How Do Money Market Conditions Affect Shadow Banking Activity? Evidence From Security Repurchase Agreements

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Abstract

Using data from the Federal Reserve Bank of New York FR 2004 report, we investigate the relationship between instruments of monetary policy and bond market repurchase agreement activity of primary government securities dealers. We identify shocks to the money market by using the recursive relationship between slow moving real activity measures and fast moving financial market activity at the weekly frequency. We find after an unexpected increase in the cost of funds, primary dealers are unable to offset a reduction in bond financing by maturity substitution. Combined with institutional details, our findings support the existence of a broad credit channel for monetary policy to shadow banking activity. As a result, monetary policy contributes to rollover and credit risk by operating through the total supply of repurchase agreements to primary dealers via both prices and quantities. We conclude from 2001 to 2007, credit-market conditions posed a systemic threat to real activity due to dealers inability to access repurchase agreement liquidity needs at the discount window. Our findings are robust to a range of policy instruments including cost of credit measures and System Open Market Account composition. (*JEL* E44, E52, G32)

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Keywords: Monetary policy transmission, shadow banking, systemic stability.

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"Goldman Sachs seeks to maintain a highly liquid balance sheet. Many of our assets are readily funded in the repurchase agreement and securities lending markets, which have generally proven to be a consistent source of funding, even in periods of market stress..."

– Goldman Sachs Annual Report, 2002

1 Introduction

The disruption in funding the summer of 2007 highlighted how the performance of nonbank financial firms can impact nonfinancial real activity. In particular, primary government securities dealers (primary dealers) such as Countrywide Securities Corporation could no longer, "borrow on the repo market" (FCIR 2011). At the same time dealer banks such as Countrywide do not have access to the discount window, the main policy tool for, "defusing liquidity crises in nonbank financial markets" (Calomiris 1994).[1] Prior to the creation of the Primary Dealer Lending Facility on March 17, 2008 there were few options for survival (Duffie 2010). These extraordinary events have forced macroeconomics to recognize the need to include market based nonbank institutions, such as primary dealers, in macroeconomic analysis (Woodford 2010; Adrian and Shin 2008, 2010).

Unfortunately, "data on [the] shadow banking sector, by its nature, can be more difficult to obtain" (Bernanke 2012). However, primary dealers, are expected to file the FR 2004 report with the Federal Reserve Bank of New York (FRBNY) on an ongoing basis. As such, the FR 2004 reports are still the best aggregate/firm-level source on gross repurchase agreement (repo) flows within the "inter(shadow)bank" system and a proxy for systemic risk through "the length of intermediation chains" (Adrian et. al. 2012; Krishnamurthy et al. 2012). In addition to reporting repo activity regularly, primary dealers are required to participate in all Treasury auctions as well as fulfill the role of on-demand counterparty for the FRBNY's trading desk, executor of Federal Open Market Committee's (FOMC) policy goals. Therefore, the initial stages of monetary and fiscal policy directly transmit to these institutions but their role as propagation mechanisms has been ignored. Not only are primary dealers uniquely informed price leaders, they are at the nexus of money creation and credit market facilitation. Consequently, the FR 2004 report provides an uncommon opportunity to evaluate macroprudential policy with respect to, "increasing the resiliency of systematically important financial firms" (Bernanke 2012).

In the following paper, we investigate the relationship between instruments of monetary policy and bond market repurchase agreement activity of primary government securities dealers. We identify shocks to the money markets by using the recursive relationship between policy instruments and real activity at the weekly frequency.[2] We find after an unexpected increase in the cost of funds, primary dealers are unable to offset a reduction in bond financing by maturity substitution.[3] Combined with institutional details, our findings support the existence of a broad credit channel for monetary policy to shadow banking activity.[4] As a result, monetary policy can contribute to rollover and credit risk by operating through the total supply of repurchase agreements to primary dealers via both prices and quantities. We conclude from 2001 to 2007, credit-market conditions posed a systemic threat to real activity due to dealers inability to access repurchase agreement

[1] Only depository institutions are able to establish borrowing privileges.

[2] The focus of Bernanke and Blinder (1992) is to establish identification at the monthly frequency however, they also find supporting evidence for the weekly frequency.

[3] Kashyap et al. (1993) argue that the behavior of credit substitutes can be used to identify the credit transmission mechanism. We extend their argument to include substitution by contract maturity.

[4] For further discussion of the broad credit transmission channel see Oliner and Rudebusch (1996) and Bernanke and Gertler (1995).

liquidity needs at the discount window. Our findings are robust to a range of policy instruments including cost of credit measures and System Open Market Account composition.

The remainder of the paper is organized as follows. Section 2 proceeds by outlining institutional details linking the transmission of monetary policy, the role of primary dealers, and the repurchase agreement market. Section 3 describes the data and empirical methodology. Section 4 presents the results and Section 5 concludes.

2 Institutional Details

Although primary dealers are systematically important for U.S. banking system, little is known about how monetary policy tools impact their ability to finance bond activity in the repo market. The following section discusses the main institutional features that link the transmission of monetary policy to shadow banking activity.

2.1 Primary Dealers and the Link to Banking Liquidity

Primary dealers represent a limited but important part of the fixed income market (Adrian and Fleming 2005). Table 1 lists the all of the primary dealers during our sample which includes commercial bank subsidiaries and stand alone broker-dealers.[5] The main role of primary dealers is to act as the on demand trading counterparty of the FRBNY in its implementation of monetary policy pursuant to the direction of the FOMC. Temporary open market operations occur 9:30 am Eastern time each morning whereas permanent open market operations can occur anytime during the day (Federal Reserve Bank of New York Annual Report 2001).

In addition, primary dealers are required to file form FR 2004 on an ongoing basis and participate in all U.S. government debt auctions. Thus, "primary dealer" is short for primary dealer in U.S. government securities. Since the Federal Reserve Board of Governors (BOG) is responsible for monitoring the activity of bank holding companies, information from primary dealers provide insight into broad banking activity. The FRBNY designates primary dealers, whose participation is required in order to retain the benefit of primary dealer status. Other than monitoring their participation in these requirements, the FRBNY has no regulatory power over the primary dealers. Thus, the FRBNY expects the dealers to submit accurate data but does not audit it.

2.2 The Role of Dealer Banks in the Shadow Credit Intermediation Process

Pozsar et al. (2010) identify, "...the credit intermediation process of diversified brokers falls under the 'external' shadow banking sub-system." This 'external' sub-system is a result of the gains from specialization. Dealers do originate loans because they don't own commercial bank subsidiaries. Therefore, dealers outsource loan origination. The credit intermediation chains managed by dealers are the simplest in shadow credit intermediation (Gorton and Metric 2008). The main instrument dealers use to finance bond activity is repurchase agreements including asset backed bonds. Dealers are heavily involved in the repurchase agreement market and "must finance, or fund, every long/short position it maintains" (Fisher 2002). For a buyer, a repurchase agreement is a spot sale of an asset combined with a forward agreement to repurchase the asset at a later date (Duffie 1996). Agreements can be for one day or longer. The spot sale is the loan principle and the agreed future purchase price is the principle plus interest due. Therefore, the difference between the spot price and the future purchase price is loan interest from which the repo rate can

[5] All information on primary dealers is from the the New York Fed's website, `http://www.newyorkfed.org/markets/primarydealers.html`.

be implicitly calculated. The level of the general collateral repo rate is implicitly determined by the federal funds rate through the cost of carry formula for a forward rate agreement even though federal funds are uncollateralized.

3 Empirical Methodology

3.1 Data Description

The FR 2004 Report filed by primary dealers details their market activity. It is collected, consolidated, and released publicly every week by the FRBNY. The FOMC uses the report to monitor the condition of the U.S. Treasury securities market, which allows it to carry out more informed open market operations. The forms include the Weekly Report of Dealer Positions, the Weekly Report of Cumulative Dealer Transactions, the Weekly Report of Dealer Financing and Fails, the Weekly Report of Specific Issues, the Daily Report of Specific Issues, and the Daily Report of Dealer Activity in Treasury Financing.[6] Each release shows market data on transactions, positions, financing, and settlement activities in the U.S. Treasury, agency debt, mortgage backed, and corporate debt securities. The Weekly Report of Dealer Financing and Fails, or FR 2004C, collects outstanding financing arrangements and fails for the calendar week. Reporting is as of the close of business each Wednesday and the FRBNY releases summary data each Thursday after market hours one week later. The financing data is reported on a gross basis of actual funds paid or received and identify as a subset repo activity across all asset classes.[7] Furthermore, repo activity is broken down by maturity. Overnight and continuing contracts mature in one business day and can be renewed daily indefinitely unless terminated on demand by either party. Term agreements have a specified length of more than one day.

Our policy variables cover traditional cost of credit measurs and also less analysed variables from the System Open Market Account (SOMA). SOMA holdings are collected from the the Board of Governors H.4.1 release published on Thursday. The effective federal funds rate is collected from the Board of Governors H.15 weekly release and the federal funds target rate is from Board of Governors press releases. We also include a real activity measures in order to control for possible endogeneity due to economic activity. In particular, we use the spot price of West Texas Intermediate Crude Oil (Cushing, Oklahoma) released by the U.S. department of Energy (Energy Information Adminstration Petroleum Status Report). Weekly prices are calculated by the EIA from daily data by taking an un-weighted average of the daily closing spot prices over the specified time period. It is released Wednesday for the week ending the previous Friday. Crude oil is an important commodity in the global market therefore, spot oil prices may also serve as a gauge of geopolitical risks which can impact money market conditions. We also include the four week average of initial jobless claims is published by U.S. Department of Labor: Employment & Training Administration in the Unemployment Insurance Weekly Claims Report. It is published Thursday for the week ending Saturday before the release and is revised. New unemployment claims are compiled weekly and show the number of individuals filing for unemployment insurance for the first time.

All variables except interest rates and temporary open market operations have been transformed into growth rates. Interest rate measures are in first differences and temporary open market operations in log levels. Our sample ranges from July 4, 2001 to January 31, 2007 ending the week

[6] Information on the data collection forms can be found on the following website: `http://www.federalreserve.gov/reportforms`.

[7] FR 2004 data represents market volumes, not origination. Therefore, multiple transactions in the same security is possible. For a detailed explanation see Krishnamurthy et al. (2012).

before the first bank placed into FDIC receivership prior to the crisis.[8]

3.2 Identification

To study the impact of monetary policy instruments on dealer repurchase agreement activity we estimate a vector autoregressive system (VAR) using a limited set of variables. Consider the following four variable VAR of finite order p:

$$\begin{bmatrix} \text{CLAIMS}_t \\ \text{FF}_t \\ \text{OIL}_t \\ \text{REPO}_t \end{bmatrix} = \begin{bmatrix} A_{11}(L) & A_{12}(L) & A_{13}(L) & A_{14}(L) \\ A_{21}(L) & A_{22}(L) & A_{23}(L) & A_{24}(L) \\ A_{31}(L) & A_{32}(L) & A_{33}(L) & A_{34}(L) \\ A_{41}(L) & A_{42}(L) & A_{43}(L) & A_{44}(L) \end{bmatrix} \begin{bmatrix} \text{CLAIMS}_{t-p} \\ \text{FF}_{t-p} \\ \text{OIL}_{t-p} \\ \text{REPO}_{t-p} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \\ u_{4t} \end{bmatrix} \tag{1}$$

where CLAIMS_t is defined as the four week moving average of initial jobless claims, FF_t is the effective federal funds rate, OIL_t is the spot price of west Texas intermediate crude oil,and REPO_t is the gross basis of funds received from repurchase agreements respectively. $A_{i,j}(L)$ is defined as the autoregressive lag polynomial of order p, and u_{it} are reduced form residuals uncorrelated with all variables dated t-1. The structural disturbances and reduced form residuals are related by:

$$\begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \\ u_{4t} \end{bmatrix} = \begin{bmatrix} b_{11} & b_{12} & b_{13} & b_{14} \\ b_{21} & b_{22} & b_{23} & b_{24} \\ b_{31} & b_{32} & b_{33} & b_{34} \\ b_{41} & b_{42} & b_{43} & b_{44} \end{bmatrix} \begin{bmatrix} \varepsilon_t^{\text{CLAIMS}} \\ \varepsilon_t^{\text{FF}} \\ \varepsilon_t^{\text{OIL}} \\ \varepsilon_t^{\text{REPO}} \end{bmatrix} \tag{2}$$

Each structural disturbance is serially uncorrelated and has a covariance matrix equal to the identity matrix. When we replace $E\left[u_t u_t^T\right] = \Sigma_u$ by its sample analogue, Σ_u has $\frac{n(n+1)}{2} = 10$ free parameters and the b matrix contains 16 elements. Therefore, $\frac{n(n-1)}{2} = 6$ additional restrictions are necessary and sufficient to estimate an exactly identified system. We impose a Choleski decomposition such that $b_{1,2} = b_{1,3} = b_{1,4} = b_{2,3} = b_{2,4} = b_{3,4} = 0$ giving the following structure:

$$\begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \\ u_{4t} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 \\ b_{21} & b_{22} & 0 & 0 \\ b_{31} & b_{32} & b_{33} & 0 \\ b_{41} & b_{42} & b_{43} & b_{44} \end{bmatrix} \begin{bmatrix} \varepsilon_t^{\text{CLAIMS}} \\ \varepsilon_t^{\text{FF}} \\ \varepsilon_t^{\text{OIL}} \\ \varepsilon_t^{\text{REPO}} \end{bmatrix} \tag{3}$$

The restricted b matrix is equivalent to assuming that changes to our chosen monetary instrument is not sensitive to within the week developments in the economy but financial market activity can react contemporaneously.

[8]The last failure before February 2, 2007 was on June 24, 2005. A list of bank failures maintained by the FDIC is at `http://www.fdic.gov/bank/individual/failed/banklist.html`.

4 Results

The fist section focuses on the behavior of primary dealers repo activity after an increase in the cost of credit and compares this behavior with the responses of dealer repo activity by contract maturity. The second section documents the behavior of dealer repo activity and contract maturity to changes in the SOMA portfolio.

4.1 Benchmark Response – An Increase in the Cost of Credit

The benchmark specifications for the VARs include one quarter of lagged variables, a constant, and weekly fixed effects since the FR 2004 report is not adjusted for seasonality.[9] The impulse responses for the recursive VAR ordered $\text{CLAIMS}_t, \text{FF}_t, \text{OIL}_t, \text{REPO}_t$ after a one standard deviation in the effective federal funds rate are plotted in Figure 1. Initial jobless claims and the spot price of oil show no significant response. The federal funds rate increases contemporaneously approximately 5 basis points and is significantly different from zero after one year. The contemporaneous response of repurchase agreement activity is negative and shows statistical significance up to a month later.

While the response of repo activity is consistent with the broad credit channel it is also consistent with the interest rate channel. That is, a decline in repo demand could be driving our results. We therefore look at the responses of repo activity by contract maturity. If the broad credit channel is operational, an increase in the cost of credit will reduce overall repo activity but also increase overnight activity, a substitute for term maturity contracts. Thereby suggesting a shift in repo supply, rather than an inward shift in repo demand. Figures 2 and 3 show the responses of OPEN and TERM activity after a positive innovation in the federal funds rate. OPEN activity is positive, significant, and persistent whereas TERM activity is negative, significant, and persistent. The responses of the two contracts suggest the broad credit channel could be operational.

As a robust check we use changes in the federal funds target level, a permanent increases in the cost of funds, as our policy variable. Figures 4, 5, and 6 display the impulse responses for the recursive VAR ordered $\text{CLAIMS}_t, \text{TARGET}_t, \text{OIL}_t, \text{REPO}_t$ and the repo components OPEN_t and TERM_t respectively. The responses of each repo variable to a permanent increase in the cost of funds is similar to the benchmark responses however only TERM is negative, significant, and persistent.

To identify whether repo activity responds differently to demand shocks we use the difference between the effective federal funds rate and target level as a measure of an increase in the cost of credit due to reserve imbalances. Figures 7, 8, and 8 display the impulse responses for the recursive VAR ordered $\text{CLAIMS}_t, \text{MISS}_t, \text{OIL}_t, \text{REPO}_t$ and the repo components OPEN_t and TERM_t respectively. MISS is positive, significant, and persistent one year later. The response of REPO and OPEN are associated with a slow and persistent decreases. TERM on the other hand, shows no significant response.

4.2 Repo Activity and the System Open Market Account

The FOMC influences the money market not only through the cost of credit but also through changes in the level of bank reserves. The level of reserves is changed through open market operations which can be temporary and or permanent. In the following subsection we explore the response of dealer repo activity after a change in the composition of the SOMA. Temporary operations are conducted through repurchase and reverse repurchase agreements while permanent through treasury securities.

[9] Our lag choice was supported by Ljung-Box Q-statistics and also the Akaike Information Criterion (AIC).

The impulse responses for the recursive VAR ordered $\text{CLAIMS}_t, \text{SOMAREPO}_t, \text{OIL}_t, \text{REPO}_t$ after a one standard deviation increase in SOMAREPO are plotted in Figure 9. CLAIMS and OIL show no significant response. SOMAREPO response is positive, significant and persistent after one year. After a two month delay REPO is positive, significant, and persistent. The response of OPEN in Figure 10 is not significant. On the other hand, the response of TERM is positive, significant, and persistent after approximately two quarters.

The impulse responses for the recursive VAR a one standard deviation increase in SOMARREPO are plotted in Figure 11. CLAIMS and OIL show no significant response. SOMARREPO response is positive, significant and persistent after one year. After a two month delay REPO is positive, significant, and persistent. The response of OPEN in Figure 10 is not significant. On the other hand, the response of TERM is positive, significant, and persistent after approximately two quarters.

The FOMC can also permanently change the level of reserves by selling and buying Treasury securities in the open market. Figures 16 to 21 plot the response of our variables of interest to an unexpected increase in the System Open Market Account holdings of Treasury securities and Treasury bills respectively. Overall these results show little significance although the responses of dealer repo activity to a shock to the System Open Market Account holding of Treasury bills shows a significant negative contemporaneous response (Figure 20) and dealer repo activity is negative but insignificant (Figure 19).

As recent history has shown the composition of the System Open Market Account could have an impact on dealer repo activity. We investigate this claim but first construct the ratio of Treasury bills to Treasury holdings in the SOMA as an indicator of the SOMA's composition. Figures 22 to 24 show the effect of an unexpected 1 percentage point increase in dealer repo, overnight, and term activity. While overnight and continuing activity is negative and significant contemporaneously, only the level of repo activity seems to show a significant affect by the first month and fading away up to the first quarter. While the response is not persistent it is clearly negative.

5 Conclusion

The monetary transmission mechanism is linked through the aggregate balance sheets of three counterparties: the banking system, the Federal Reserve System, and the primary dealers. Traditionally, macroeconomists have focused on the first two and ignored the last. However, because banking is no longer narrow, shadow banking can no longer be be ignored. When the Federal Reserve conducts monetary policy in the banking system, the structure of the transmission mechanism enables private money creation through the FRBNY's counterparty relationships. Furthermore, as our results show, some FOMC actions can influence supply and demand for money substitutes such as repurchase agreements. Moreover, the FRBNY's relationship with the primary dealers, is that of counterparty not regulator. As such, rollover and credit risk and its costs are regulated by a different institution, the U.S. Securities Exchange Commission (SEC). This gap in oversight suggests that current macroprudential policy designed to promote systemic stability is susceptible to coordination failure.

REFERENCES

Adrian, Tobias, Brian Begalle, Adam Copeland, and Antoine Martin. 2012. Repo and securities lending. *Federal Reserve Bank of New York Staff Reports.* No. 529.

Adrian, Tobias, Michael J. Fleming. 2005. What financing data reveal about dealer leverage. *Current Issues in Economics and Finance.* 11(3): 1-7.

Adrian, Tobias, Hyun Song Shin. 2009. Money, liquidity, and monetary policy. *American Economic Review.* 99(2): 600-605.

——-. 2010a. Financial intermediaries and monetary economics. In *Handbook of Monetary Economics.* Vol. 3 ed.1. Ed. Benjamin M. Friedman and Michael Woodford, Chapter 12, 601-650. Elsevier.

Bernanke, Ben S.. 2012. Fostering financial stability.

Bernanke, Ben S., and Alan S. Blinder. 1992. The federal funds rate and the channels of monetary transmission. *American Economic Review.* 82(4) (Sep.): 901-921.

Bernanke, Ben S., Mark Gertler, and Simon Gilchrist. 1996. The financial accelerator and the flight to quality. *The Review of Economics and Statistics.* 78(1) (Feb.): 1-15.

Calamiris, Charles W..1994. Is the discount window necessary? a penn-central perspective. *Federal Reserve Bank of St. Louis* (May): 31-55.

Copeland, Adam, Antoine Martin, and Michael Walker. 2010. The tri-party repo market before the 2010 reforms. *Federal Reserve Bank of New York Staff Reports* No. 477.

——-. 2011. Repo runs: evidence from the tri-party repo market. *Federal Reserve Bank of New York Staff Reports* No. 506.

Duffie, Darrell. 1996. Special repo rates. *The Journal of Finance* 51(2): 493-526.

——-.2010. The failure mechanics of dealer banks. *Journal of Economic Perspectives* 23(1) (Winter): 51-72.

Financial Crisis Inquiry Commission. 2011. The financial crisis inquiry report. New York:Public Affairs.

Fisher, Mark. 2002. Special repo rates: an introduction. *Federal Reserve Bank of Atlanta Economic Review* (Quarter 2): 27-43.

Gorton, Gary, and Andrew Metric. 2010. Securitized banking and the run on repo. *Jouranl of Financial Economics* 104(3): 425-451.

Kashyap, Anil K., Jeremy C. Stein, and David W. Wilcox. 1993. Monetary policy and credit conditions: evidence from the composition of external finance. *American Economic Review* 83(1): 78-98.

Krishnamurthy, Arvind, Stefan Nagel, and Dmitry Orlov. 2012. Sizing up repo. *NBER Working Paper* No. 17768.

Oliner, Stephen D., and Glenn D. Rudebusch. 1996. Is there abroad credit channel for monetary policy¿ *Federal Reserve Bank of San Francisco Economic Review* No. 1.

Pozsar, Zoltan, Tobias Adrian, Adam Ashcraft, and Haley Boesky. 2010. Shadow banking. *Federal Reserve Bank of New York Staff Reports* No. 485.

Sims, Christopher A., and Tao Zha. 1999. Error bands for impulse responses. *Econometrica* 67(5): 1113-1156.

Woodford, Michael. 2010. Financial intermediation and macroeconomic analysis. *Journal of Economic Perspectives* 24(4): 21-44.

APPENDIX A

Tables

Table 1: Primary Dealers - July 2001 to January 2007

Primary Dealers at Begining of Sample	Withdrawn	Name Change	Added	Merger
ABN AMRO Inc.	9/15/2006	12/9/2002		
BMMO Nesbitt Burns Corp.	4/1/2002			
BNP Paribas Securities Corp.				
Bank of America Securities LLC				
Bank One Capital Markets, Inc.	8/2/2004			8/2/2004
Barclays Capital Inc.				
Bear, Stearns & Co., Inc.				
CIBC World Markets Corp.				
Credit Suisse First Boston Corporation		3/18/2003		
–		1/17/2006		
Daiwa Securities America Inc.				
Deutsche Banc Alex Brown Inc.		3/30/2002		
Dresdner Kleinwort Wasserstein Securities LLC		9/18/2006		
Fuji Securities Inc.		4/1/2002		
Goldman, Sachs & Co.				
Greenwich Capital Markets, Inc.				
HSBC Securities, Inc.		1/17/2006		
J.P. Morgan Securities, Inc.				8/2/2004
Lehman Brothers Inc.				
Merrill Lynch Government Securities Inc.				
Morgan Stanley & Co. Inc.				
Nomura Securities International, Inc.				
Solomon Smith Barney Inc.				4/7/2003
SG Cown Securities Corporation	10/31/2001			
UBS Warburg LLC.		6/12/2003		
Zions First National Bank	3/31/2002			
Primary Dealers Added				
Countrywide Securities Corporation			1/15/2004	
Cantor Fitzgerald & Co.			8/1/2006	

Figures

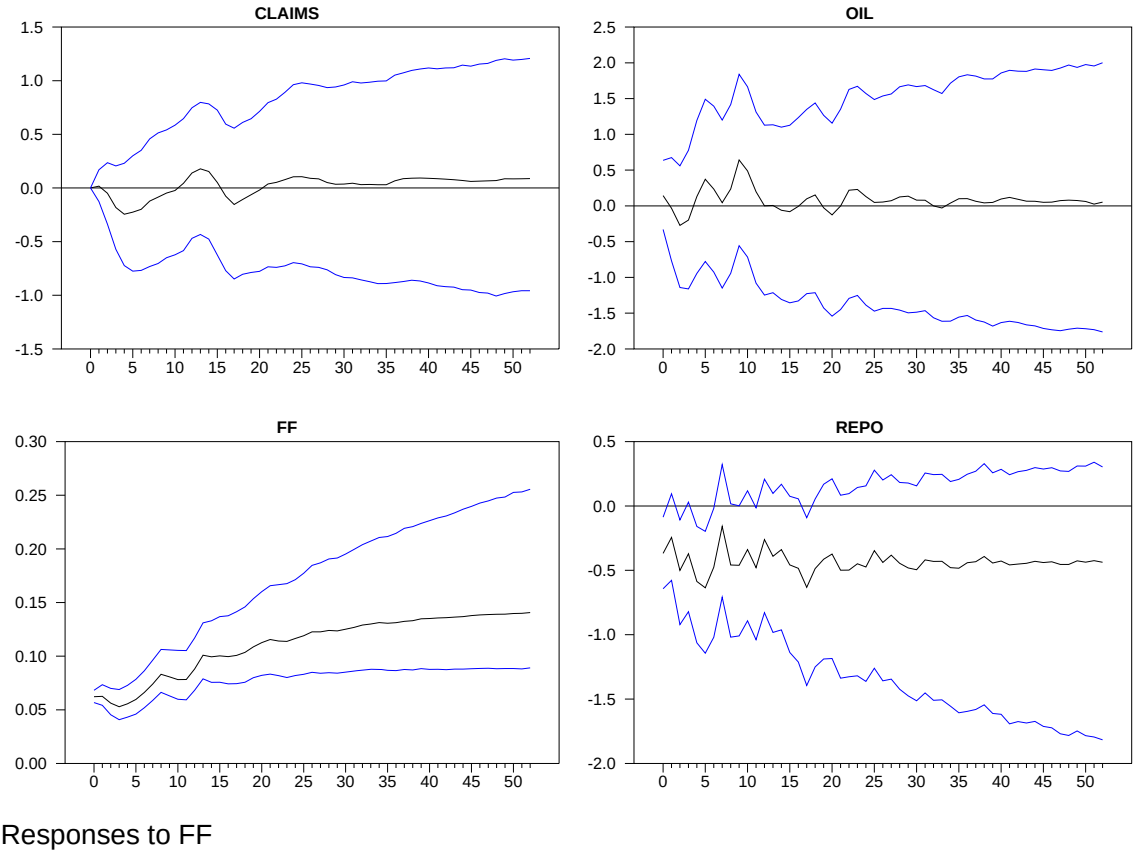

Figure 1: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), the effective federal funds rate (FF), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from repurchase agreements (REPO) to a one standard deviation shock to the federal funds rate (FF). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

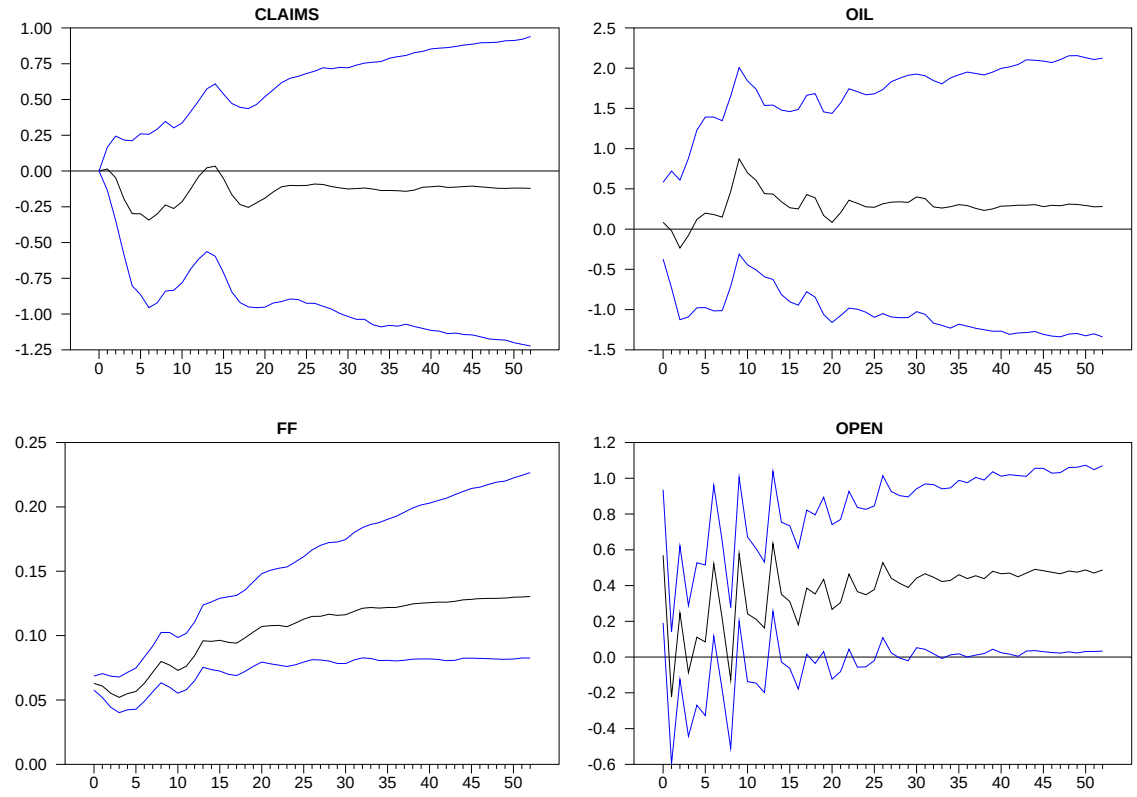

Figure 2: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), the effective federal funds rate (FF), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from overnight and continuing repurchase agreements (OPEN) to a one standard deviation shock to the federal funds rate (FF). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

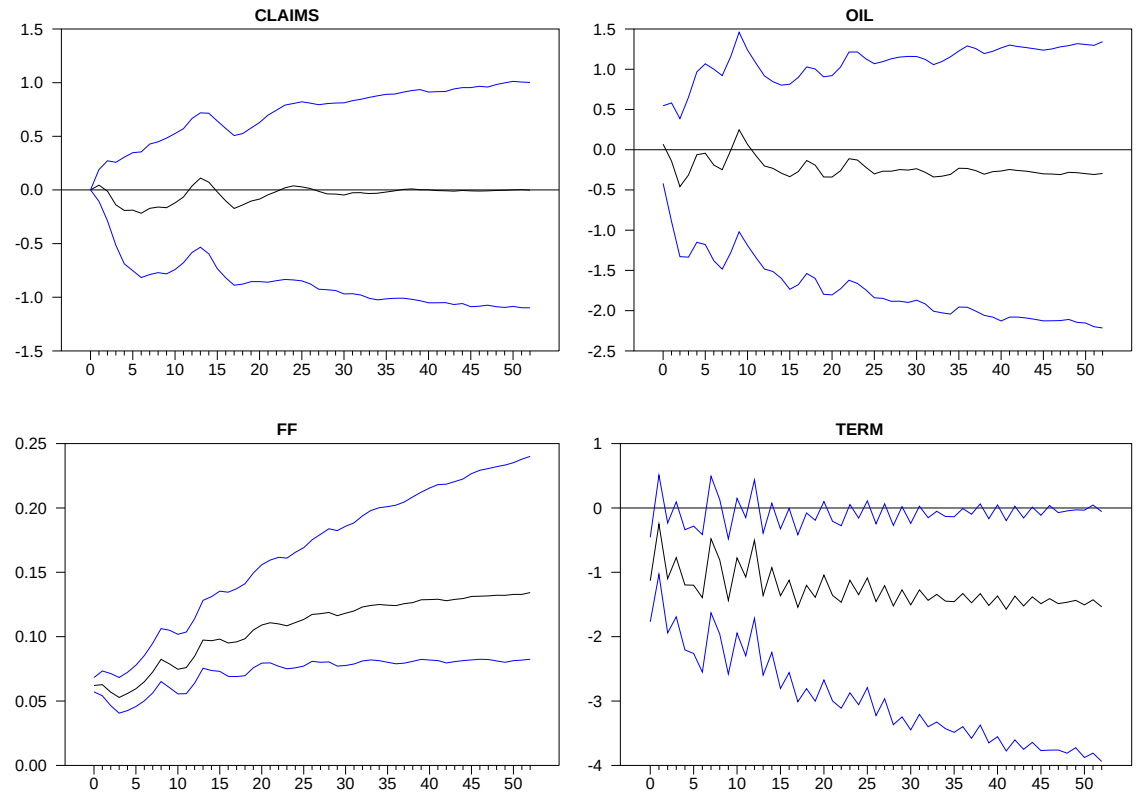

Figure 3: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), the effective federal funds rate (FF), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from term repurchase agreements (TERM) to a one standard deviation shock to the federal funds rate (FF). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

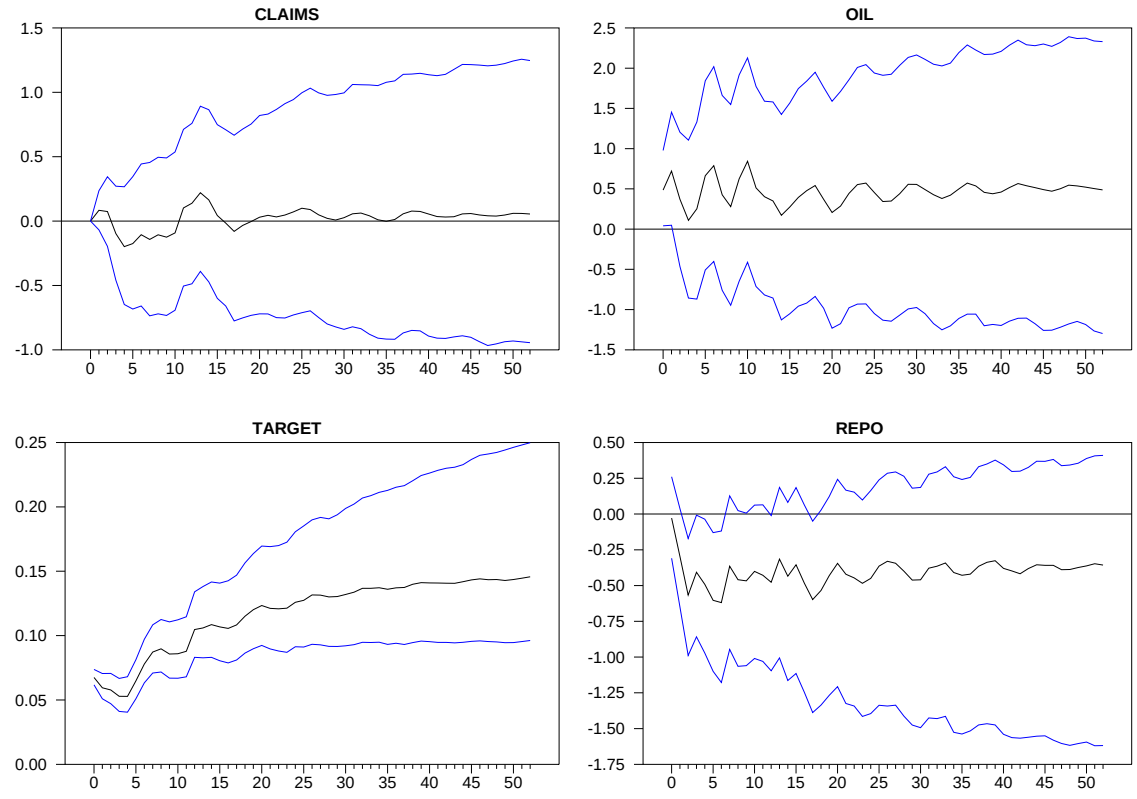

Figure 4: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), the target federal funds rate (TARGET), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from repurchase agreements (REPO) to a one standard deviation shock to the target federal funds rate (TARGET). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

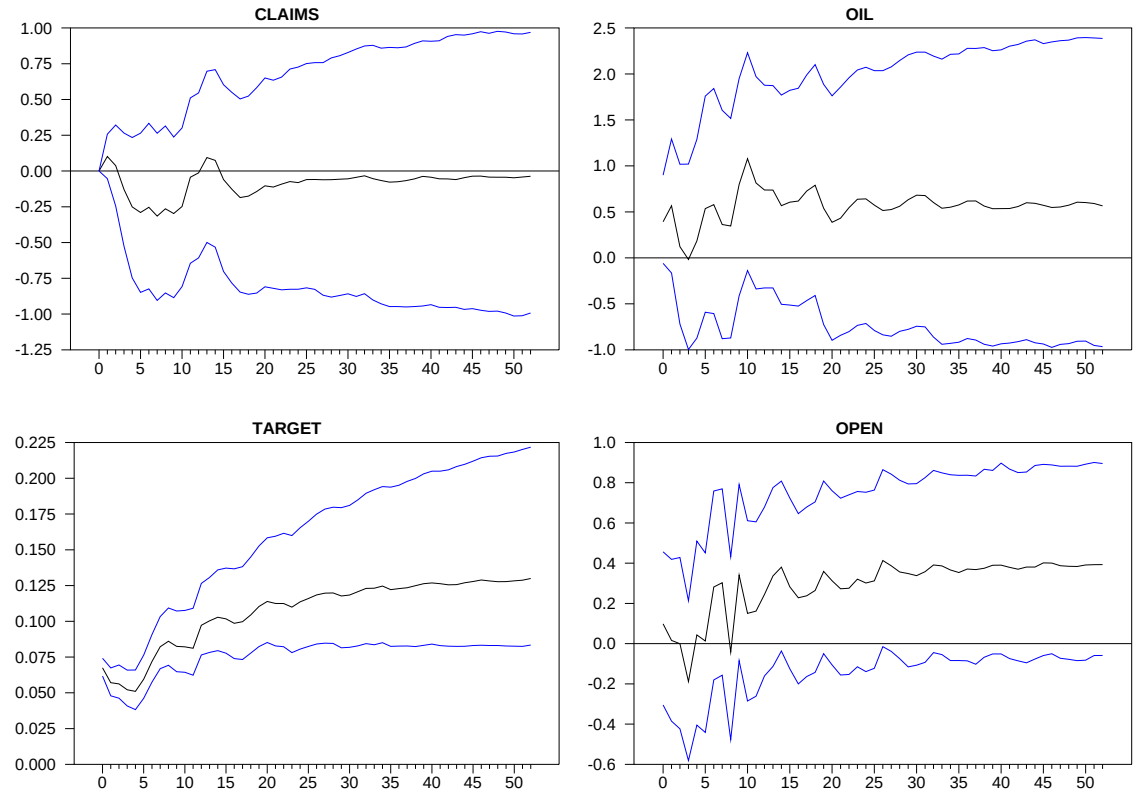

Figure 5: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), the target federal funds rate (TARGET), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from overnight and continuing repurchase agreements (OPEN) to a one standard deviation shock to the target federal funds rate (TARGET). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

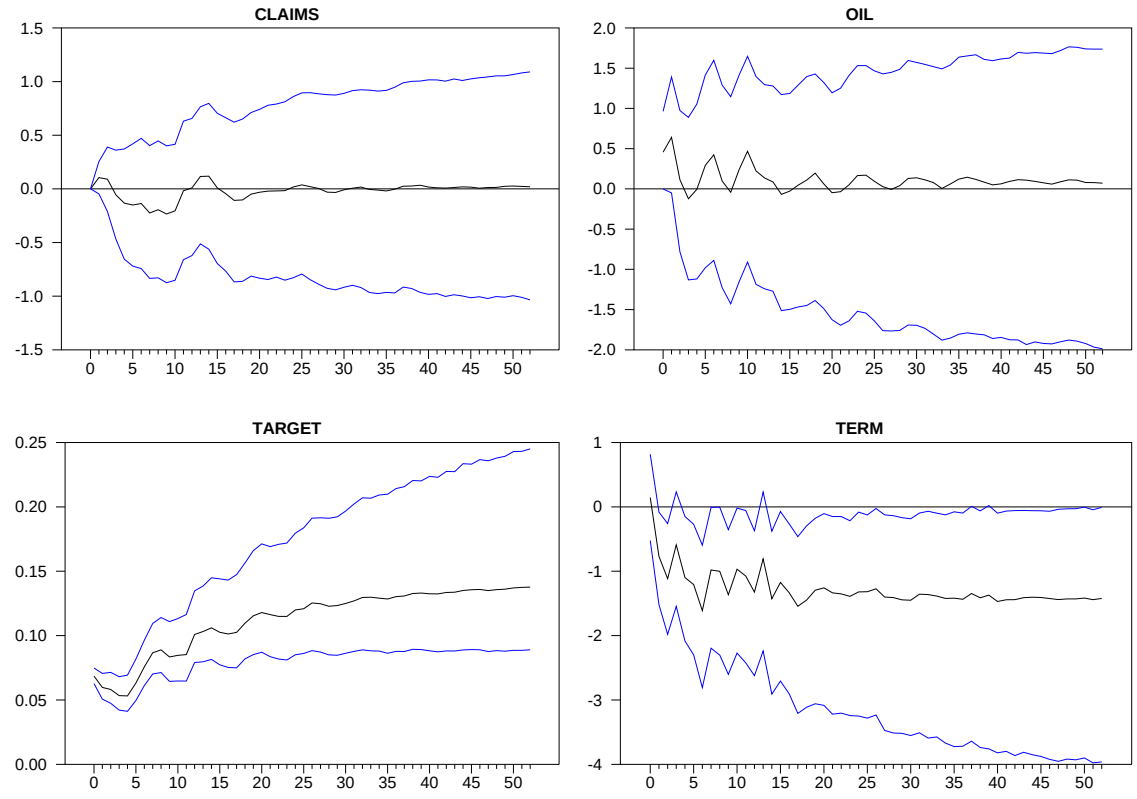

Figure 6: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), the target federal funds rate (TARGET), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from term repurchase agreements (TERM) to a one standard deviation shock to the target federal funds rate (TARGET). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

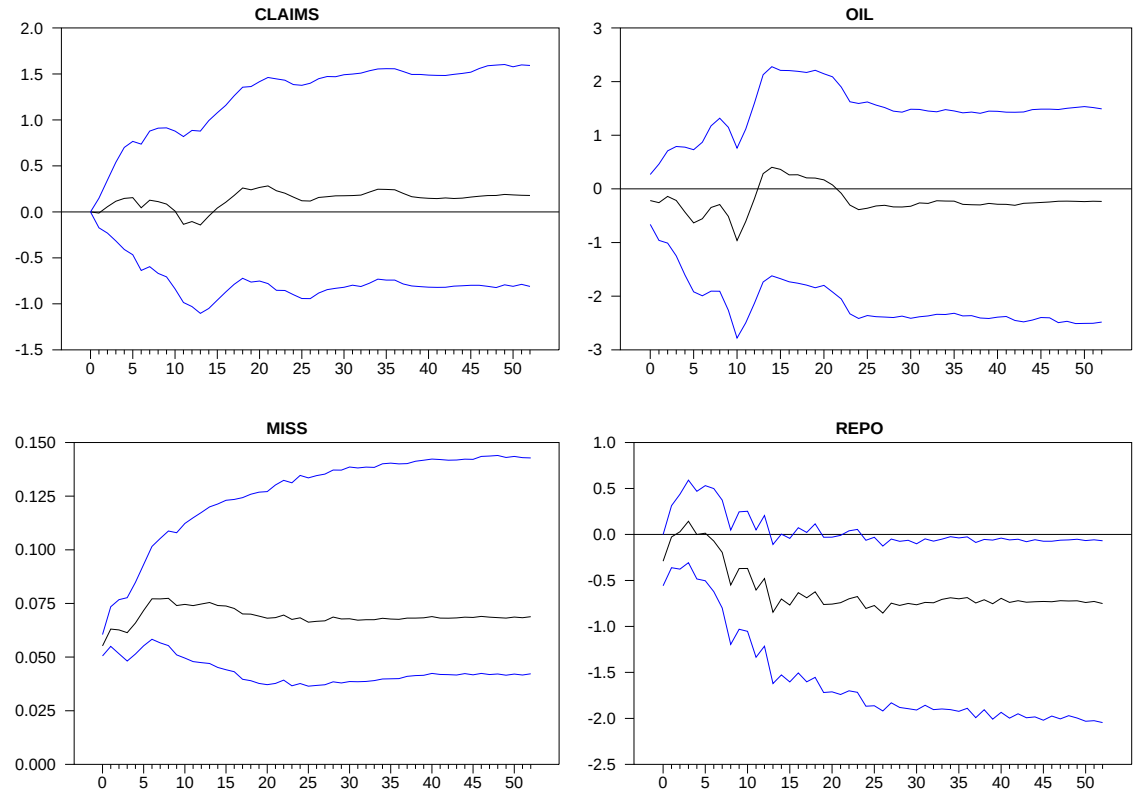

Figure 7: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), the difference between the effective federal funds rate and the target (MISS), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from repurchase agreements (REPO) to a one standard deviation shock to difference between the effective federal funds rate and the target (MISS). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

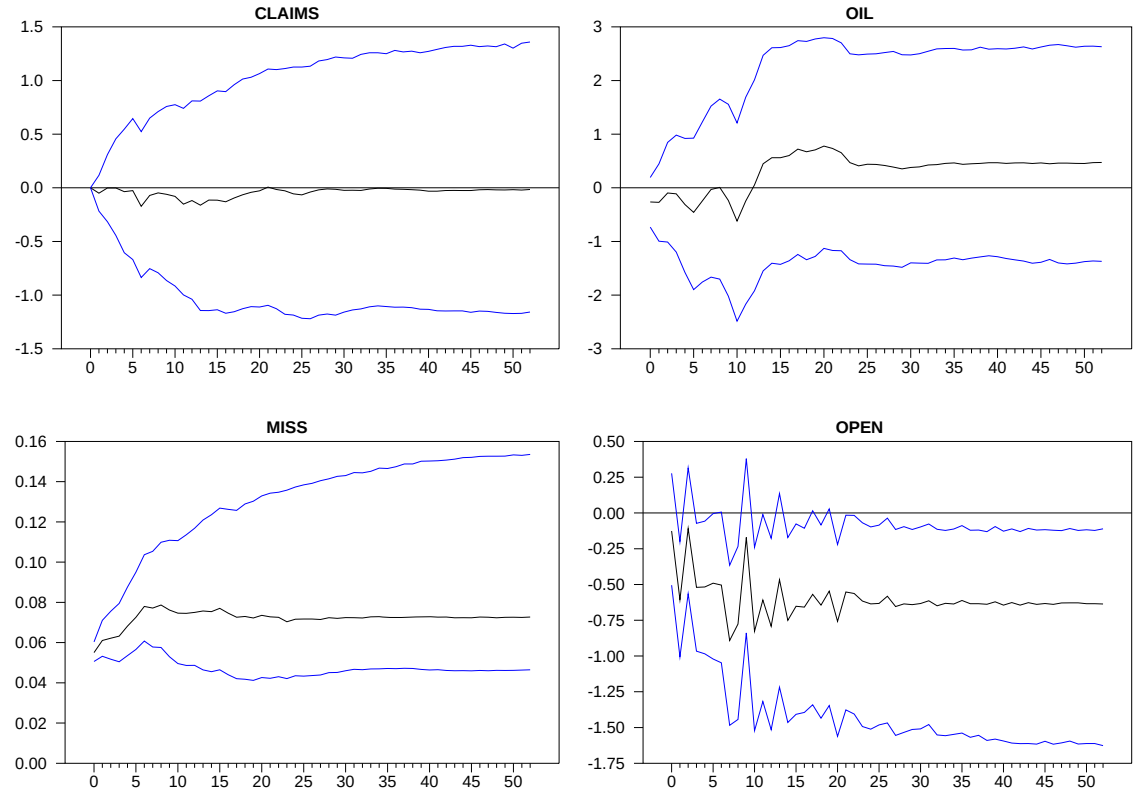

Figure 8: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), the difference between the effective federal funds rate and the target (MISS), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from overnight and continuing repurchase agreements (OPEN) from a one standard deviation shock in the difference between the effective federal funds rate and the target (MISS). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

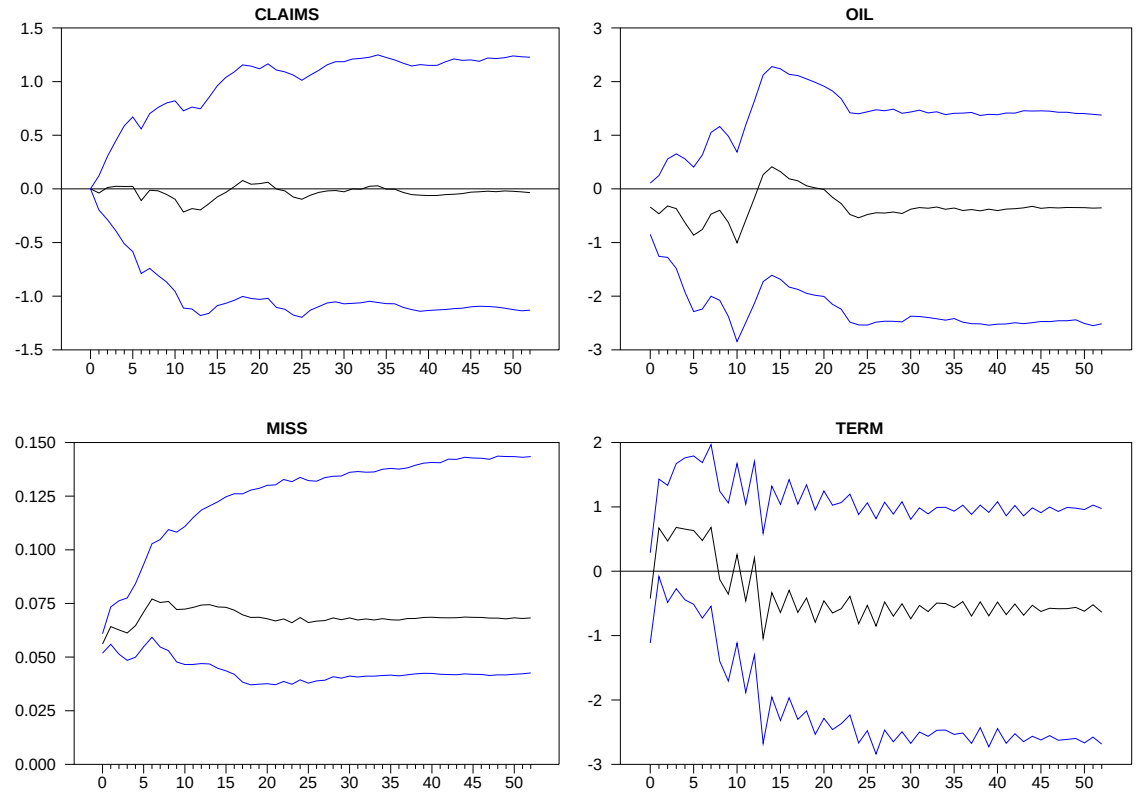

Figure 8: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), the difference between the effective federal funds rate and the target (MISS), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from term repurchase agreements (TERM) to a one standard deviation shock in the difference between the effective federal funds rate and the target (MISS). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

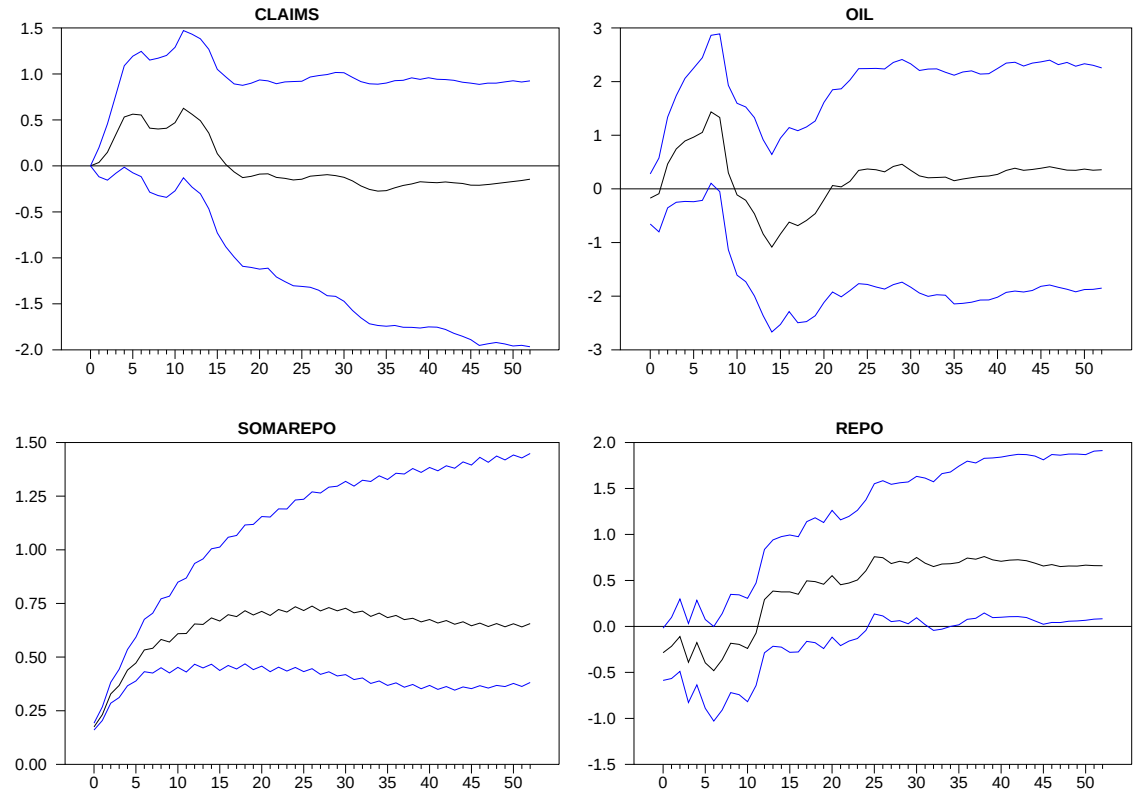

Figure 10: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), System Open Market Account repurchase agreements (SOMAREPO), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from repurchase agreements (REPO) to a one standard deviation shock in System Open Market Account repurchase agreements (SOMAREPO). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

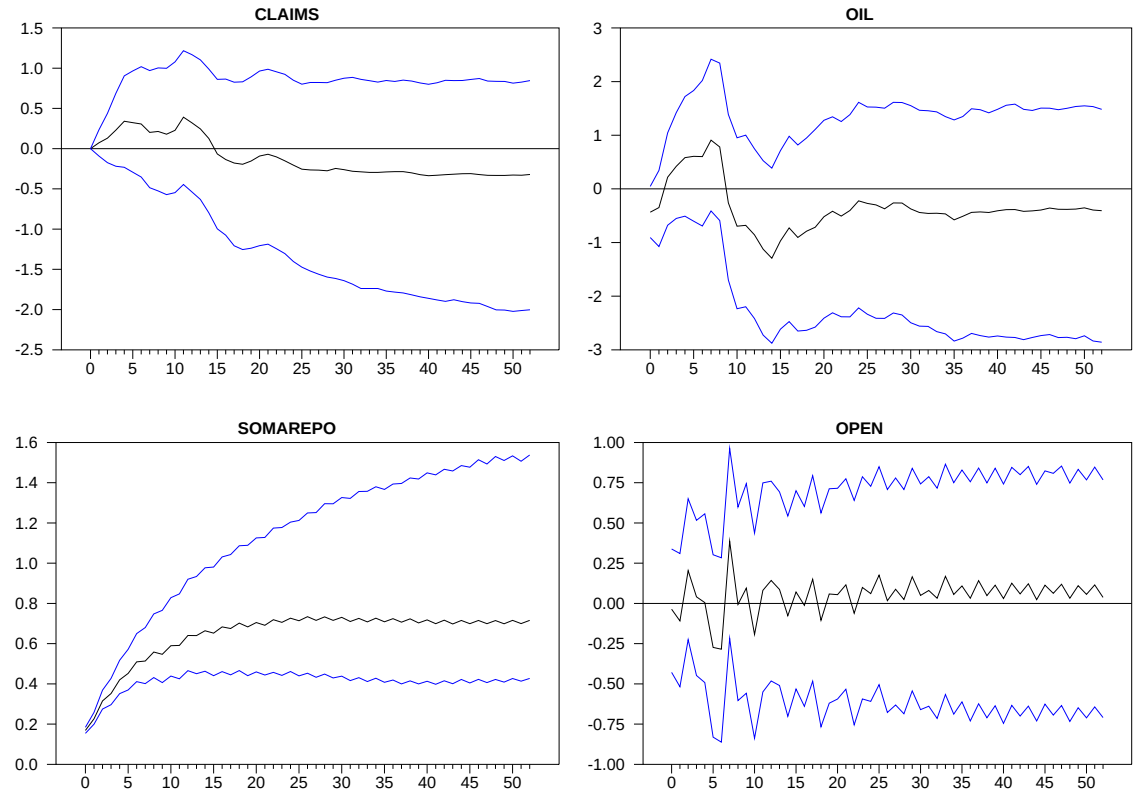

Figure 11: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), System Open Market Account repurchase agreements (SOMAREPO), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from overnight and continuing repurchase agreements (OPEN) to a one standard deviation shock in System Open Market Account repurchase agreements (SOMAREPO). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

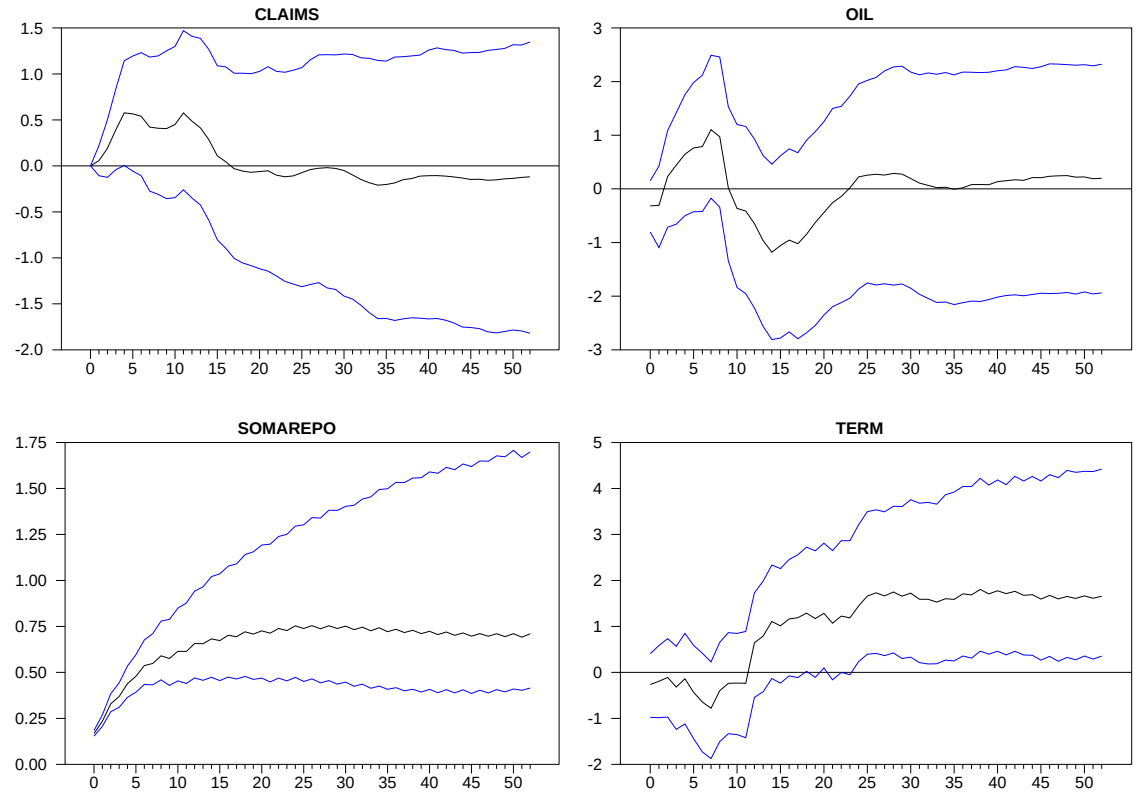

Figure 12: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), System Open Market Account repurchase agreements (SOMAREPO), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from term repurchase agreements (TERM) to a one standard deviation shock in System Open Market Account repurchase agreements (SOMAREPO). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

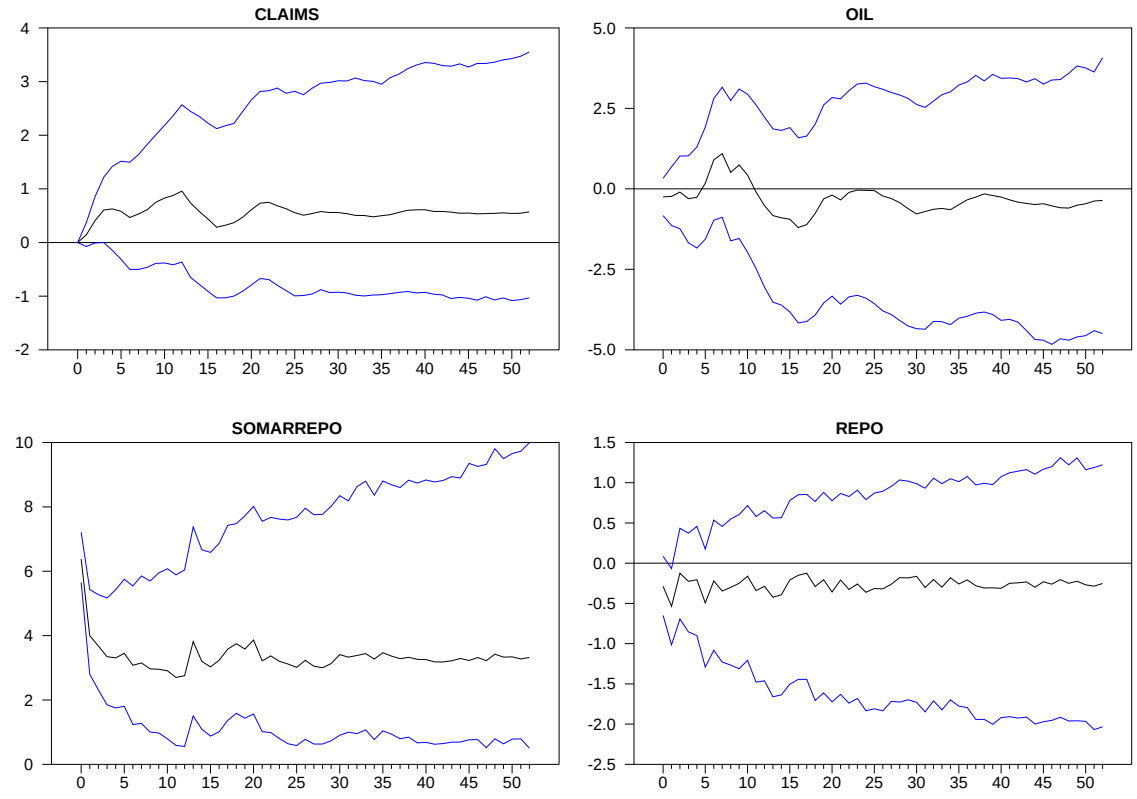

Figure 13: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), System Open Market Account reverse repurchase agreements (SOMARREPO), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from repurchase agreements (REPO) to a one standard deviation shock in System Open Market Account reverse repurchase agreements. The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

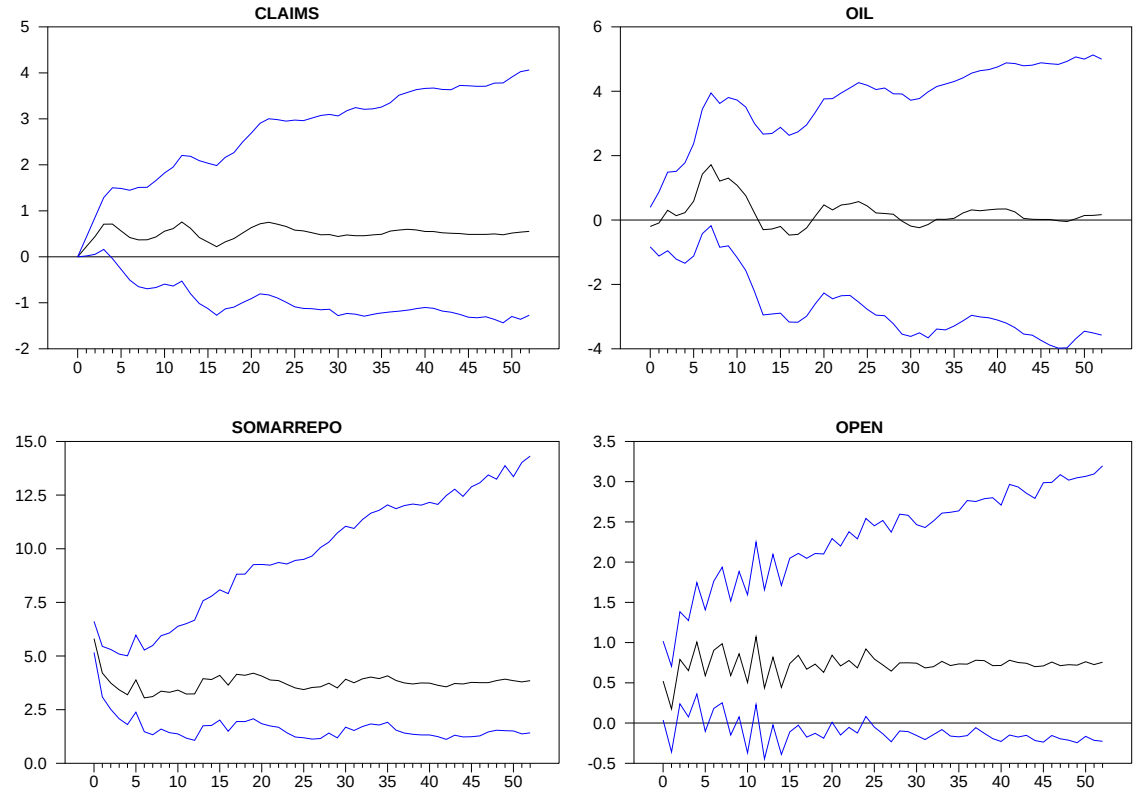

Figure 14: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), System Open Market Account reverse repurchase agreements (SOMARREPO), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from overnight and continuing repurchase agreements (OPEN) to a one standard deviation shock in System Open Market Account reverse repurchase agreements (SOMARREPO). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

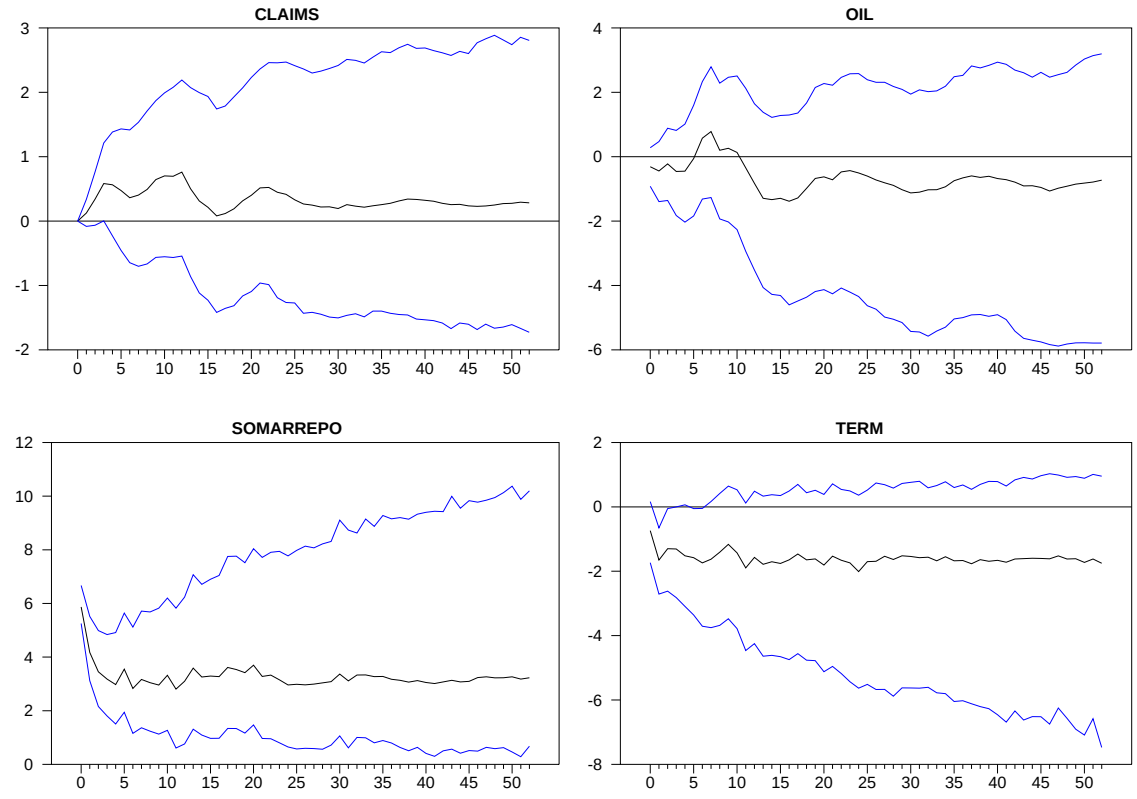

Figure 15: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), System Open Market Account reverse repurchase agreements (SOMARREPO), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from term repurchase agreements (TERM) to a one standard deviation shock in System Open Market Account reverse repurchase agreements (SOMARREPO). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

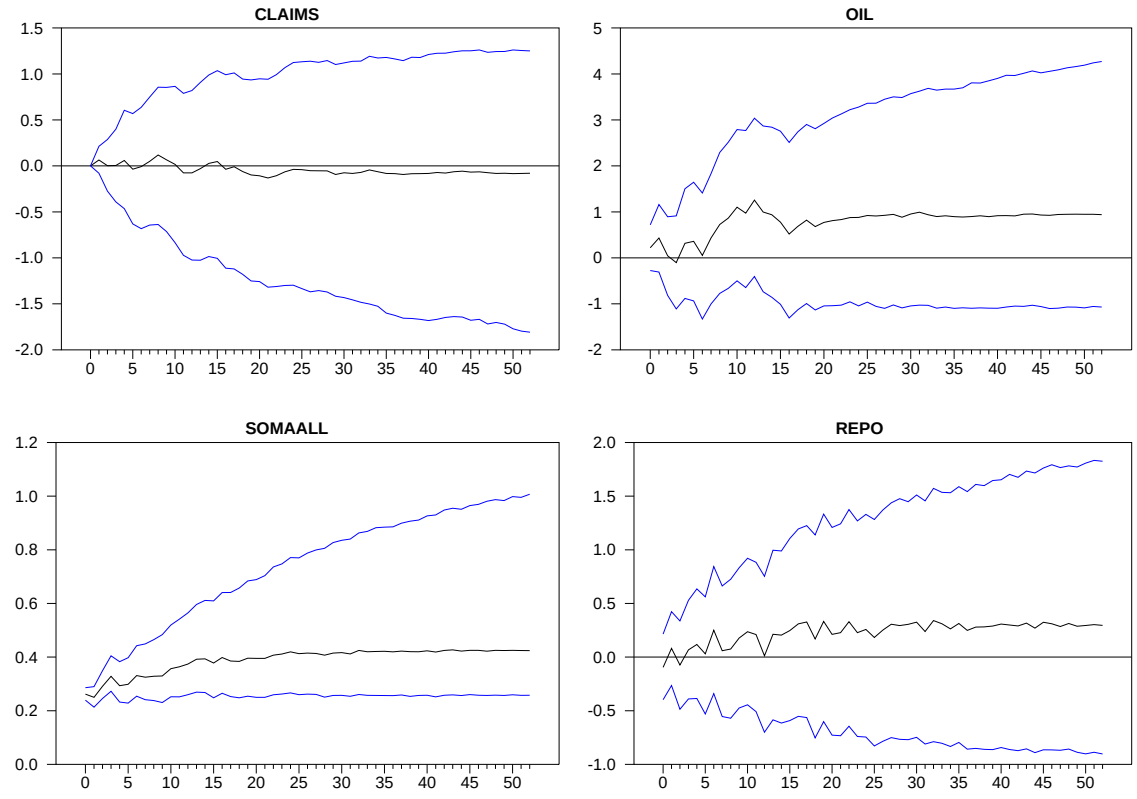

Figure 16: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), System Open Market Account Treasury security holdings (SOMAALL), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from repurchase agreements (REPO) to a one standard deviation shock in System Open Market Account Treasury security holdings (SOMAALL). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

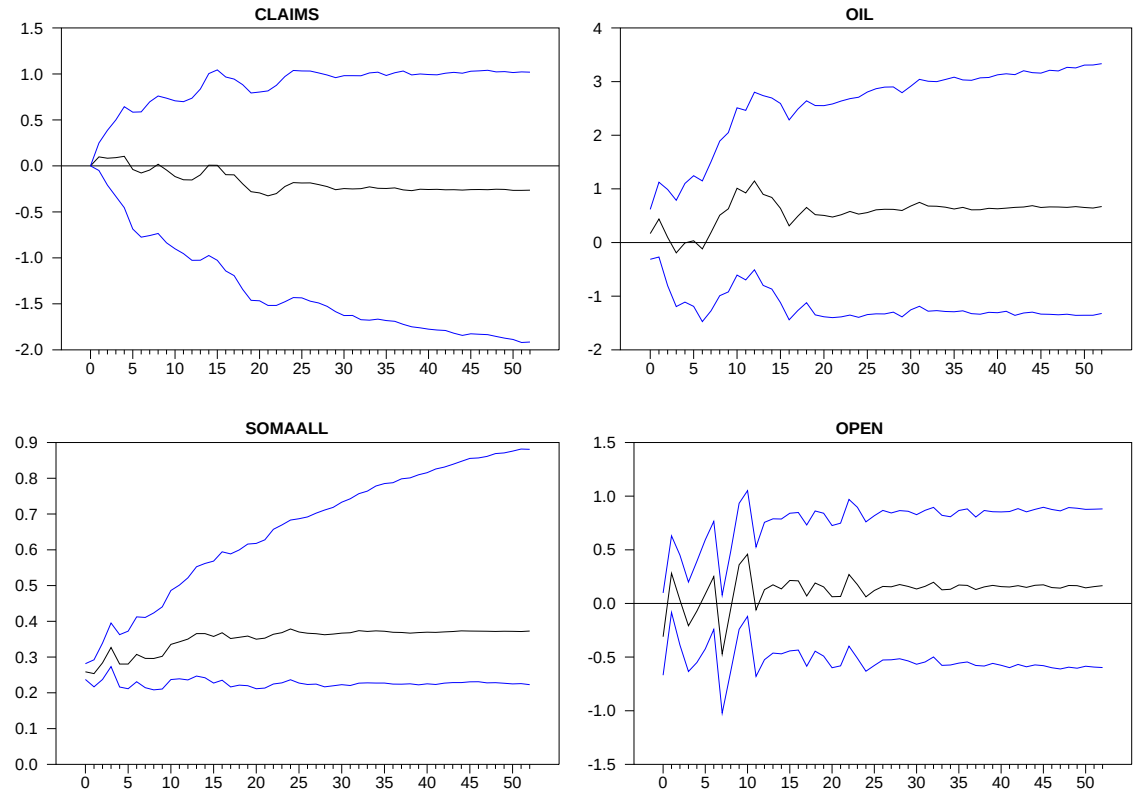

Figure 17: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), System Open Market Account Treasury security holdings (SOMAALL), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from overnight and continuing repurchase agreements (OPEN) to a one standard deviation shock in System Open Market Account Treasury security holdings (SOMAALL). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

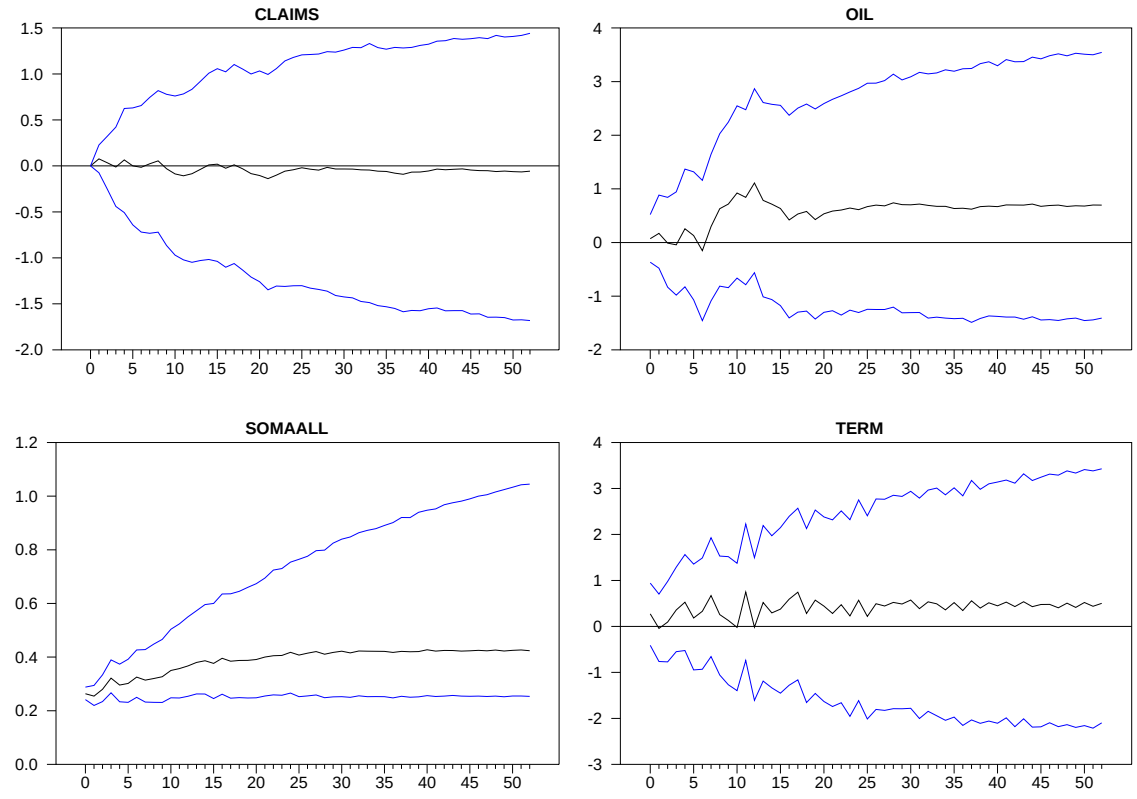

Figure 18: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), System Open Market Account Treasury security holdings (SOMAALL), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from term repurchase agreements (TERM) to a one standard deviation shock in System Open Market Account Treasury security holdings (SOMAALL). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

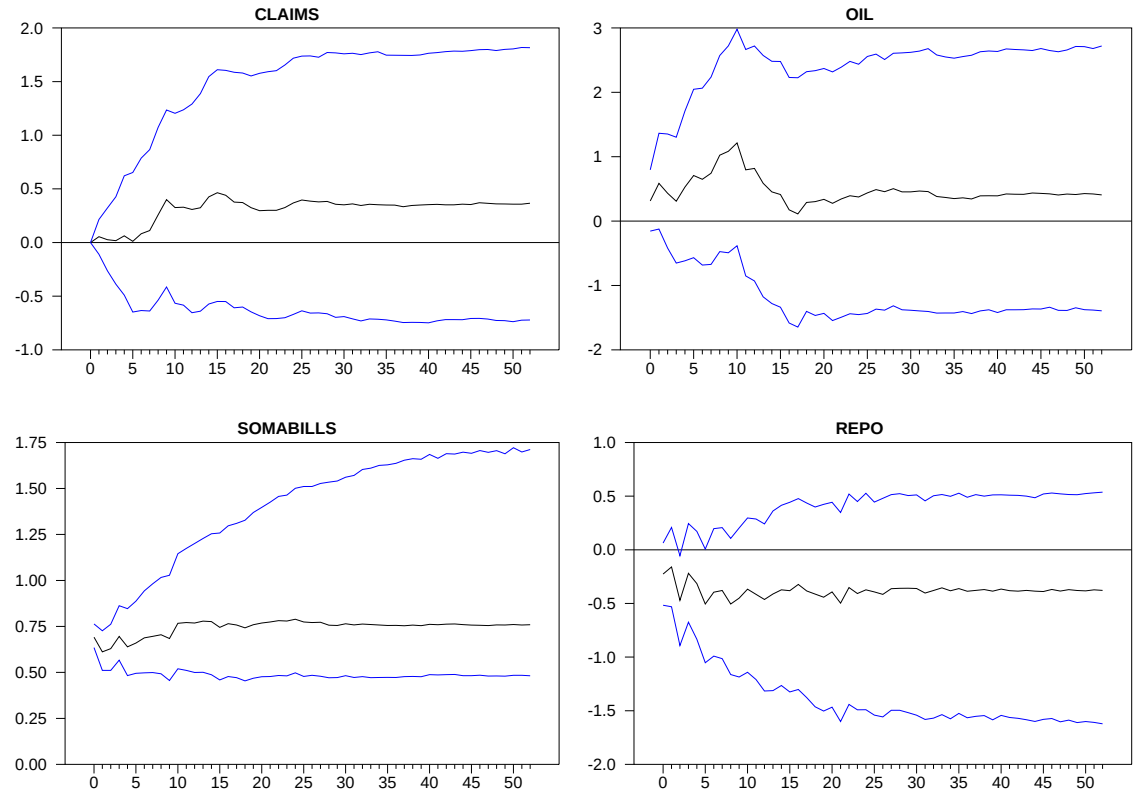

Figure 19: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), System Open Market Account Treasury bill holdings (SOMABILLS), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from repurchase agreements (REPO) to a one standard deviation shock in System Open Market Account Treasury bill holdings. The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

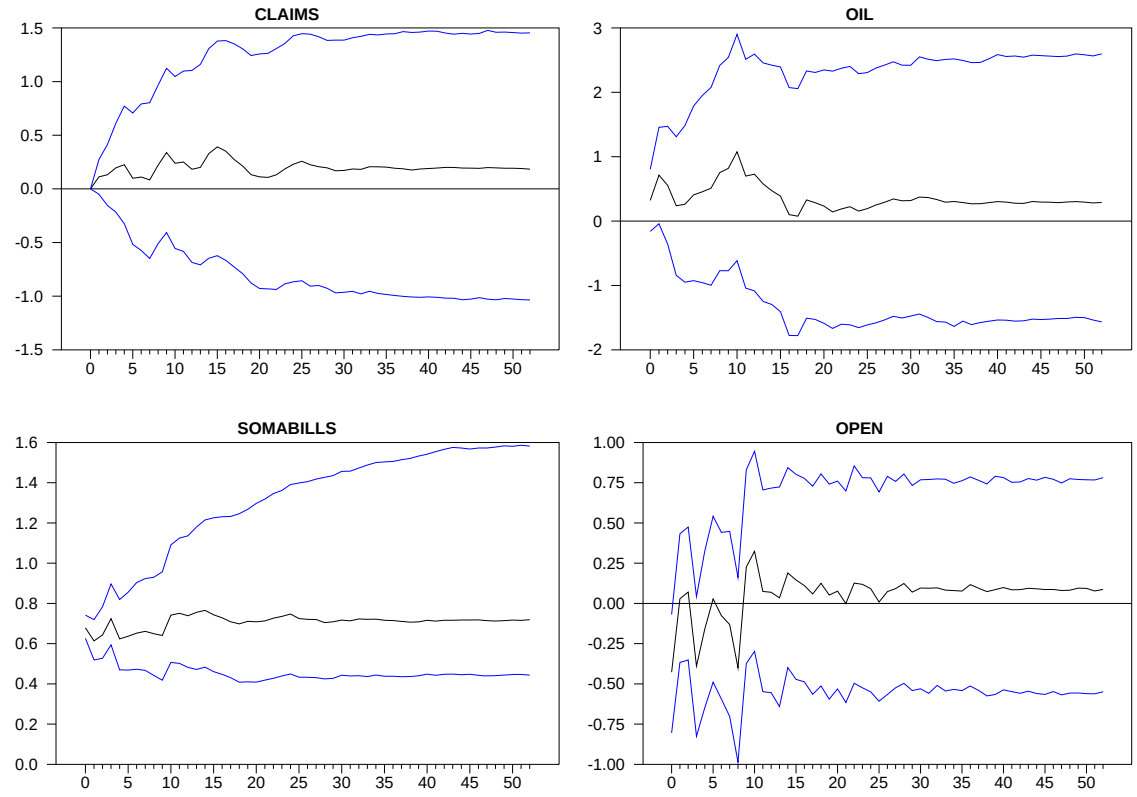

Figure 20: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), System Open Market Account Treasury bill holdings (SOMABILLS), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from overnight and continuing repurchase agreements (OPEN) to a one standard deviation shock in System Open Market Account Treasury bill holdings (SOMABILLS). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

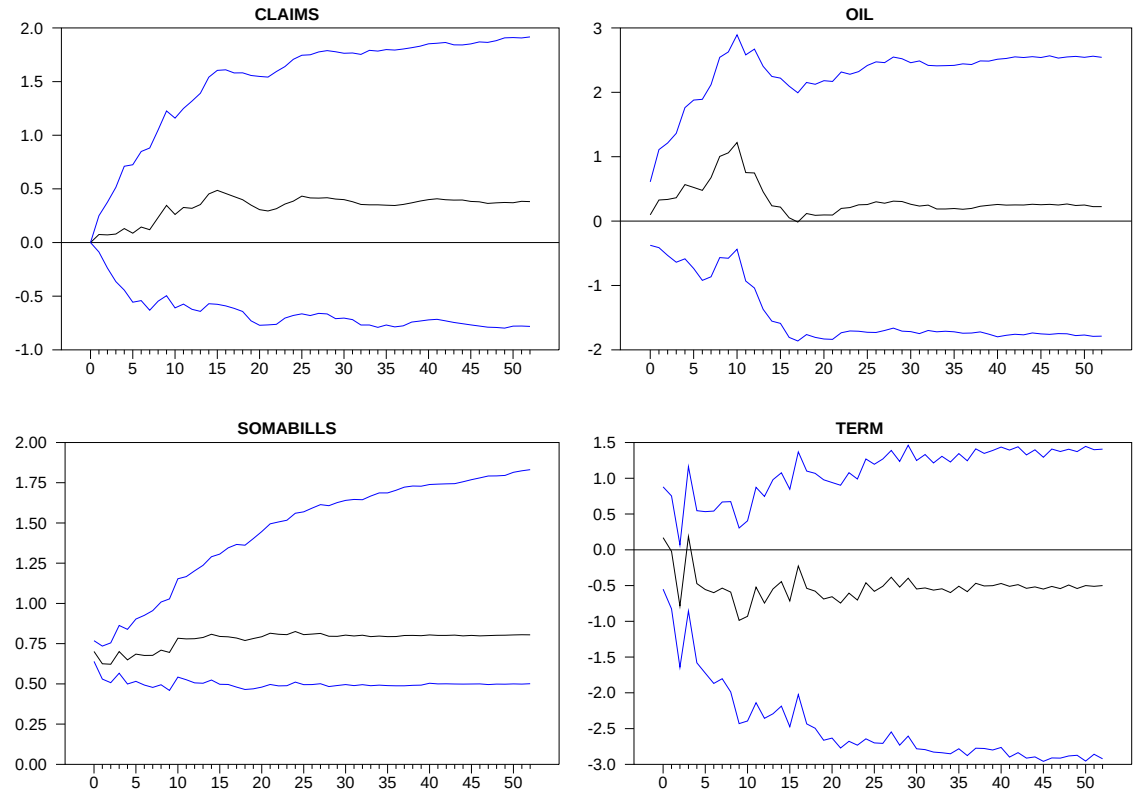

Figure 21: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), System Open Market Account Treasury bill holdings (SOMABILLS), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from term repurchase agreements (TERM) to a one standard deviation shock in System Open Market Account Treasury bill holdings (SOMABILLS). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

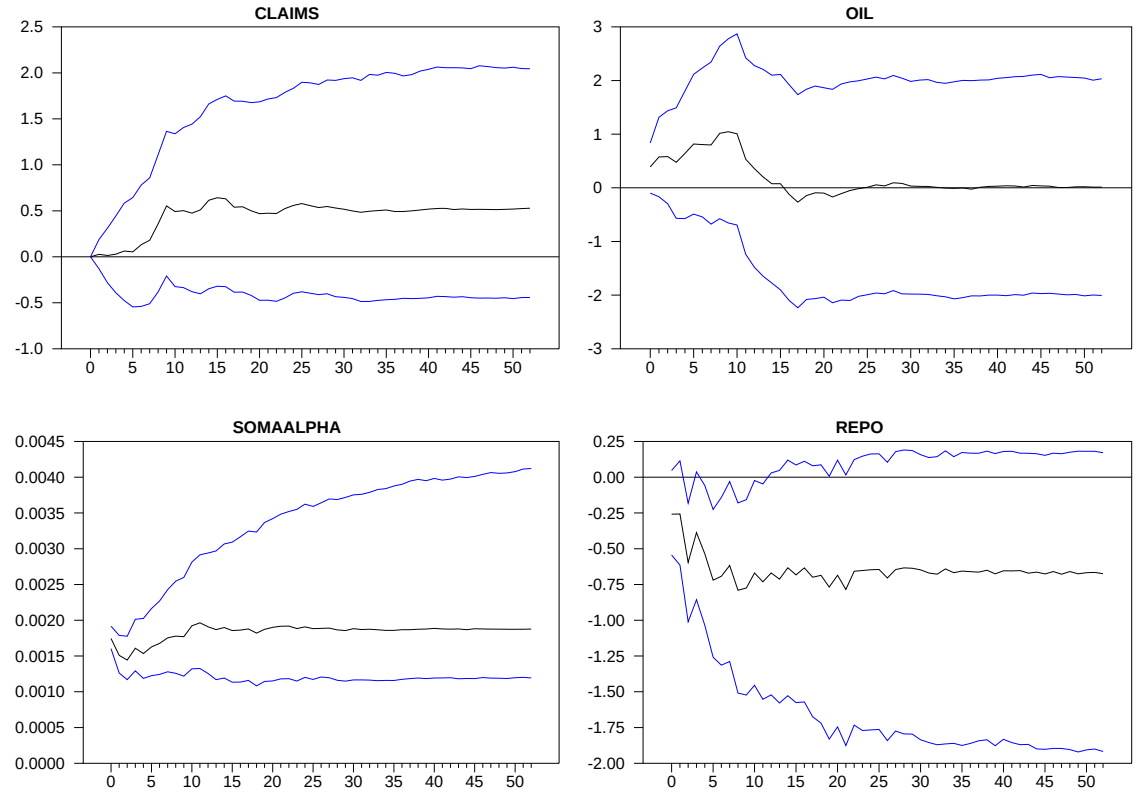

Figure 22: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), the fraction of Treasury Bills to Treasury securities in the System Open Market Account (SOMAALPHA), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from repurchase agreements (REPO) to a one standard deviation shock in the fraction of Treasury Bills to Treasury securities in the System Open Market Account (SOMAALPHA). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

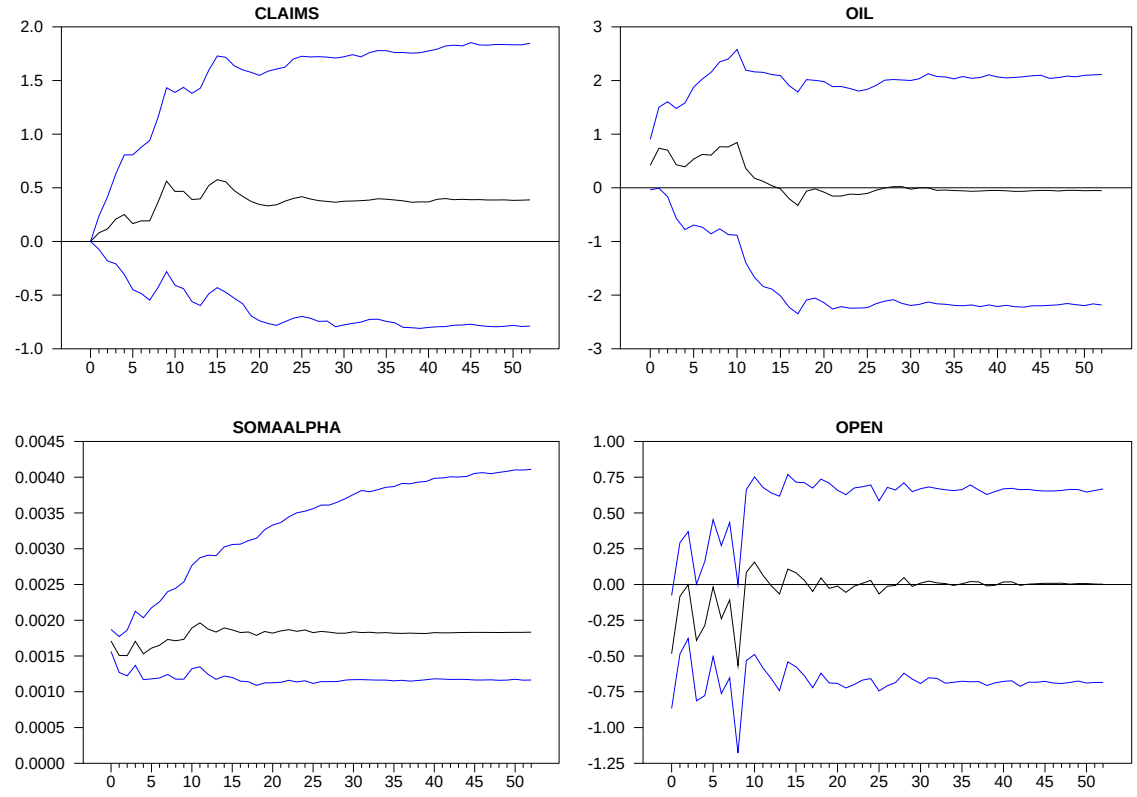

Figure 23: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), the fraction of Treasury Bills to Treasury securities in the System Open Market Account (SOMAALPHA), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from overnight and continuing repurchase agreements (OPEN) to a one standard deviation shock in the fraction of Treasury Bills to Treasury securities in the System Open Market Account (SOMAALPHA). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.

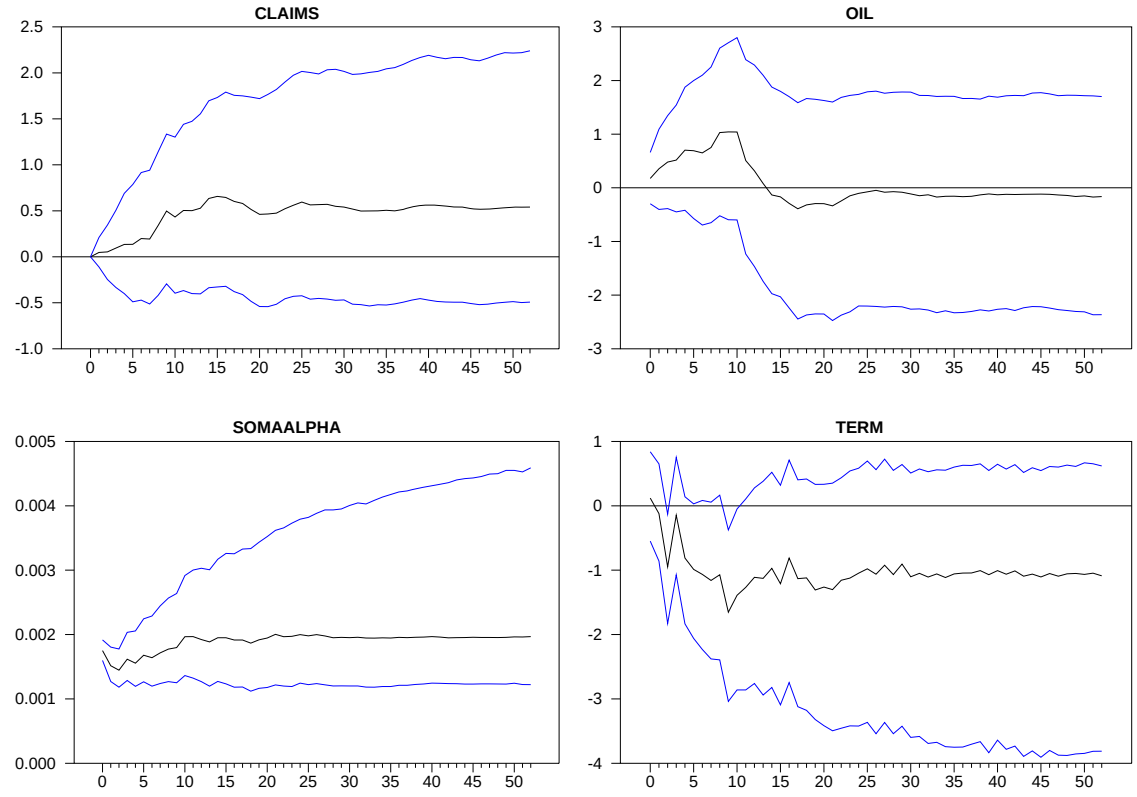

Figure 24: This graph plots the 52 week response of the four week moving average of initial jobless claims (CLAIMS), the fraction of Treasury Bills to Treasury securities in the System Open Market Account (SOMAALPHA), the spot price of west Texas intermediate crude oil (OIL), and gross funds received by primary dealers from term repurchase agreements (TERM) to a one standard deviation shock to in the fraction of Treasury Bills to Treasury securities in the System Open Market Account (SOMAALPHA). The results are based on the benchmark identification (2001-2007). Coefficients are estimated with ordinary least squares (OLS). The error bands represent 90% confidence intervals based on 2,000 draws using the methods described in Sims and Zha (1999). Point estimates are the median of the simulated responses.