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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 global investment fund inflows to euro area equities and debt. These inflows do not only imply elevated asset prices, but also coincide with increased debt and equity issuance in the euro area. 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; G11; G15

Key words: Monetary policy; international spillovers; capital flows; investment funds

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The views expressed in this paper are those of the author only and do not necessarily reflect the views of the European Central Bank or the Eurosystem.

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, 2015; Rey, 2016).

As highlighted by Shin (2013), the relevance of banking sector capital flows for spreading global liquidity across borders receded significantly in the aftermath of the global financial crisis.¹ 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.”

This paper sheds light on the role of these international investment funds for the transmission of global financial conditions to the euro area (EA) in the post-financial crisis episode using a structural Bayesian Vector Auto Regression (BVAR) approach. The paper addresses the following research questions: Do investment fund portfolio flows to the euro area 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 and potential portfolio adjustments lead to changes in financial conditions for EA firms and real activity?

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, according to which 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.

For global investment funds in the post-crisis era, the transmission of looser US financial conditions globally and to the EA can occur in the following ways: By means of a search-for-yield channel, global investors, who may also experience fund inflows after accommodative monetary policy actions, reallocate their portfolios away from US assets and towards international and EA assets that are associated with a higher comparative expected return (Kroencke, Schmeling, and Schrimpf, 2015; Fratzscher, Lo Duca, and Straub, 2018). The relatively higher interest rate differential between the US and, say,

¹McCauley, Bénétrix, McGuire, and von Peter (2017) show that this reduction is mainly driven by a retrenchment of euro area banks.

the EA will, however, only lead to capital flows in case of deviations from covered interest rate parity, for which there exists ample evidence in the empirical literature (see, for example, Du, Tepper, and Verdelhan, 2018). The relatively more attractive interest rate in the EA would, otherwise, be completely offset by the nominal devaluation of the Dollar that usually accompanies interest rate cuts in the US.

At the same time, lower US interest rates can have positive valuation effects on Dollar-denominated assets. Due to pro-cyclical flow-performance behaviour of investors, portfolio flows could also be directed towards US assets.² The devaluation of the Dollar can have valuation effects that increase the return of US investors on their foreign assets. Accordingly, portfolio flows towards foreign assets could rise. Vice-versa, EA investors that hold Dollar-denominated assets face a value loss during a Dollar depreciation, which could induce them to repatriate capital and, thereby, lead to additional portfolio inflows towards the euro area.

Via its effect on global risk appetite (Bekaert, Hoerova, and Lo Duca, 2013, Bruno and Shin, 2015a), looser US monetary policy could affect the risk profile of EA investment portfolios. For a transmission to the real economy it is relevant whether these potential portfolio adjustments and capital inflows to the EA lead to asset price inflation only or also to improved financing conditions for EA non-financial corporations, 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 financing 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 macroeconomic and financial variables in the US and the EA, focussing in particular on international investment fund flows.

I find evidence for significant spill-overs of US monetary policy to EA bond and equity markets via the investment fund sector. After accommodative monetary policy action by the Federal Reserve, global investment funds increase their purchases of EA bonds and equities, while the issuance of private-sector debt securities and equity also rises. In line with an observed higher risk appetite, inflows are particularly strong to the riskier segments of financial markets, such as high-yield corporate bonds and equities with a small market capitalisation. Industrial production, as a measure for real economic activity, increases in both currency areas. Confirming the earlier findings of the literature on the

²For empirical evidence on the pro-cyclical flow-performance behaviour of fund investors, see, e.g., Timmer (2018), Goldstein, Jiang, and Ng (2017), and Feroli, Kashyap, Schoenholtz, and Shin (2014).

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

global financial cycle that risky asset prices surge on a global level, I also find that bond and equity indices rise in both regions.

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. At the same time, 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 a causal ordering in the form of triangular factorisation, which facilitates a direct comparison of the results with the related literature, such as Bruno and Shin (2015a) or Miranda-Agrippino and Rey, 2015.⁵

Related literature

Closest to this paper in terms of approach and methods is the paper by Miranda-Agrippino and Rey (2015), who study the effects of US monetary policy on US and EA macro-financial variables in a BVAR. They focus solely on transmission via global banks and their sample ends in 2010, which does not allow them to study the more market-based second phase of global liquidity, which stands in the focus of the present paper. Related, Gerko and Rey (2017) perform VAR analyses of US and United Kingdom monetary policy spill-overs 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. None of these papers considers international policy transmission via non-banks.

Several papers analyse the effects of monetary policy and global factors on debt and equity portfolio flows. Habib and Venditti (2019) demonstrate that US monetary policy and more general financial shocks are indeed the main drivers of global capital flow cycles.

⁴See, for example Cominetta, Lambert, Levels, Rydén, and Weistroffer (2018) on this point.

⁵At the same time, this identification scheme can imply potentially restrictive assumptions on the timing of shock responses, e.g., that some variables cannot respond to monetary policy within the same period or vice-versa. High-frequency identification of monetary policy shocks, as proposed by Gertler and Karadi (2015) in conventional VARs and by Caldara and Herbst (2019) for a BVAR-setting, instead allows for simultaneous responses of all variables and is, therefore, an important alternative identification strategy.

Fratzscher et al. (2018) find that US quantitative easing induced significant international portfolio reallocations by global investors, while Fratzscher, Lo Duca, and Straub (2016) do not observe significant portfolio rebalancing in response to early unconventional monetary policy by the ECB between 2007 and 2012. Bubeck, Habib, and Manganeli (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. Feroli et al. (2014) argue that in a search-for-yield environment flows into an asset class can induce momentum in returns that lead 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, di Giovanni, Kalemli-Özcan, Peydro, and Ulu (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, Nicoletti, and Vidal Martínez (2016) find that US quantitative easing policies had a significant impact on corporate bond issuance across advanced and emerging economies.

The rest of the paper is structured as follows. Section 2 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 3, where Section 3.1 focusses on the reaction on bond markets, while Section 3.2 provides results for equity markets. The sensitivity of the results with respect to changes in the ordering of the monetary policy variable and to alternative measures for all variables is analysed in Section 4. A conclusion including an outlook on possible further research in this field is given in Section 5.

2 Analysing the second phase of global liquidity

To study the transmission of global financial conditions to the EA in a BVAR framework, I set up a baseline model of five variables that includes a measure for US monetary policy, the USD/EUR nominal exchange rate, the VIX volatility index as a measure of global risk aversion, the nominal flows of international investment funds to EA assets, and the debt securities issuance of non-financial corporations in the EA. This selection of variables is akin to the model used by Bruno and Shin (2015a), except that they add a measure for the leverage of global banks instead of the investment fund portfolio flows and the debt issuance.

Using a marginal approach, this baseline model is subsequently augmented by further

macroeconomic and financial variables for the US and the EA, in order to analyse the risk-taking behaviour of investors, aspects of the transmission mechanism, and the effects on the real economy. A further model studies the impact on investment fund flows to EA equities and the issuance of the latter.

2.1 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 provider EPFR Global. Aggregated investment fund data is available in this source by fund type (e.g., equities, bonds), regional investment focus (e.g., global, US, Western Europe), and by domicile country. This data source decomposes the evolution of total net assets over time into nominal net flows and into valuation changes, where the former stand in 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 – mainly because of regulatory reasons – the data set allows for the construction of the net flows of non-EA investors to bond and equity funds with an investment focus on Europe. Throughout the paper all flows are used in cumulative percentage terms relative to the start of the sample.

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, in high-yield or investment-grade assets, or with a long, medium, or short maturity focus. 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 out-flows 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 equities and bonds, but, according to Miao and Pant (2012) and Fratzscher (2012), it provides a relatively representative sample with aggregate portfolio flows from EPFR matching the patterns of those from official balance-of-payments statistics closely. The main advantages of the EPFR data compared to balance-of-payments data are the more detailed breakdowns in different asset classes and the possibility to decompose portfolio flows into nominal and valuation changes. Moreover, the official statistics on 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 convolute the identification of the response of the funds sector to global financial shocks.

Regarding the measure for US monetary policy, I follow Gertler and Karadi (2015) in using the one-year US treasury rate as my baseline policy indicator. The main reason

for this choice is that the Federal Reserve was still able to manipulate this interest rate by unconventional policy instruments when the federal funds rate was lowered to its zero lower bound and, hence, constituted a bad indicator for the actual stance of US monetary policy. Additional results in Section 4 show that the findings are also robust to using the Wu and Xia (2016) shadow federal funds rate and the two-year US treasury rate.

An overview of all variables used in the analysis together with their sources and applied transformations are given in Appendix A.

2.2 Estimation method and identification

The model is estimated as a BVAR with 4 lags and a constant term for each variable by means of a Minnesota prior, as originally proposed by Litterman (1986) that uses the full residual variance-covariance matrix of the same VAR estimated by ordinary least squares.⁶

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 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 to 4 on the basis of comparing the model marginal likelihood.

To identify the effects of the monetary policy shock, I use a causal ordering in the form of triangular factorisation. This identification scheme assumes restrictions to the contemporaneous responses of variables to shocks. The main difference to a standard Cholesky factorisation is that the variances of the orthogonalised shocks are not restricted to be unity. In general, this identification implies that a variable ordered at position j can be affected by the contemporaneous shocks to variables ordered at a position $i < j$, but not by current shocks to variables ordered at a position $k > j$. Shocks to variables with index k can influence variable j only with a lag.

The ordering of variables is, hence, decisive under this identification approach and should be based on economic reasoning. Slower moving variables, such as bond issuance that usually has a forerun of several months between decision and implementation, should, therefore, be ordered before faster moving variables like the VIX and the exchange rate

⁶For the estimation I make use of the BEAR toolbox Version 4.2 by Dieppe, Legrand, and van Roye (2016).

that adjust instantaneously to new developments. For the baseline model, I place slower moving quantities before the faster moving financial market rates. Accordingly, I order bond issuance first, followed by the investment fund flows, the one-year rate, the VIX, and the exchange rate last.

In this way, the VIX and the exchange rate can react instantaneously on shocks to the one-year interest rate, while flows and bond issuance can only react with a lag. Monetary policy, ordered third, in turn, can react immediately on developments in the latter two variables. The ordering of further variables is discussed upon their introduction to the model. The robustness of the results to an alternative ordering is explored in Section 4.

3 Results

In this section, I show impulse response functions to the US monetary policy shock. Section 3.1 describes the reaction of bond markets and macro variables and it also provides evidence on the discussed transmission channel via interest rate differentials. Additional results on equity markets are provided in Section 3.2.

3.1 The effects of global liquidity on EA bond markets and the macroeconomy

Figure 1 presents the responses of the variables in the baseline model to study the transmission of global financial conditions, as measured by a 1% monetary policy shock to the one-year US treasury rate, to the euro area via the bond markets. All results are shown for an expansionary US monetary policy shock. The blue lines always give the median response of the variables' posterior distribution; the blue-shaded areas show the 70% 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 x-axis denotes the number of months after the shock.

The results indicate significant spill-over effects from US monetary policy to the euro area economy and financial markets. The findings are consistent with the transmission channels discussed in the introduction. The nominal portfolio flows of international investment funds to EA bonds increase statistically significant with a maximum effect of 1% around 15 months after impact. The debt securities issuance of EA non-financial corporations also increases significantly, which is indicative that global financial cycles do not only affect risky asset prices, as shown, e.g. by Miranda-Agrippino and Rey (2015), but it also affects the amount of debt issued by EA firms. Although the foreign inflows to EA bond markets do not necessarily need to be the sole drivers of the increase in debt issuance, they are likely to contribute to the improving financing conditions for EA firms. This nexus constitutes one of the main findings of the paper.

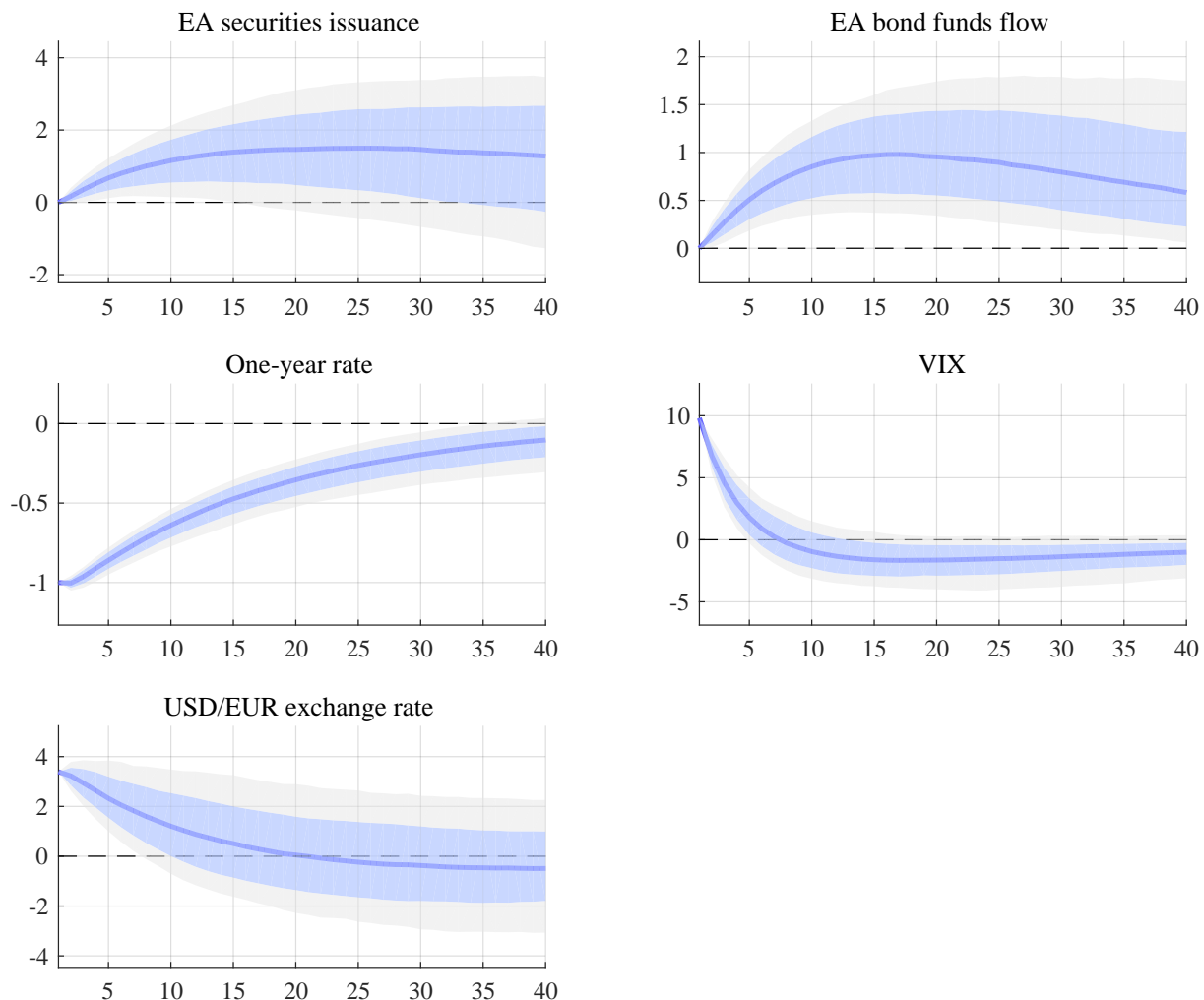


Figure 1: Impulse responses in baseline model for bond fund flows

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 1% decrease of the one-year US treasury rate (blue lines) with 70% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with recursive identification.

The monetary policy shock also has an effect on the risk aversion of global financial investors, as proxied by the VIX. After an initial increase, risk aversion declines persistently and statistically significantly at 70% after 12 months. This pattern is also found by Bekaert et al. (2013) and Bruno and Shin (2015a), who likewise interpret this observation as an overall decline in risk aversion.

A loosening of US monetary policy leads to an immediate depreciation of the US Dollar relative to the Euro. Interestingly, this result does not display a “delayed overshooting” of the exchange rate, first described by Eichenbaum and Evans (1995) and also found by Bruno and Shin (2015a).

Next, I discuss the results of more granular breakdowns of investment fund flows that are depicted in Figure 2. Following a marginal approach, the variables in each row of the figure are added separately to the baseline model of Figure 1. The responses shown in the left column (denoted “All bond funds”) display the international investment fund inflows

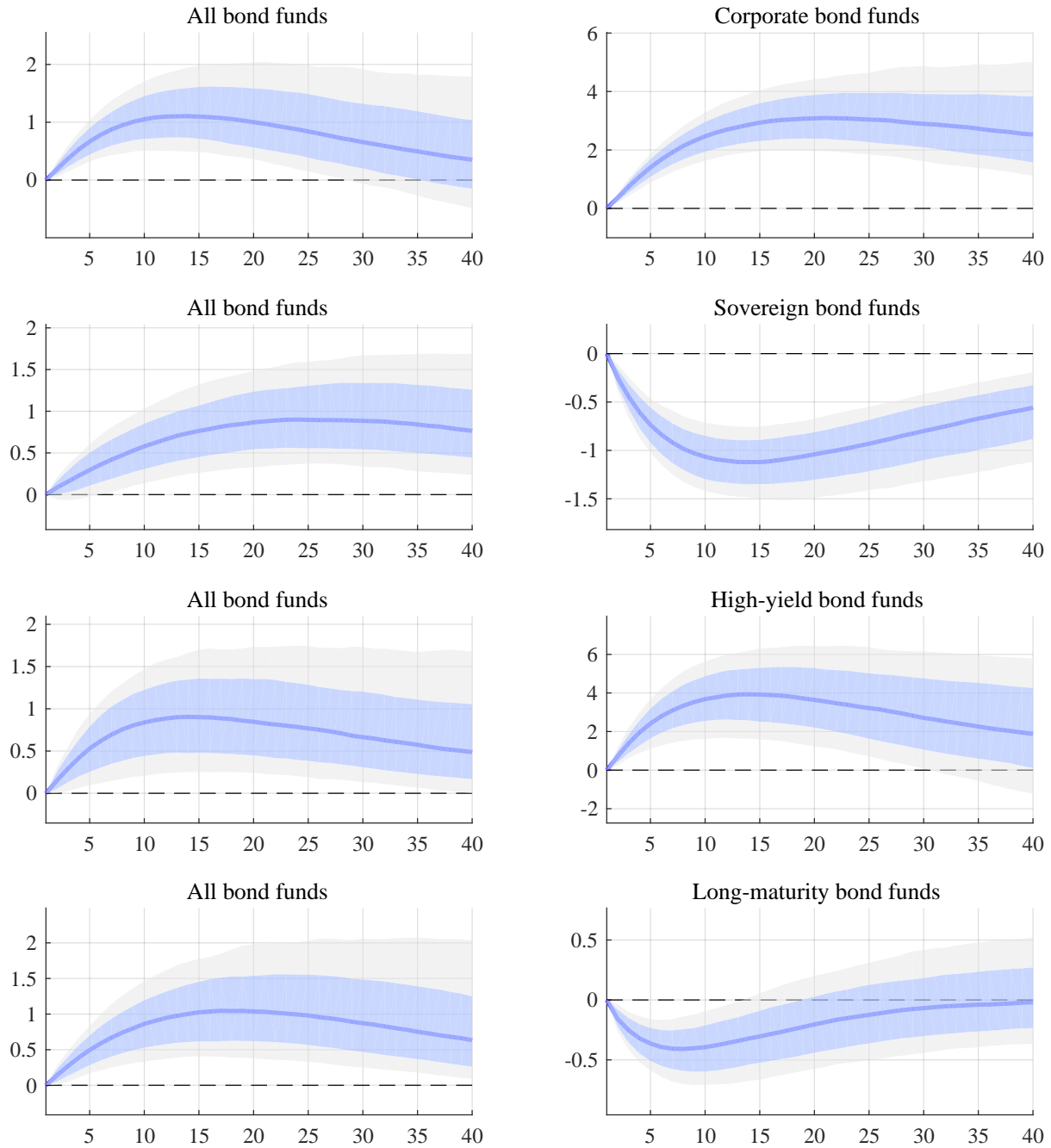


Figure 2: Impulse responses of fund flows to different EA bond types

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 1% decrease of the one-year US treasury rate (blue lines) with 70% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with recursive identification. Variables in each row are added separately to the baseline model in Figure 1.

variable also used in the previous figure, in order to facilitate comparison of the results.⁷ The right column, in turn, shows the response of the new more granular indicators. These variables are always ordered at third position in the VAR after the overall flows and before the monetary policy measure.

Using a breakdown between flows to corporate versus sovereign bonds, the responses

⁷The responses of the other variables in the baseline model that are not shown again are very similar to those displayed in Figure 1 and are available upon request.

in the first row reveal that the investment fund flows to EA corporate bonds also increase after the expansionary shock. In fact, flows to corporate bonds increase by more than the overall bond fund flows to the EA.

The responses in the second row indicate that international funds investing in EA sovereign bonds instead experience outflows after the expansionary shock. These findings are well aligned with the earlier observation of increased global risk appetite in Figure 1. Accordingly, investors rebalance from less risky sovereign bonds to more risky corporate bonds.

The model in the third row of Figure 2 focusses particularly on high-yield corporate bonds. Also in line with a rebalancing to more risky assets, the net flows into this asset class are particularly strong compared to the overall outflows. High-yield inflows reach a peak of 4% about one year after the shock.

The last row of the figure analyses the maturity structure of the flows. The bottom right panel shows that funds focussing on long-maturity assets, defined as having a residual maturity of six or more years, experience outflows after the decrease in interest rates. This is consistent with the observed outflows from sovereign bond, since the latter tend to have longer maturities than corporate bonds.⁸

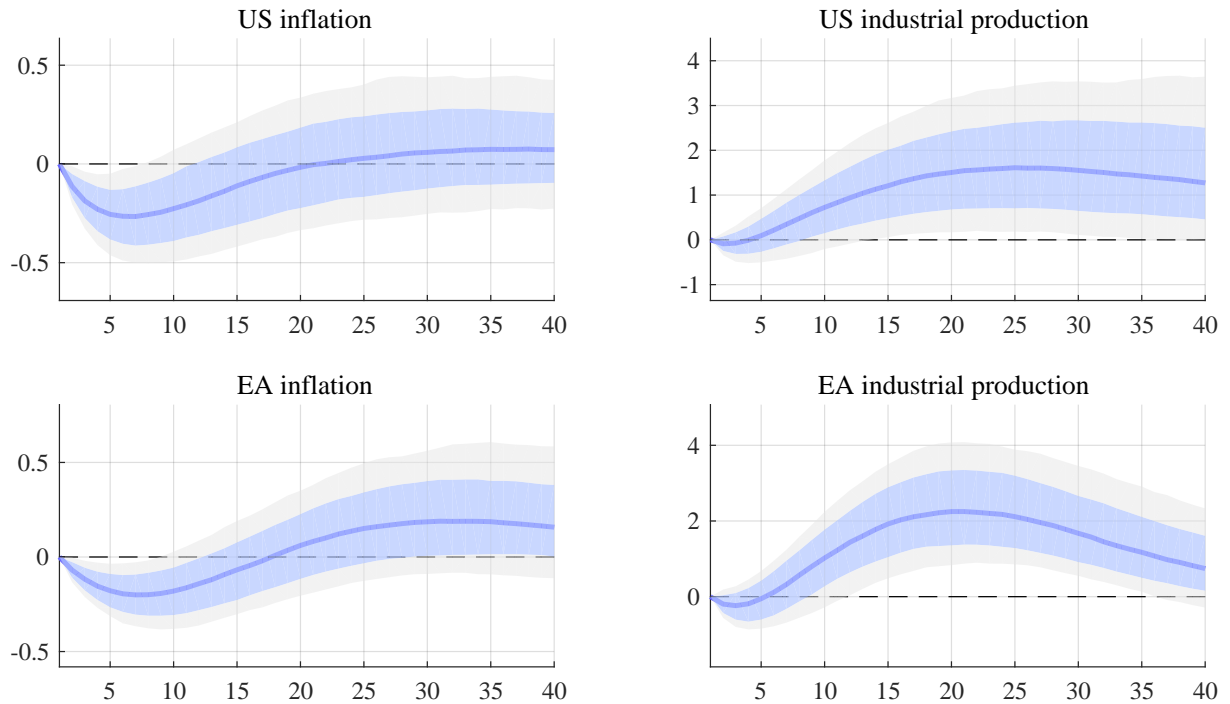


Figure 3: Impulse responses of US and EA macro variables

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 1% decrease of the one-year US treasury rate (blue lines) with 70% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with recursive identification. US and EA variables are added separately to the baseline model in Figure 1.

⁸For example, aggregate statistics from the ECB Securities Holding Statistics (SHSS) reveal that the average residual maturity of EA bonds held by EA investment funds was on average 7.6 years in their sovereign and 5.9 years in their corporate portfolio in the third quarter of 2018.

The question whether the observed financial spill-overs also have an impact on EA macroeconomic indicators is explored in Figure 3. As a reference, the figure also shows results for US variables. US and EA variables are added group-wise to the baseline model from Figure 1 with inflation ordered first, and industrial production ordered second, as is standard in the literature (see Ramey, 2016).

Industrial production increases statistically significantly in both regions one year after the impulse, which is also in line with the findings by Miranda-Agrippino and Rey (2015).⁹ Although the increase in EA real economic activity is certainly due to a combination 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. In principle, the transmission to real economic activity could, for example, also work via the bank-based channels discussed in the earlier literature on the global financial cycle. Bruno and Shin (2015a) mention, however, that the empirical evidence for their bank-based effects is much weaker in a sample that extends also to the early post-crisis episode.

As opposed to the reaction of industrial production in both regions, the response of inflation is not fully in line with conventional economic intuition. In both regions, inflation decreases for a few months at a small but statistically significant rate of about 0.2% before turning insignificant. This finding constitutes the notorious price puzzle discussed extensively in the literature for recursively identified VARs (see Ramey, 2016 for an overview). At the same time, these insignificant responses are very well in line with the muted inflation that was observable over the last decade in both the US and the EA.

Figure 4 analyses the discussed transmission channel via interest rate differentials between the two currency areas in combination with globally active investors that reach for yield. The figure shows that a monetary expansion in the US is followed by a cut in monetary policy rates, as measured by the EONIA rate, in the EA. The EA policy rate measure (ordered third) decreases by up to 30 basis points around 16 months after the shock. This partial co-movement raises the question to what extent interest rate differentials, as one of the prerequisites to initiate capital flows out of the US and towards the EA, are actually observable after an interest rate shock.

To this end, the figure provides reactions of the difference between the US and the EA policy rates, as well as between the respective two- and ten-year government bond rates (ordered fourth in the VAR). While the policy rate differential is not statistically different from zero, the two- and the ten-year rate differential decrease on impact by 0.66% and 0.31%, respectively. Both responses remain statistically significant for at least one and a half years. This result provides some evidence for the transmission effect from the monetary policy innovation to portfolio flows of international investment funds.

⁹It should be noted that the size of the impulse responses between the two regions cannot be compared here, as EA and US effects are estimated in separate models.

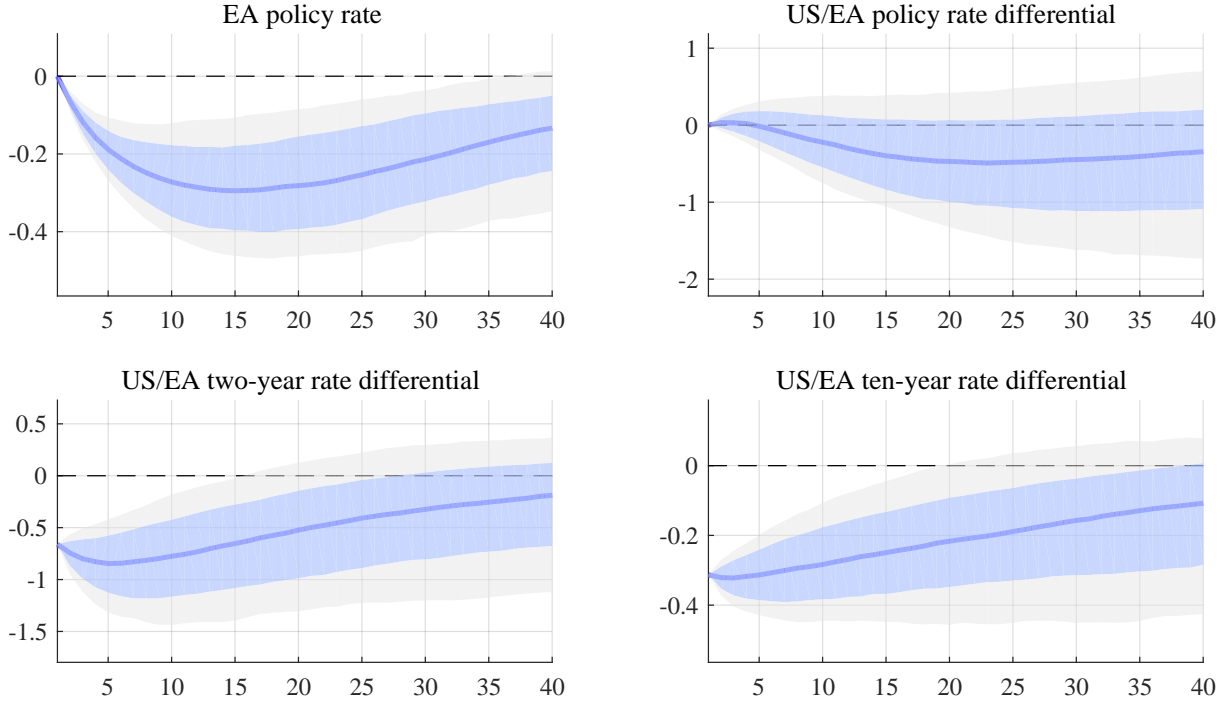


Figure 4: Impulse responses of US and EA interest rates

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 1% decrease of the one-year US treasury rate (blue lines) with 70% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with recursive identification. Each variable is added separately to the baseline model in Figure 1.

To study the reaction and international co-movement of asset prices, Figure 5 shows the impulse responses of the Standard & Poors 500 and the EuroStoxx equity indices (both ordered second to last) as well as indices for the investment-grade and high-yield segments of EA and US bond markets (ordered forth). All measures in both regions increase persistently after the interest rate decline. This is consistent with the observation by the literature initiated by Rey (2015) on a global financial cycle in risky asset prices. It implies more attractive conditions for firms who seek for additional funding on bond and equity markets.

3.2 Effects on EA equity markets

After the investigation of the responses of bond markets, this section analyses the effects of the US monetary expansion on EA equity markets.

Figure 6 presents impulse responses for a baseline model of equity markets. The model is analogous to the bond baseline model discussed in Figure 1. Instead of EA debt issuance and the fund flows to EA bonds, this model features variables on the issuance of EA equity and the flows to global investment funds investing in EA equity. To ensure stationarity of the estimated model, the tightness of the prior needs to be reduced slightly. To this end, I loosen the overall tightness parameter to $\lambda_1 = 0.25$ and I decrease the lag decay parameter to $\lambda_3 = 1$. Intuitively, this implies that coefficients for higher-order lags are

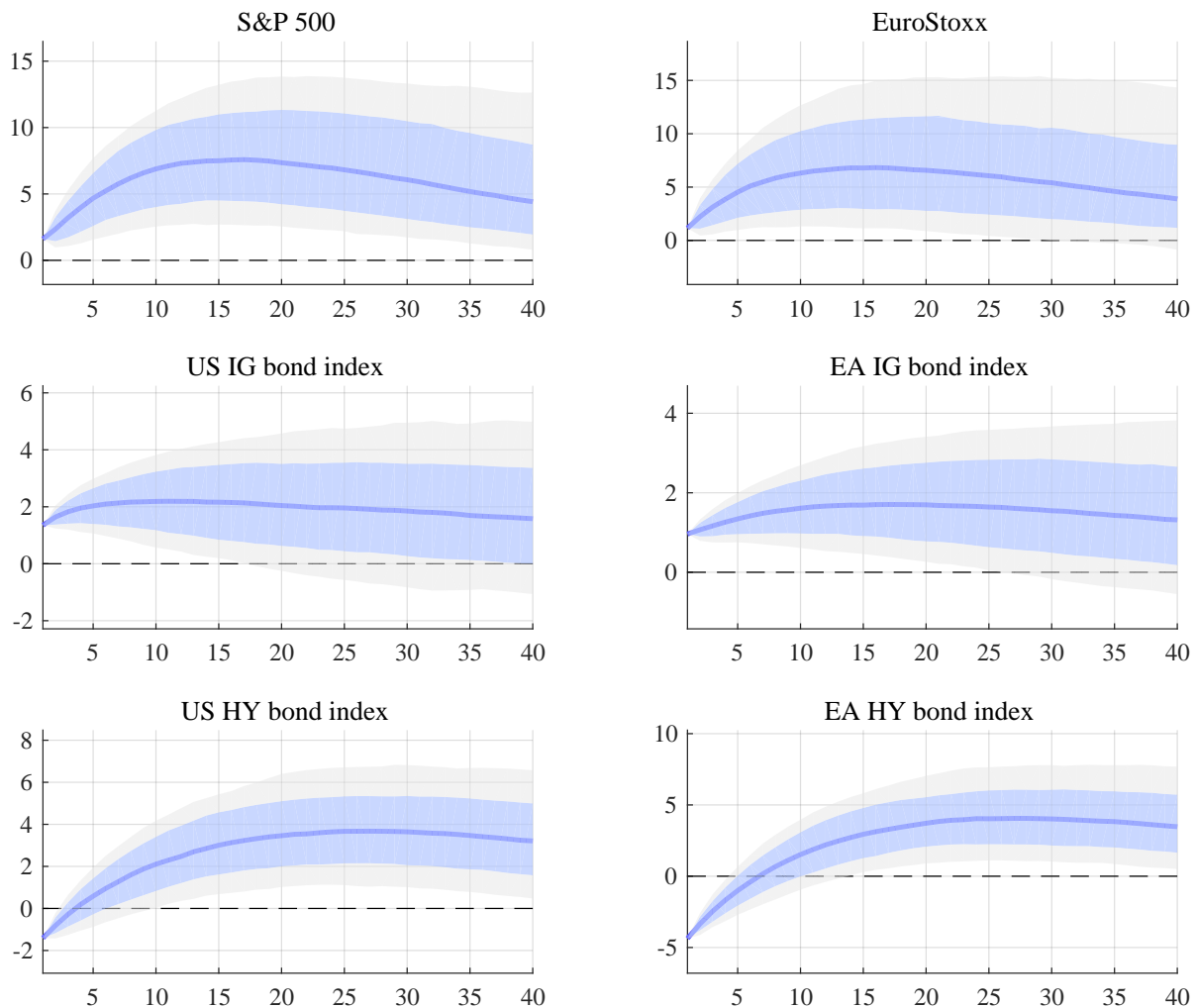


Figure 5: Impulse responses of US and EA financial market indices

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 1% decrease of the one-year US treasury rate (blue lines) with 70% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with recursive identification. Each variable is added separately to the baseline model in Figure 1. Bond market indices are either for investment-grade (IG) or high-yield (HY) securities.

less likely to be zero, allowing them to potentially counteract against a first lag with a coefficient value larger than one.

The results found for the equity markets are similar to those for the bond markets. After the decline of US interest rate the net flows of global investors to EA equities increase persistently by up to 2%. At least the 70%-credibility interval of this estimate always excludes the zero line. Issuance of new equities in the EA also rises significantly. Accordingly, EA firms raise more capital both on debt and equity markets after an easing of financial conditions in the US. In this way, firms will be relatively less constrained to finance new investments and to expand their operations.

The response of the VIX has a similar pattern as in the bond baseline model, but the reaction never turns negative. The VIX, in this case, does not seem to be an appropriate proxy for risk aversion, as it fails here to document the decline of the latter that is

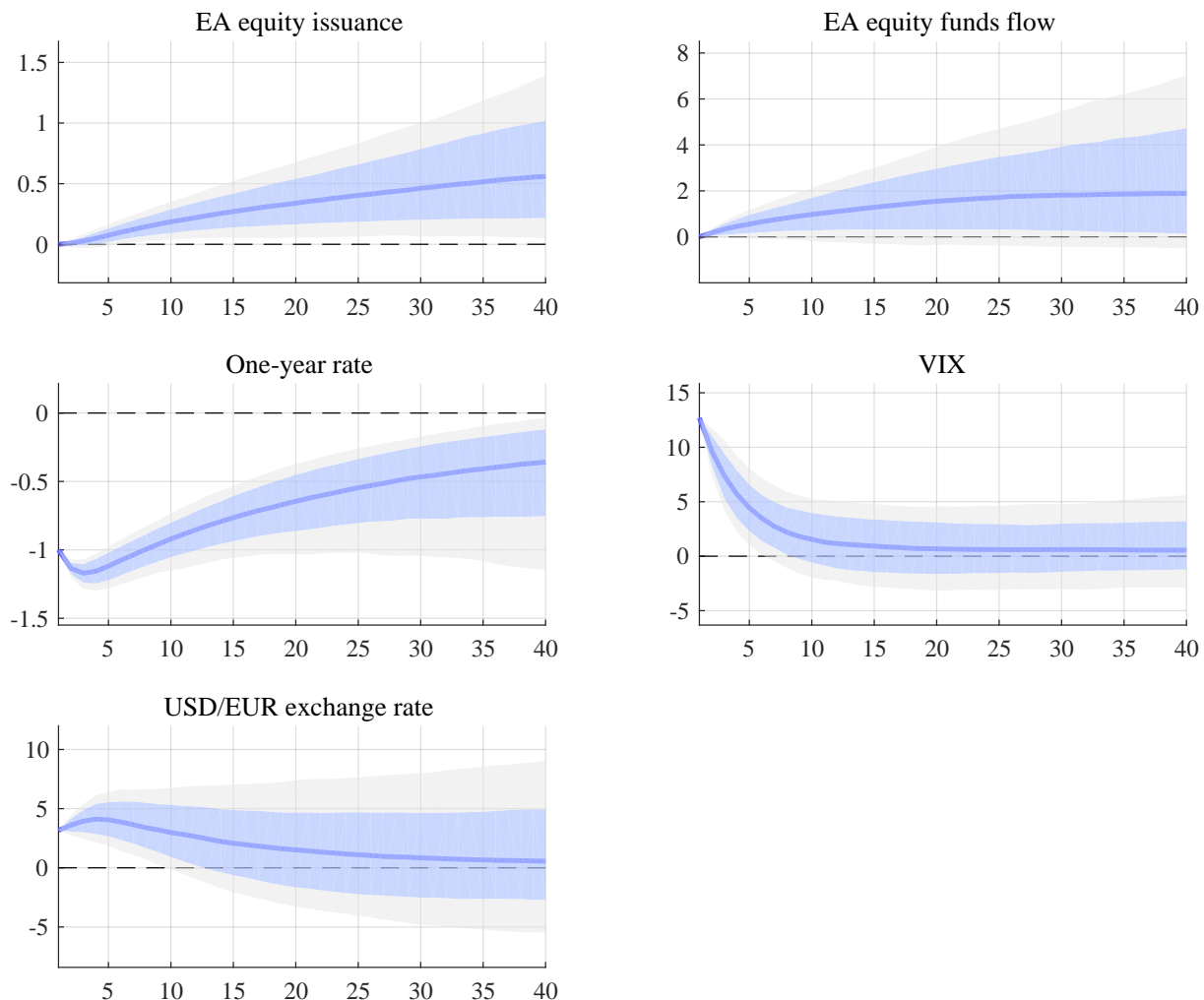


Figure 6: Impulse responses in baseline model for equity funds flows

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 1% decrease of the one-year US treasury rate (blue lines) with 70% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with recursive identification.

documented in the related literature (Bekaert et al., 2013) and also found in my earlier results.

Figure 7 studies further aspects of equity markets, where the two variables in the first row are added jointly, and the variables in the second row separately to the baseline model in Figure 6.

The panels in the first row contrast the overall response of the net flows to EA equities with the flows to equities issued by firms with a relatively small market capitalisation between USD 300 million and 2 billion. 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 reaction in the upper right panel shows that the percentage increase of small caps (ordered second in the VAR) is significantly more pronounced than the overall increase of equity flows depicted in the upper left panel. While the percentage change for small caps five months after impact reads 2.6%, it is 1.1% for the change in the overall flows to EA equity. This finding is again indicative of a rebalancing to riskier

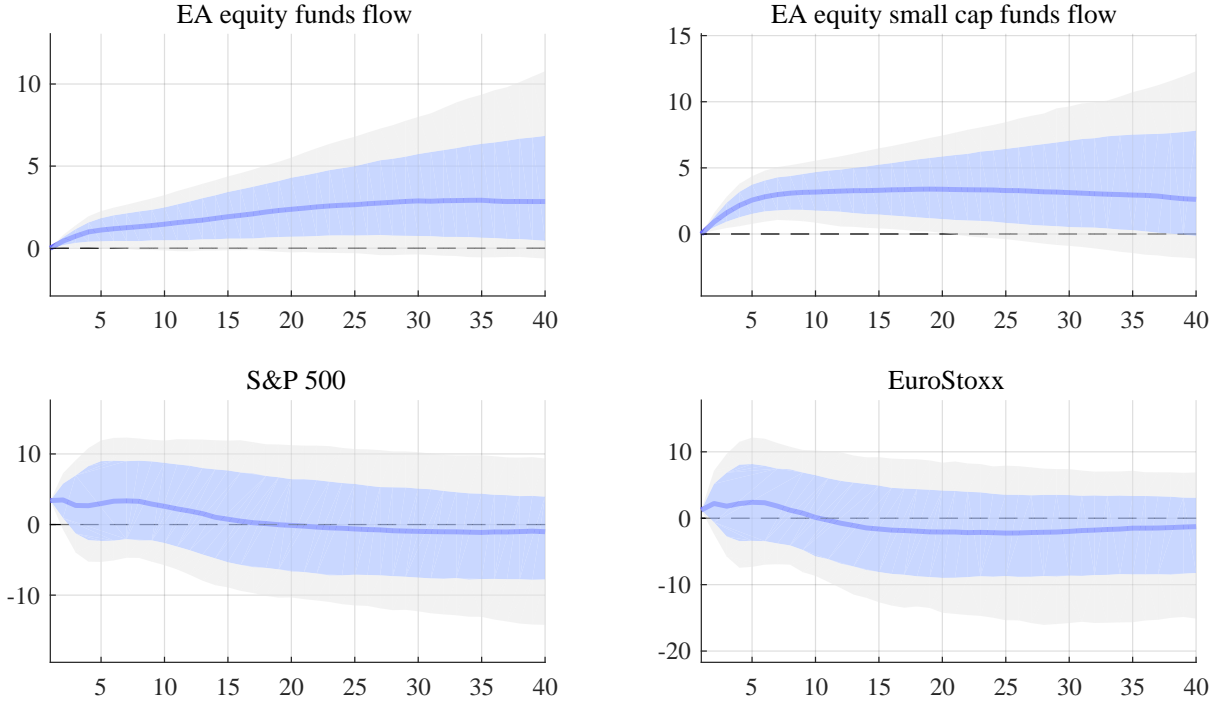


Figure 7: Impulse responses to equity returns and fund flows

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 1% decrease of the one-year US treasury rate (blue lines) with 70% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with recursive identification. The two variables in the first row are added jointly, the variables in the second row are added separately to the baseline model in Figure 1.

segments of financial markets after a global loosening.

The second row of Figure 7 depicts the reactions of US and EA equity indices. The S&P 500 and the EuroStoxx decline with median responses that have a similar magnitude as those observed in Figure 5. The credibility bands are, however, much wider – potentially related to the fact that the models including equity flows and issuance are relatively close to featuring roots of their characteristic polynomial that lie outside the unit circle.

4 Sensitivity analysis

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

As the ordering of the variables is the decisive identifying assumption in a recursive structural VAR, it is important to check the sensitivity of the results to alternative orderings. In all results provided in Section 3, the one-year rate was ordered third, reflecting a reasoning that prices move faster than quantities after the monetary shock. One can, yet, also argue that the monetary policy indicator should be ordered first to mirror “the periodic decision making process at the Federal Reserve and the slowly evolving implementation of monetary policy,” as argued by Bruno and Shin (2015a). Ordering monetary policy first implies that the securities issuance and the investment fund flows can react instantaneously to policy changes, while monetary policy itself can react to issuance and

flow changes only with a lag.

A comparison of the alternative orderings is shown in Figure 8 for the baseline model with flows to EA corporate bonds. The first column depicts responses with the one-year rate ordered third as before. The second column shows the results for the one-year rate ordered first. The figure shows that all findings are highly robust to this alternative ordering. Compared to the baseline case in the left column, the reaction of bond issuance is shifted slightly upwards, while the response of the investment fund flows is shifted downwards. Both measures still increase persistently and significantly.

Sensitivity of the results with respect to alternative monetary policy indicators is analysed in Figure 9. The left column shows results using the Wu and Xia (2016) shadow federal funds rate instead of the one-year rate. This measure 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. The right column of the figure presents results using the two-year US treasury rate, as the control of the Federal Reserve about this rate was presumably even less constrained than over the one-year rate, as discussed by Gertler and Karadi (2015).

The patterns of all responses are quite similar to those obtained using the one-year rate. The reaction of bond issuance and flows is virtually identical when using the two-year rate, while responses are slightly larger in case of the shadow federal funds rate. One notable difference to the baseline result is that the response of the Dollar-Euro exchange rate is estimated very imprecisely and is no longer found to be statistically significant.

In order to investigate the robustness of the significant appreciation of the Dollar found in the baseline results, I rerun the model of Figure 1 using the nominal effective US Dollar exchange rate as an alternative measure. The results are displayed in Figure 10 of Appendix B. As a decline of this measure denotes a depreciation of the Dollar relative to a trade-weighted basket of other currencies, this model specification, hence, confirms the devaluation of the Dollar found in the earlier results.¹⁰

As a final check, I re-estimate the baseline model using the VSTOXX volatility index for European equity markets instead of the VIX. The results of this exercise can be found in Figure 11 of Appendix B. All main results for the bond market variables again continue to hold. The pattern of the VSTOXX response is similar the one of the VIX, although the negative reaction that starts after 15 months is not found to be statistically significant at conventional levels.

¹⁰Running the model with the nominal effective Euro exchange rate yields a revaluation of the euro, which is again in line with the main results.

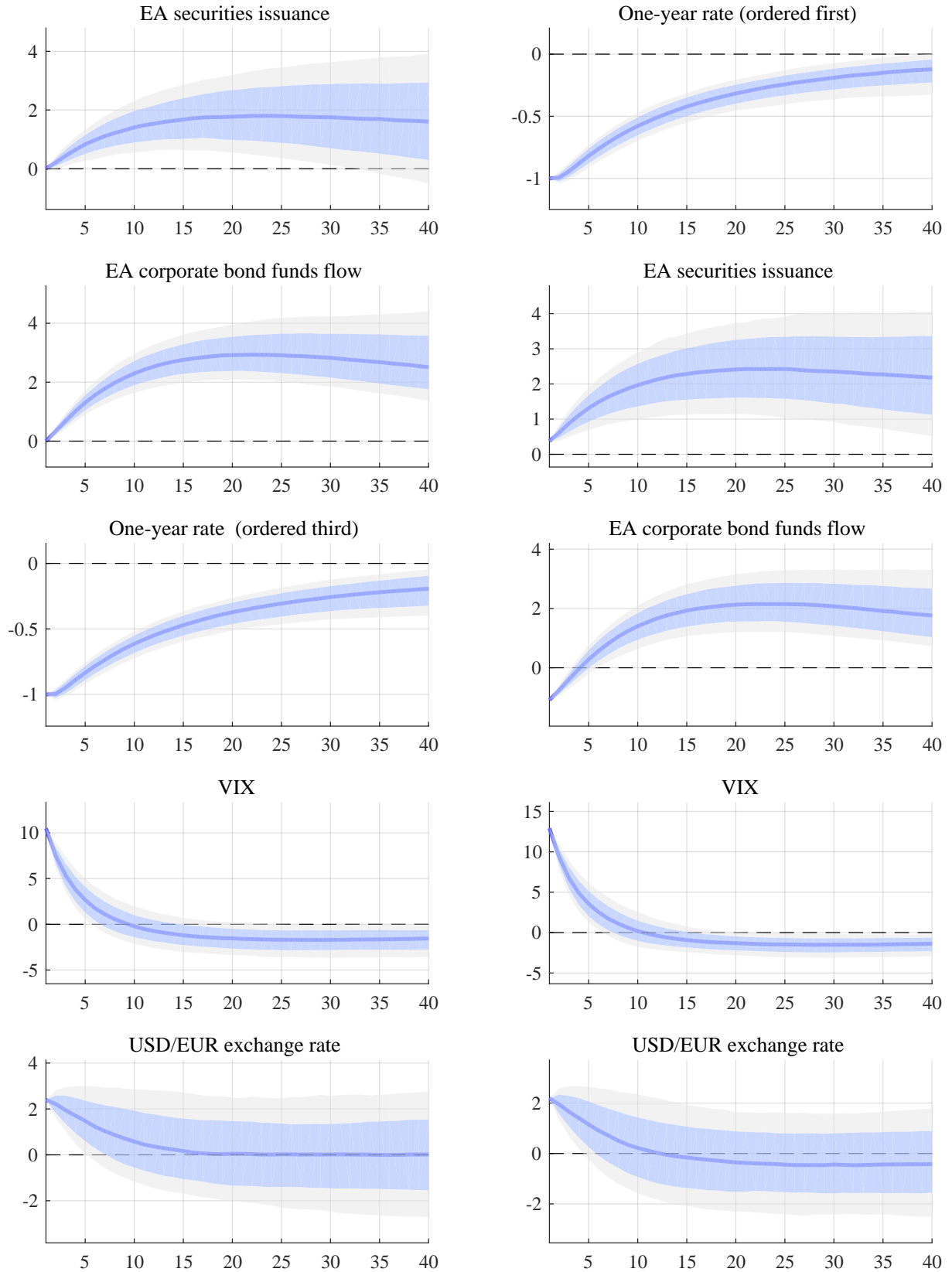


Figure 8: Impulse responses in bond funds model with alternative ordering

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 1% decrease of the one-year US treasury rate (blue lines) with 70% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with recursive identification. Each column shows a model with different ordering. Column 1: As the baseline in Figure 1 with the one-year rate ordered third. Column 2: one-year rate ordered first.

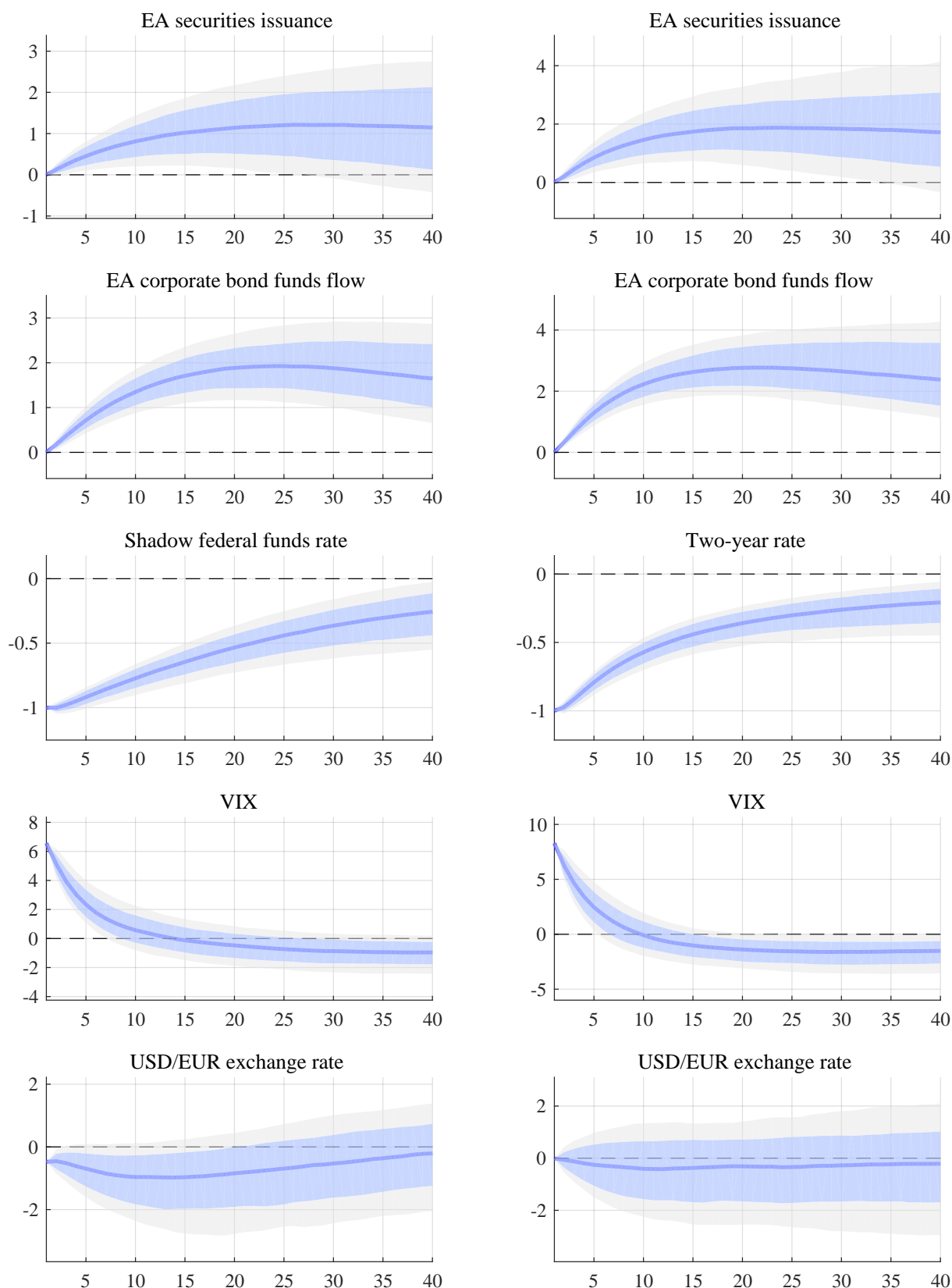


Figure 9: Impulse responses to alternative monetary policy indicators

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 1% decrease of a monetary policy measure (blue lines) with 70% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with recursive identification. Instead of the one-year US treasury rate, the model in Column 1 uses the Wu and Xia (2016) shadow federal funds rate, while the model in Column 2 uses the two-year US treasury rate.

5 Conclusion

This paper provides empirical evidence for substantial spill-overs from global financial conditions, proxied 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 spill-overs via non-bank financial institutions such as investment funds. The results suggest that a loosening of US monetary policy leads to inflows from global investment funds to EA equities and bonds. These inflows are particularly strong for the riskier segments of financial markets and they also coincide with increased equity and debt issuance by EA non-financial corporations. The latter finding 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.

Further analysis of this topic could be conducted along the following dimensions. The paper currently focusses exclusively on the role of global investors to EA assets. A natural corollary to the present analysis would be to also investigate the behaviour of domestic EA investment funds in response to global shocks.

This exercise could also help to better understand the transmission of US monetary policy to EA debt and equity issuance, by allowing quantifying the relative importance of foreign and domestic flows, as well as of further determinants of securities issuance.

Further research could also investigate the reaction and relevance of bank-based capital flows in the post-crisis episode and study its interactions with the rapidly growing investment fund sector.

Finally, in terms of methods, the results from the recursively identified VAR could be compared with results that are obtained from an identification procedure based on external instruments, as in Gertler and Karadi (2015), Jarociński and Karadi (2019), or Caldara and Herbst (2019).

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Appendix

A 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 (Source: EPFR Global): Nominal net portfolio flows of either bond or equity funds domiciled outside the euro area with regional investment focus “Western Europe,” calculated as cumulative percentage flows relative to sample starting point in April 2007. Additional breakdowns used:
 - Corporate / sovereign bonds
 - High-yield bonds
 - Long maturity bonds investment focus, defined as 6 or more years.
 - Small cap equity, which includes equities of firms with a market capitalisation between USD 300 million and 2 billion.
- Debt securities issuance (Source: ECB Securities Statistics): Notional stocks of all securities issued by euro area non-financial corporations; all currencies combined; mnemonic [SEC]; transformed to logs.
- Equity issuance (Source: ECB Securities Statistics): Notional stocks of all equity shares issued by euro area non-financial corporations; all currencies combined; mnemonic [SEC]; transformed to logs.
- EA government bond rates (Source: ECB Financial Market Data): Euro area 2,10-year government benchmark bond yield; mnemonic [FM]; no further transformations.
- US treasury rates (Source: FRB of St. Louis FRED): 1,2,10-year treasury constant maturity rate; percent; not seasonally adjusted; mnemonic [GS]; no further transformations.
- EONIA rate (Source: ECB Financial Market Data): monthly averages; mnemonic [FM]; no further transformations.
- US Effective federal funds rate (Source: FRB of St. Louis FRED): percent; monthly averages; not seasonally adjusted; mnemonic [FEDFUNDS]; no further transformations.
- Wu and Xia (2016) shadow federal funds rate (Source: <https://sites.google.com/view/jingcynthiawu/shadow-rates> [Last access: 26/06/2019]): no further transformations.

- US Dollar/Euro exchange rate (Source: ECB Exchange Rates): ECB reference exchange rate, US dollar/Euro, 2:15 pm (C.E.T.); monthly averages; mnemonic [EXR]; transformed to logs.
- US nominal effective exchange rate (Source: Bank for International Settlements): Broad index 2010=100; monthly averages; mnemonic [NBUS]; transformed to logs.
- EA industrial production (Source: ECB Short-Term Statistics): Industrial production for the euro area; total industry (excluding construction) - NACE Rev2; working day and seasonally adjusted; mnemonic [STS]; transformed to annual growth rates.
- US industrial production (Source: FRB of St. Louis FRED): Industrial production index; index 2012=100; seasonally adjusted; mnemonic [INDPRO]; transformed to annual growth rates.
- EA inflation (Source: ECB Indices of Consumer Prices): HICP - overall index, monthly index; neither seasonally nor working day adjusted; mnemonic [ICP]; transformed to annual growth rates.
- US inflation (Source: FRB of St. Louis FRED): Consumer Price Index for All Urban Consumers: All Items; index 1982-184=100; seasonally adjusted; mnemonic [CPIAUCSL]; transformed to annual growth rates.
- Eurostoxx equity index (Source: ECB Financial Market Data): Dow Jones Euro Stoxx 50; EUR Price Index - Historical close; end of period; mnemonic [FM]; transformed to annual growth rates.
- SP500 equity index (Source: ECB Financial Market Data): Standard and Poors 500 Index - Historical close; end of period; mnemonic [FM]; transformed to annual growth rates.
- VIX volatility index (Source: Datastream): monthly averages; mnemonic [CBOE-VIX]; no further transformations.
- VSTOXX volatility index (Source: Datastream): monthly averages; mnemonic [VSTOXXI]; no further transformations.
- European IG bond index (Source: Bloomberg): Bloomberg Barclays Euro Aggregate Corporate Total Return Index Value Unhedged EU; mnemonic [LECP TREU:IND]; transformed to logs.
- European HY bond index (Source: Bloomberg): Bloomberg Barclays Pan-European High Yield (Euro) TR Index Value Unhedged EUR; mnemonic [LP02 TREU:IND]; transformed to logs.

- US IG bond index (Source: Bloomberg): Bloomberg Barclays US Corporate Total Return Value Unhedged USD; mnemonic [LUACTRUU:IND]; transformed to logs.
- US HY bond index (Source: Bloomberg): Bloomberg Barclays US Corporate High Yield Total Return Index Value Unhedged USD; mnemonic [LF98TRUU:IND]; transformed to logs.

B Results with alternative baseline variables

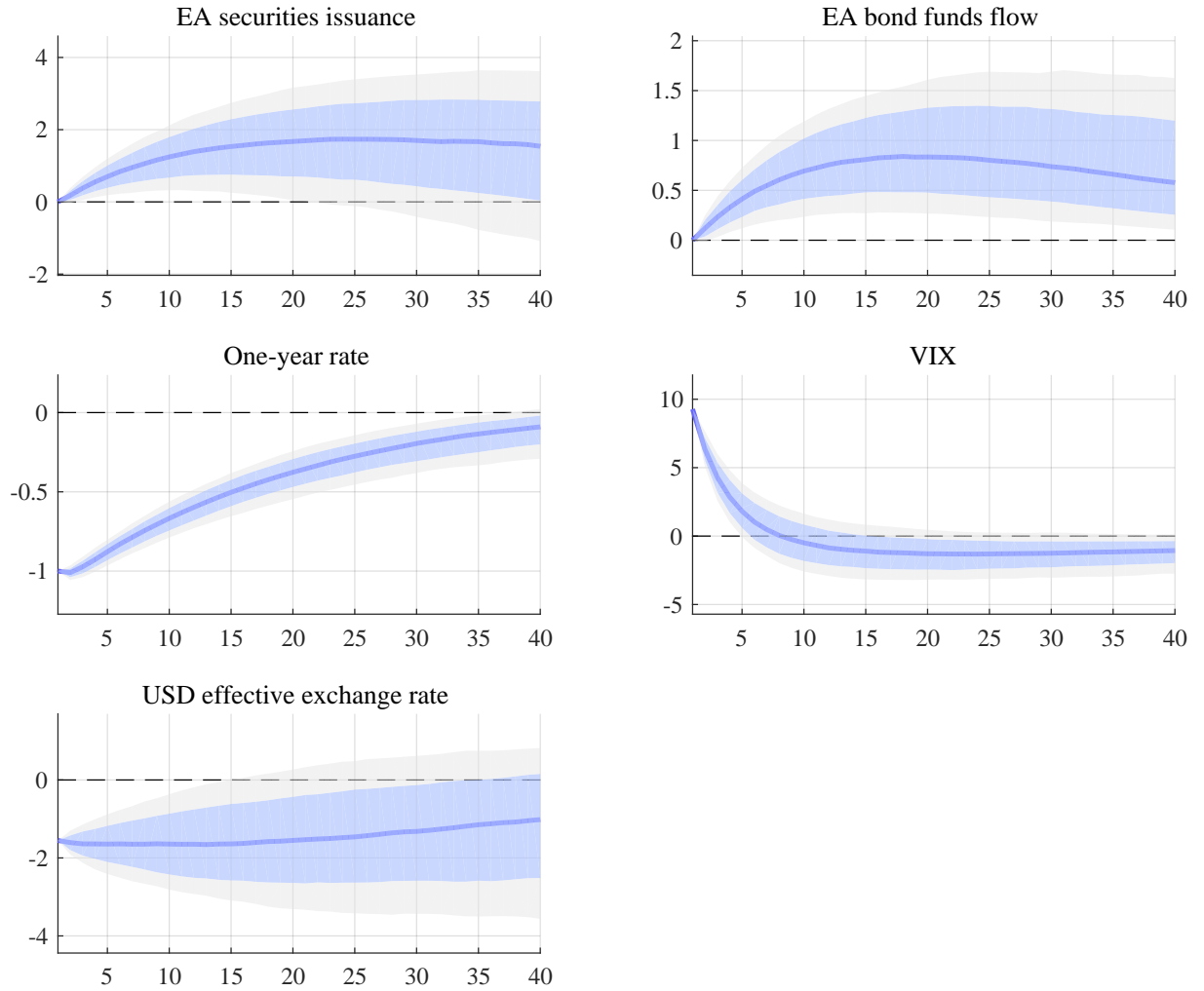


Figure 10: Impulse responses in baseline model with effective exchange rate

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 1% decrease of the one-year US treasury rate (blue lines) with 70% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with recursive identification.

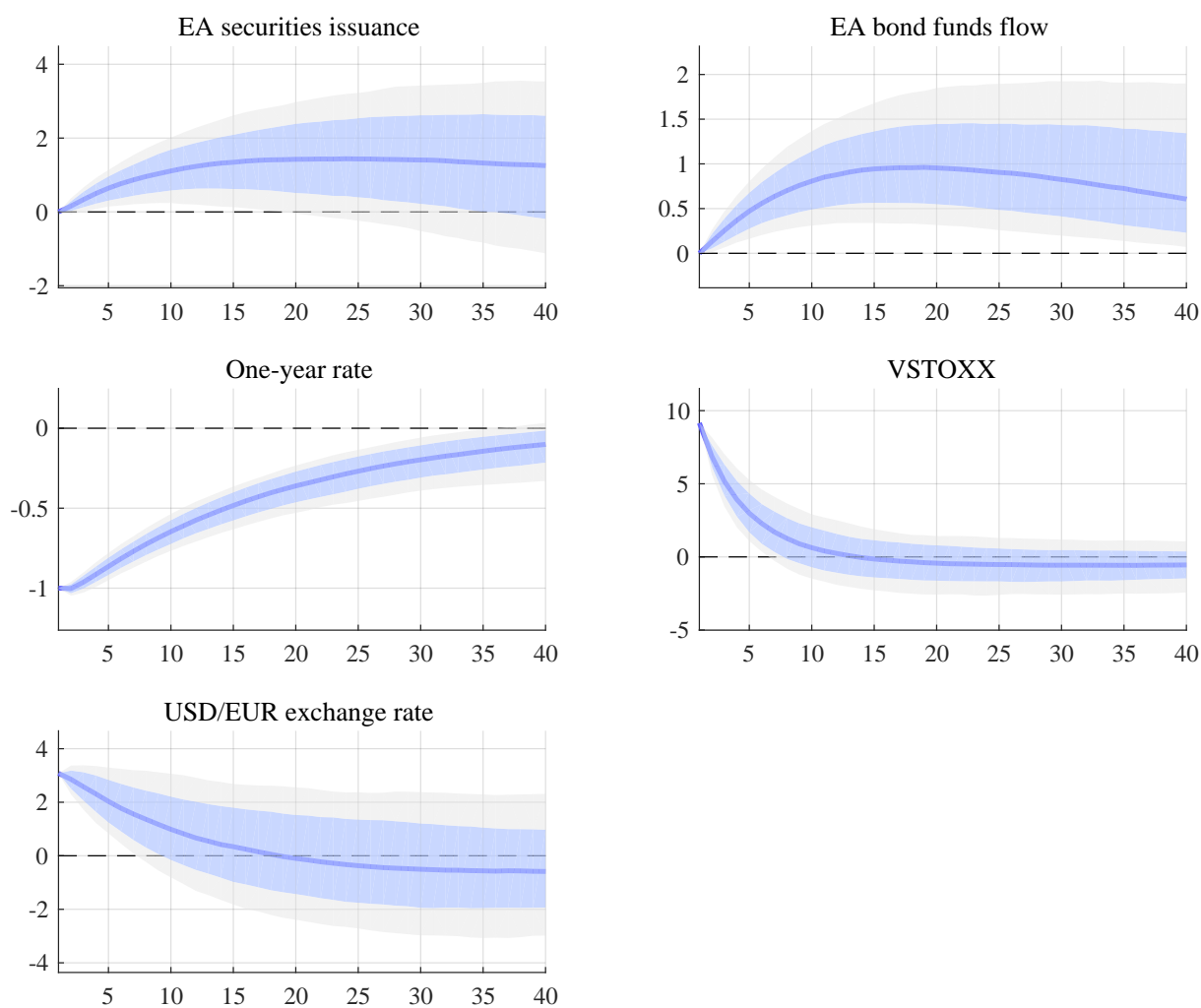


Figure 11: Impulse responses in baseline model with VSTOXX

Notes: Impulse responses to an expansionary US monetary policy shock inducing a 1% decrease of the one-year US treasury rate (blue lines) with 70% (blue-shaded areas) and 90% (grey-shaded areas) credibility intervals obtained from a structural BVAR with recursive identification.