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Asymmetric effects of conventional and unconventional monetary policy when rates are low

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Abstract

We study asymmetric inflation effects of both conventional and unconventional monetary policy in the euro area during the period of low nominal interest rates. We find that rate cuts are inflationary also during low interest rates. Positive quantitative easing surprises have a deflationary effect, but negative quantitative easing surprises have no inflationary effects. This result may be explained by information effects. The effect of monetary policy depends on the size of policy surprise and is lower during recessions than during booms. We also provide evidence that interest rate policy, forward guidance and quantitative easing are complementary to one another.

Keywords: Monetary policy, asymmetric effects, inflation

JEL codes: E50, E31

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1. Introduction

The effectiveness of monetary policy can be assessed by studying how the economy responds to a monetary policy shock. In standard theory models, the responses are symmetric for contractionary and expansionary shocks. However, as first documented by Cover (1992), contractionary monetary policy shocks may have stronger effects than expansionary shocks. As suggested by the theory of reversal interest rate, this *sign asymmetry* may be especially pronounced during low or negative nominal interest rates (Ulate, 2021; Abadi, Brunnermeier and Koby, 2022).

In this paper, we study possible asymmetric effects of both conventional and unconventional monetary policy when nominal interest rates are low. Our focus is on the sign asymmetry, but we also consider other asymmetries and nonlinearities found in the literature. Our results broaden the evidence of asymmetric effects of monetary policy by considering different policy instruments and interest rate regimes and hence shed further light on the earlier findings in the literature.

We contribute to the literature in the following ways. First, using the state-of-the-art methodology by Altavilla et al. (2019) for the euro area, we find that policy rate cuts are inflationary both during normal times and during low interest rates. We find little support for asymmetric effect on inflation of conventional monetary policy. This result may be seen as somewhat surprising given the recent results that the effect of monetary policy through bank lending may be lower during low or negative rates (e.g. Borio and Gambacorta, 2017; Ulate, 2021). However, the evidence regarding diminished effects on bank lending is somewhat mixed and there is also contradicting evidence (see e.g. Altavilla, Burlon, Giannetti and Holton, 2022). Importantly, monetary policy may transmit to macroeconomic variables like inflation also through other channels, such as asset prices. Bubeck, Maddaloni and Peydró (2020) find that negative rates may boost risk-taking. Hence, existence of a reversal rate for bank lending would not necessarily mean that the total effect of monetary policy on inflation is reversed as monetary policy may still have intended effects on aggregate demand through other channels.

Second, we study asymmetric effects of monetary policy separately for different monetary policy tools, which has not been done in the earlier literature, and show that the asymmetric effects may vary across policy tools. Regarding forward guidance – policies aiming to affect medium-term interest rates – the effects are stronger in response to expansionary monetary policy shocks. Regarding quantitative easing (QE), and contrary to expectations, positive QE surprises have deflationary effects while negative QE surprises have no effect on inflation. The result may be explained by information effects of QE policy surprises: central banks may give information about the state of the economy simultaneously with monetary policy surprises (e.g. Jarociński and Karadi, 2020).

Third, in addition to sign asymmetry, we study how the magnitude of the effect on inflation of monetary policy is related to the *size* of the policy shock and the phase of the *business cycle*. We find some evidence that large policy shocks are more effective than small policy shocks (cf. Ascari and Haber 2022). However, there seems to be variation across different types of monetary policy tools. Regarding the business cycle, we find that monetary policy is less effective in recessions and more effective in booms. The result holds also in a longer sample that covers years before the financial crisis. Garcia and Schaller (2002) and Lo and Piger (2005) find an opposite result while Tenroyro and Thwaites (2016) find results similar to ours.

Finally, we find some evidence of complementarities between QE, conventional monetary policy, and forward guidance policies as suggested by Rostagno et al. (2019).

Our results may be of interest to many central banks who plan to shrink their balance sheets in the future. For example, the results regarding QE and its complementarities may have implications for quantitative tightening as well.

The remainder of the paper is as follows. Section 2 reviews the earlier literature. Section 3 represents our data and methodology. Section 4 shows our results. Section 5 discusses about the role of information effects. Section 6 concludes.

2. Literature review

We summarize the existing literature in Table 1.[1] The literature focuses on the effects of monetary policies implemented by the Fed.

Early results by Cover (1992) show that negative money-supply shocks have larger effects on output than positive shocks. The phenomenon is known as sign asymmetry. Tenroyro and Thwaites (2016) find similar results regarding sign asymmetry. Garcia and Schaller (2002) find that monetary policies implemented during recessions have a larger effect on output growth than monetary policies implemented during expansions. Lo and Piger (2005) discover similar results. However, Tenroyro and Thwaites (2016) observe opposite evidence in their research. When it comes to shock size, Ascari and Haber (2022) find evidence that larger shocks have a proportionally greater impact on inflation than smaller shocks. Shirota (2021) instead discovers that larger shocks are subject to diminishing effects.

Karras (2013) evaluates sign and size asymmetries separately and jointly during four time periods[2]. He finds support for both sign and size asymmetries when evaluating them separately or jointly. This holds even when the Quantitative Easing (QE) periods are excluded. Furthermore, Karas (2013) presents that monetary policy contractions have a greater impact on economy than expansionary policies. He also offers evidence for size asymmetry. Size asymmetry is more pronounced during negative shocks compared to positive shocks. The marginal effect is reducing when the shocks size is increased.

[1] See also the survey of Florio (2004).

[2] Full/Long: Q1/1950 - Q4/2011, Full/Short: Q1/1950-Q3/2008, Volcker/Long: Q3/1979 - Q4/2011, and finally Volcker/Short: Q3/1979 - Q3/2008.

Table 1. Earlier literature

Sign asymmetry		Business cycle asymmetry		Size asymmetry	
Expansionary shocks more effective	Contractionary shocks more effective	MP more effective in recessions	MP more effective in booms	Diminishing marginal effect	Increasing marginal effect
	Cover (1992) Tenroyro and Thwaites (2016) Karras (2013)	Garcia and Schaller (2002) Lo and Piger (2005)	Tenroyro and Thwaites (2016)	Shirota (2021) Karras (2013)	Ascari and Haber (2022)

Hence the rarity of quantitative tightening periods, empirical research scrutinizing the effects of quantitative tightening are scarce. Albeit that, Smith and Valcarcel (2023) evaluate the effects of normalization of the Federal Reserve's balance sheet during time-period 2017 to 2019. They discover in their research that the unwinding that took place in the US constrained financial conditions. However, Smith and Valcarcel (2023) highlight that the effects may vary depending on the role of financial markets in different economies. Regardless the economy, the effects, however, should not be seen as mirror to the effects of QE as immediate interest rate effects may be different. These findings support the idea of policy asymmetries.

3. Data and methodology

3.1 Empirical approach

Our data are from the euro area and at monthly frequency. We measure monetary policy using the methodology of Altavilla et al. (2019). Specifically, we use their Target, Timing, Forward guidance (FG) and Quantitative easing (QE) shocks updated to the end of 2021.[3] The methodology is not repeated here because we replicate the shocks exactly as in Altavilla et al. (2019). Target shock represents conventional monetary policy. Timing shock captures the revision of policy expectations by shifting the expected policy action between the current meeting and the next or the one following, in a way that leaves longer-term policy expectations about unchanged. It can be seen as a special type of forward guidance. FG shock affects medium-term rates (peaking at about two years). QE shock represents policies affecting long-term yields without affecting short-term yields on impact. The shocks are scaled so that Target shock has unit effect on one-month OIS, Timing has a unit effect on six-month OIS, FG has a unit effect on two-year OIS and QE has unit effect on the ten-year OIS (in basis points).

We use the sample from 01/2014 to 8/2022 as our focus is on the period of low or even negative rates. In addition, QE and forward guidance became central tools in the ECB's toolbox only after financial crisis and European debt crisis. We however present the results for Target shock also for a longer sample to see whether asymmetries work differently during normal times and during low rates. The shocks are shown in Figure 1.

We analyse different types of asymmetries, but our focus is on the sign asymmetry. In other words, we analyse whether contractionary and expansionary shocks have different effects in absolute terms. Figure 2 presents an initial analysis where 12 months ahead annual inflation is plotted against the shocks.[4] Linear regression lines are estimated and plotted separately for negative shock values and non-negative shock values. This initial analysis suggests that negative and positive shocks may have different inflation effects. When it comes to negative shocks, more negative shocks are not related to accelerating inflation in the future.

[3] The data are constructed utilising the R package by Martin Baumgärtner which is based on the replication code of Altavilla et al. (2019) (https://www.martinbaumgaertner.de/code/ea-mpd-r/). When no monetary policy decisions were announced during the month the shock value is assumed to be zero. In the case of multiple announcements an average was calculated.
[4] Alternative data illustrations are presented in Appendix D.

Figure 1. Updated shocks of Altavilla et al. (2019).

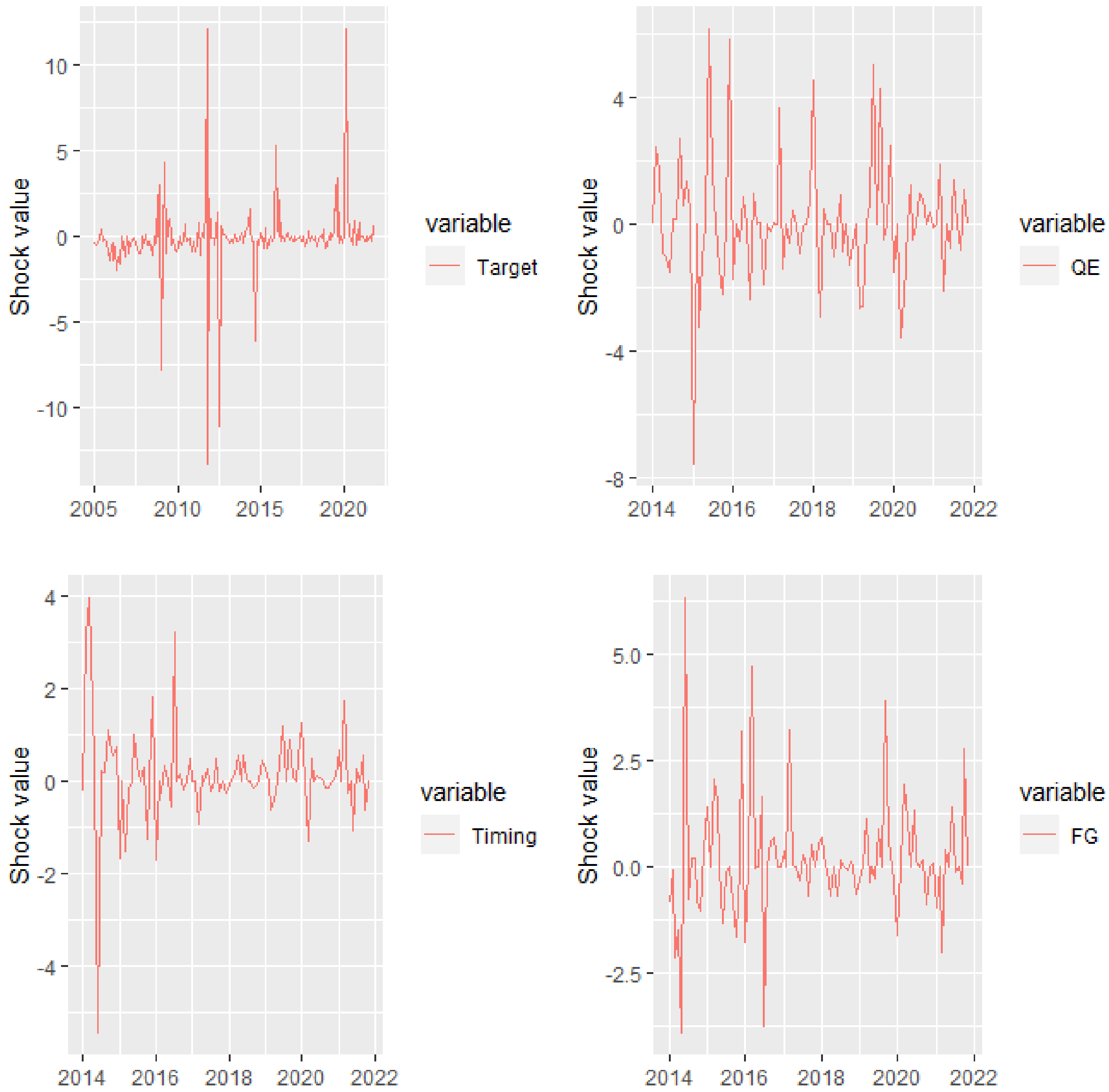
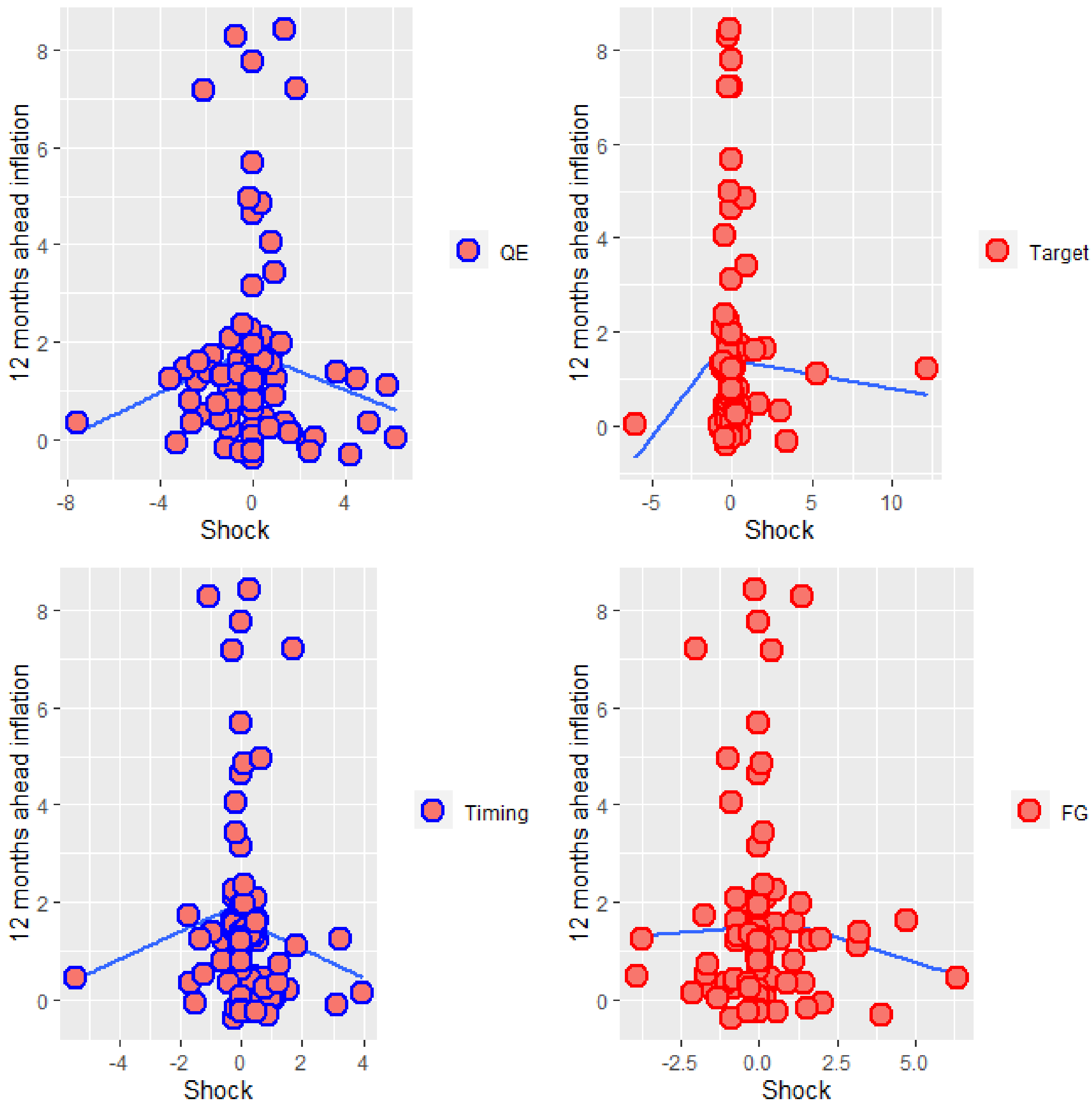


Figure 2. 12 months ahead year-over-year inflation against different shock variables. Note: The lines are the fits of linear regression estimated separately for negative and non-negative shocks. The data are from the period 01/2014-08/2022.



To assess the effects more carefully, we estimate a local projection (see Jorda, 2005) of the form:

$$\Delta\log(HICP)_{t+h} = \alpha_h + \delta_{h,1} MP_t negMP_t + \delta_{h,2} MP_t posMP_t + \gamma_h{}' X_{t-1} + e_t, \quad (1)$$

where $HICP$ is seasonally adjusted HICP by the ECB, α_h is a constant and MP_t is monetary policy shock. $negMP_t$ is a dummy variable that gets the value of 1 if the monetary policy shock is negative (expansionary). $posMP_t$ is analogous to $negMP_t$. vector X_{t-1} includes control variables, e_t is the error term. The control variables are lagged by one period because monetary policy may have immediate effects which we do not want to control out (see e.g., Jorda, 2005; Plagborg-Møller and Wolf, 2021).[5] As a control variable we use lagged log-change in industrial production, lagged 1-year inflation swap rate, lagged 3-month OIS rate and the lagged log-change in oil price. The equation is estimated using OLS in the baseline. Smooth local projections following Barnichon and Brownlees (2019) are used as a robustness check. Heteroskedasticity and autocorrelation robust standard errors are used. When interpreting the results, it should be noted that we report the parameter estimates for different h as such. In other words, one should expect negative response to both positive and negative shocks (we do not multiply the coefficients by -1 in the case of negative shocks).

3.2 Additional analyses

In addition to sign asymmetry, we also analyse size and business cycle asymmetries. When it comes to size asymmetry, we use following specification:

$$\Delta\log(HICP)_{t+h} = \alpha_h + \theta_{h,1} MP_t + \theta_{h,2} MP_t LargeMP_t + \gamma_h{}' X_{t-1} + e_t, \quad (2)$$

where $LargeMP_t$ is a dummy that is one if the absolute value of the shock is higher than median.

[5] For example, monetary policy affects interest rates immediately. We do not want to control this effect.

To assess business cycle asymmetries, we use the following model:

$$\Delta\log(HICP)_{t+h} = \alpha_h + \beta_{h,1}MP_t + \beta_{h,2}MP_tOG_{t-1} + {\gamma_h}'X_{t-1} + e_t, \quad (3)$$

where OG_{t-1} is average of different output gap estimates (specified in next subsection).

Finally, Rostagno et al. (2019) argue that different monetary policy tools work as complements. For example, they argue that negative short-term interest rates reinforce the impact of asset purchases on term premium through the Gesell tax effect. On the other hand, asset purchases could complement short-term target rate policies by providing extra liquidity that keeps overnight money market rates close to the ECB's deposit facility rate. To assess whether these types of complementarities exist we estimate the following local projection:

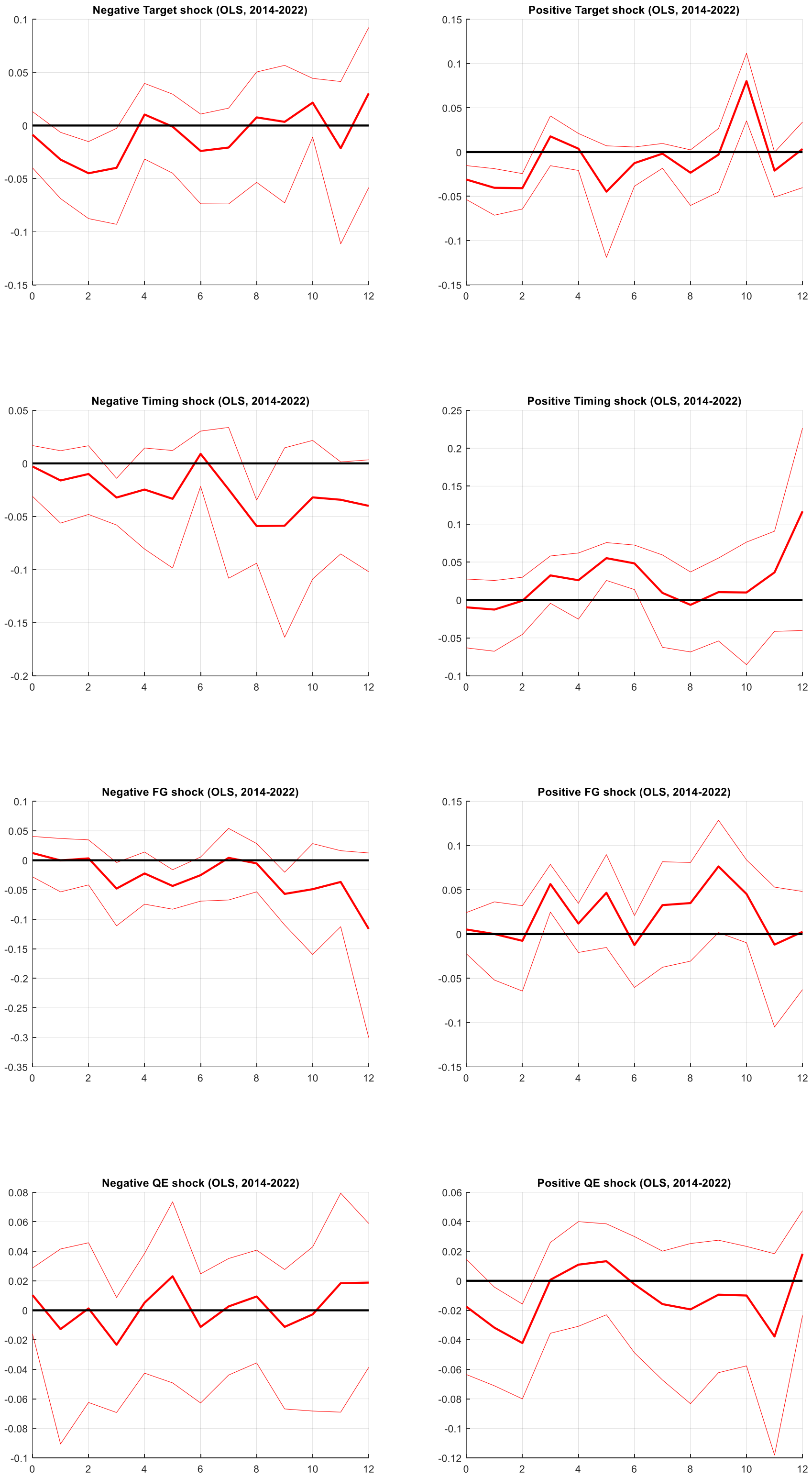
$$\Delta\log(HICP)_{t+h} = \alpha_h + \vartheta_{h,1}MPshocks_t + \vartheta_{h,2}MPinteractions_t + {\gamma_h}'X_{t-1} + e_t, \quad (4)$$

where vector $MPshocks_t$ includes all 4 shocks of Altavilla et al. (2019) and $MPinteractions_t$ includes their interactions. We interpret statistically significant interaction terms as evidence for complementarities.

3.3 Data sources

The inflation data are from the ECB. Industrial production is seasonally adjusted and from Eurostat. Inflation swap data are from Bloomberg. OIS data are from Bloomberg. Oil (Brent, spot) price is in dollar terms and from Intercontinental Exchange (ICE). In our additional exercises we use output gap measures from IMF, European Commission and OECD. Quarterly output gaps are linearly interpolated at monthly frequency when used.

Figure 3. OLS estimates for local projection of equation (1). Note: 95 % HAC confidence intervals are reported. Data are from 01/2014 to 08/2022. Shocks are in basis points. Log-difference of HICP is multiplied by 100.



4. Results

4.1 Main results

The baseline results are shown in Figure 3.[6] We do not find evidence supporting asymmetric effect for Target shock. This result is somewhat surprising given the evidence by Cover (1992), Karras (2013), Tenroyro and Thwaites (2016) and the fact that the results are obtained using data from the period of low or negative interest rates. The results suggest that even if monetary policy effects through bank lending diminish in the proximity of effective lower bound, other channels of conventional monetary policy are still operational.

When it comes to shocks related to forward guidance (Timing and FG), we do not find evidence that "contractionary" forward guidance would lower inflation. Instead, expansionary shocks have inflationary effects as expected.

For the QE, impulse response functions are peculiar. The results suggest that "contractionary" QE shocks (less QE than expected) lead to lower inflation. However, expansionary QE shocks are found to have zero effect on inflation.

4.2 Size asymmetry

Figure 4 shows the results regarding the interaction between monetary policy shock and the size dummy. The results are somewhat mixed. When it comes to Target shock, the results suggest that the shock gets extra boost if the shock is larger than median. This is in line with state dependent models and the results of Ascari and Haber (2022). Some evidence about similar effect is found also for the QE shock. When it comes to FG and Timing shocks, no evidence in favour on increasing marginal effects are found.

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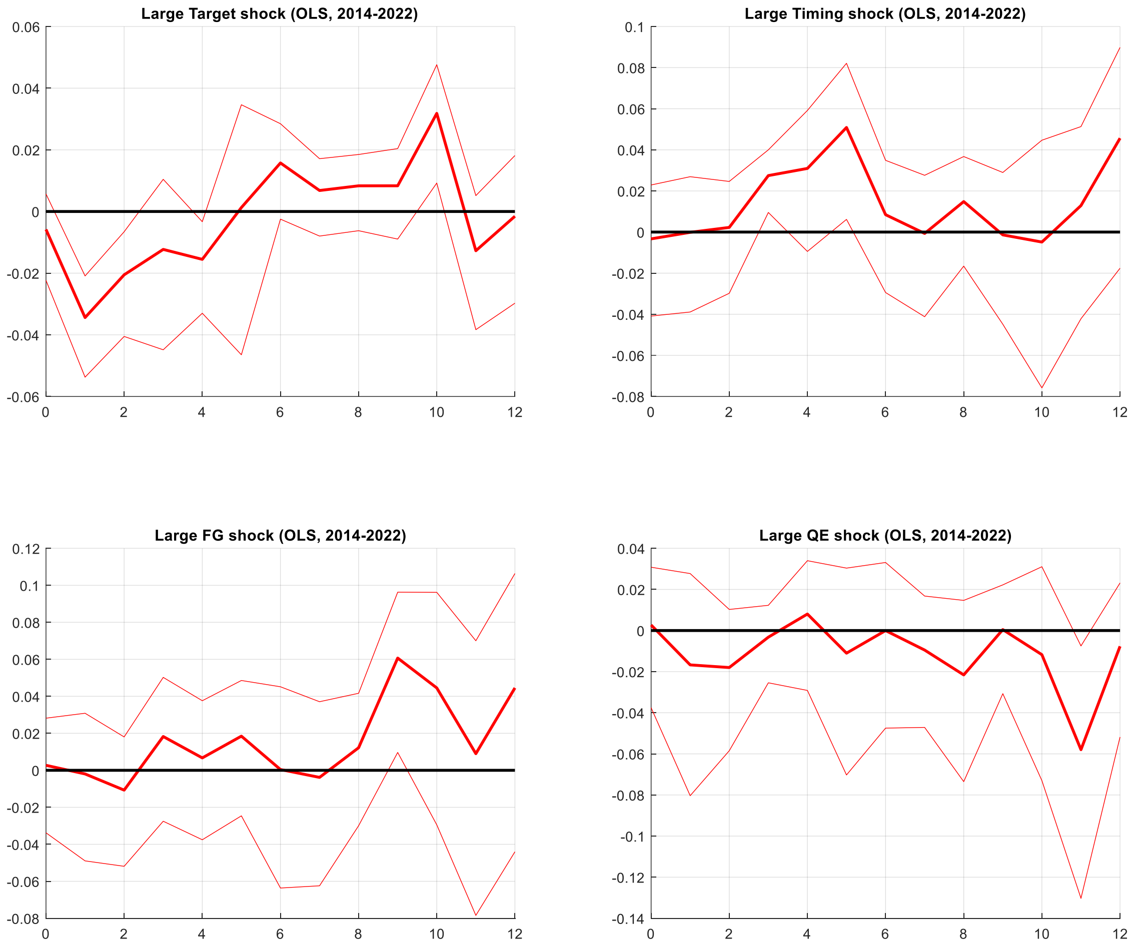
[6] Notice that we report the coefficient estimates as such (not multiplied by -1 in the case of negative shock). In other words, one should always expect negative response. Results using longer sample are reported in Appendix A. Results using smooth local projections are reported in Appendix B.

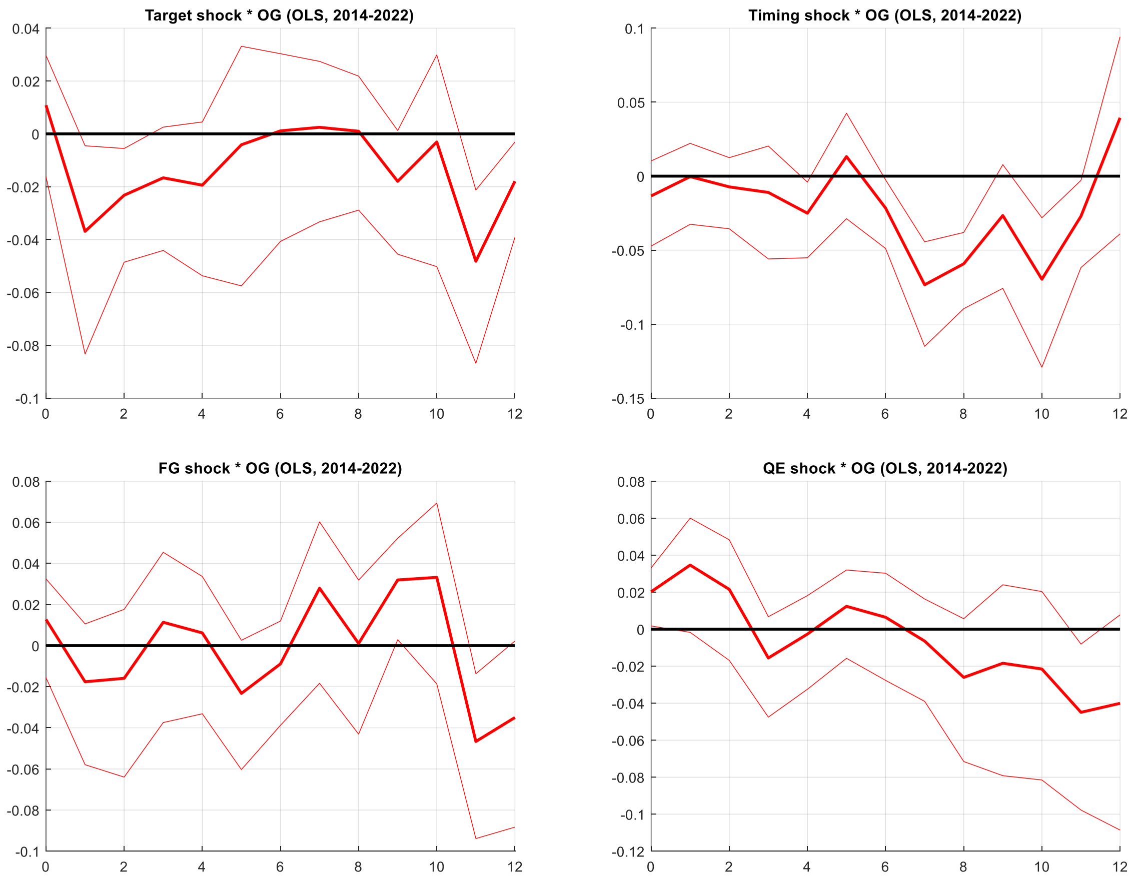
Figure 4. OLS estimates for local projection of equation (2). Note: 95 % HAC confidence intervals are reported. Data are from 01/2014 to 08/2022. Shocks are in basis points. Log-difference of HICP is multiplied by 100.



4.3 *Business cycle asymmetry*

Figure 5 shows the estimates for interactions between shocks and output gap. The results are broadly in line with the results of Tenroyro and Thwaites (2016): a stronger inflation effect is found when output gap is more positive. However, these results should be taken with a grain of salt as the sample is rather short and does not include periods during which output gap is very positive. However, the results remain roughly the same when longer sample is used for Target shock (see Appendix A).

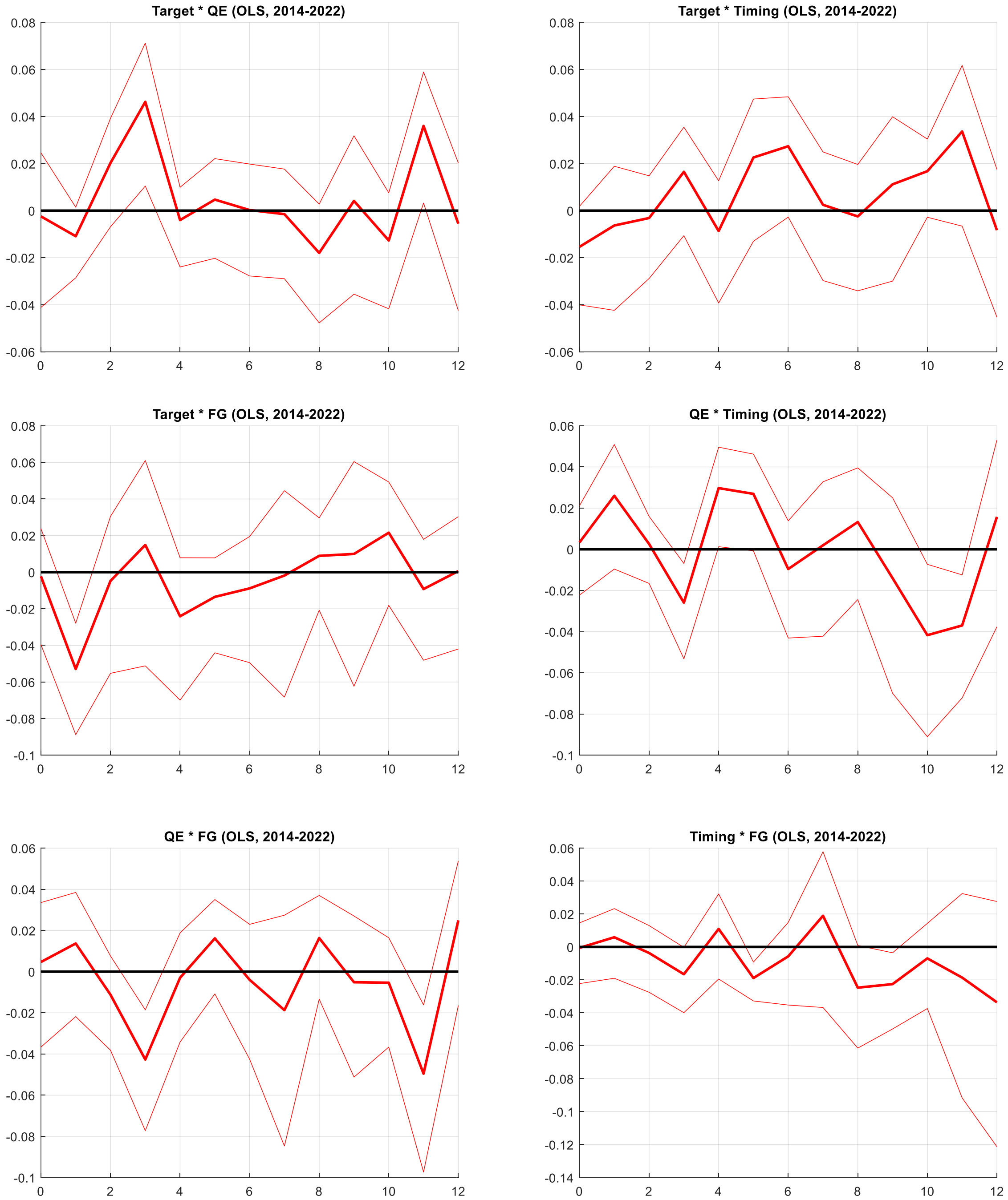
Figure 5. OLS estimates for local projection of equation (3). Note: 95 % HAC confidence intervals are reported. Data are from 01/2014 to 08/2022. Shocks are in basis points. Log-difference of HICP is multiplied by 100.



4.4 *Complementarities*

Figure 6 reports the results regarding complementarities. All the six interactions are estimated simultaneously. The approach is purely empirical, and the specification is not motivated anything else but the discussion of Rostagno et al. (2019). The results give some weak support for complementarities. The results give some support that forward guidance and conventional monetary policy work as complementarities. QE and forward guidance complement each other as well. However, these results are not entirely robust to using smooth local projection method (see Appendix B).

Figure 6. OLS estimates for local projection of equation (4). Note: 95 % HAC confidence intervals are reported. Data are from 01/2014 to 08/2022. Shocks are in basis points. Log-difference of HICP is multiplied by 100.



5. The role of information effects

Recent macroeconomic literature has emphasised the role of so-called information effects (e.g. Jarociński and Karadi, 2020). Monetary policy surprises are often accompanied by news about central bank's view about the business cycle. The analysis so far has not disentangled these two shocks which may explain some of the unexpected results.

Figure 7. Updated shocks of Altavilla et al. (2019) disentangled from information effects (pure shocks) together with original shocks. Note: The MP shock is assumed to be zero if the announcement effect to stock prices had the same sign as the announcement effect to interest rates.

In this section, we assess this issue briefly. We use the simple method proposed by Jarociński and Karadi (2020). Specifically, we use only those shocks of Altavilla et al. (2019) which are accompanied with stock market reaction with the opposite sign (rate hike and stock price decline at the same time). This simultaneous stock market reaction is obtained from the event-study database produced as a side-product of Altavilla et al. (2019). Jarociński and Karadi (2020) show that this simple method yields similar results as their more sophisticated approach. The “pure” monetary policy shocks are reported in Figure 7. As can be seen from the figure, many relatively shocks in the sample are classified as information shocks rather than pure monetary policy shocks.

Figure 8. OLS estimates for local projection of equation (1) using pure monetary policy shocks. Note: 95 % HAC confidence intervals are reported. Data are from 01/2014 to 08/2022. Shocks are in basis points. Log-difference of HICP is multiplied by 100.

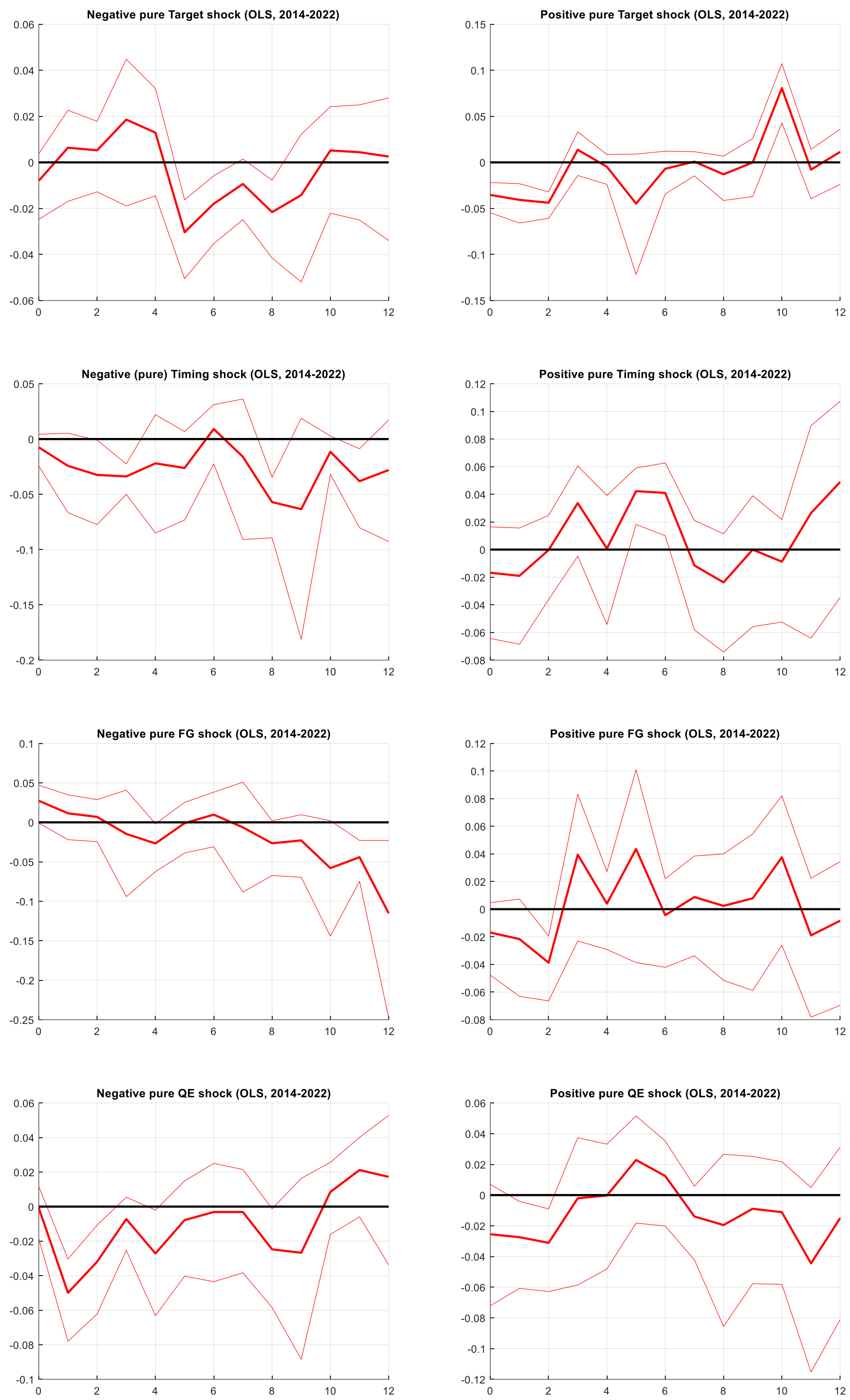


Figure 8 shows our main results regarding sign asymmetry when pure monetary policy shocks are used. A notable result is that expansionary QE shocks are found to have inflationary effects when information effects are removed. This result provides a possible explanation for the surprising baseline result that expansionary QE has no effect on prices. QE was conducted during the years when the ECB was especially worried about the state of the economy and inflation remained historically low. Many QE related surprises emerged together with news about the state of the economy.

Appendix C reports other results when pure monetary policy shocks are used instead of non-filtered shocks. When it comes to size and business cycle asymmetries the results are about the same. Complementarity results change a bit after taking into account information effects. The results support favourable complementarities for Target and FG, Target and QE, QE and FG.

6. Concluding remarks

We provide some evidence on the asymmetries of conventional and unconventional monetary policy. In the case of quantitative easing, contractionary shocks are estimated to affect inflation more strongly than expansionary shocks. However, this result may be explained by information effects – not by pure monetary policy shocks. When it comes to conventional monetary policy, we find that rate cuts boost inflation in low interest rate environment as well. This result is interesting given that monetary policy effects during low or negative rates via banking sector may be ineffective (e.g. Ulate, 2021).

It should be noted that our results are conditional on the successfulness of identification in Altavilla et al. (2019). In our analysis, we take these shocks as given. Another caveat concerning our results related to QE shock is the relatively short sample period during which the ECB's policy rates have been in the negative territory. In addition, during the period the ECB has not conducted QT in the sense that it would have sold assets to reduce inflation. Hence, the specific estimation period may restrict the generalisation our results as argued by Smith and Valcarcel (2023).

In the future research, asymmetric effects of QE and QT should be analysed with alternative identification strategies and samples that cover both central bank balance sheet expansions and contractions.

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Appendix

Appendix A. Using data beginning from 2005

Figure A 1. OLS estimates for local projection of equation (1). Note: 95 % HAC confidence intervals are reported. Data are from 01/2005 to 08/2022. Shocks are in basis points. Log-difference of HICP is multiplied by 100.

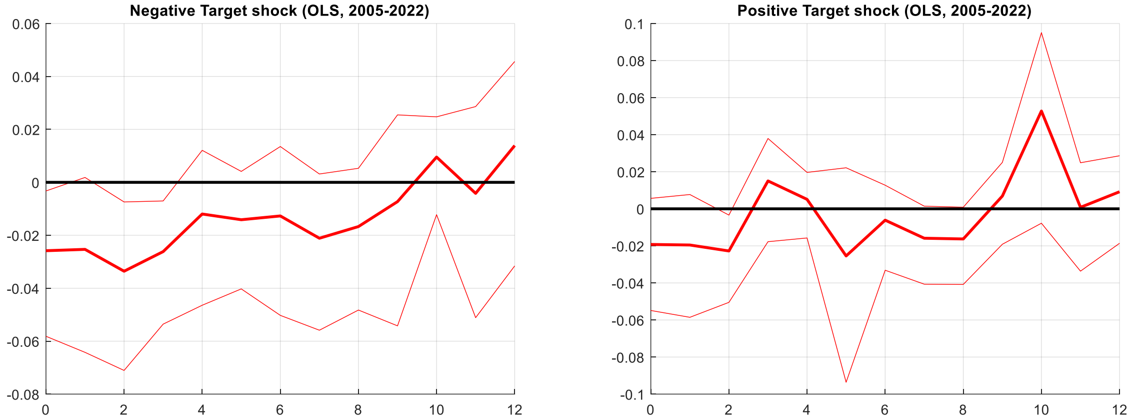


Figure A 2. OLS estimates for local projection of equation (2). Note: 95 % HAC confidence intervals are reported. Data are from 01/2005 to 08/2022. Shocks are in basis points. Log-difference of HICP is multiplied by 100.

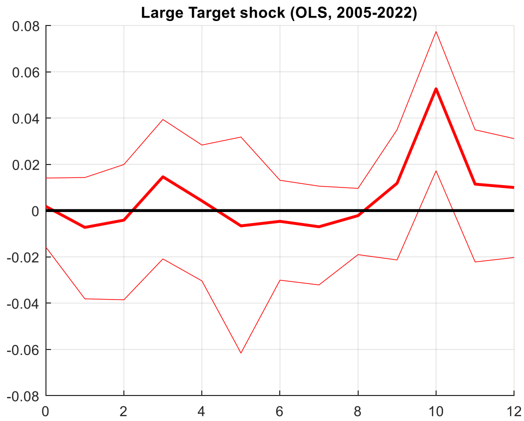
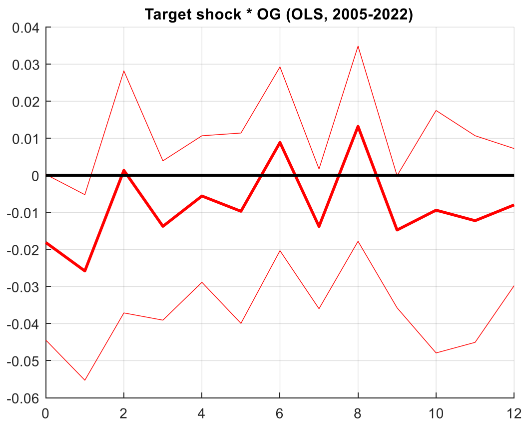


Figure A 3. OLS estimates for local projection of equation (3). Note: 95 % HAC confidence intervals are reported. Data are from 01/2005 to 08/2022. Shocks are in basis points. Log-difference of HICP is multiplied by 100.



Appendix B. Smooth local projections

Figure B 1. Smooth LP estimates for local projection of equation (1). Note: 95 % HAC confidence intervals are reported. Data are from 01/2014 to 08/2022. Shocks are in basis points. Log-difference of HICP is multiplied by 100.

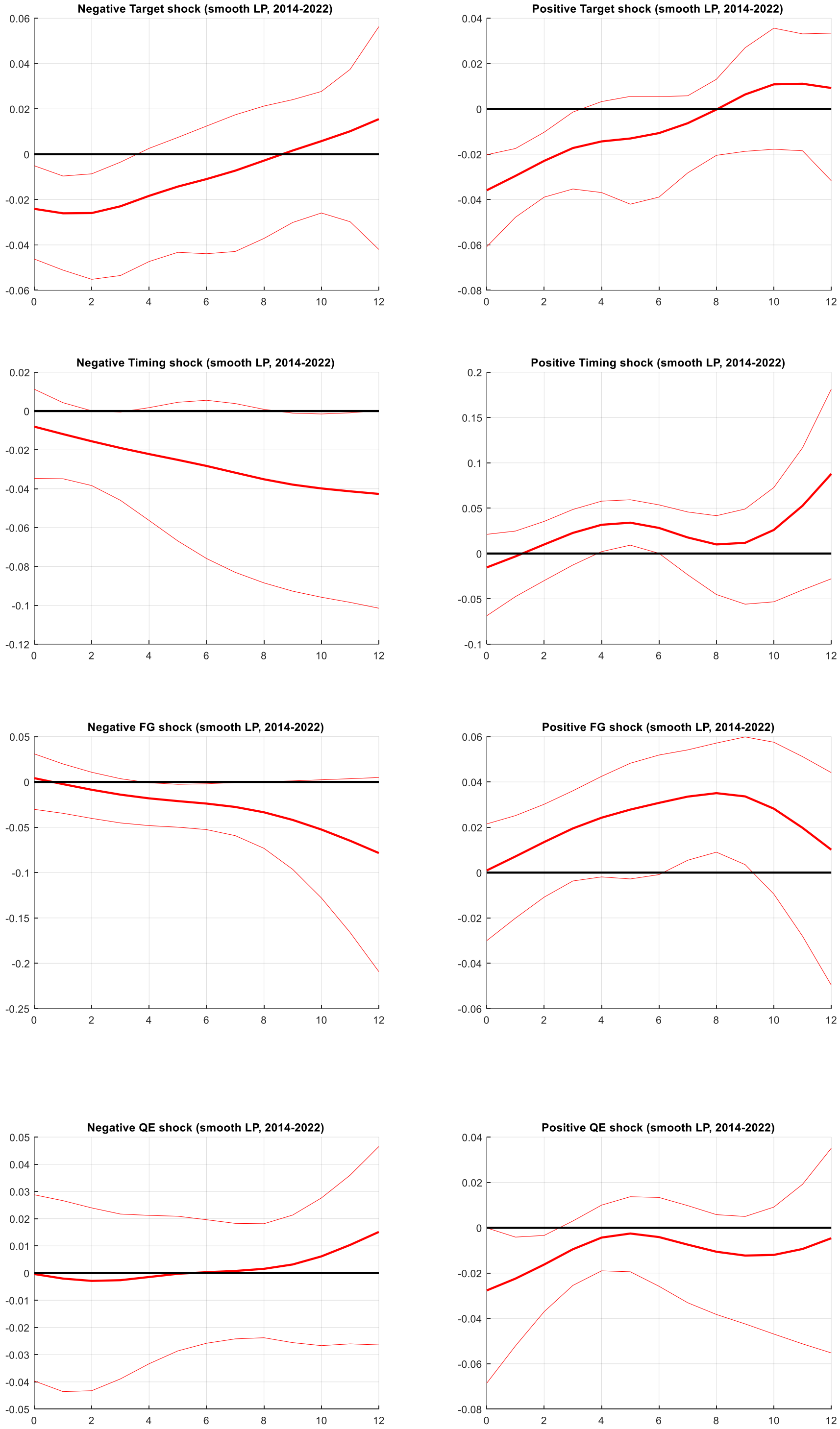


Figure B 2. Smooth LP estimates for local projection of equation (2). Note: 95 % HAC confidence intervals are reported. Data are from 01/2014 to 08/2022. Shocks are in basis points. Log-difference of HICP is multiplied by 100.

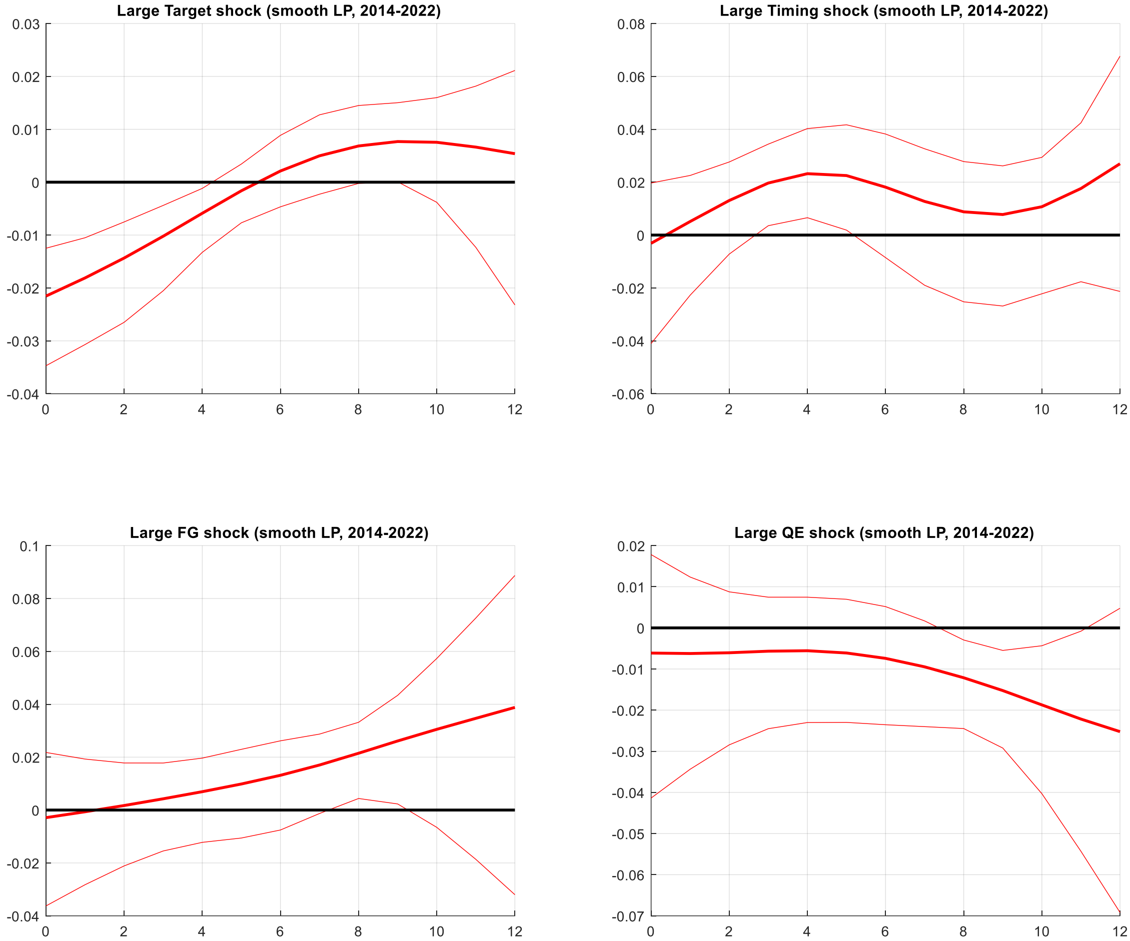


Figure B 3. Smooth LP estimates for local projection of equation (3). Note: 95 % HAC confidence intervals are reported. Data are from 01/2014 to 08/2022. Shocks are in basis points. Log-difference of HICP is multiplied by 100.

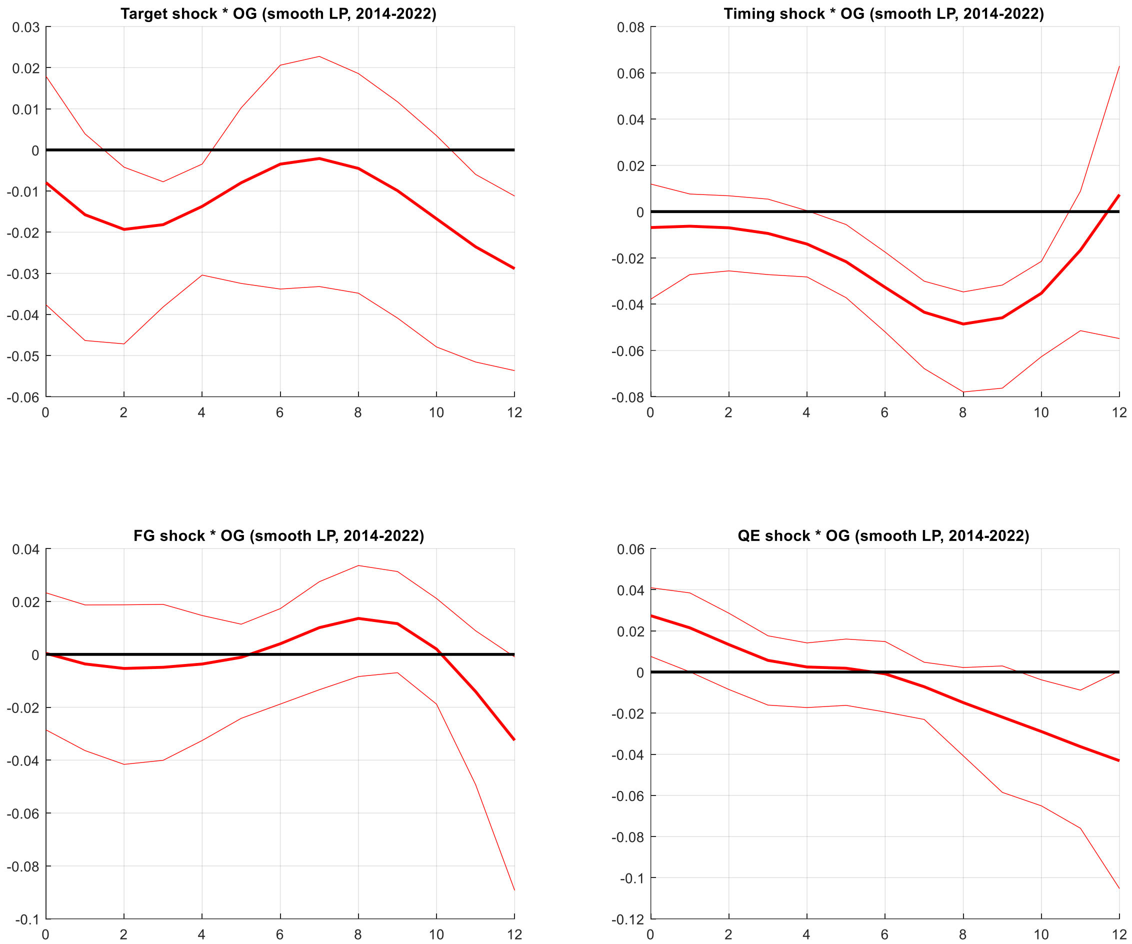
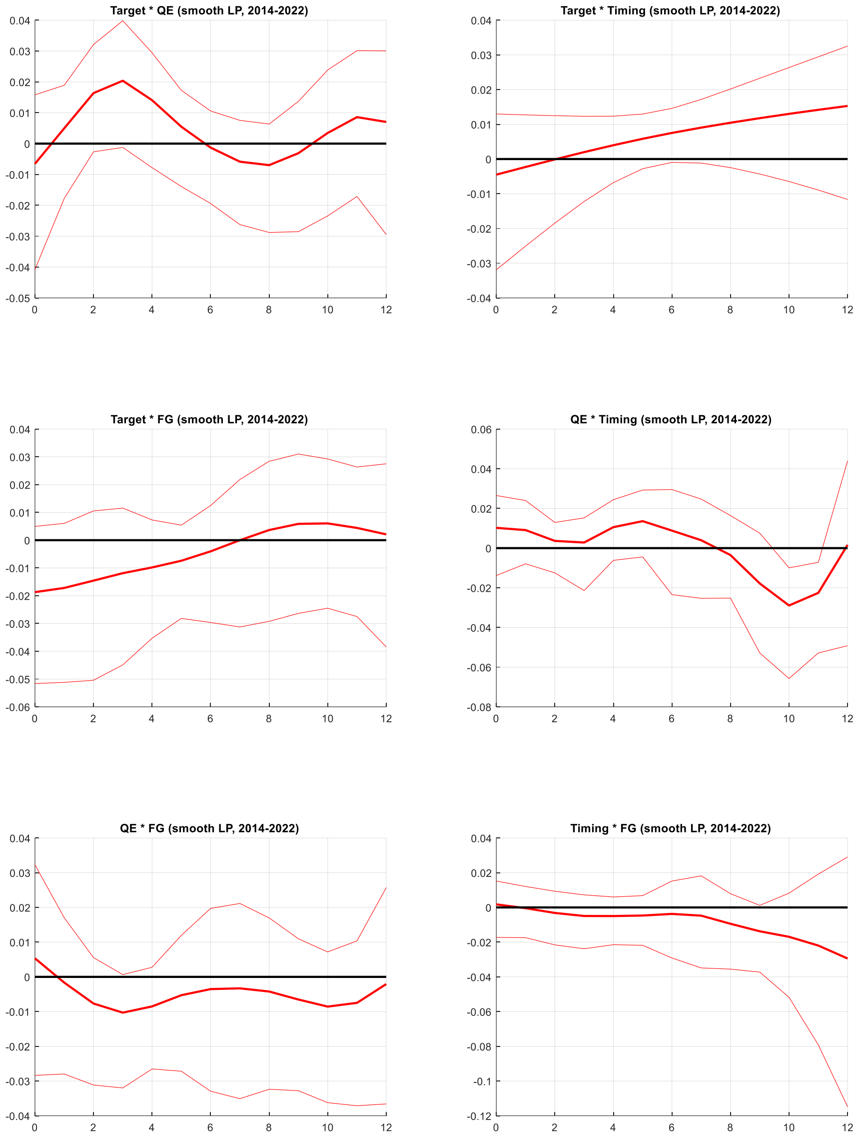


Figure B 4. Smooth LP estimates for local projection of equation (4). Note: 95 % HAC confidence intervals are reported. Data are from 01/2014 to 08/2022. Shocks are in basis points. Log-difference of HICP is multiplied by 100.



Appendix C. Pure monetary policy shocks in additional analyses

Figure C 1. OLS estimates for local projection of equation (2) using pure monetary policy shocks. Note: 95 % HAC confidence intervals are reported. Data are from 01/2014 to 08/2022. Shocks are in basis points. Log-difference of HICP is multiplied by 100.

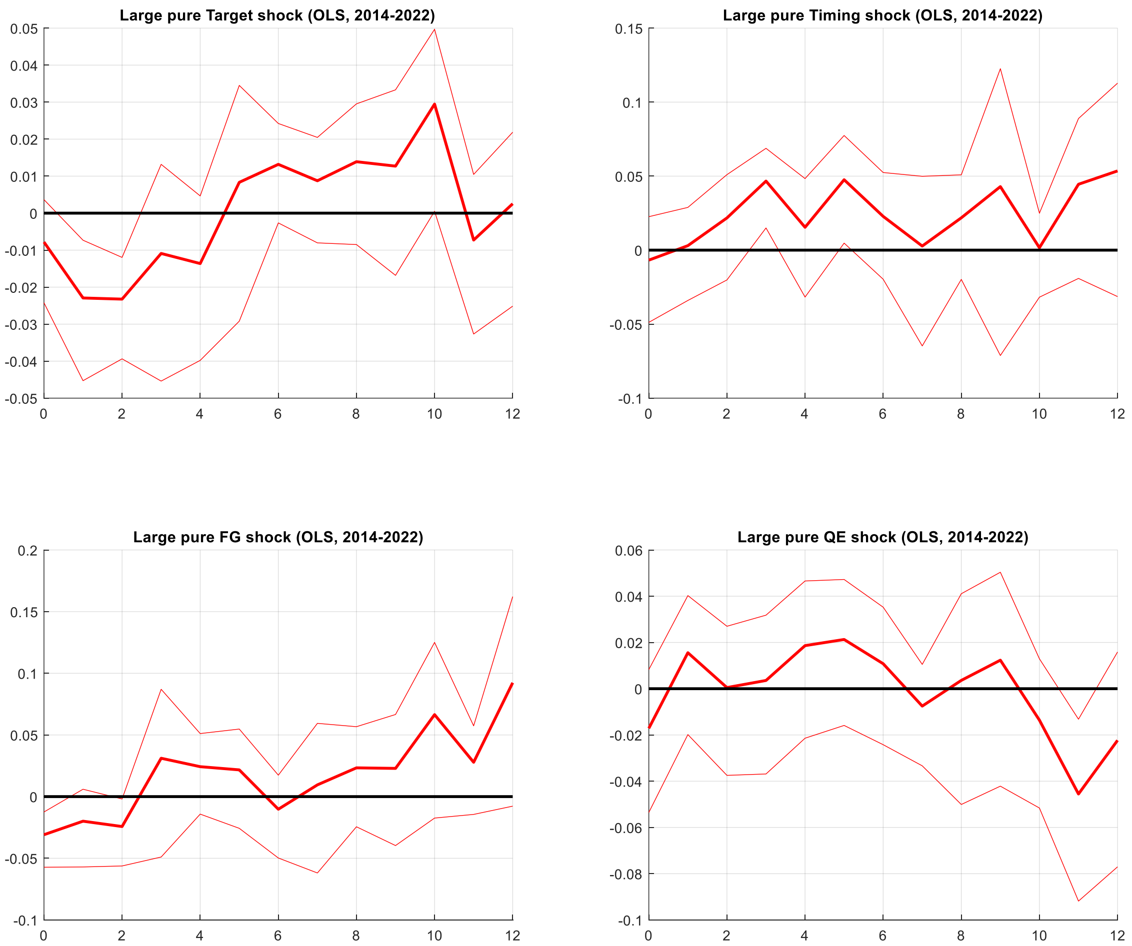


Figure C 2. OLS estimates for local projection of equation (3) using pure monetary policy shocks. Note: 95 % HAC confidence intervals are reported. Data are from 01/2014 to 08/2022. Shocks are in basis points. Log-difference of HICP is multiplied by 100.

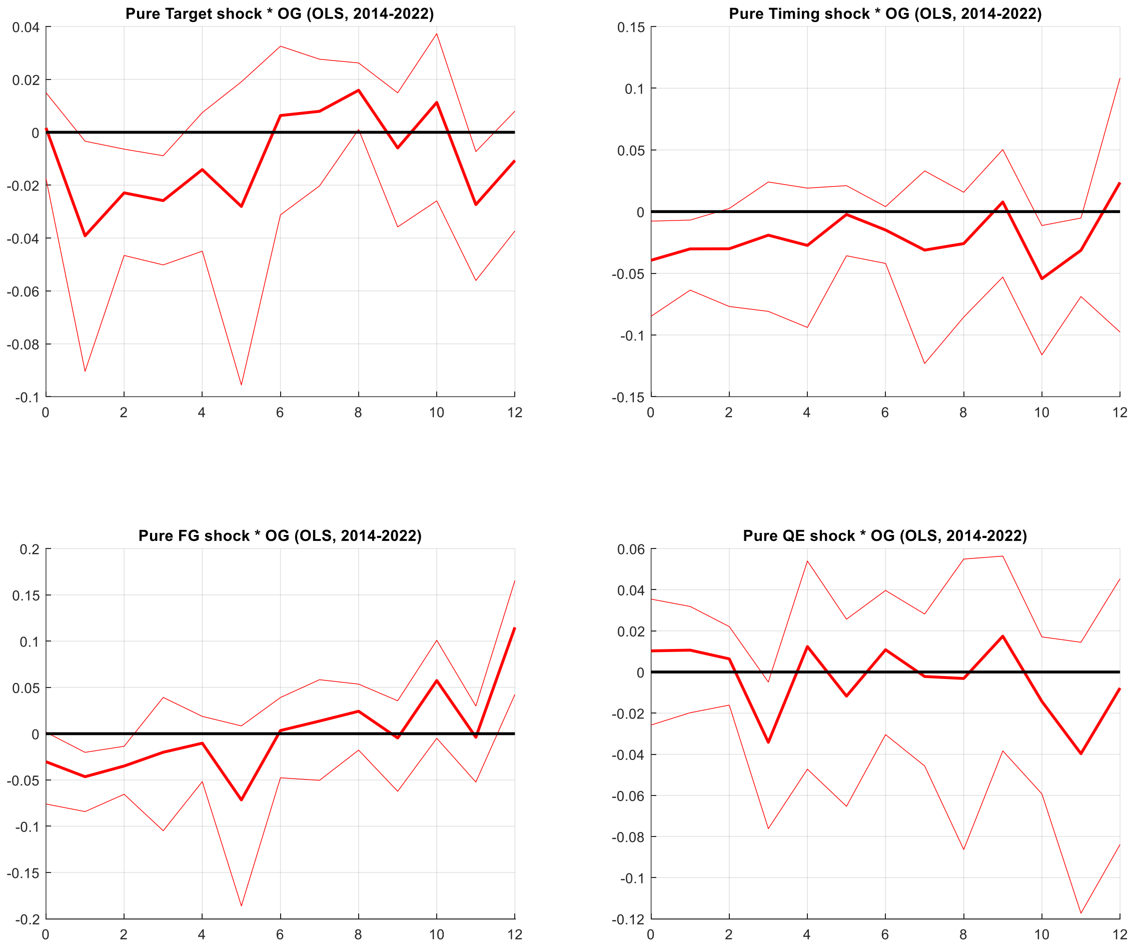
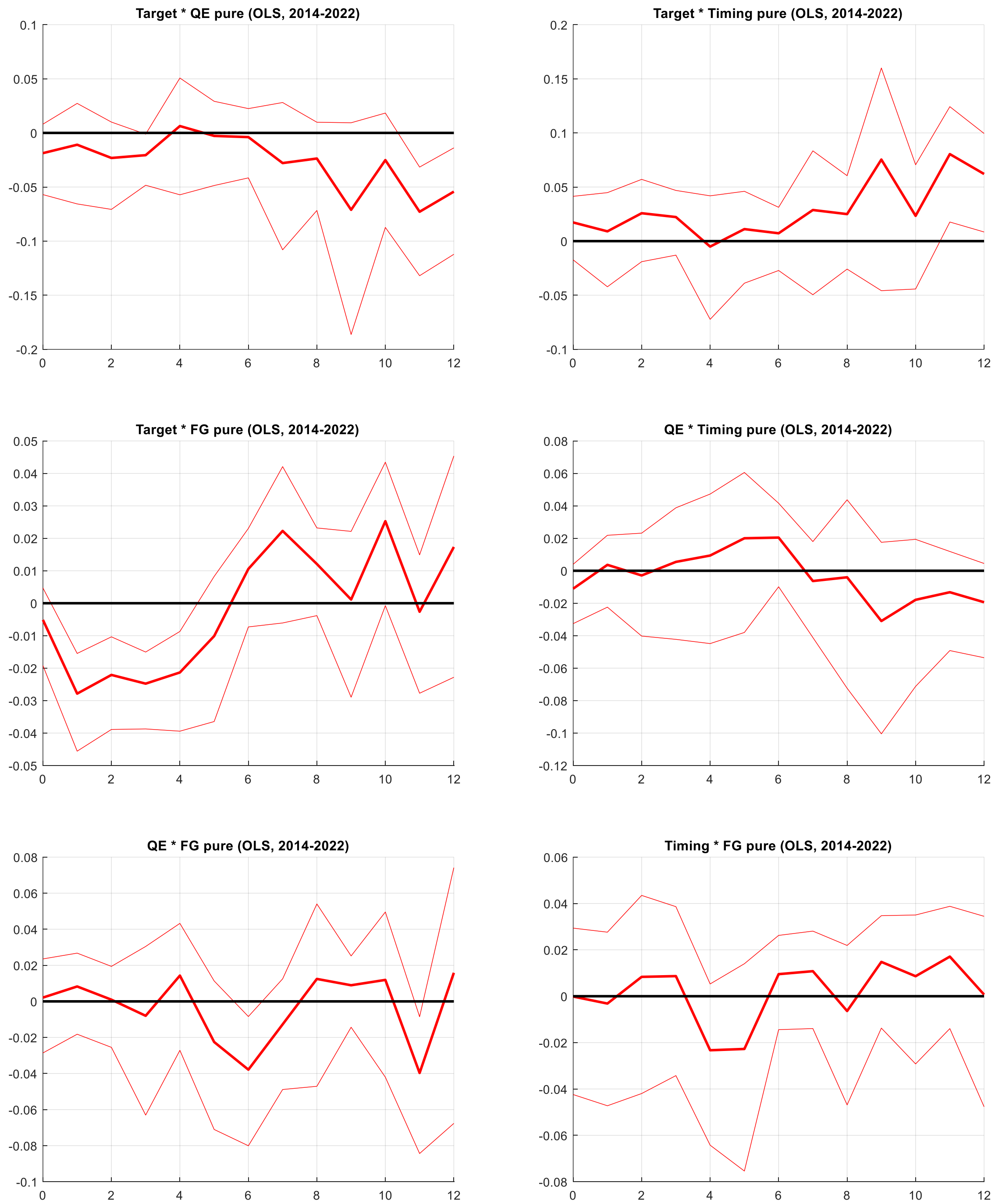


Figure C 3. OLS estimates for local projection of equation (4) using pure monetary policy shocks. Note: 95 % HAC confidence intervals are reported. Data are from 01/2014 to 08/2022. Shocks are in basis points. Log-difference of HICP is multiplied by 100.



Appendix D. Alternative data illustrations

Figure D 1. 6 months ahead 6-month price change against different shock variables. Note: The lines are the fits of linear regression estimated separately for negative and non-negative shocks. The data are from the period 01/2014-08/2022.

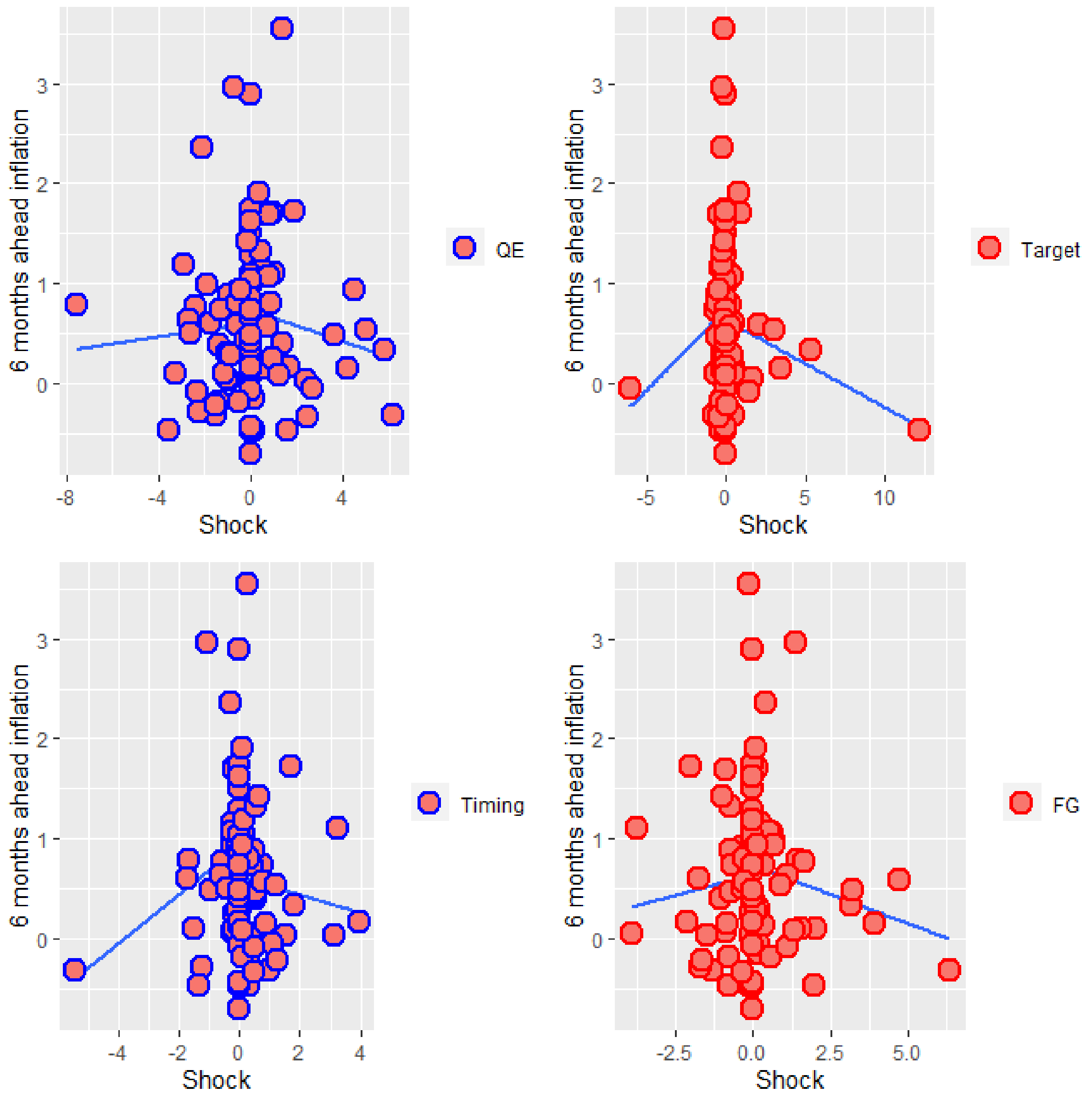


Figure D 2. 3 months ahead 3-month price change against different shock variables. Note: The lines are the fits of linear regression estimated separately for negative and non-negative shocks. The data are from the period 01/2014-08/2022.

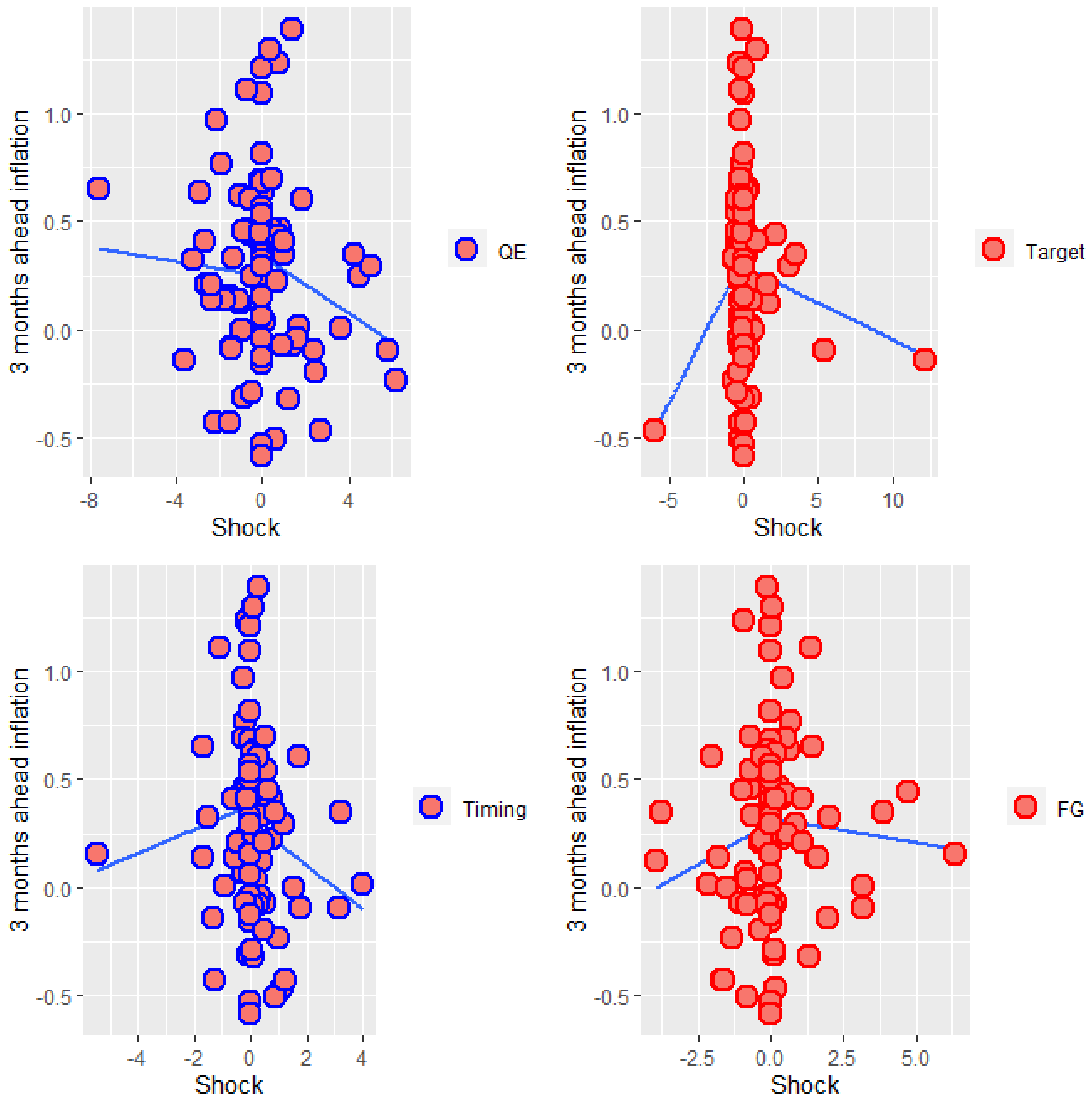
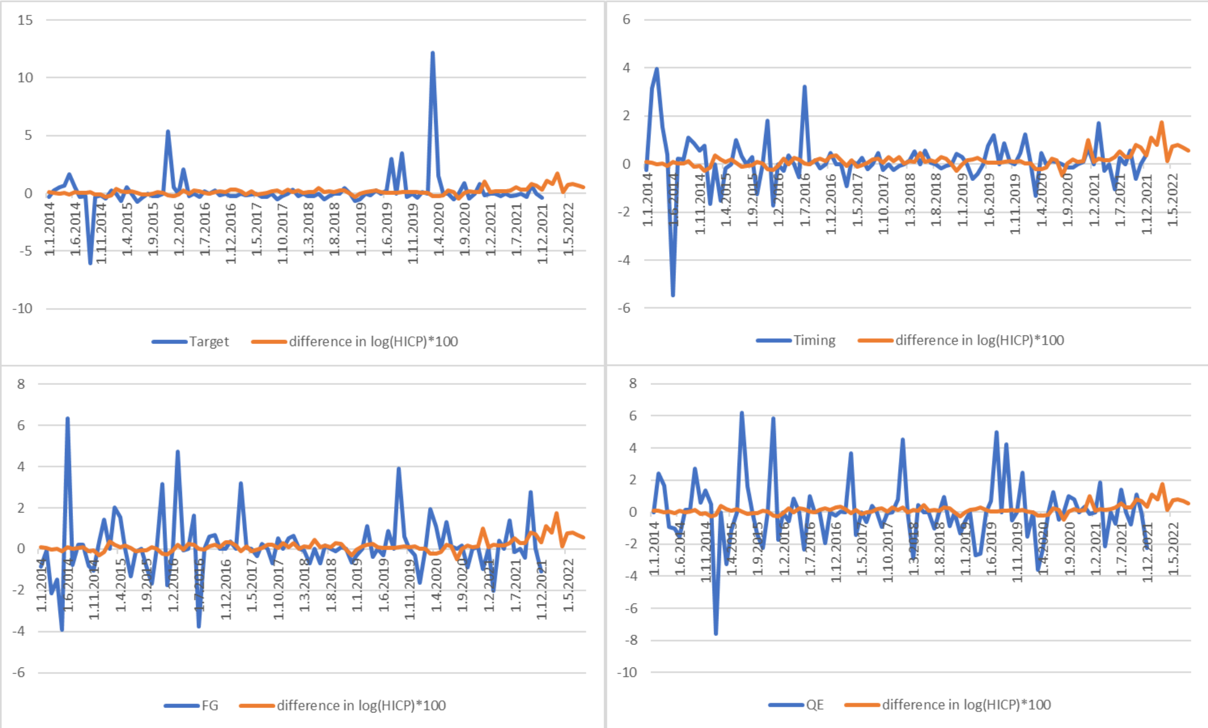


Figure D 3. Shock proxies and monthly inflation.



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