



ADB Working Paper Series

**THE TRANSMISSION OF INTEREST RATES
HOOPS TO ASIA – ARE EFFECTS DIFFERENT
BELOW THE ZERO LOWER BOUND?**

Martin Feldkircher, Florian Huber,
Pornpinun Chantapacdepong,
and Maria Teresa Punzi

No. 690
March 2017

Asian Development Bank Institute

Martin Feldkircher is a senior economist at the Oesterreichische National Bank. Florian Huber is an assistant professor of economics at the Vienna University of Economics and Business. Pornpinun Chantapacdepong is a research fellow at the Asian Development Bank Institute. Maria Teresa Punzi is an assistant professor of economics at the Vienna University of Economics and Business.

The views expressed in this paper are the views of the author and do not necessarily reflect the views or policies of ADBI, ADB, its Board of Directors, or the governments they represent. ADBI does not guarantee the accuracy of the data included in this paper and accepts no responsibility for any consequences of their use. Terminology used may not necessarily be consistent with ADB official terms.

Working papers are subject to formal revision and correction before they are finalized and considered published.

The Working Paper series is a continuation of the formerly named Discussion Paper series; the numbering of the papers continued without interruption or change. ADBI's working papers reflect initial ideas on a topic and are posted online for discussion. ADBI encourages readers to post their comments on the main page for each working paper (given in the citation below). Some working papers may develop into other forms of publication.

Suggested citation:

Feldkircher, M., F. Huber, P. Chantapacdepong, and M Punzi. 2017. The Transmission of Interest Rates Hocks to Asia – Are Effects Different below the Zero Lower Bound. ADBI Working Paper 690. Tokyo: Asian Development Bank Institute. Available: <https://www.adb.org/publications/transmission-interest-rates-shocks-asia>

Please contact the authors for information about this paper.

Emails: punzimt@gmail.com, mpunzi@wu.ac.at

Asian Development Bank Institute
Kasumigaseki Building, 8th Floor
3-2-5 Kasumigaseki, Chiyoda-ku
Tokyo 100-6008, Japan

Tel: +81-3-3593-5500
Fax: +81-3-3593-5571
URL: www.adbi.org
E-mail: info@adbi.org

© 2017 Asian Development Bank Institute

The Transmission of Interest Rate shocks to Asia - Are Effects Different below the Zero Lower Bound?

Martin Feldkircher¹, Florian Huber², Pornpinun Chantapacdepong³, and Maria Teresa Punzi^{*4}

¹Oesterreichische National Bank

²Vienna University of Economics and Business

³Asian Development Bank Institute

⁴Vienna University of Economics and Business

Abstract

We use a non-linear factor-augmented vector-autoregressive model to evaluate international effects of an unexpected decrease in euro area policy rates. Given the current environment of ultra low or negative interest rates, we especially focus on potential differences in the transmission of the monetary policy shock depending on the level of interest rates in the country from where the shock originates, i.e., the euro area. A euro area monetary policy shock when euro area interest rates are positive at the time the shock occurs tends to trigger positive spillovers to industrial production, house and stock prices and negative effects on short- and long-term interest rates, as well as on inflation. Results tend to be similar when interest rates are already below zero at the time monetary policy turns out to be expansionary, however responses are estimated with a larger degree of uncertainty. In some cases, a distinct transmission depending on the level of interest rates in the euro area, is observable but no general patterns emerge from the data.

Keywords: NIRP, yield curve, capital flow, emerging Asia, FAVAR.

JEL Codes: C3 E3, E5.

*Corresponding author: Maria Teresa Punzi, Vienna University of Economics and Business. E-mail: punzimt@gmail.com, mpunzi@wu.ac.at. All views expressed are those of the authors and do not necessarily represent the opinions of, and should not be attributed to, the Oesterreichische National Bank. We would like to thank participants of the 19th Annual Conference of the Asian Development Bank Institute, Tokyo for helpful comments.

1 Introduction

The European Central Bank (ECB), the Bank of Japan (BOJ) and several smaller European monetary authorities (Denmark, Switzerland and Sweden) have set their key interest rates into negative territory. The ECB has been the first major central bank around the world following the so-called negative interest rate policy (NIRP) by lowering its facility deposit rate to -0.1% in June 2014, and, with a further cut in 2016, the deposit rate stood at -0.4%. Other major central banks, such as the BOJ, have followed by setting key interest rates into negative territory (see Fig. 1). The NIRP is one tool of modern monetary policy measures and aims at discouraging commercial banks from keeping their money with the central bank thereby promoting more loans at lower rates to businesses and households. This should ultimately boost private consumption, investment, and gross domestic product (GDP) growth. However, persistent negative rates could increase the risk that commercial banks would raise commission fees on deposits to offset higher costs they have to pay at the central bank for depositing reserves. This could increase the incentive to withdraw from commercial banks, quenching the credit channel and endangering overall stability of the banking sector. Lowering interest rates significantly can also have important international effects: investors searching for higher returns might be willing to take extra risks by making investments overseas.

In this paper, we assess the implications of the NIRP for Asian economies. In particular, we focus on the economic and financial impact of the NIRP adopted by the ECB on the Peoples Republic of China (PRC), the Republic of Korea, Indonesia, India, Malaysia, the Philippines, and Thailand. Empirical work indicates that Asian economies are influenced by monetary policy measures in advanced economies, such as quantitative easing and other unconventional monetary instruments.¹ Arteta, Kose, Stocker, and Taskin (2016) and Carney (2016) suggest that the NIRP would have a similar impact on emerging markets as previous alternative unconventional monetary policy tools. Ultra-low and negative interest rates in Europe and Japan, coupled with a slow expected hike in the United States (US) policy rate, drive long-term yields down encouraging the search for yield by investors. As a result, emerging and developed Asia can be exposed to incommensurate volatile swings in foreign currencies, international capital inflows, and asset prices.

Our study employs a non-linear factor-augmented vector autoregressive (FAVAR) model akin to Bernanke, Boivin, and Eliasch (2005) that models macroeconomic factors by taking into account a broad range of macro and financial data. To assess the international dimension of negative interest rate shocks, we assume that the structural relations within our modeling framework change allowing estimated coefficients to depend on the level of interest rates (below or above zero). This allows us to unveil spillover effects by performing impulse response analysis conditional on the prevailing regime. Because selected interest rates have only been negative for a relatively limited amount of time, we adopt Bayesian shrinkage priors in the

¹Punzi and Chantapacdepong (2016) found that central banks in the Asia and Pacific region have accommodated their monetary policy in response to unconventional monetary policy measures in advanced economies. More specifically, this has led to lower interest rates, currency appreciation, and asset price boom associated with strong capital flows in the region.

Minnesota tradition to ease eventual overfitting issues. Our analysis shows that an expansionary monetary policy shock in a normal interest rate environment leads directly to easier monetary conditions in Asia. This result corroborates the findings of [Rey \(2015\)](#) on the dilemma and global financial cycle where central banks in Asia have been losing their independency in setting an appropriate policy rate in order to deliver price stability and economic growth. This result changes when the shock occurs when interest rates are already below zero. Here, Asian economies still respond with easier monetary policy conditions through market expectations of future policy rates. Therefore, NIRP spills over to Asian economies through the signalling channel and through short- and long-term interest rate channels. Also the portfolio re-balance channel is quite important in the international transmission of NIRPs as declining short-term interest rates tend to raise the demand for assets characterized by longer duration and higher yield, thus compressing long-term yields. Heterogeneity emerges when considering exchange rates, asset prices and capital inflows. Therefore, the exchange rate and asset price channels work only for few countries.

This paper contributes to the literature on the international spillover effects of conventional and unconventional monetary policy on advanced and emerging markets. One empirical strand of the literature focuses on the global spillovers of the US monetary policy. [Canova \(2005\)](#), [Kim \(2001\)](#), [Maćkowiak \(2007\)](#), [Nobili and Neri \(2006\)](#), and [Feldkircher and Huber \(2016\)](#) show that US conventional monetary policy can generate significant cyclical fluctuations in emerging markets through a financial channel. [Rey \(2015\)](#), [Shin \(2012\)](#) and [Bruno and Shin \(2015\)](#) show that the conduct of US monetary policy can affect banking and capital flow through the interaction of the US policy rate with the commercial banks' balance sheet. [Cerutti, Claessens, and Ratnovski \(2014\)](#) study how monetary policy in the US, the UK, EU and Japan spillover to other countries through the capital flows. Another strand of the literature focuses on the international spillover effects of the recent US unconventional monetary policy. [Fratzscher, Lo Duca, and Straub \(2013\)](#) demonstrates that the US unconventional monetary policy leads to adverse impact to emerging markets because of the higher procyclicality of portfolio flows induced by quantitative easing policies. [Miyajima, Mohanty, and Yetman \(2014\)](#), using a panel vector autoregressive approach, find that quantitative easing in the US leads to lower long-term bond yield and term premium in Asia. Other authors find that the US unconventional monetary policy leads to lower long-term bond yield and term premium and increasing capital flows in Asia. See [Miyajima, Mohanty, and Yetman \(2014\)](#), [Anaya, Hachula, and Offermanns \(2015\)](#) and [Chen, Filardo, He, and Zhu \(2015\)](#). However, literature on the NIRP is quite limited. [Jobst and Lin \(2016\)](#) analyze the implications of the transmission of the NIRP and bank profitability in the euro-area. [Bech and Malkhozov \(2016\)](#) study the operational aspects of the implementation of the NIRP and find that negative interest rates affect money markets and other interest rates similarly to what positive rates would do, with the exception of retail deposit rates. [Hameed and Rose \(2016\)](#) study the implication on effective exchange rates and bilateral rates due to the NIRP in Denmark, the EU, Japan, Sweden and Switzerland. They find marginal effect of these policies on exchange rates. [Arteta, Kose, Stocker, and Taskin \(2016\)](#) study the sources and implications

of the NIRP through various transmission channels, and find that similar to unconventional monetary policy measures, the NIRP spills over to emerging economies through the portfolio re-balancing channel, as investors search for yields. [Arteta, Kose, Stocker, and Taskin \(2016\)](#) analyze the implications of the NIRP with event cases. We contribute to the literature by analyzing the implications of both European and Japanese NIRPs on Asian economies. Our paper develops a dynamic FAVAR model in order to consider several macro and financial variables that can respond to such international monetary policy in advance economies. Our paper is the first to report the main difference of the impact on macro-financial variables when there is a negative shock to the policy rate in a positive and negative territory.

The rest of the paper is organized as follows. Section 2 presents the econometric model. Section 3 presents the main stylized fact in Asia and discuss the identification problem. Section 4 presents results of the corresponding impulse responses for each analyzed country. Section 5 concludes.

2 Econometric framework

2.1 A Non-linear Factor-Augmented Vector-Autoregressive Model

In light of the specific research question at hand, we need a modeling approach that provides a parsimonious representation of the world economy and at the same time allows for sufficient flexibility when it comes to analyzing interest rate shocks within two regimes: a regime when interest rates are positive and a regime with interest rates are negative.

Nowadays, econometric specifications that are capable of handling large datasets are readily available ([Banbura, Giannone, and Reichlin, 2010](#); [Feldkircher and Huber, 2016](#); [Crespo Cuaresma, Feldkircher, and Huber, 2016](#)) . However, in our application we need to estimate the parameters in two regimes, with one regime being characterized by only relatively few observations. This calls for even more shrinkage along several dimensions. To this end we adopt a Bayesian factor-augmented VAR model that builds on the assumption that the global economy is driven by a relatively low number of dynamic factors that represent global driving forces like the international business cycle ([Kose, Otrok, and Whiteman \(2003\)](#)) or a global financial cycle.

We proceed in two steps. First, we assume that y_t is an $M \times 1$ vector of international macroeconomic variables, excluding the interest rate to be shocked may be well described by a set of $K \ll M$ dynamic factors ((see [Stock and Watson, 2011](#))),

$$y_t = \begin{cases} \Lambda_0 f_t + \beta_0 r_{it} + \Sigma_0^{1/2} \varepsilon_t, & \text{if } r_{it} > 0 \\ \Lambda_1 f_t + \beta_1 r_{it} + \Sigma_1^{1/2} \varepsilon_t, & \text{if } r_{it} \leq 0 \end{cases}, \quad (2.1)$$

with Λ_j ($j = 0, 1$) being regime-specific factor loadings of dimension $M \times K$ and β_j is an M -dimensional coefficient vector that relates the key interest rate r_{it} to y_t . In our case y_t is an M -dimensional vector of macroeconomic and financial variables for seven countries. $\Sigma_j = \text{diag}(\sigma_{j1}, \dots, \sigma_{jM})$ is a diagonal variance-covariance matrix with Σ_j denoting the matrix square root and ε_t is a standard normally distributed zero mean error term. [Eq. \(2.1\)](#) implies

that we treat r_{it} as an observed factor in the model and that all the cross-correlation between the elements in y_t stems exclusively from the common factors and are not relegated to Σ_j .

Second, we assume that the factors and r_{it} are stacked in a $K + 1$ -dimensional vector z_t and follow a non-linear VAR of order p , i.e.,

$$z_t = \begin{cases} z_{t-1}A_{1,0} + \dots + z_{t-p}A_{p,0} + \Omega_0^{0.5}\eta_t & \text{if } r_{it} > 0 \\ z_{t-1}A_{1,1} + \dots + z_{t-p}A_{p,1} + \Omega_1^{0.5}\eta_t & \text{if } r_{it} \leq 0 \end{cases} . \quad (2.2)$$

Here we let $A_{i,j}$ denote $K + 1 \times K + 1$ -dimensional matrixes of lagged autoregressive coefficients and Ω_j denotes a variance-covariance with $\Omega_j^{0.5}$ denoting its matrix square root / Cholesky decomposition. Finally, $\eta_t \sim \mathcal{N}(0, I_{K+1})$ is a Gaussian white noise error. Note that, depending on whether interest rates in the country the shock originates, i.e., in the euro area, we estimate different parameters. Moreover, there is a direct link from Eq. (2.2) to Eq. (2.1) through the factor loadings. This implies that once a monetary policy shock is identified in the VAR representation we can investigate the impulse responses of all variables contained in our data set.

Since we adopt a Bayesian approach to estimation and inference we specify suitable priors on the free parameters in the state and observation equations. More specifically, we adopt a standard (conjugate) Minnesota prior (Doan, Litterman, and Sims, 1984; Sims and Zha, 1998) on the autoregressive parameters in Eq. (2.2), an inverted Wishart prior on Ω_j and a normally distributed prior with zero mean and variance one on the free elements of Λ_j .

To identify a negative interest rate shock, both in case the policy rate is already into a positive or negative territory, we adopt zero impact restrictions on the factors as in Bernanke, Boivin, and Elias (2005), with short-term interest rates ordered last. This captures the notion that global macroeconomic forces, captured by the latent factors, react with a one-month lag to interest rate shocks in both regimes. In addition, the factor model itself is identified by specifying the upper $M \times M$ matrix of the loadings to equal an identity. This identification scheme overidentifies the observation equation and implies that the first M time series are essentially the factors plus noise.

The zero impact restrictions on the state equation in Eq. (2.2) induce a triangular causal structure on how interest rate shock impact the global economy. Note, however, that after calculating the impulse responses, we use the factor loadings matrix to recover the implicit responses of y_t , where the contemporaneous effect of an interest shock on the j th element of y_t is given by the j th element of β_0 and β_1 , indicating that in terms of the observation equation we also allow for a faster transmission of shocks.

3 Data Descriptions and Identification

For the purpose of our analysis, we consider monthly data for seven Asian economies: the PRC, the Republic of Korea, Indonesia, India, Malaysia, the Philippines, and Thailand. In particular, we consider output (proxied by the manufacturing production index), short-term interest rate, long yield 10-year government bond, inflation, real effective exchange rate, asset

prices (house price index and equity price index) and capital flows (debt flows and equity flows). See Table 1.

In the last decade, Asia has been facing challenges from the global financial crisis of 2008, the European debt crisis, and advanced economies' implementation of unconventional monetary policies, and lately extending to negative interest rate policies. These policies have given rise to concerns over financial stability and international capital flows into Asia. Government bond yield, house price index and stock price index in Asia are influenced more by the monetary policies of the advanced economies than by their own policies and fundamentals. Fig. 2 illustrates plots of asset prices in Asia. The red vertical lines represent the beginning of the quantitative easing in the US on 25 November 2008, announcement of negative interest rates in Europe on 5 June 2014, and a surprise introduction of negative interest rates in Japan in January 2016. The Asian stock index shot up with respect to these three events, especially in the case of high non-resident investors like Indonesia. The continued increasing trend for the stock index is observed since the quantitative easing (QE) in the US. The long-term government bond yield also dropped with respect to these three events. The low or negative bond yield in Europe and in Japan, and the expectation of a slower than previously expected rate hike in the US, have encouraged the search-for-yield behavior. The resulting return of international capital flows to Asian bonds has boosted Asian currencies and pushed down yields on Asian government bonds. Again, the decreasing trend is observed over the long run. The house price in Asia also showed an increasing trend since the QE. The volatile currencies, international capital flows, and higher asset price, have been common in Asia since the global financial crisis. Economic fundamentals in Asia itself have gone through the peak and through over the decade. After the QE, many emerging markets had to begin hiking interest rates to curb rising inflationary pressures. Emerging markets were perceived to be resilient to the global financial crisis, with better external and fiscal fundamentals than many advanced economies. This has been reflected in the positive trend of emerging market sovereign ratings, reinforcing the attractiveness of these markets for foreign investors. Capital inflows were due to the fundamentals-based rebalancing of institutional portfolios toward emerging market assets. Global investors had a high risk appetite on Asian assets. However, after the taper tantrum on 21 May 2013, the wave of capital flows became more volatile due to various international factors: (i) the pace of monetary policy normalization in the US, (ii) the slowdown in the PRC, (iii) the slide in oil prices, and (iv) higher political uncertainty and elevated geopolitical tensions. Locally, the growth momentum (and inflation) in Asia slowed down due to weaker balance of payments, worsening external debt conditions, and reduction in real economic activity. Monetary policy in Asia therefore became more accommodative to support growth. This, in turn, lowered expected relative interest returns and caused capital to flow out of Asia. Moreover, the exchange rate return on investing in Asian assets, which previously had been a byproduct of investment, declined. This is because there was greater risk aversion on Asian assets and there was downward pressure on all emerging Asian currencies due to weaker economic fundamentals. With this, capital inflow into Asia slowed down. Nevertheless, the slower than expected policy rate hike in the

US and the continued monetary policy expansion of the EU and Japan created another wave of capital inflow into Asia. Regardless that economic fundamentals in Asia have been less robust than before. The inflow during this period is to search for higher return on investment and the flow itself is quite sensitive to the change in global risk sentiment. Central banks in Asia tend to pursue accommodative monetary policy to shore up economic growth and, in part, to keep proportionate interest rate spread over advanced economies.

4 Empirical Results

In this section we report the impulse responses to an expansionary monetary policy shock in the euro area. The results are depicted in Figures 3 to 9. For each country, we show responses once when the interest rate in the euro area was positive when the shock hit the economy ($R^{EA} > 0$) in the top panel, and when interest rates have been negative ($R^{EA} < 0$) in the bottom panel.

In most economies, a traditional monetary expansion triggers significant spillovers to Asia. More specifically, domestic interest rates tend to follow the rate cut in the euro area, implying significant rate cuts in Asia. These cuts also shelter from strong currency appreciations - most domestic currencies weaken in the short-run. Short-run interest rate cuts tend to be passed on to long-term yields. As a result of easy monetary conditions, industrial production tends to increase. Surprisingly, inflation decelerates in most economies and significantly so in the short-run. The reason could be attributed to the export slowdown of these countries with Europe. This implies an international prize puzzle. Finally, with yields on debt securities falling, equity prices and housing prices tend to tick up throughout the region.

Results of an expansionary monetary policy shock when interest rates are already below zero, tend to show similar results, but credible sets tend to be wider. In some cases, however, a distinct transmission depending on the level of interest rates in the euro area, is observable. For example, while in the PRC a traditional monetary policy shock in the euro area decelerates price growth in the short-run, a policy surprise when interest rates are below zero boosts inflation but not significantly so. Consequently, and in the short-run, the real exchange rate appreciates in response to the former, while it depreciates indicating a gain in external competitiveness in the latter case. The same applies to house prices hinting at a different international transmission channel depending on the level of interest rates in the country which the shock originates. Another example is in the Republic of Korea, where the policy rate, long-term yields and inflation increase in the short-run, when interest rates are below zero in the euro area at the time of the shock, while the opposite is the case when euro area rates are lowered, while they are above zero. This translates also into a distinct, short-run response of the real exchange rate, with an immediate appreciation that peters out very slowly, while it gradually appreciates in the latter case. Last, in Thailand, the policy rate moves in opposite directions in the short-run, and significantly so, which triggers different responses of inflation and the real exchange rate, which in the short-run depreciates when interest rates are above zero at the time the shock hits the economy, while it appreciates in the opposite case.

These results point at a significant degree of heterogeneity among Asian economies. Taking a regional stance, we find that the PRC shows the most significant responses for a broad set of macroeconomic variables. Most of the responses to the shock with euro area interest rates in positive territory, die out after 20 to 30 months. Exceptions to this are the policy rate and house prices showing rather persistent responses. By contrast, responses to the euro area monetary policy shock when the interest rate lies in negative territory are accompanied by wide credible sets, while in the long-run, inflation, and short- and long-term interest rates are significantly negative. In India, looking at the shock at $R^{EA} > 0$, inflation ticks up in the short-run, although not significantly so. This is in contrast to the majority of other Asian economies. As in the PRC, responses of short- and long-term interest rates and house prices are rather persistent, while spillovers to other variables are more short-lived. This result is broadly unchanged when looking at the ($R^{EA} > 0$) case. Interestingly, inflation decelerates persistently. Responses in Indonesia are very similar to those in the PRC, except that responses of industrial production to the euro area monetary policy shock when euro area interest rates are positive, are non-significant in Indonesia. In the Republic of Korea and looking at the $R^{EA} > 0$ case first, we find a very pronounced appreciation of the real exchange rate and a significant initial drop of house prices after which a gradual increase occurs. Similar to responses in India, and Indonesia, short- and long-term interest rates on the one hand and inflation on the other hand respond significantly negatively in the longer term when interest rates are below zero. In Malaysia we see an initial drop of industrial production, albeit not precisely estimated, while in the medium term, monetary easing in the euro area has a positive and significant effect on economic activity. In contrast to the majority of countries covered here, there is no significant response of the real exchange rate in Malaysia. Malaysia is also the only country for which we do not find significant spillovers to any of the variables covered when $R^{EA} < 0$ at the time the shock occurs. In the Philippines, economic activity responds with an initial (and significant) drop to the shock when $R^{EA} > 0$, but medium-term responses are positive. Akin to the PRC, house prices tick up significantly and rather persistently so. On top of that, there is a pronounced increase in stock prices, which is also significant in the medium-term. Similar to responses in India, Indonesia and the republic of Korea, short- and long-term interest rates on the one hand and inflation and the other hand respond significantly negatively in the longer term when interest rates are below zero. Last, and with the exception of industrial production, Thailand shows very pronounced and significant responses of all variables to an expansionary monetary policy shock when euro area interest rates are above zero. These are negative for interest rates, inflation and real exchange rates on the one hand, and positive for house prices and stock prices on the other hand. While negative interest rates and inflation responses in the longer-term to a shock when $R^{EA} < 0$ applies is quite common for the region, real exchange rates in Thailand respond in the opposite way as when $R^{EA} > 0$ in the short-run. This implies that the economy responds differently when interest rates are above or below zero in the country from where the shock originates.

To sum up, a traditional euro area monetary policy shock tends to lead to easier monetary conditions in Asian economies. This result corroborates the findings of [Rey \(2015\)](#) on dilemma and global financial cycle where central banks in Asia have been partially losing their independency in setting domestic interest rates solely according to domestic macroeconomic and financial conditions. A similar impact on Asian economies has been found in the literature, when advanced economies adopted unconventional monetary policy measures. See [Miyajima, Mohanty, and Yetman \(2014\)](#), [Chen, Filardo, He, and Zhu \(2015\)](#), [Bruno and Shin \(2015\)](#), [Anaya, Hachula, and Offermanns \(2015\)](#) and [Punzi and Chantapacdepong \(2016\)](#). This result does not change drastically when interest rates lie in negative territory at the time of the monetary policy shock. Therefore, the NIRP spills over to Asian economies through the signaling channel and through short- and long-term interest rate channels. While these are some general patterns that emerge from the data, country specifics tend to play also a vital role.

5 Conclusions

We investigate spillovers of a positive euro area monetary policy shock to Asia. Given the current environment of ultra-low interest rates, a comprehensive assessment of these spillovers requires examining potential non-linearities in the transmission of monetary policy shocks. To this end we use a factor-augmented vector-autoregressive model to look separately at the consequences of monetary easing when euro area interest rates are above and below zero.

Our results for a euro area monetary policy shock when euro area interest rates are positive at the time the shock occurs are as follows: First, short- and long-term interest rates tend to decrease in parallel with the rate cut in the euro area. Second, inflation decelerates, indicating an international price puzzle. Third, together with the interest rate decrease, this implies an increase in external competitiveness for most economies. Last and as a consequence of the reduction of debt security yields, equity and house prices tend to tick up. Results on an expansionary monetary policy shock when interest rates are already below zero tend to be similar, but credible sets are wider. In some cases, however, a distinct transmission depending on the level of interest rates in the euro area, is observable. Other differences seem to be driven by country specifics.

References

- ANAYA, P., M. HACHULA, AND C. OFFERMANN (2015): “Spillovers of US unconventional monetary policy to emerging markets: The role of capital flows,” Discussion Paper 2015/35, School of Business & Economics.
- ARTETA, C., A. KOSE, M. STOCKER, AND T. TASKIN (2016): “Negative interest rate policies: Sources and implications,” Discussion Paper 11433, CEPR.
- BANBURA, M., D. GIANNONE, AND L. REICHLIN (2010): “Large Bayesian vector auto regressions,” *Journal of Applied Econometrics*, 25(1), 71–92.
- BECH, M. L., AND A. MALKHOZOV (2016): “How have central banks implemented negative policy rates?,” *BIS Quarterly Review*.
- BERNANKE, B. S., J. BOIVIN, AND P. ELIASZ (2005): “Measuring the Effects of Monetary Policy: A Factor-Augmented Vector Autoregressive (FAVAR) Approach,” *The Quarterly Journal of Economics*, 120(1), 387–422.
- BRUNO, V., AND H. S. SHIN (2015): “Capital flows and the risk-taking channel of monetary policy,” *Journal of Monetary Economics*, 71, 119–132.
- CANOVA, F. (2005): “The transmission of US shocks to Latin America,” *Journal of Applied econometrics*, 20(2), 229–251.
- CARNEY, M. (2016): “Redeeming an unforgiving world,” in *Speech to the 8th Annual Institute of International Finance G20 Conference*.
- CERUTTI, E., S. CLAESSENS, AND L. RATNOVSKI (2014): *Global liquidity and drivers of cross-border bank flows*, no. 14-69. International Monetary Fund.
- CHEN, Q., A. FILARDO, D. HE, AND F. ZHU (2015): “Financial crisis, US unconventional monetary policy and international spillovers,” *Journal of International Money and Finance*.
- CRESPO CUARESMA, J., M. FELDKIRCHER, AND F. HUBER (2016): “Forecasting with Global Vector Autoregressive Models: A Bayesian Approach,” *Journal of Applied Econometrics*, 31(7), 1371–1391.
- DOAN, T., R. LITTERMAN, AND C. SIMS (1984): “Forecasting and conditional projection using realistic prior distributions,” *Econometric reviews*, 3(1), 1–100.
- FELDKIRCHER, M., AND F. HUBER (2016): “The international transmission of US shocks—Evidence from Bayesian global vector autoregressions,” *European Economic Review*, 81, 167–188.
- FRATZSCHER, M., M. LO DUCA, AND R. STRAUB (2013): “On the international spillovers of US quantitative easing,” Discussion paper.
- HAMEED, A., AND A. K. ROSE (2016): “Exchange Rate Behavior with Negative Interest Rates: Some Early Negative Observations,” Discussion Paper 11498, CEPR.
- JOBST, A., AND H. LIN (2016): *Negative Interest Rate Policy (NIRP): Implications for Monetary Transmission and Bank Profitability in the Euro Area*. International Monetary Fund.
- KIM, S. (2001): “International transmission of US monetary policy shocks: Evidence from VAR’s,” *Journal of Monetary Economics*, 48(2), 339–372.
- KOSE, M. A., C. OTROK, AND C. H. WHITEMAN (2003): “International business cycles: World, region, and country-specific factors,” *The American Economic Review*, 93(4), 1216–1239.
- MAĆKOWIAK, B. (2007): “External shocks, US monetary policy and macroeconomic fluctu-

- ations in emerging markets,” *Journal of Monetary Economics*, 54(8), 2512–2520.
- MIYAJIMA, K., M. S. MOHANTY, AND J. YETMAN (2014): “Spillovers of US unconventional monetary policy to Asia: the role of long-term interest rates,” Discussion Paper 478.
- NOBILI, A., AND S. NERI (2006): “The transmission of monetary policy shocks from the US to the euro area,” Discussion Paper 606.
- PUNZI, M. T., AND P. CHANTAPACDEPONG (2016): “Spillover Effects of Unconventional Monetary Policy on Asia-Pacific Region,” Discussion paper.
- REY, H. (2015): “Dilemma not trilemma: the global financial cycle and monetary policy independence,” Discussion Paper 21162, National Bureau of Economic Research.
- SHIN, H. S. (2012): “Global banking glut and loan risk premium,” *IMF Economic Review*, 60(2), 155–192.
- SIMS, C. A., AND T. ZHA (1998): “Bayesian methods for dynamic multivariate models,” *International Economic Review*, pp. 949–968.
- STOCK, J. H., AND M. W. WATSON (2011): “Dynamic factor models,” *Oxford handbook of economic forecasting*, 1, 35–59.

Table 1: Variables

Variables	Description
IP	Manufacturing Production Index (Base 2010=100)
Policy Rate	Short-Term Interest Rate
Long Yield	10-Year Government Bond – Short-Term Interest Rate
π	Inflation
REER	Real Effective Exchange Rate
HPI	House Price Index
Equity	Stock Price Index
Debt Flows	IIF Portfolio Debt
Equity Flows	IIF Portfolio Equity

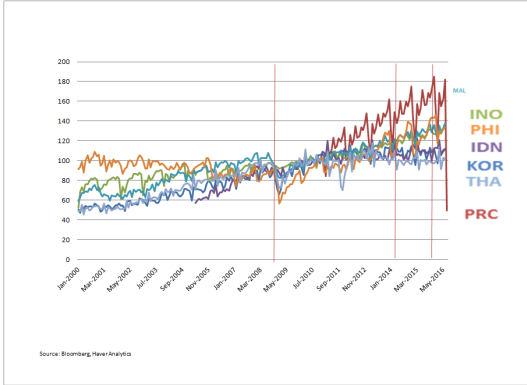
Fig. 1: Euro LIBOR 3-month rate.



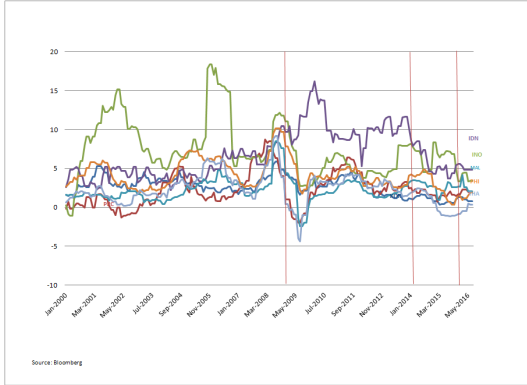
LIBOR = London interbank offered rate.

Fig. 2: Stylized Fact for Several Asian Countries.

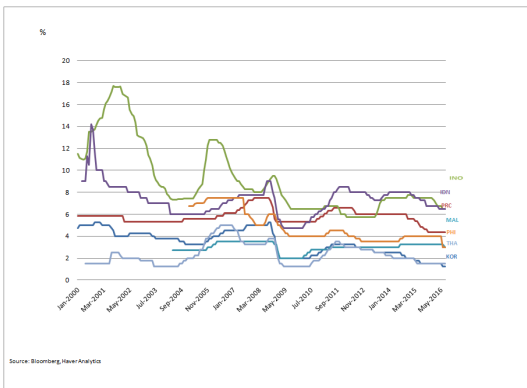
(a) Manufacturing Production Index



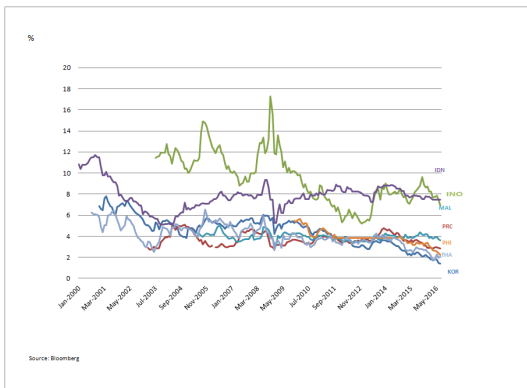
(b) Inflation



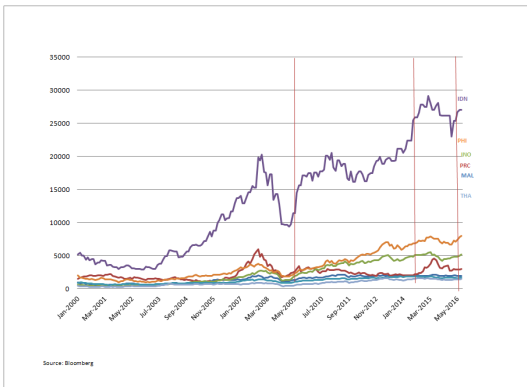
(c) Policy Rate



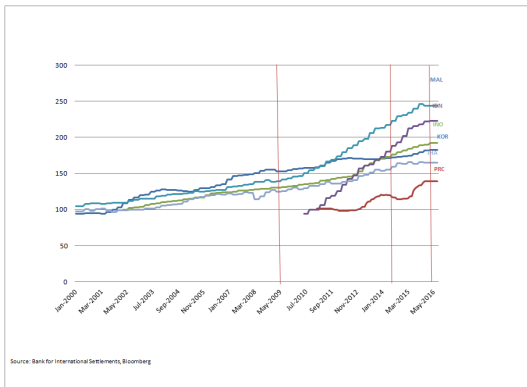
(d) Long-term government bond yield



(e) Stock Price Index



(f) House Price Index

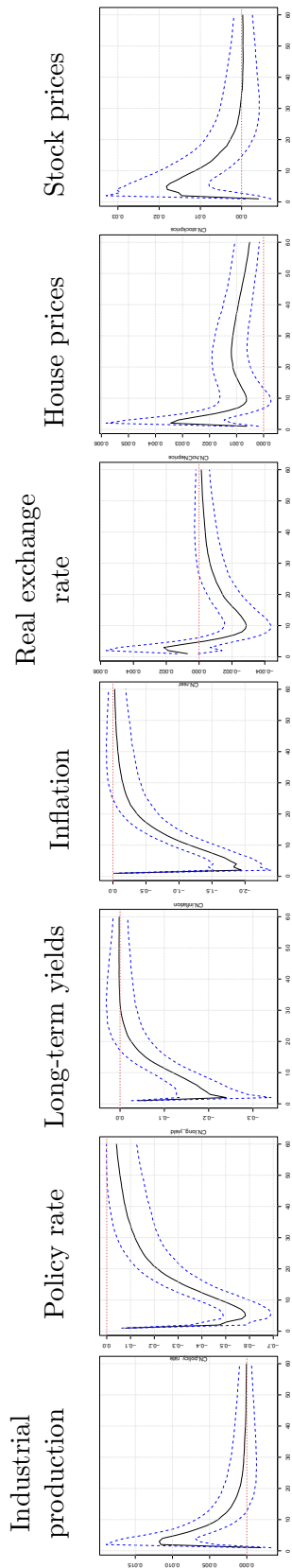


PRC = Peoples Republic of China, IDN = India, INO = Indonesia, KOR = Republic of

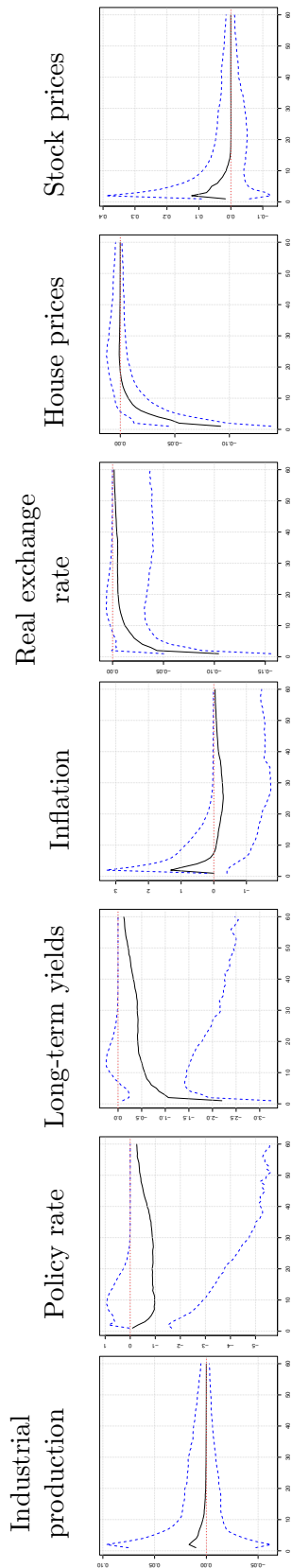
Korea, PHI = Philippines, THA = Thailand.

Fig. 3: People's Republic of China: Responses to an Expansionary Monetary Policy Shock

$R^{EA} > 0$



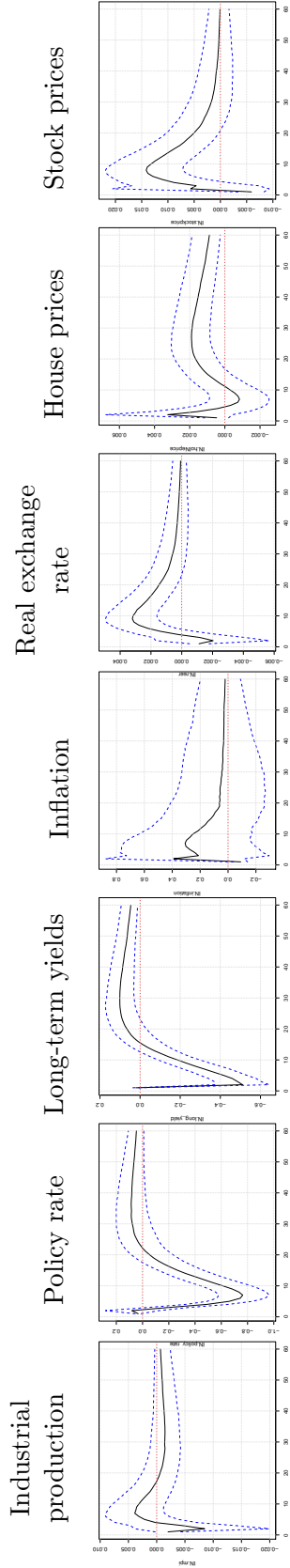
$R^{EA} < 0$



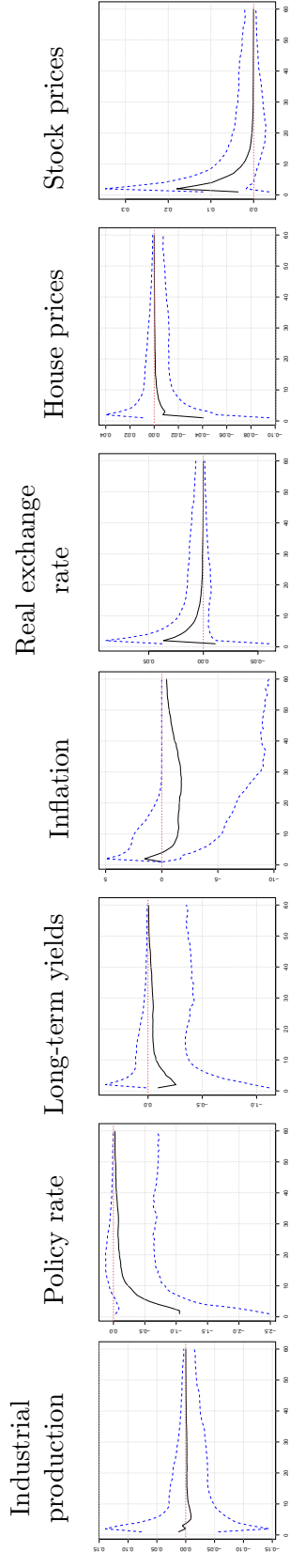
Notes: The top/bottom panel of the figure shows selected impulse responses to an expansionary monetary policy shock in the euro, when euro area interest rates are positive/negative at the time of the shock. Solid line refers to the posterior median; dashed lines denote 68% credible intervals. Source: Author.

Fig. 4: India: Responses to an Expansionary Monetary Policy Shock

$R^{EA} > 0$



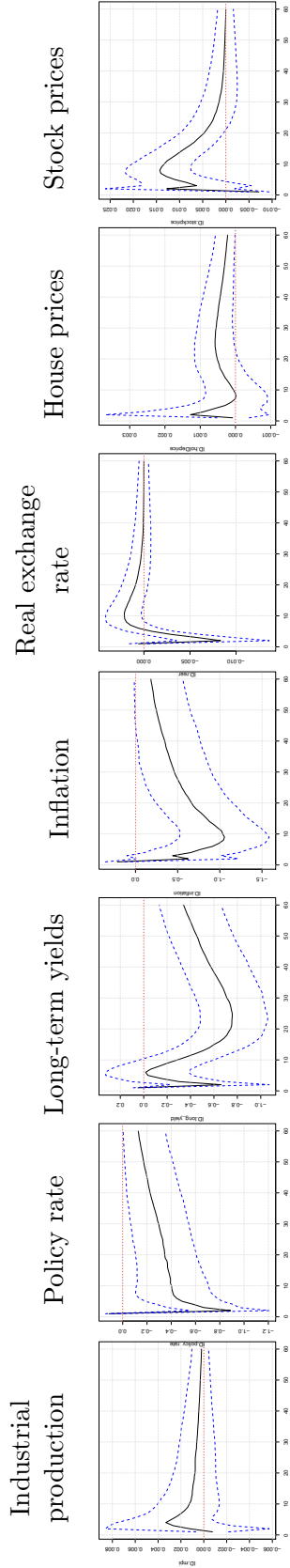
$R^{EA} < 0$



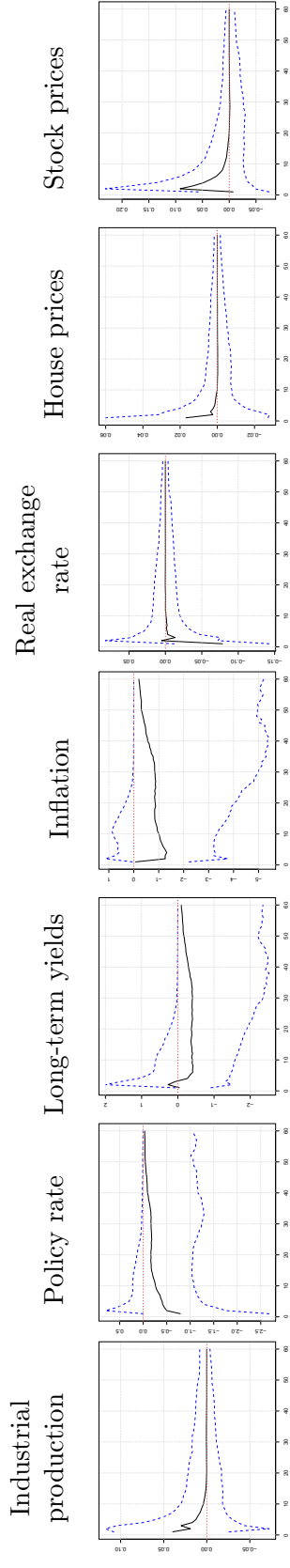
Notes: The top/bottom panel of the figure shows selected impulse responses to an expansionary monetary policy shock in the euro, when euro area interest rates are positive/negative at the time of the shock. Solid line refers to the posterior median; dashed lines denote 68% credible intervals. Source: Author.

Fig. 5: Indonesia: Responses to an Expansionary Monetary Policy Shock

$R^{EA} > 0$



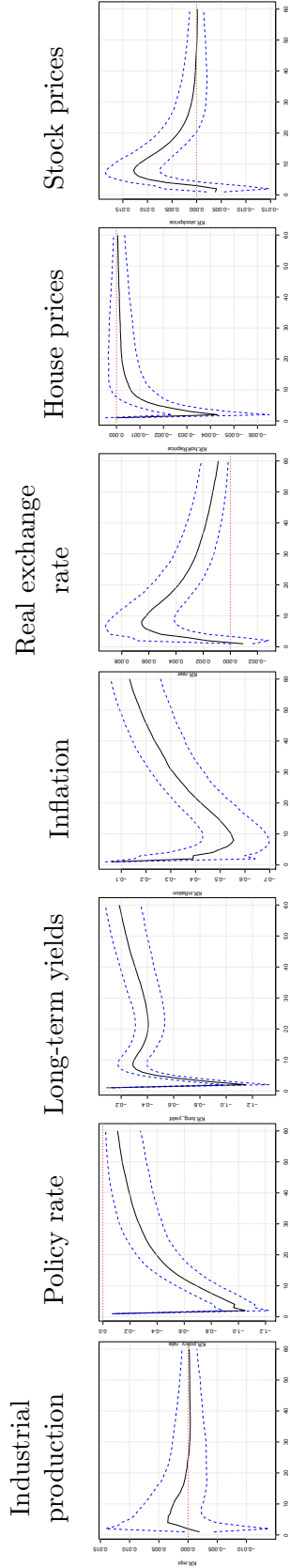
$R^{EA} < 0$



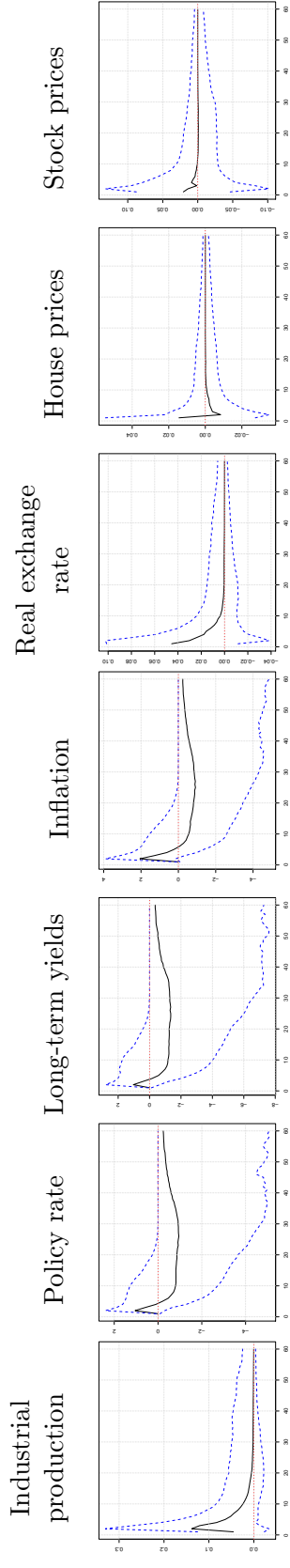
Notes: The top/bottom panel of the figure shows selected impulse responses to an expansionary monetary policy shock in the euro, when euro area interest rates are positive/negative at the time of the shock. Solid line refers to the posterior median; dashed lines denote 68% credible intervals. Source: Author.

Fig. 6: Republic of Korea: Responses to an Expansionary Monetary Policy Shock

$R^{EA} > 0$



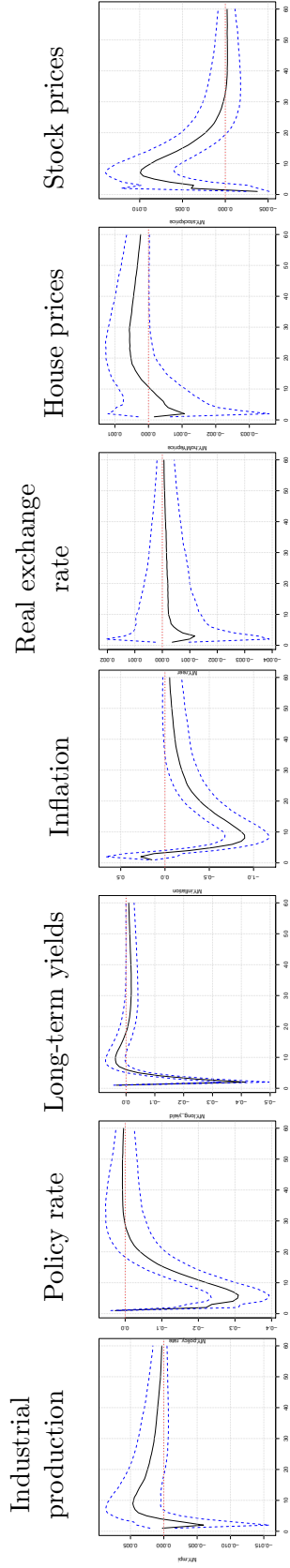
$R^{EA} < 0$



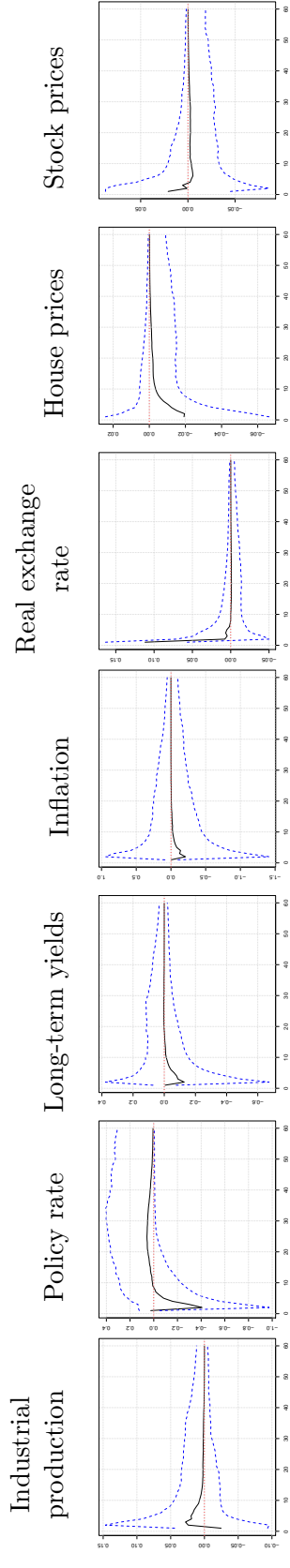
Notes: The top/bottom panel of the figure shows selected impulse responses to an expansionary monetary policy shock in the euro, when euro area interest rates are positive/negative at the time of the shock. Solid line refers to the posterior median; dashed lines denote 68% credible intervals. Source: Author.

Fig. 7: Malaysia: Responses to an Expansionary Monetary Policy Shock

$R^{EA} > 0$



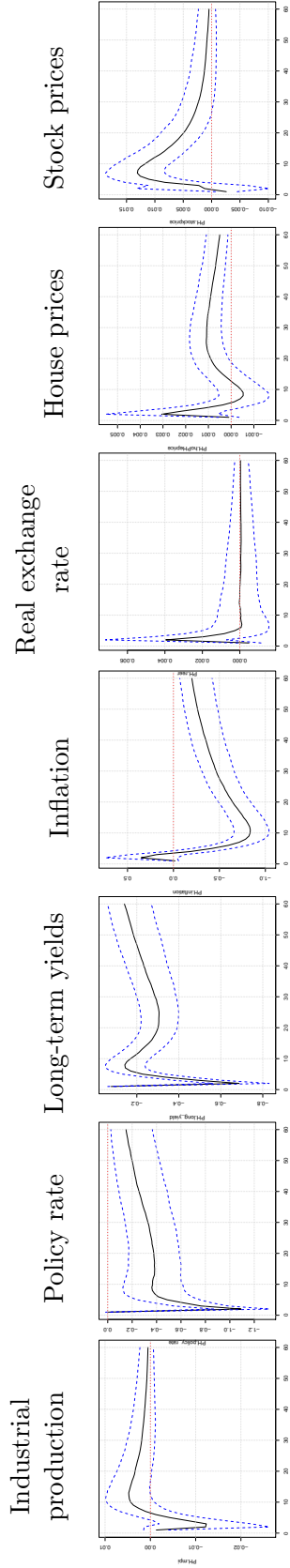
$R^{EA} < 0$



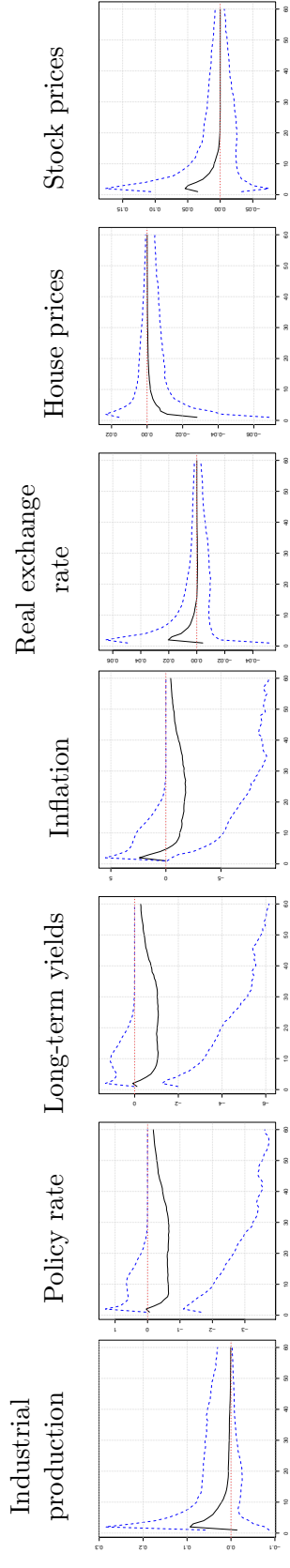
Notes: The top/bottom panel of the figure shows selected impulse responses to an expansionary monetary policy shock in the euro, when euro area interest rates are positive/negative at the time of the shock. Solid line refers to the posterior median; dashed lines denote 68% credible intervals. Source: Author.

Fig. 8: Philippines: Responses to an Expansionary Monetary Policy Shock

$R^{EA} > 0$



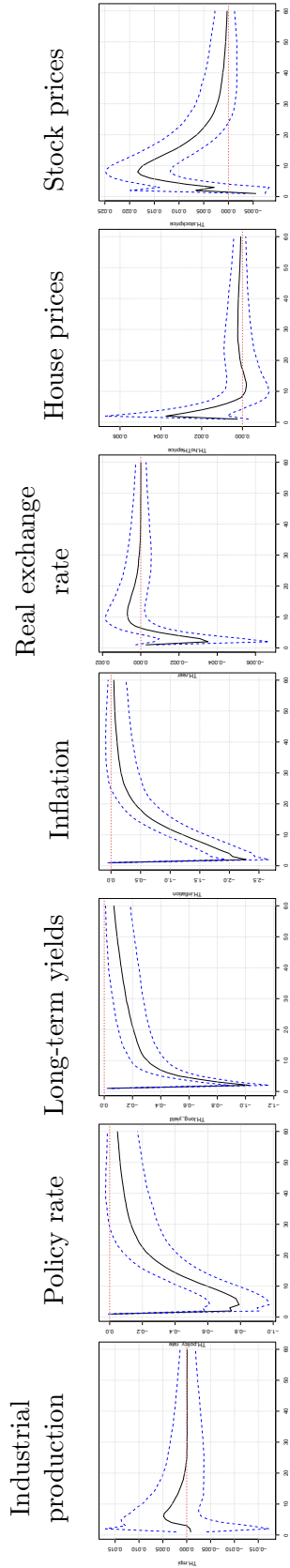
$R^{EA} < 0$



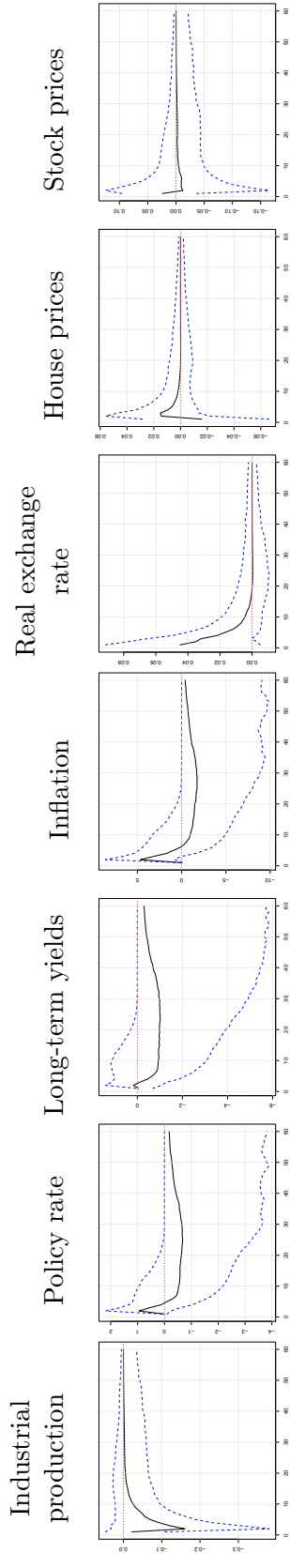
Notes: The top/bottom panel of the figure shows selected impulse responses to an expansionary monetary policy shock in the euro, when euro area interest rates are positive/negative at the time of the shock. Solid line refers to the posterior median; dashed lines denote 68% credible intervals. Source: Author.

Fig. 9: Thailand: Responses to an Expansionary Monetary Policy Shock

$R^{EA} > 0$



$R^{EA} < 0$



Notes: The top/bottom panel of the figure shows selected impulse responses to an expansionary monetary policy shock in the euro, when euro area interest rates are positive/negative at the time of the shock. Solid line refers to the posterior median; dashed lines denote 68% credible intervals. Source: Author.