year. The response of EA industrial production is estimated less precisely. It turns significant after 13 months when it also reaches its peak of about 0.1%. Although this increase in EA real economic activity is certainly due to a combination

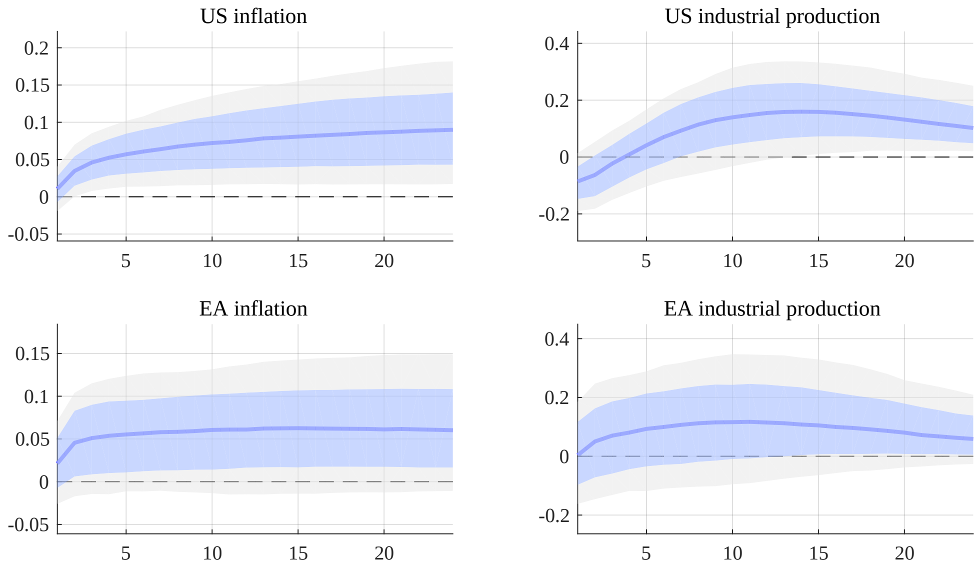

Figure 13: Impulse responses of macro variables

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 5 bps decrease of the ten-year US treasury rate (blue lines) with 68% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with high-frequency sign restriction identification. Each variable added separately to the baseline model in Figure 4. Models with US (EA) macro variables additionally include the excess bond premium (BBB-spread).

of several transmission channels, it is clearly also consistent with the observed rise in EA private-sector bond issuance, which leaves firms with more capacity to finance new equipment and create new jobs that would ultimately lead to an increase of industrial production and GDP.

Consumer price inflation also rises in both the US and the EA, where again the effects are stronger and more significant in the US. As a consequence of the result that changes in global financial conditions can directly affect euro area inflation, the ECB would need to consider these effects when determining euro area monetary policy.

5 Sensitivity analysis

This section discusses a series of robustness checks for the main results of the paper.

First, I analyse the robustness of the main results with respect to the identification scheme of the VAR. Figure 14 shows the baseline model using a standard high-frequency identification instead of the more involved Jarociński and Karadi (2020) approach. In the standard approach, the high-frequency monetary surprise factor continues to be part of the model, but the surpise change of the S&P 500 index is left out. The model is then identified with the Cholesky decomposition, where the high-frequency variable is ordered first.[14] This implies that all other variables in the VAR can respond contemporaneously to the monetary policy shock, while monetary policy responds to all further variables only

[14]This procedure is closely related to the external instruments approach proposed by Gertler and Karadi (2015) and it is also used by Jarociński and Karadi (2020) for comparison purposes.

with a lag. Given the high speed with which all the financial variables used in the model react to news, this ordering is very plausible. Moreover, it also mirrors “the periodic decision making process at the Federal Reserve and the slowly evolving implementation of monetary policy,” as argued by Bruno and Shin (2015a).

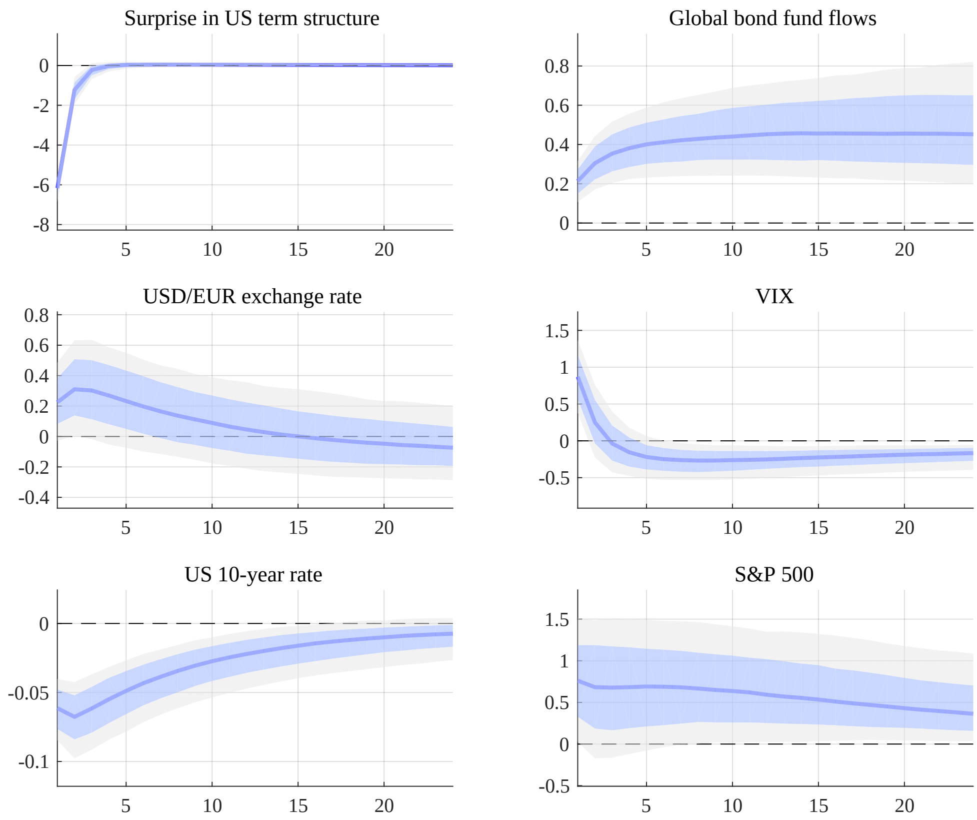

Figure 14: Impulse responses in baseline model with standard high-frequency identification

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 6 bps decrease of the ten-year US treasury rate (blue lines) with 68% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with high-frequency Cholesky identification. High-frequency monetary policy indicator (surprise in US term structure) ordered first.

Figure 14 makes clear that the responses of all variables in the baseline from Figure 4 are highly robust when using the standard high-frequency approach, both qualitatively and quantitatively. Figure 26, Appendix B confirms that this also holds for all investment fund flow types depicted in Figure 5.

To prove that the results do not depend on the selection of the specific monetary policy shock indicator and the high-frequency approach in general, I demonstrate that similar results can also be obtained using a conventional Cholesky identification of the monetary policy shock without making use of high-frequency data. To this end, I add the Wu and Xia (2016) shadow federal funds rate as the monetary policy indicator to the model. This variable is an adjusted federal funds rate that takes into account the effects of the unconventional measures that were conducted while the effective federal funds rate was close to its zero lower bound. Figure 15 shows results for the baseline model. The shadow federal funds rate decreases by 13 bps on impact. As with the high-frequency

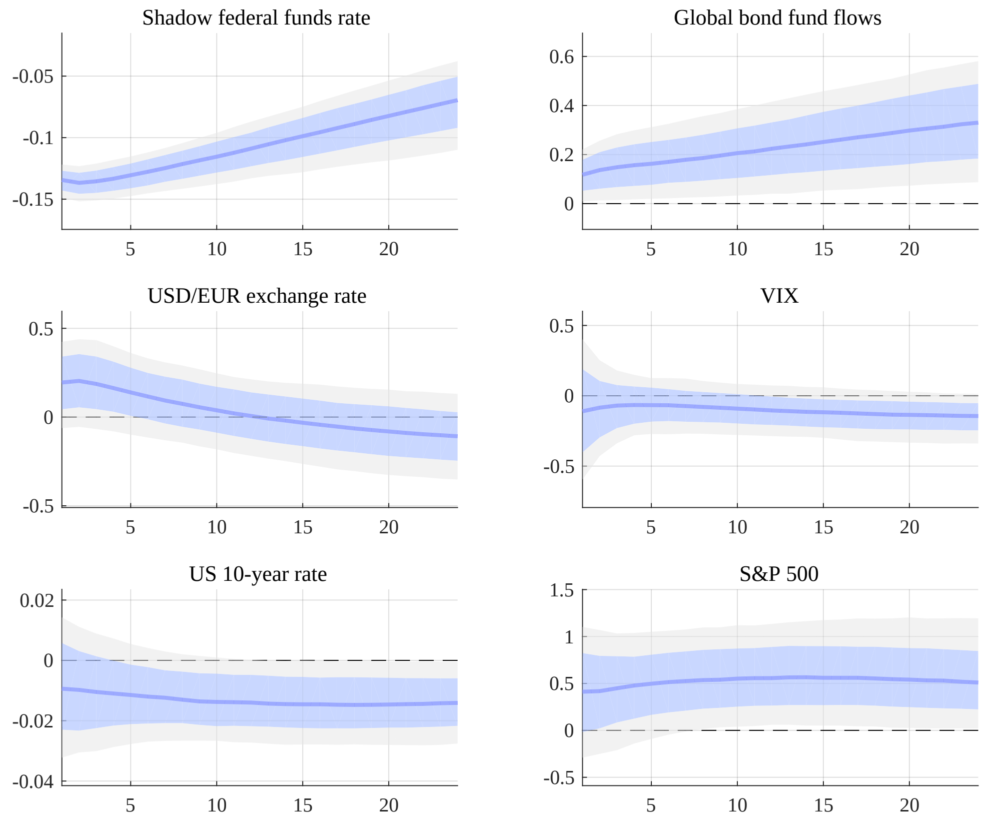

Figure 15: Impulse responses in baseline model with recursive identification

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 1 bps decrease of the ten-year US treasury rate (blue lines) with 68% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with Cholesky recursive identification. Wu and Xia (2016) shadow federal funds rate is used as monetary policy indicator and is ordered first.

methods, this leads to a depreciation of the dollar relative to the euro, a reduction of the VIX, an increase of the S&P 500 index, and inflows to global bond funds. Figure 27, Appendix B shows that the results are robust also for the further investment fund flow categories.

As a final check, I analyse the robustness of the results in a sample that starts in June 2009 when the US recession due to the global financial crisis was declared to be over. This reduces the sample size further to only 118 observations. Results can be found in Figures 28 and 29, Appendix B. The responses of the exchange rate and the S&P 500 index are now mostly insignificant. The VIX still decreases after the shock, but the initial positive spike now lasts for six months. Nevertheless, all bond fund flows maintain the correct signs and remain to be highly significant. In line with the rebalancing to riskier assets, sovereign bond funds are now also found to experience outflows. The equity fund flows are estimated insignificantly, however, and they even become negative in case of the small cap flows. This last somewhat odd finding is related to the negative insignificant reaction of the S&P equity index, which weighs down on the reaction of the fund flows.

6 Conclusion

This paper provides empirical evidence for substantial spill-overs from changes in global financial conditions, induced by US monetary policy, to the euro area during the period between 2007 and 2019, covering the second phase of global liquidity. The results are consistent with a transmission of these spill-overs through the growing investment fund sector. The results suggest that a loosening of US monetary policy leads to inflows to the investment fund sector globally and within the euro area, especially on corporate bond markets. These inflows are particularly strong for the riskier segments of financial markets and they also coincide with increased securities issuance by EA non-financial corporations. The latter observation indicates a relevance of these financial spill-overs for the real economy. The findings demonstrate the growing importance of non-bank financial intermediation over the last decade and have important policy implications for monetary and financial stability.

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Appendix

A Data

A.1 Data sources and description

This appendix gives a brief description of all variables used in the analysis together with their source and the transformation applied.

- Investment fund variables: Monthly nominal net portfolio flows of investment funds calculated as cumulative percentage flows of lagged assets under management relative to sample starting point in April 2007.

  Asset classes used:

  - All bond funds
  - Corporate / sovereign bond funds
  - High-yield bond funds
  - Money market funds
  - Mixed funds, which consists of all multi asset funds
  - All equity funds
  - Small cap equity, which includes equities of firms with a market capitalisation between USD 300 million and 2 billion

  Investment focus-domicile combinations:

  - Global investment focus, global domicile
  - Regional investment focus "Western Europe", domiciled in the euro area (EA-12)
  - Regional investment focus "Western Europe", domiciled outside the euro area (EA-12)

  Source: EPFR Global

- Debt securities issuance: Notional stocks of all securities issued by euro area non-financial corporations. Source: ECB Securities Statistics; data set mnemonic [SEC]. Transformed to logs.

- Equity issuance: Notional stocks of all equity shares issued by euro area non-financial corporations. Source: ECB Securities Statistics; data set mnemonic [SEC]. Transformed to logs.

- DE government bond rates: German 1, 3, 10-year government benchmark bond yield. Source: ECB Financial Market Data; data set mnemonic [FM]. No further transformations.
- US Treasury rates: 1, 10-year treasury constant maturity rate. Source: FRB of St. Louis FRED; mnemonic [GS]. No further transformations.
- Shadow federal funds rate. Source: Wu and Xia (2016). No further transformations.
- US Dollar/Euro exchange rate: ECB reference exchange rate, US dollar/Euro, 2:15 pm (C.E.T.). Source: ECB Exchange Rates; data set mnemonic [EXR]. Transformed to logs.
- Eurostoxx stock index: Dow Jones Euro Stoxx 50 Index - Historical close. Source: ECB Financial Market Data; data set mnemonic [FM]. Transformed to annual growth rates.
- S&P 500 stock index: Standard and Poors 500 Index - Historical close. Source: ECB Financial Market Data; mnemonic [FM]. Transformed to annual growth rates.
- VIX volatility index. Source: Datastream; mnemonic [CBOEVIX]. No further transformations.
- VSTOXX volatility index. Source: Datastream; mnemonic [VSTOXXI]. No further transformations.
- Global risk factor. Source: Habib and Venditti (2019). No further transformations.
- Excess bond premium: Financial friction index for the United States. Source: Gilchrist and Zakrajšek (2012). No further transformations.
- EA BBB-spread: Spread between iBoxx Euro BBB-rated non-financial corporates yield index; residual maturity 3-5 years; and 3-year German government benchmark bond yield. Source: ECB Financial Market Data; data set mnemonic [FM]. No further transformations.
- European HY bond index: Bloomberg Barclays Pan-European High Yield (Euro) TR Index Value Unhedged EUR. Source: Bloomberg; mnemonic [LP02TREU:IND]. Transformed to logs.
- US HY bond index: Bloomberg Barclays US Corporate High Yield Total Return Index Value Unhedged USD. Source: Bloomberg; mnemonic [LF98TRUU:IND]. Transformed to logs.
- EA industrial production: Industrial production for the euro area; total industry (excluding construction) - NACE Rev2; monthly index. Source: ECB Short-Term Statistics; data set mnemonic [STS]. Transformed to annual growth rates.

- US industrial production: Industrial production index; monthly index 2012=100. Source: FRB of St. Louis FRED; mnemonic [INDPRO]. Transformed to annual growth rates.

- EA inflation: HICP - overall index, monthly index. Source: ECB Indices of Consumer Prices; mnemonic [ICP]. Transformed to annual growth rates.

- US inflation: Consumer Price Index for All Urban Consumers: All Items; monthly index 1982-1984=100. Source: FRB of St. Louis FRED; mnemonic [CPIAUCSL]. Transformed to annual growth rates.

- US bank lending: Commercial and Industrial Loans, All Commercial Banks; outstanding amounts in US Dollar. Source: FRB of St. Louis FRED; mnemonic [BUSLOANS]. Transformed to annual growth rates.

- EA bank lending: Loans reported by monetary financial institutions excluding ESCB in the euro area; outstanding amounts in EUR. Source: ECB Balance Sheet Item Statistics; data set mnemonic [BSI]. Transformed to annual growth rates.

High-frequency data used to construct monetary policy shock measures:

- 30-day federal funds rate futures: continuous contract for the front month and for delivery in 2, 3, 4 months; daily frequency; basis points. Source: Bloomberg; mnemonic [FF Comdty].

- Eurodollar futures: continuous contract for delivery in 6, 9, 12 months; daily frequency; basis points. Source: Bloomberg; mnemonic [ED Comdty].

- US Treasury rates: 2, 5, 10-year treasury constant maturity rate; daily frequency. Source: FRB of St. Louis FRED; mnemonic [DGS].

- S&P 500 equity stock index: daily frequency. Source: Bloomberg; mnemonic [SPX:IND].

A.2 Additional overview charts

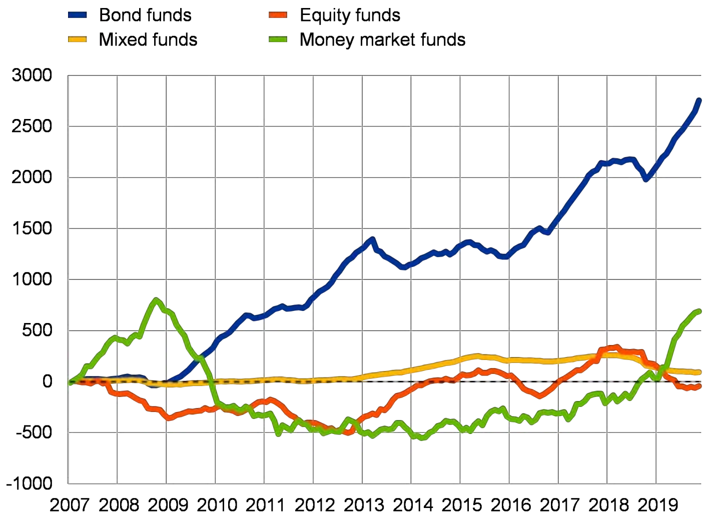

Figure 16: Cumulative global investment fund flows

Notes: Cumulative nominal monthly global flows into different investment fund classes relative to April 2007. Axis unit: USD billion.

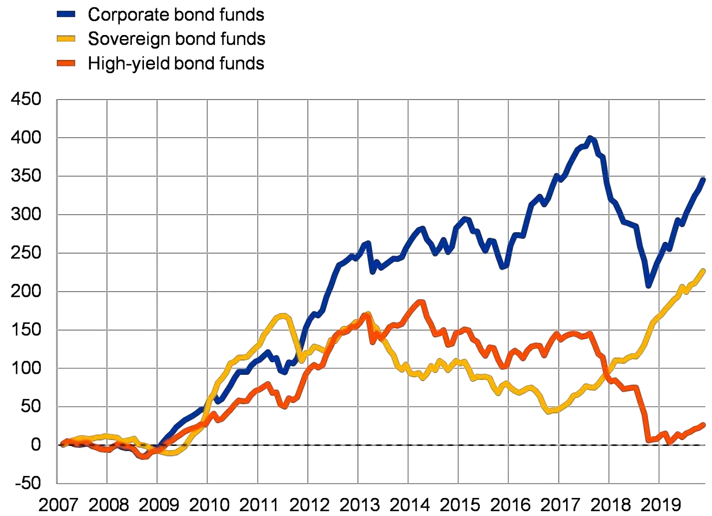

Figure 17: Cumulative global bond investment fund flows

Notes: Cumulative nominal monthly global flows into different bond fund classes relative to April 2007. Axis unit: USD billion.

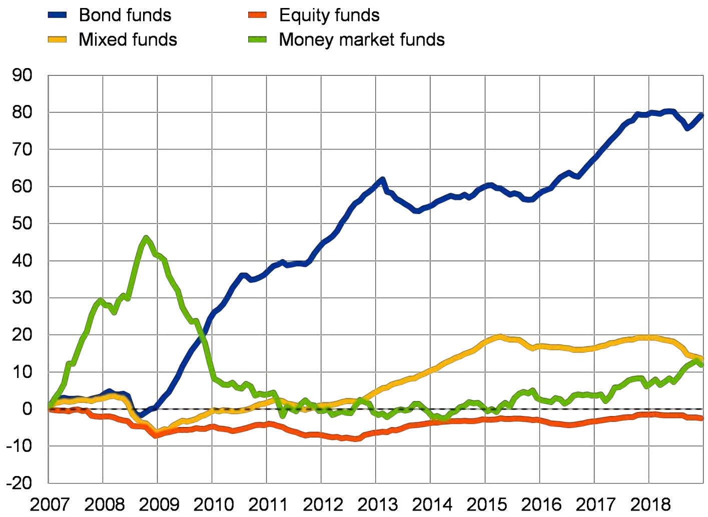

Figure 18: Cumulative percentage global investment fund flows

Notes: Cumulative monthly global flows into different investment fund classes in percent of lagged assets under management relative to April 2007. Construction follows methodology by EPFR Global. Variables as used in BVAR models in Section 4. Axis unit: percentages.

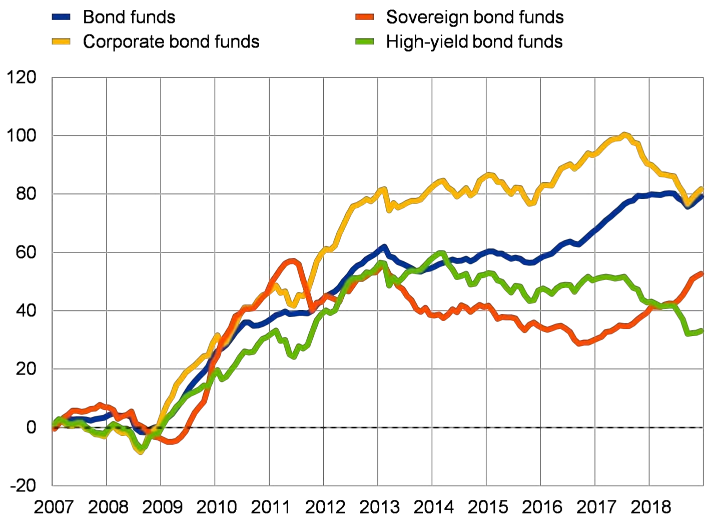

Figure 19: Cumulative percentage global bond investment fund flows

Notes: Cumulative monthly global flows into different bond fund classes in percent of lagged assets under management relative to April 2007. Construction follows methodology by EPFR Global. Variables as used in BVAR models in Section 4. Axis unit: percentages.

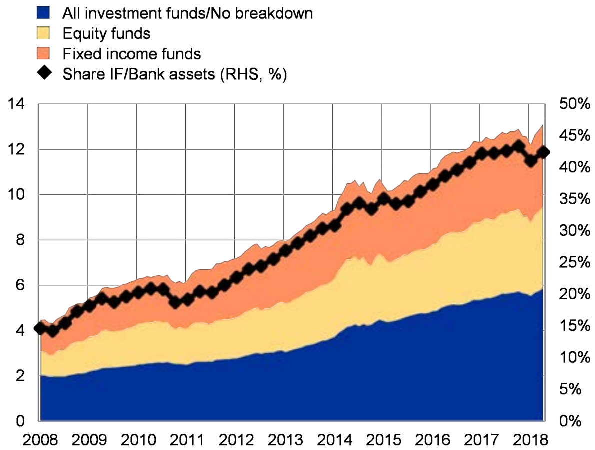

Figure 20: Total assets under management of euro area investment funds

Notes: Left axis unit: EUR trillion. Right axis unit: percentages. Black diamond line shows percentage ratio of total assets of investment funds relative to banks in the euro area.

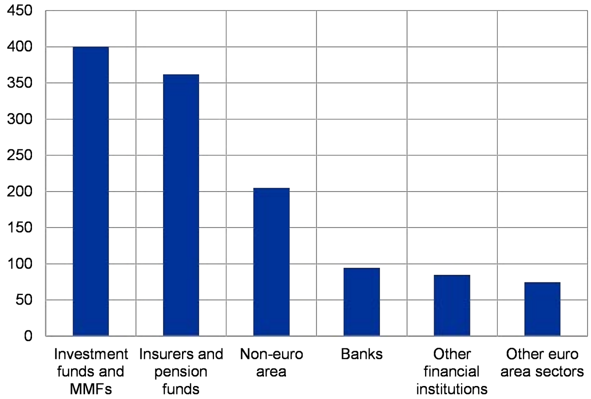

Figure 21: Investor base of bonds issued by euro area non-financial corporations

Notes: Axis unit: EUR billion. Data shown for end of 2019.

Data source: ECB Securities Holding Statistics

A.3 Monetary policy shock identification

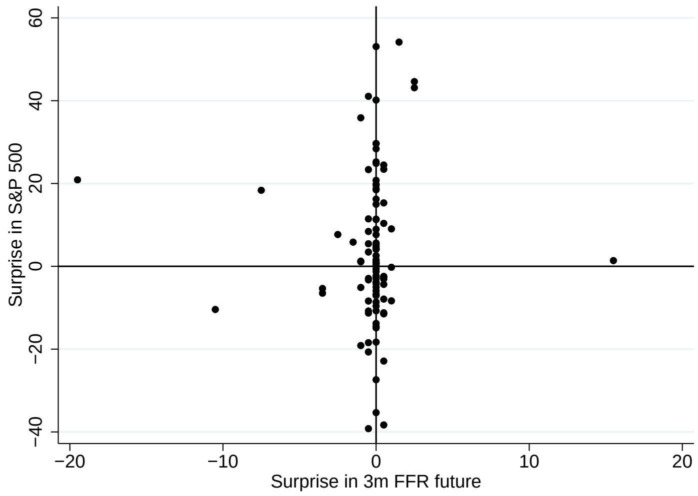

Figure 22: 3-months federal funds rate future and stock price surprises at FOMC announcements

Notes: Horizontal axis in basis points, vertical axis in index points. Each dot represents one FOMC announcement between April 2007 and March 2019.

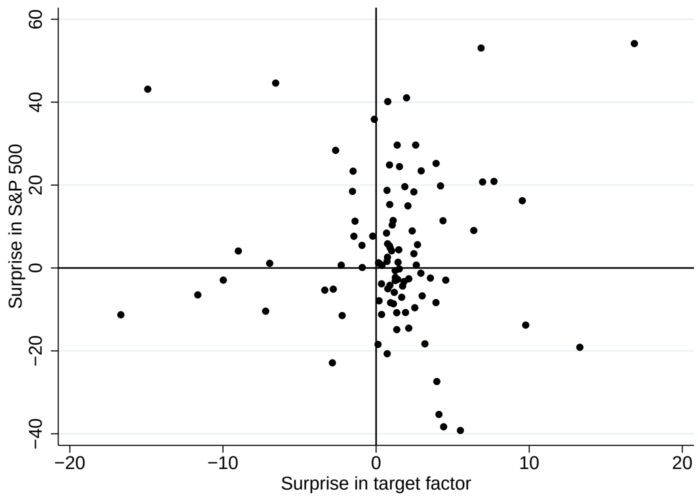

Figure 23: Target factor and stock price surprises at FOMC announcements

Notes: Horizontal axis in basis points, vertical axis in index points. Each dot represents one FOMC announcement between April 2007 and March 2019.

Table 3: Identifying restrictions in VAR model under Jarociński-Karadi method

	Shock type		
	Monetary policy	CB information	other
Variables	(negative co-movement)	(positive co-movement)	
High-frequency:			
Interest rate measure	+	+	0
Stock index	-	+	0
Low-frequency:			
Investment fund flows etc.	•	•	•

Notes: Table shows restrictions on the contemporaneous responses of variables to shocks to implement the identification method by Jarociński and Karadi (2020). +, -, and 0 denote sign and zero restrictions, while • denotes unrestricted responses.

B Additional results

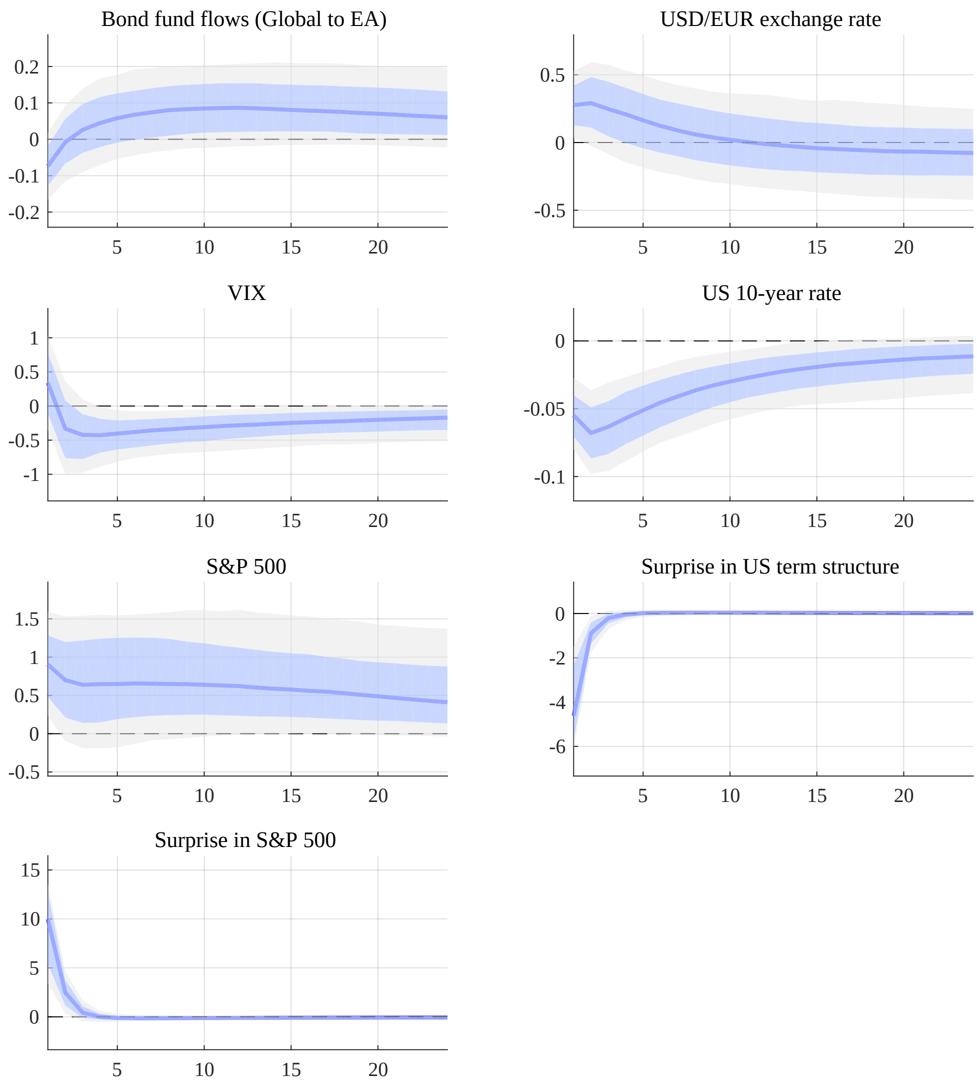

Figure 24: Impulse responses of baseline model for global-to-euro-area investment fund flows

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 5 bps decrease of the ten-year US treasury rate (blue lines) with 68% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with high-frequency sign restriction identification.

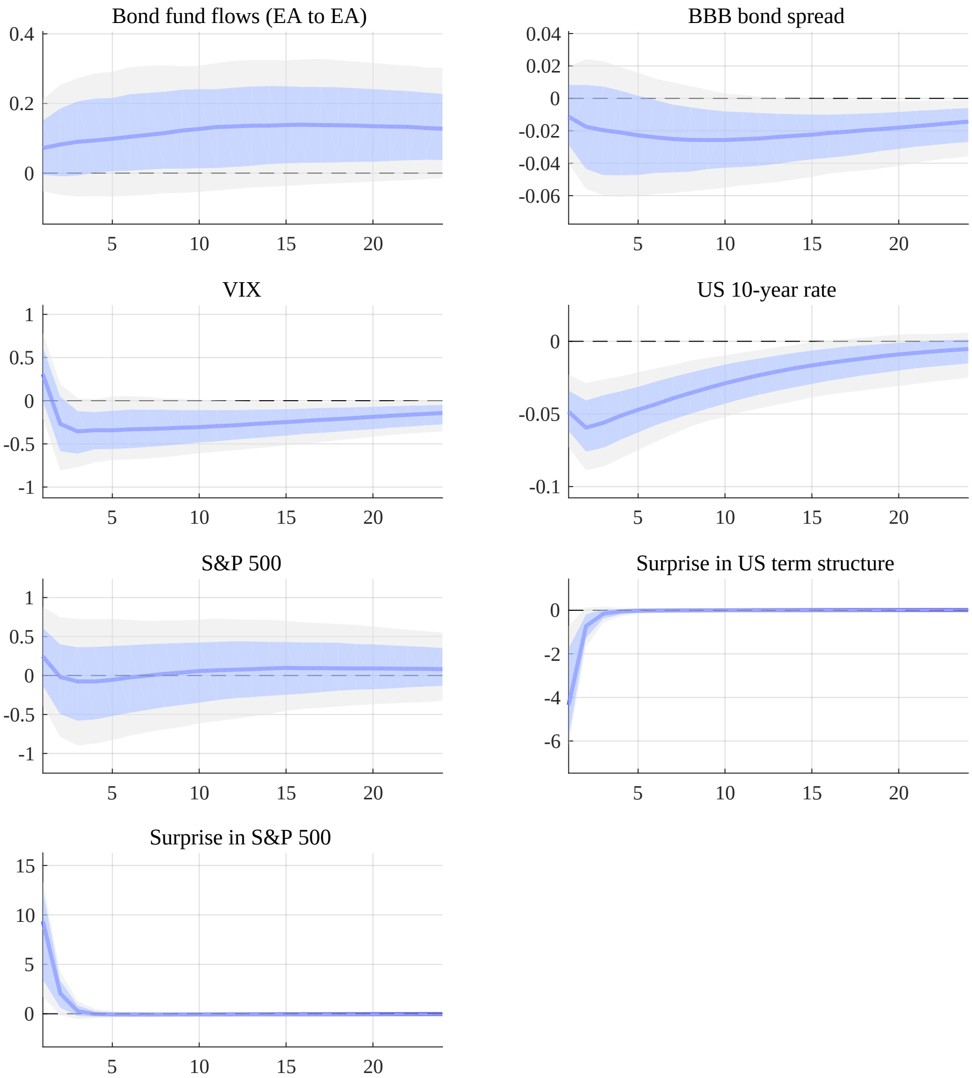

Figure 25: Impulse responses of baseline model for euro-area-to-euro-area investment fund flows

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 5 bps decrease of the ten-year US treasury rate (blue lines) with 68% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with high-frequency sign restriction identification.

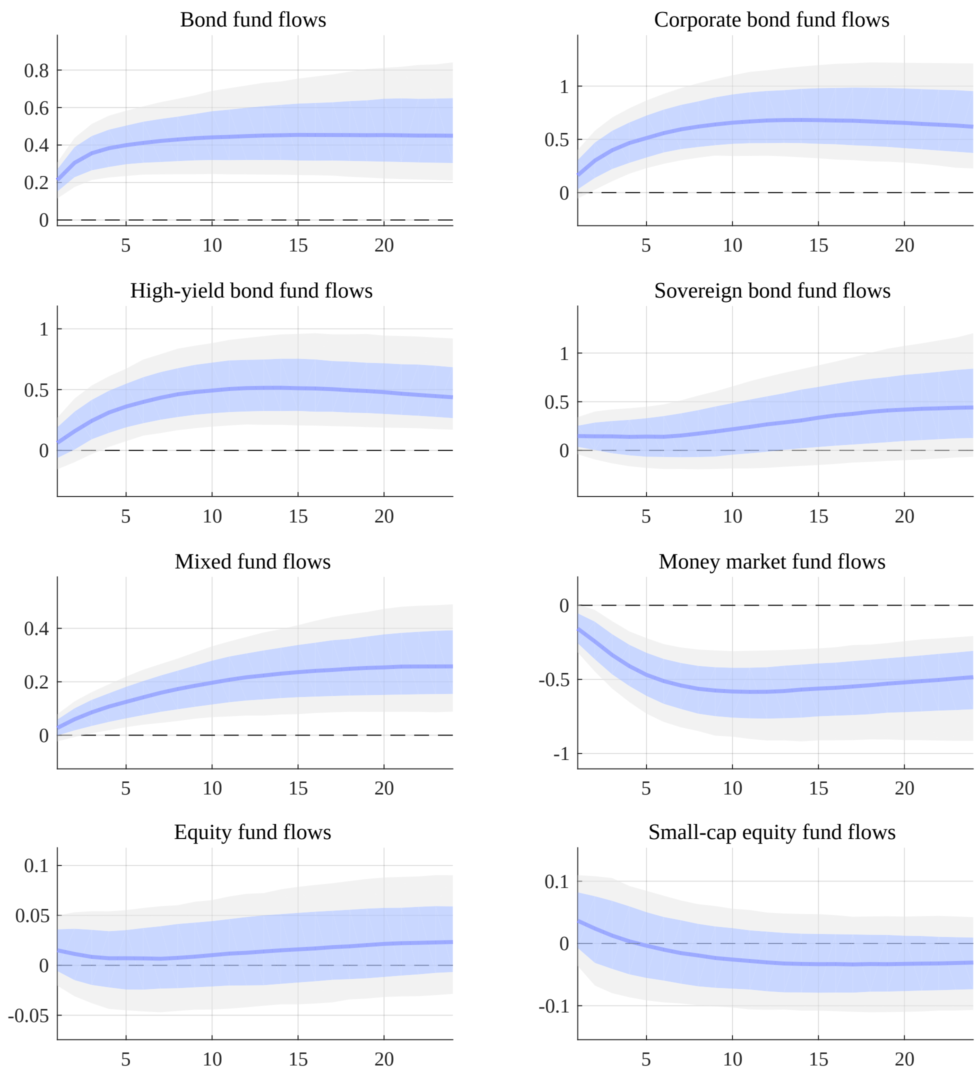

Figure 26: Impulse responses Impulse responses of global investment fund flows with standard high-frequency identification

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 6 bps decrease of the ten-year US treasury rate (blue lines) with 68% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with high-frequency Cholesky identification. High-frequency monetary policy indicator (surprise in US term structure) ordered first. Each variable added separately to the baseline model in Figure 14.

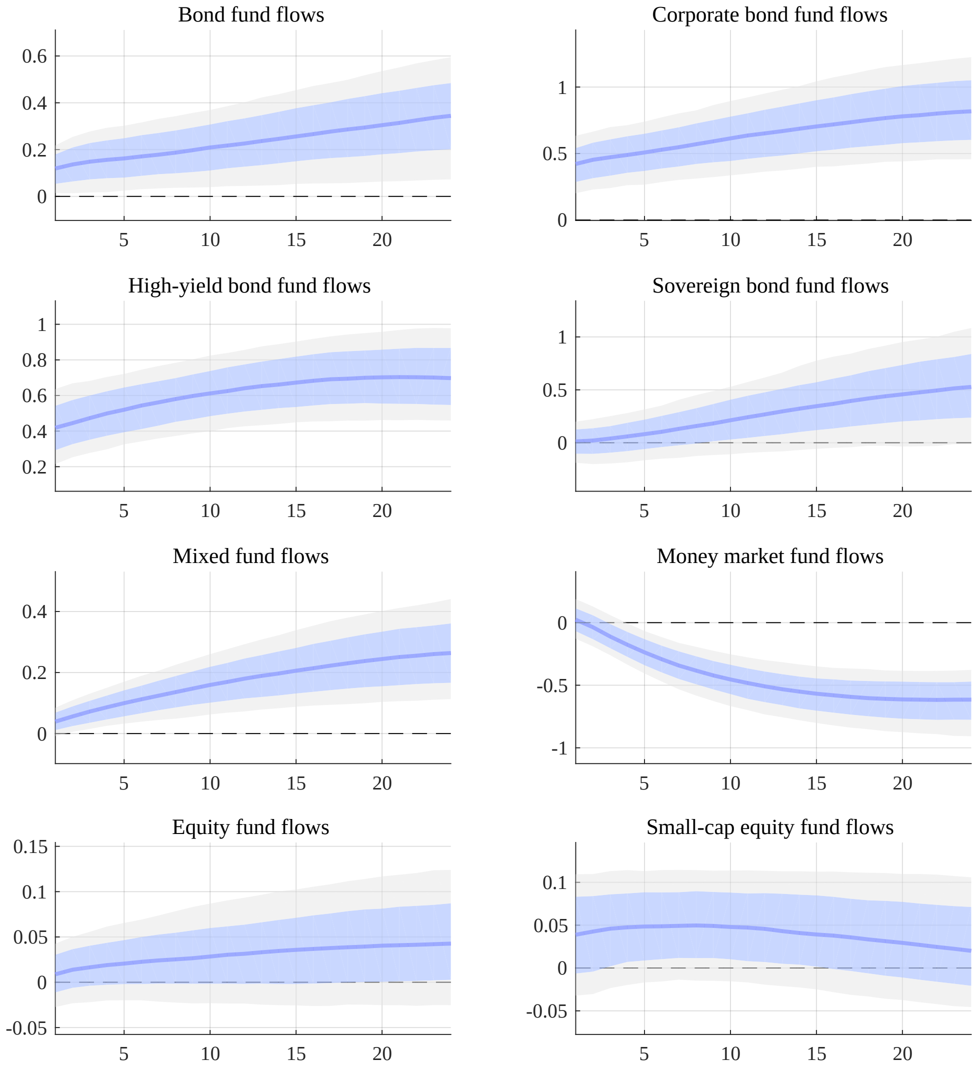

Figure 27: Impulse responses of global investment fund flows with recursive identification

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 1 bps decrease of the ten-year US treasury rate (blue lines) with 68% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with Cholesky recursive identification. Wu and Xia (2016) shadow federal funds rate is used as monetary policy indicator and is ordered first. Each variable added separately to the baseline model in Figure 15.

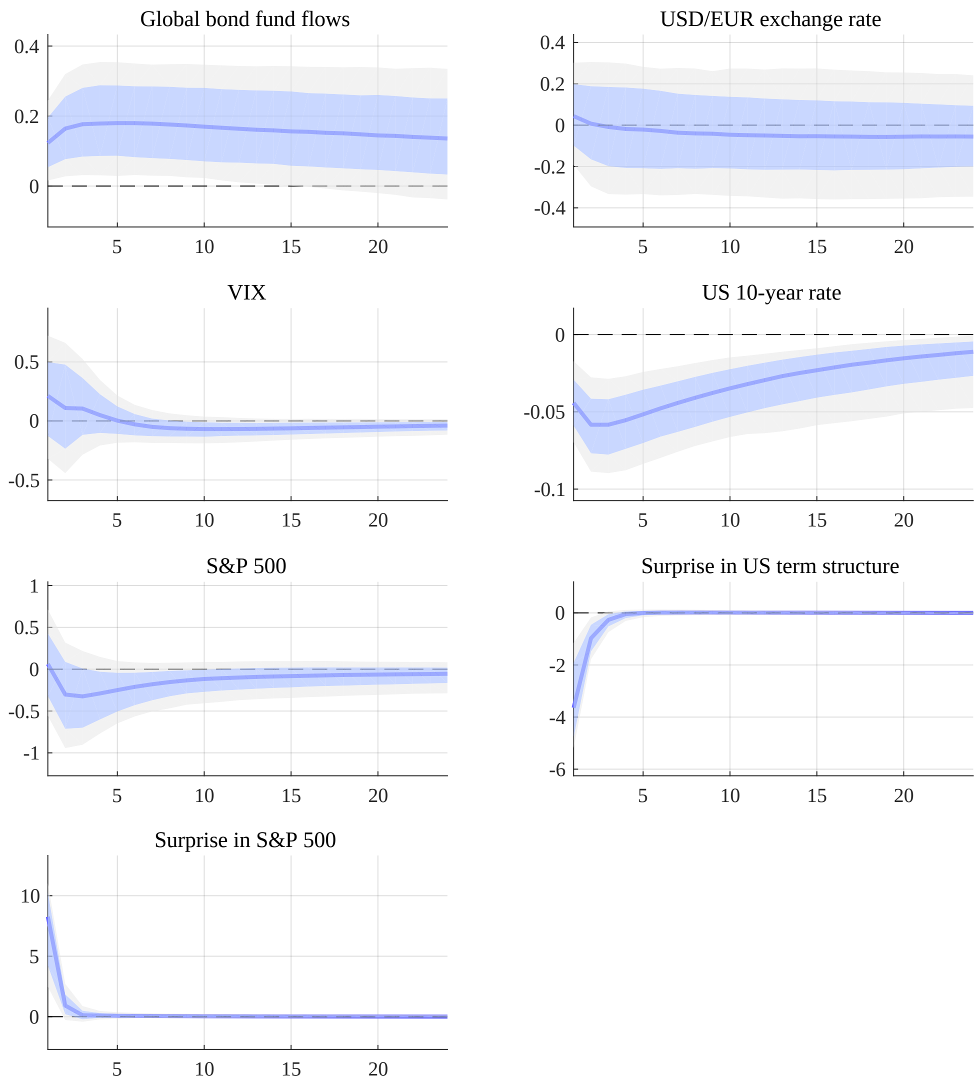

Figure 28: Impulse responses in baseline model using sample without global financial crisis

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 5 bps decrease of the ten-year US treasury rate (blue lines) with 68% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with high-frequency sign restriction identification. Sample starts after end of the recession around the global financial crisis (June 2009).

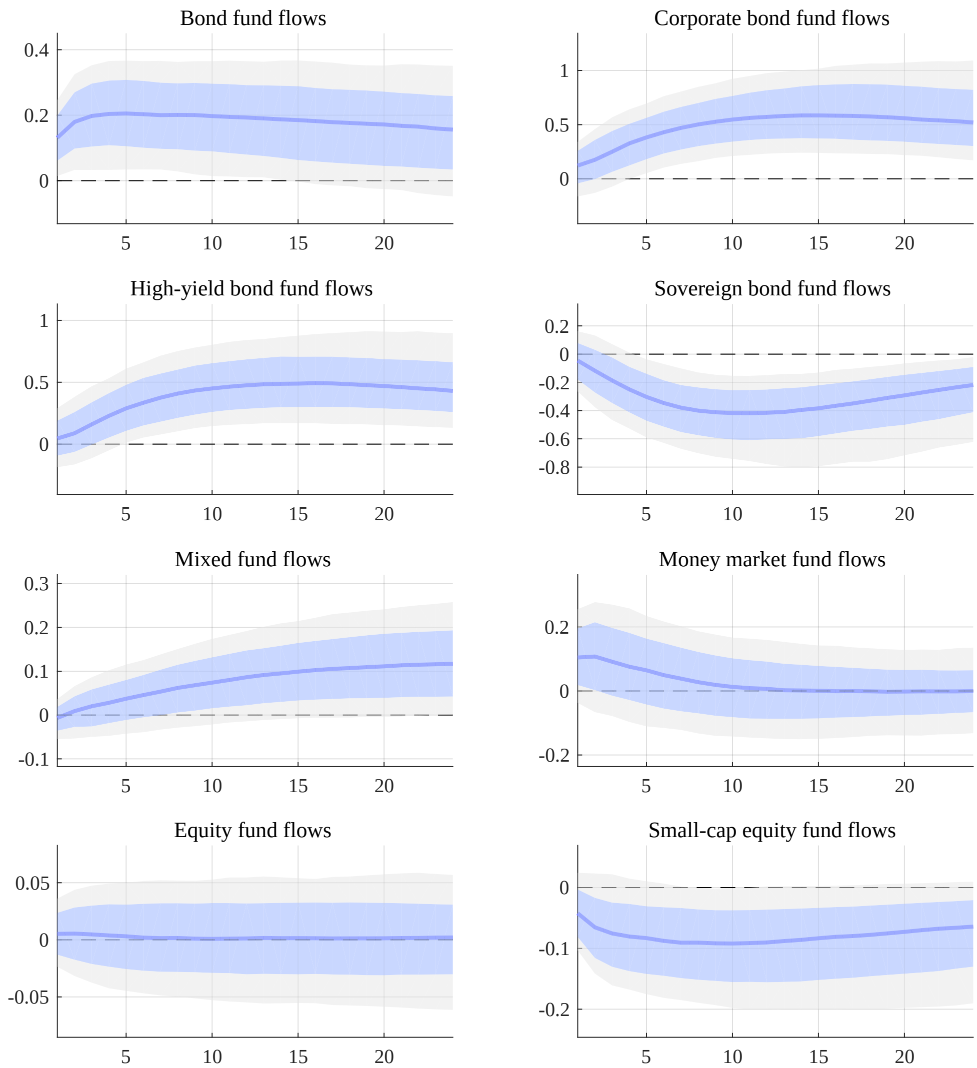

Figure 29: Impulse responses of global investment fund flows using sample without global financial crisis

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 5 bps decrease of the ten-year US treasury rate (blue lines) with 68% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with high-frequency sign restriction identification. Each variable added separately to the baseline model in Figure 28. Sample starts after end of the recession around the global financial crisis (June 2009).

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