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Hot Money and Quantitative Easing: The Spillover Effects of U.S. Monetary Policy on Chinese Housing, Equity and Loan Markets*

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Abstract

We study a factor-augmented vector autoregression model to estimate the effects of changes in U.S. monetary policy, as well as changes in U.S. policy uncertainty, on the Chinese economy. We find that since the Great Recession, a decline in the U.S. policy rate would result in a significant increase in Chinese regulated interest rates, and rise in Chinese housing investment. One possible reason for this is the substantial inflow of hot money into China. Responses of Chinese variables to U.S. shocks at the zero lower bound are different from that in normal times, which suggest structural changes in both the Chinese economy and the U.S. monetary policy transmission mechanism. Moreover, an increase in U.S. policy uncertainty negatively impacts Chinese stock and real estate market during normal times, but not at the zero lower bound.

JEL codes: F3, C3, E4, E5

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1 Introduction

The federal funds rate has hit the zero lower bound for extended periods since the great recession and researchers have been keenly interested in investigating how the U.S. unconventional monetary policy and its tapering affect the emerging markets, in particular, the Chinese market. However, as the largest emerging economy, Chinese economy has rarely been studied in this context. A popular explanation is that since the capital account has not been full opened up and the exchange rate is not flexible in China, U.S. expansionary monetary policy does not have much impact on Chinese economy. Is it true that there is barely any spillover effect of U.S. monetary policy on Chinese economy? Given our particular interest in the performance of Chinese economy, how the People's Bank of China reacts to U.S. monetary policy shock is also a relevant and meaningful problem for investigation. Moreover, since the outbreak of the Financial Crisis in U.S., economists have wondered if U.S. policy uncertainty has detrimental effects on the U.S. economy. We will study in our paper, whether there is any spillover effect on the Chinese economy attributed to U.S. policy uncertainty, measured by Baker et al. (2012)'s recently proposed new index of U.S. economic policy uncertainty.

In short, we use a broad set of Chinese economic indicators and run a factor-augmented vector autoregression model to estimate the effects of changes in U.S. policy rate and policy uncertainty on the Chinese economy. Similar methodology was used to study the Chinese economy by Fernald et al. (2014) and He et al. (2013). However, they focus on the impact of Chinese monetary policy shock, without mentioning the impact of U.S. monetary policy and policy uncertainty shock on Chinese economy.

The advantage of the factor-augmented vector autoregression (FA-VAR) approach is that we are able to include a large number of data series, 176 series in our FA-VAR model, without being constrained by concerns to preserve degree-of-freedom as in the case of standard VAR

approach. One criticism of the standard VAR approach is that the small number of variables included does not represent the rich information set the central bank and market participants actually use, and thus policy innovations may be contaminated. An example would be Sims (1992)'s explanation that imperfectly controlling for information about future inflation would result in the phenomenon of "price puzzle", namely the common finding in VAR models that contractionary monetary policy shock is followed by an increase in the price level, rather than a decrease. The use of factor-augmented vector autoregression approach also addresses potential endogeneity issues arising from the notion that the Federal Reserve may adjust monetary policy in response to economic conditions in China. Endogeneity concerns are supported by historical precedents when the Fed lowered short-term U.S. interest rates in light of the Russian default and the Asian financial crisis in the late 90s, (Neely, 2004). Since we are using the factor-augmented vector autoregression as used in Bernanke et al. (2004), the impulse response measure the effects due to an unforecasted innovation in U.S. monetary policy, controlling for a rich information set of Chinese and U.S. macroeconomic variables.

Our estimation results suggest that there are significant cross-country spillover effects. Among all Chinese macroeconomic series we investigated, two groups of variables exhibit interesting dynamics: Chinese benchmark interest rates respond to U.S. monetary policy shock significantly, while trade balance and exchange rate does not change significantly. This suggests that U.S. monetary policy shock does not affect Chinese economy through the trade channel. This is consistent with Canova (2005)'s earlier finding that U.S. monetary shock does have significant impact on Latin American countries during the sample period of 1980-2002, and the main transmission channel is interest rate, whereas the trade channel is insignificant. Moreover, our results suggest in addition to interest rates, hot money may also play an important role in the transmission mechanism. This resonates with Prasad & Wei (2007)'s finding that hot money, rather than trade surplus, is the most important component

of reserve accumulation in China. We also find that the responses of Chinese economy to U.S. monetary policy shock and policy uncertainty shock exhibit different dynamics in periods before and after the zero lower bound is binding in the U.S. This suggests the structural changes both in Chinese economy and the U.S. monetary policy transmission.

The remainder of the paper is structured as follows: Section 2 reviews literature, Section 3 illustrates the model and data we use. Section 4 shows the results and analysis and Section 6 concludes.

2 Literature Review

Maćkowiak (2007) used the structural VAR approach to study the effects of external shock on eight emerging economies (Hong Kong, Korea, Malaysia, Philippines, Singapore, Thailand, Chile and Mexico), which are assumed to be small open economies that have no influence on U.S interest rates, though U.S. interest rates may affect the small open economies. However, this assumption is not applicable to the case of China. China has been a large trade partner with U.S. and according to World Bank (2014), soon to become the largest economy in the world based on purchasing power parity, and the state of Chinese economy is certainly on the mind of central bankers around the world, which may pose endogeneity challenges for the methodology. Maćkowiak (2007) has found that U.S. monetary shock affect the real output and price level in emerging economies even more strongly than real output and price level of U.S. itself. Furthermore, U.S. monetary shock can quickly affect short-term interest rate and exchange rate in emerging markets. In our FA-VAR approach, we find that the impact of U.S. monetary shock on Chinese industrial production is rarely statistically significant, nor does it affect RMB/USD exchange rate due to the managed floating of the People's Bank of China (PBOC), although it can have substantial effect on

Chinese benchmark interest rates.

Theoretical work by Haberis & Lipinska (2012) shows that inability of foreign monetary policy to stabilise the foreign economy at the zero lower bound creates a spillover that affects how well the home policymaker is able to stabilise its own economy. Although China is not a small open economy, we do find that PBOC's responses in setting required reserve ratio and benchmark interest rates are different in the zero lower bound period and non-zero lower bound period.

The FA-VAR approach has been used before by Aastveit et al. (2012) to investigate spillover effects, in which oil demand shock from different regions of the world are identified and spillover from emerging-country oil demand shock to developed-country activity are studied.

Dedola et al. (2013) has studied global implications of national unconventional policies. Their key finding is that lack of cooperation in general will result in suboptimal credit policies. In our results, especially at the times when zero lower bound is binding in the U.S., we find that the PBOC takes contractionary credit measures when there is expansionary monetary policy shock in the U.S., plausibly aimed at restricting credit available to Chinese economy when hot money is flowing into China, and failure to do so would possibly mean the amount of credit available is above what is optimal for Chinese economy.

3 FA-VAR Model and Data

3.1 Model

We use the factor-augmented vector autoregressive model proposed by Bernanke et al. (2004) to investigate the effects of U.S. monetary policy and policy uncertainty on Chinese economy. There is a large number of observed macroeconomic time series X_t ($N \times 1$ vector),

which contain very rich information on the economic condition. We also have observed variables Y_t (we call them "policy indicators" in this paper), and we want to investigate how the shock to Y_t affect X_t. In this paper, we focus on Y_t that includes two particular variables: U.S. policy rate, and U.S. policy uncertainty.

However, it is challenging to use all the series in X_t in a structural VAR analysis, since there are hundreds of series, but the number of observations on each series is short. Fortunately, many studies have confirmed that a few factors can explain a large fraction of the variance of many macroeconomic series. So, instead of directly using all the macroeconomic series, these informational series are summarized using a small number of unobservable factors F_t ($K \times 1$ vector, where K is much smaller than N). Since the factors F_t are unobservable, they are constructed by principal component analysis. The dynamics of F_t and Y_t are assumed to follow the following transition equation:

$$\begin{pmatrix} F_t \\ Y_t \end{pmatrix} = \Phi(L) \begin{pmatrix} F_{t-1} \\ Y_{t-1} \end{pmatrix} + \nu_t, \tag{1}$$

where $\Phi(L)$ is a polynominal of lag operator, and ν_t is the error term with mean zero and covariance matrix Σ. We assume that the error term can be represented as linear combinations of structural shocks: $\nu_t = P\epsilon_t$. The structural shocks (ϵ_t) we consider here include U.S. monetary policy shocks, ϵ_t^{MP}, U.S. policy uncertainty shocks, ϵ_t^{PU}, and shocks to factors, ϵ_t^{F}. Among these structural shocks, we are particularly interested in the monetary policy shock and policy uncertainty shock.

Following Bernanke et al. (2004), the macroeconomic series X_t are related to the factors F_t and the policy indicators Y_t by an observation equation as follows:

$$X_t = \Lambda^f F_t + \Lambda^y Y_t + e_t. \tag{2}$$

The procedures used to construct the factors are described in Appendix II.

3.2 Data

We include 176 monthly macroeconomic series in China and the complete table of variables included are found in Appendix I. The sample period is from January 2000 to February 2014. We choose to start from 2000 due to data availability. All of the series except policy variables are adjusted for the Chinese New Year effect as in Fernald et al. (2014), and then adjusted for seasonality by using the United States Census Bureau X-13 program. We deal with missing values through the EM algorithm introduced by Stock & Watson (2002).

The U.S. monetary policy measure we use is the shadow federal funds rate proposed by Wu & Xia (2014), who extended the effective federal funds rate with a latent measure that allows for negative policy rate when the zero lower bound is binding, and this series is plotted in Figure 1. The U.S. policy uncertain measure we use is a prominent news-based measure proposed by Baker et al. (2012), as shown in Figure 2.

3.3 Estimation

The estimation method follows Bernanke et al. (2004). We first extract the first three principal components of the observed macroeconomic series over our sample period, and then separate out the part in the principal components that is orthogonal to Y_t as factors F_t. After that, we estimate the transition equation Equation (1) and the observation equation Equation (2) by OLS. Impulse response functions and variance decomposition of each macroeconomic series can be obtained by combining the estimation results of these two equations. Identification is achieved by the recursiveness assumption, which means the error term in each regression is constructed to be uncorrelated with the error in the preceding equations. More specifically, the factors are constructed not to respond to monetary policy

shocks and policy uncertainty shocks contemporaneously.

We separate the full sample period into two subsamples. The first period is from 2000M1 to 2008M9, and the second one is from 2009M12 to 2014M2. The second period is consistent with the period during which the Federal funds rate stays at zero and several unconventional monetary policies are implemented by the Federal Reserve. We estimate the model with both subsample data and the full sample data.

4 Results

We choose stock market variables, bond market variables, policy rates, price variables, real estate variables, and real economic activity variables to investigate their dynamics in response to U.S. monetary policy shock and U.S. policy uncertainty shock.

4.1 Impulse Responses

The figures report the impulse responses in standard deviation units. We standardize the monetary policy shock to correspond to a decrease of the effective federal funds rate by 25 basis points, during normal times, or a decrease of the Wu-Xia shadow federal funds rate by 25 basis points, during the times when the zero lower bound is binding. The sizes of the U.S. policy uncertainty shock is standardized to 10% of its standard deviation. The top, bottom, and middle lines correspond to 90% bootstrap confidence intervals and bootstrap median respectively. From Section 4.1.1 and Section 4.1.2, we investigate the responses of Chinese variables of interest to U.S. monetary shock and U.S. policy uncertainty shock, respectively, during the period when the zero lower bound is binding in the U.S.In Section 5.0.3, we investigate the responses before the zero lower bound is binding.

4.1.1 Impulse Responses of Chinese variables to U.S. Monetary Policy Shock at ZLB

Figure (3) demonstrates the effects of an expansionary U.S. monetary policy shock on Chinese industrial output, PMI, Chinese monetary authority assets, and CPI. We see that for a very brief period, the Chinese monetary authority does hold more foreign assets in the form of foreign exchange, presumably to ease pressure on the managed floating exchange rate regime. By doing so, PBOC can also seek to maintain the competitiveness of Chinese exports, and we do not see from Figure 4 that expansionary U.S. monetary policy has caused any significant effect on Chinese trade balance or Chinese exports to U.S.

Figure (4) shows that RMB exchange rate with respect to U.S. Dollar, and Foreign Direct Investment, does not respond significantly to U.S. monetary policy shock. However, the same figure shows that there is significant increase in foreign "hot money" flowing in China in response to expansionary U.S. monetary policy shock. "Hot money" is approximated by subtracting trade surplus (or deficit) and net flow of foreign direct investment from the change in foreign reserves, as in Martin & Morrison (2008). Thus, we can infer from the IRFs that the channel through which U.S. monetary policy spillover to China is mainly the "hot money" channel, rather than the trade channel or the exchange rate channel.

Figure (5) includes the changes in M2, loans, required reserve ratio, and interest rates. Since the required reserve ratio and bank lending and deposit rates are still regulated by the People's Bank of China (PBOC), the central bank of China, the changes in nominal loan rates can be treated as the policy response of PBOC to U.S. monetary policy. Kim (2001) has found that using VAR models, U.S. expansionary monetary policy shock lead to booms in the non-U.S., G-6 countries, and a decrease in the world real interest rate might be an important transmission channel. However, there are significant differences between the economy of China and that of the G-6 countries. Since we are using the FA-VAR approach,

we find that after controlling for a rich set of Chinese and U.S. variables, PBOC would raise regulated interest rates and increase required reserve ratio to cool down Chinese economy and curb pressure of inflation and over-investment, in response to unanticipated expansionary innovations in U.S. monetary policy. The fall in M2 can also be attributed to the same motive of PBOC to prevent the Chinese economy from overheating due to unforecasted expansionary U.S. monetary policy. As Gertler and Karadi (2014) has documented, monetary policy can typically produce modest movements in short rates that lead to large movements in credit costs. Although at its peak, the increase in nominal lending rate is less than 7% of its standard deviation, the decrease in loan is much more substantial, indicating the success of PBOC in curbing borrowing through increase in required reserve ratio and lending rates.

Figure (6) shows the responses of Chinese stock market to U.S. monetary policy shock. We take the Shanghai Stock Exchange as an example. An expansionary U.S. monetary policy shock does not cause significant impact on the Shanghai Stock Exchange Composite Index, though it does causes an decline in price/earning ratios in the medium-run, and the effect is not significant either in the short-run or in the long-run. One reason for this decline is PBOC's contractionary monetary policy in response to U.S. expansionary policy. The other reason is that an expansionary U.S. monetary policy makes the U.S. stock market a more attractive alternative for investors, especially given the fact that Chinese stock market is operating in the absence of effective institutions and is still quite deficient in its market mechanisms (Chen, 2013). The same figure also displays the responses of real estate market. Investment in real estate as well as floor space started both rise significantly from the beginning, and the rise is quite persistent. Different from the stock market, Chinese real estate market seems more attractive when the interest rate in the U.S. is low. The sticky demand for housing and the local government revenue incentives provide security for the boom of Chinese real estate market when the U.S. enters quantitative easing. For foreign

investors, instead of investing in the U.S. with a low return rate, investing in Chinese real estate market seems to be a more attractive option. For Chinese investors as well, investing in real estate might be an effective hedge against concerns for imported inflation. When we divide the source of funding for Chinese real estate investment into four categories: domestic loans, foreign investment, self-raised and other, we do not find any particular category of real estate investment to be significant, despite the fact that aggregate real estate investment is significant.

From these figures mentioned above, we can bring up the hypothesis that U.S. monetary policy does have spillover effects on Chinese real economy, but does not affect Chinese economy purely from the interest rate channel. We find extra evidence from studying the impact of U.S. monetary policy on Chinese interest rates for government bond using higher frequency data and the methodology of identification through heteroscedasticity. Figure (7) shows that the impact of U.S. monetary policy shock on some market-determined Chinese government bond rates are significantly different from zero, however, the effects decay really fast, all of them only last for two or three days with very small magnitude. Instead, as mentioned previously, in Figure (4), "hot money", being quite significant in the magnitude of response, seems to be the spillover channel.

4.1.2 Impulse Responses of Chinese variables to U.S. Policy Uncertainty Shock at ZLB

Figure (8) shows that at the zero lower bound, with positive U.S. policy uncertainty shock, there is no significant effect on Chinese industrial output, monetary authority foreign assets, PMI, and retail sales. Figure (9) shows there is no significant effect on Chinese trade balance, exchange rate, or hot money either. Figure (10) shows that China raises its require reserve ratio and also Chinese benchmark interest rates, which can be interpreted as PBOC's

desire to caution against investment in an uncertain environment.

Figure (11) tells us higher U.S. policy uncertainty does not affect the Shanghai Stock Exchange Composite Index or price/earning ratios significantly. However, U.S. policy uncertainty shock does increase new floor space started in China, would increase in the short-run but not in the medium-run or long-run.

According to the previous analysis, the effects of U.S. policy uncertainty on Chinese macroeconomic variables are very short-lived. This is consistent with the finding in Bloom (2009) that the impact of uncertainty shock on firms lasts for only 6 months.

5 Robustness Checks

5.0.3 Before the Zero Lower Bound Period

Figure (12) to Figure (20) illustrate the impulse responses of variables to U.S. monetary policy shock and U.S. policy uncertainty shock before the federal funds rate hit zero lower bound. Expansionary U.S. monetary policy shock significantly increases the U.S. policy uncertainty before the zero lower bound is binding, whereas such shock does not generate significant effect on U.S. policy uncertainty at the zero lower bound. The responses of some Chinese variables are different from those at the zero lower bound. For example, with negative U.S. monetary policy shock, the Chinese benchmark interest rates are decreasing instead of increasing in the medium-run, which is more in line with the results from Kim (2001)'s VAR exercise that non-U.S. G-6 countries would lower interest rates in response to expansionary U.S. monetary policy shock. In addition, there is no significant contraction in Chinese M2 or total amount of loans before the zero lower bound is binding. The results on stock markets and real estate investment are generally in the same direction. Besides the differences in the response to U.S. monetary shock, the reaction to U.S. policy uncer-

tainty shock is also different in these two periods. There are significant negative responses in Chinese benchmark interest rates in the medium-run, whereas at the zero lower bound, the responses of Chinese benchmark interest rates are significantly positive. This can be interpreted as indication that PBOC may be concerned that increase in U.S. policy uncertainty could potentially widen output gap in China, and therefore PBOC tries to accommodate investments in China by lowering benchmark interest rates, before the zero lower bound is binding in the U.S.; whereas PBOC does not become accommodative in response to increase in U.S. policy uncertainty when the zero lower bound is binding in the U.S., possibly due to fear that China might face over-investment due to inflow of cheap credit from overseas. In addition, Shanghai Stock Exchange index, price/earnings ratio of Shanghai Stock Exchange, total real estate investment, real estate investment from domestic loans and self-raised sources, which do not have significant changes under the same shock at the zero lower bound, now decline significantly, suggesting that there are significant spillover of U.S. policy uncertainty on Chinese economy before the zero lower bound is binding in the U.S.

The differences can be explained from two aspects. The first reason is Chinese economy has undergone substantial changes in the recent years. Both the interest rate and exchange rate system are changed significantly during the 2000's. From 2005, a managed floating exchange rate based on market supply and demand with to a basket of currencies has been implemented; the bonds market is becoming larger, although still not large enough for transmitting the monetary policy effectively; liberalization process of the interest rate is on the way. All these changes cause the change in the response of macroeconomic variables to U.S. monetary policy shock. Figure (16) is the impulse responses of Chinese government bond rates to U.S. monetary policy before the zero lower bound is binding in the U.S. Similar to Figure (7), daily data and identification through heteroscedasticity methodology are used. By comparing Figure (7) and Figure (16),we can find that before the zero lower bound is

binding, the U.S. monetary policy shock barely have any significant impact on Chinese bond market. Although its effect is still small now, it has been bigger than before.

The second reason is there is a structural change in the U.S. monetary policy transmission mechanism at the zero lower bound. This is supported by the responses of the Chinese benchmark interest rates. Before the zero lower bound period, the response of the Chinese benchmark interest rates to a monetary policy shock is hump-shaped, and the change is persistent. However, at the zero lower bound, there is no hump-shape in the response. That is, the response reaches its peak at the time the shock hits, and declines monotonically after that. Moreover, the effect of a monetary policy shock dies off more quickly at the zero lower bound. This is consistent with the results in Zhang (2014).

5.1 Variance Decomposition

A standard result of the VAR literature is that the U.S. monetary policy shock accounts for very small fraction of the forecast errors of U.S. real economic activity. Intuitively, U.S. monetary policy shock should not play a very important role in accounting for the forecast errors of Chinese macro variables. So instead of looking at about the absolute value of the variance decomposition, we are more interested in the relative importance of U.S. monetary policy shock and policy uncertainty shock to Chinese economy.

Table (1) presents the ratios between the fraction of the 1-, 2-, 6-, 12-month forecast errors caused by U.S. monetary policy shock and that caused by U.S. policy uncertainty shock for selected Chinese macroeconomic variables. By comparing the 1-month ahead variance decomposition ratios both before and at the zero lower bound period, we see that U.S. monetary policy shock are more important than policy uncertainty shock for more variables at the zero lower bound period. And as time going on, the importance of policy uncertainty shock collapse quickly at the zero lower bound. The differences imply that U.S.

policy uncertainty could only affect the Chinese economy for a short period of time, and the Chinese market in general pay more attention to current U.S. monetary policy is instead of what the policy might be in the future.

It is interesting to notice that while the stock market as a whole is still more sensitive to U.S. policy uncertainty shock at the zero lower bound, the PE ratio of finance intermediaries and real estate companies become to rely more on monetary policy rather than the policy uncertainty.

5.2 Full-sample Analysis

We also estimate the FA-VAR system using the data of the full sample period, from January 2000 to February 2014. However, the results are not significant. On the surface, this supports the claim that the U.S. monetary policy cannot have a big impact on the Chinese economy. But actually, this insignificance is caused by the structural change during the two subsample periods, which makes the effects in the two subsample periods offset each other.

6 Conclusion

Contrary to the existing understanding that a U.S. monetary policy shock has no significant impact on China, we find that it does have significant spillover effects on Chinese economy. Since the Great Recession, a decline in U.S. policy rate would result in significant rise in Chinese housing investment, possibly due to substantial inflow of 'hot money' into China. The PBOC's response is to increase in Chinese regulated interest rates in order to curb over-investment. Responses of variables to U.S. shock at the zero lower bound are different from that in normal times, which suggests the structural change in both Chinese economy and U.S.

monetary policy transmission mechanism. In addition, increase in U.S. policy uncertainty has negative effects on Chinese real estate and stock markets during normal times, but not at the zero lower bound. The U.S. policy uncertainty shock has become less important than the U.S. monetary policy shock in recent years, indicating that we now care more about the realized policy itself instead of the unknown possibilities of what economic policy actions will be undertaken in the future.

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A Tables

Table 1: Variance Decomposition of Selected Variables

Variables	Variance Decomposition Ratio (MP/PU)[1]							
	At the ZLB				Before the ZLB			
	1m	6m	12m	24m	1m	6m	12m	24m
SSEI	1.45	0.21	1.01	5.00	0.81	0.32	0.34	0.46
PE ratio (SSE All)	2.42	0.22	1.05	5.07	0.43	0.31	0.34	0.47
PE ratio (SSE A)	2.71	0.22	1.05	5.07	0.68	0.32	0.32	0.41
PE ratio (SSE Fin)	2.17	0.33	1.13	4.99	0.08	0.27	0.31	0.41
PE ratio (SSE RE)	0.81	0.35	1.17	4.83	0.21	0.30	0.33	0.45
PE ratio (SSE Const)	0.57	0.44	1.11	3.74	0.59	0.30	0.33	0.46
PE ratio (SSE Manu)	1.65	0.25	1.03	4.92	6578.75	0.30	0.32	0.43
Loan	0.97	0.39	1.14	4.58	0.05	0.09	0.14	0.17
Loan Rate (1yr)	0.10	0.97	2.98	4.53	1.98	0.32	0.33	0.44
HH DR (1yr)	0.08	1.07	3.36	5.27	1.03	0.33	0.33	0.42
SHIBOR (1d)	240.34	1.92	5.53	10.57	0.32	0.41	0.23	0.18
Bond Index (Inter Bank ST)	0.37	0.28	0.73	2.94	0.05	0.18	0.16	0.22
CPI	1.20	0.33	1.00	4.49	0.10	0.16	0.18	0.34
InvestRE	4.93	3.47	3.25	3.82	581.50	0.50	0.19	0.12
NHS	0.184	0.524	2.181	56.772	4.615	3.149	60.259	62.506
Comm Bldg Sales	0.63	0.94	1.89	2.66	225.77	0.53	0.20	0.12
PMI Manufacturing	1.05	0.32	1.06	4.68	0.32	0.41	0.23	0.18
PMI new orders	9.55	0.53	1.20	5.05	0.32	0.41	0.23	0.18
Macro index	0.82	0.42	1.21	4.61	0.05	0.11	0.16	0.21

[1] "MP" and "PU" represent monetary policy shock and policy uncertainty shock respectively. The "Variance Decomposition Ratio" means the ratio between the percentage of 1-, 2-, 6-, and 12-month ahead forecast variance that monetary policy shocks account for and that policy uncertainty account for.

B Figures

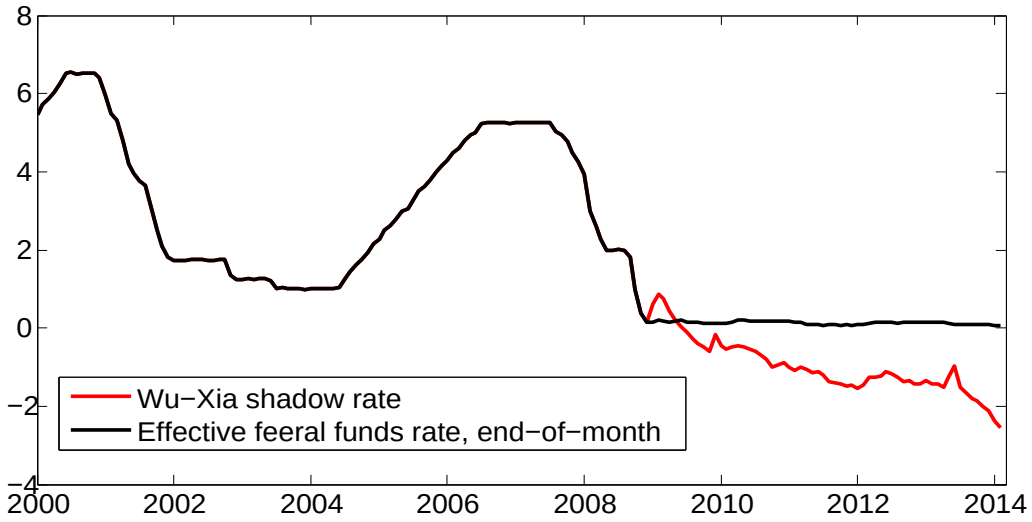

Figure 1: The Wu-Xia Shadow Federal Funds Rate compared to effective federal funds rate

Source: Board of Governors of the Federal Reserve System and Wu and Xia (2014)

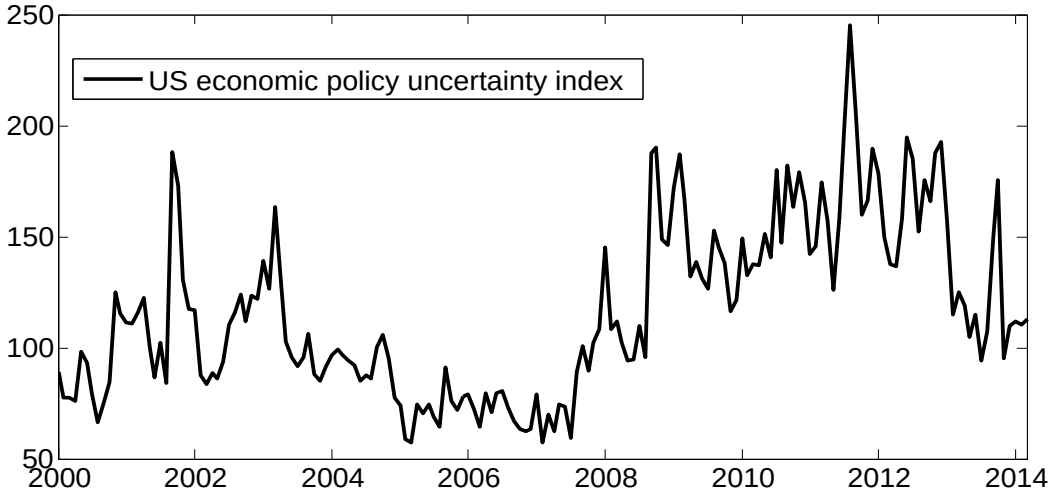

Figure 2: Monthly U.S. Economic Policy Uncertainty Index

Source: Baker, Scott R., Nicholas Bloom, and Steven J. Davis. (2013)

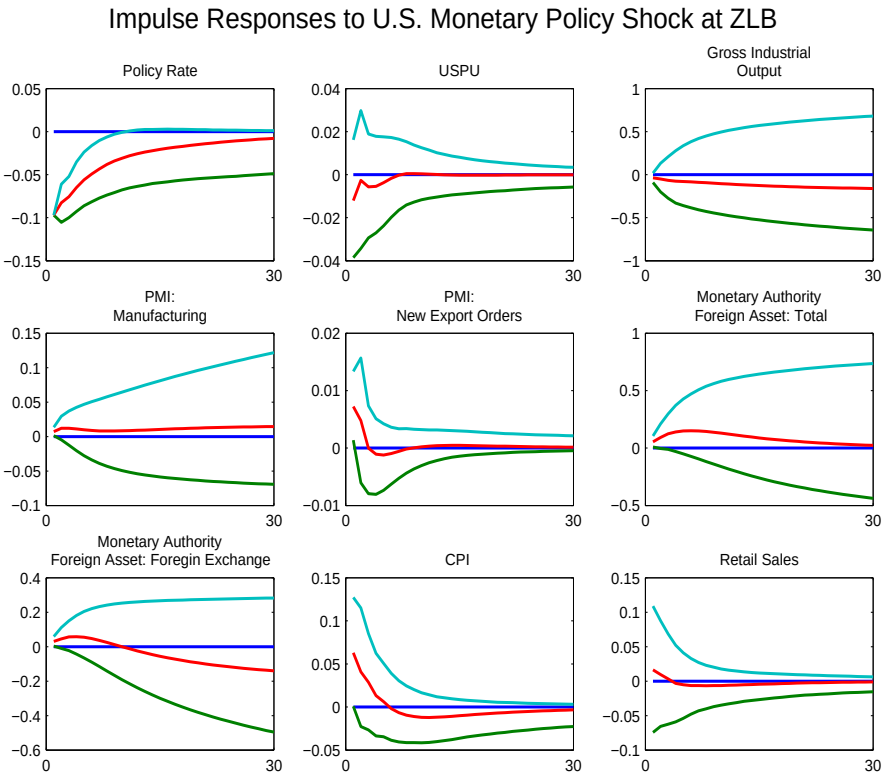

Figure 3: Impulse Responses to U.S. Monetary Policy Shock at the ZLB.

Impulse responses to a monetary policy shock from 0 to 30 months at the zero lower bound, estimated using data from January 2009 to February 2014. The solid lines are bootstrap median, and the dashed lines are 90 percent bootstrap confidence intervals. The monetary policy shock corresponds to a decrease of the Wu-Xia Shadow Federal Funds Rate by 25 basis points.

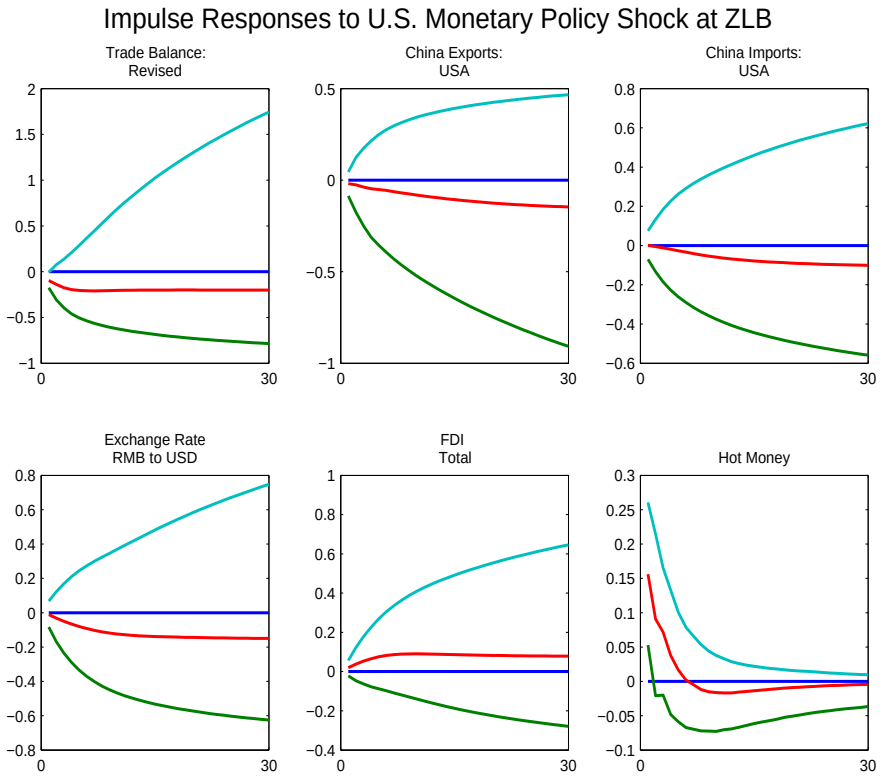

Figure 4: Impulse Responses to U.S. Monetary Policy Shock at the ZLB.

Impulse responses to a monetary policy shock from 0 to 30 months at the zero lower bound, estimated using data from January 2009 to February 2014. The solid lines are bootstrap median, and the dashed lines are 90 percent bootstrap confidence intervals. The monetary policy shock corresponds to a decrease of the Wu-Xia Shadow Federal Funds Rate by 25 basis points.

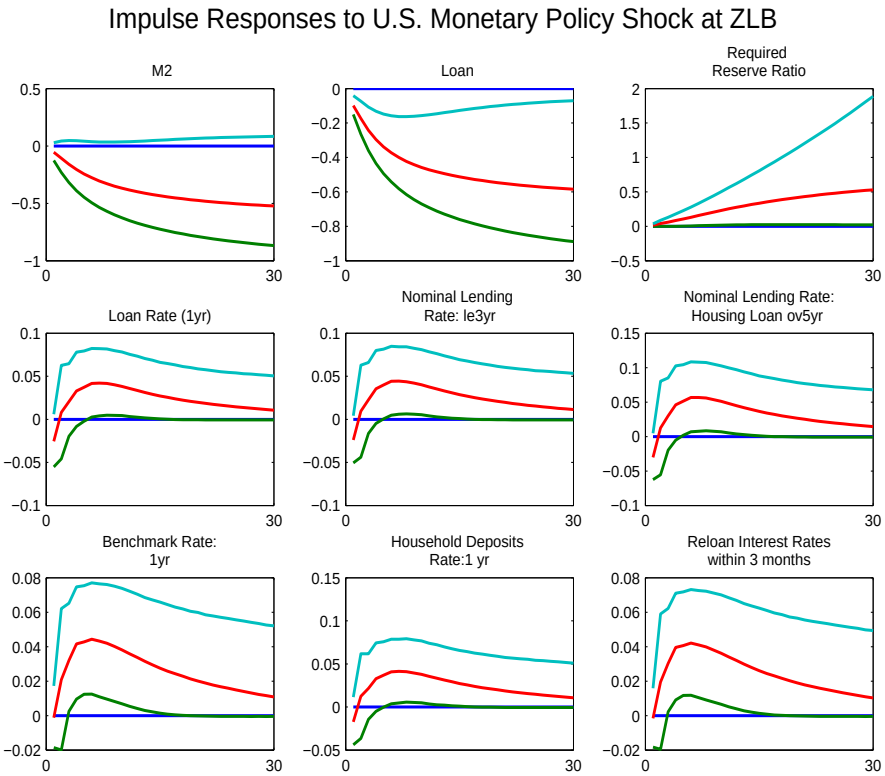

Figure 5: Impulse Responses to U.S. Monetary Policy Shock at the ZLB.

Impulse responses to a monetary policy shock from 0 to 30 months at the zero lower bound, estimated using data from January 2009 to February 2014. The solid lines are bootstrap median, and the dashed lines are 90 percent bootstrap confidence intervals. The monetary policy shock corresponds to a decrease of the Wu-Xia Shadow Federal Funds Rate by 25 basis points.

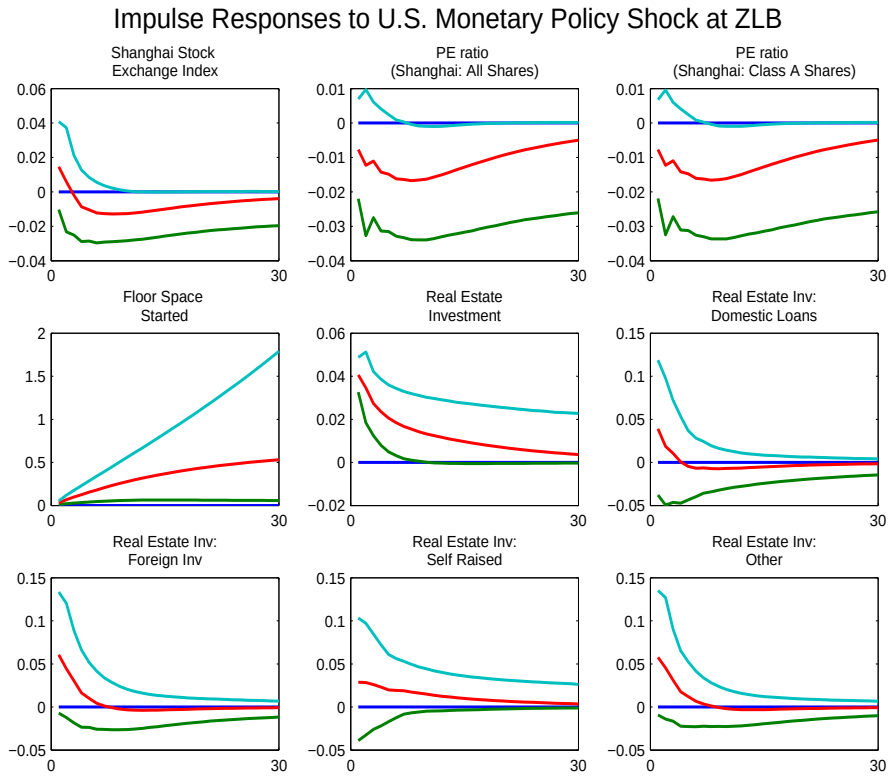

Figure 6: Impulse Responses to U.S. Monetary Policy Shock at the ZLB.

Impulse responses to a monetary policy shock from 0 to 30 months at the zero lower bound, estimated using data from January 2009 to February 2014. The solid lines are bootstrap median, and the dashed lines are 90 percent bootstrap confidence intervals. The monetary policy shock corresponds to a decrease of the Wu-Xia Shadow Federal Funds Rate by 25 basis points.

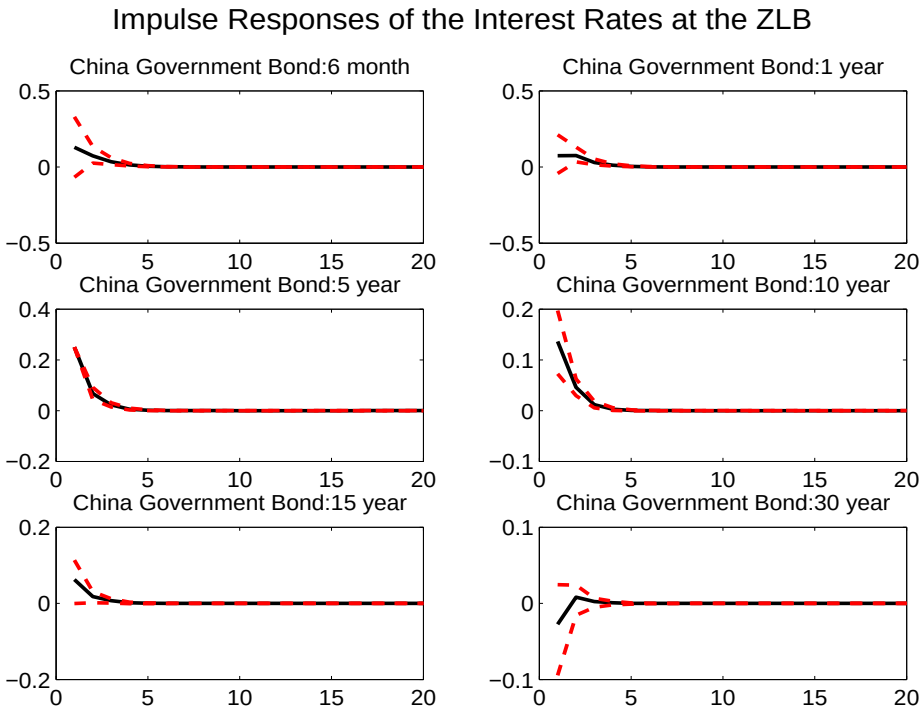

Figure 7: Impulse Responses to U.S. Monetary Policy Shock at the ZLB.

Impulse responses to a monetary policy shock from 0 to 20 days at the zero lower bound, estimated using data from January 2009 to February 2014. The solid lines are bootstrap median, and the dashed lines are 90 percent bootstrap confidence intervals. The monetary policy shock corresponds to a decrease of the Wu-Xia Shadow Federal Funds Rate by 25 basis points.

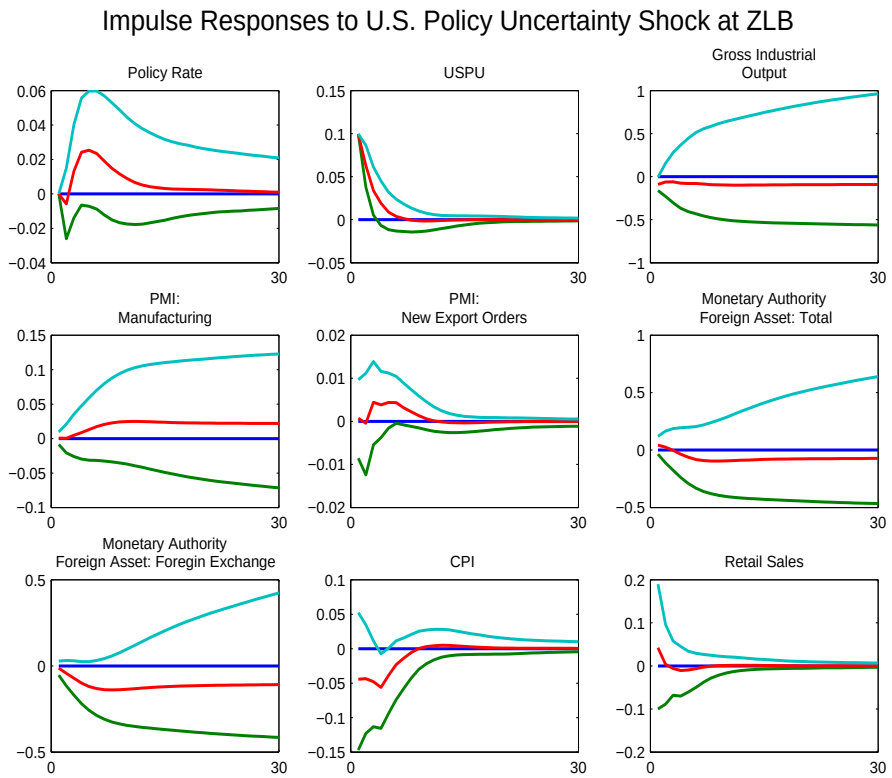

Figure 8: Impulse Responses to U.S. Policy Uncertainty Shock at the ZLB.

Impulse responses to a Policy Uncertainty shock from 0 to 30 months at the zero lower bound, estimated using data from January 2009 to February 2014. The solid lines are bootstrap median, and the dashed lines are 90 percent bootstrap confidence intervals. The Policy Uncertainty shock corresponds to an increase of U.S. Policy Uncertainty Index by 10% of standard deviation.

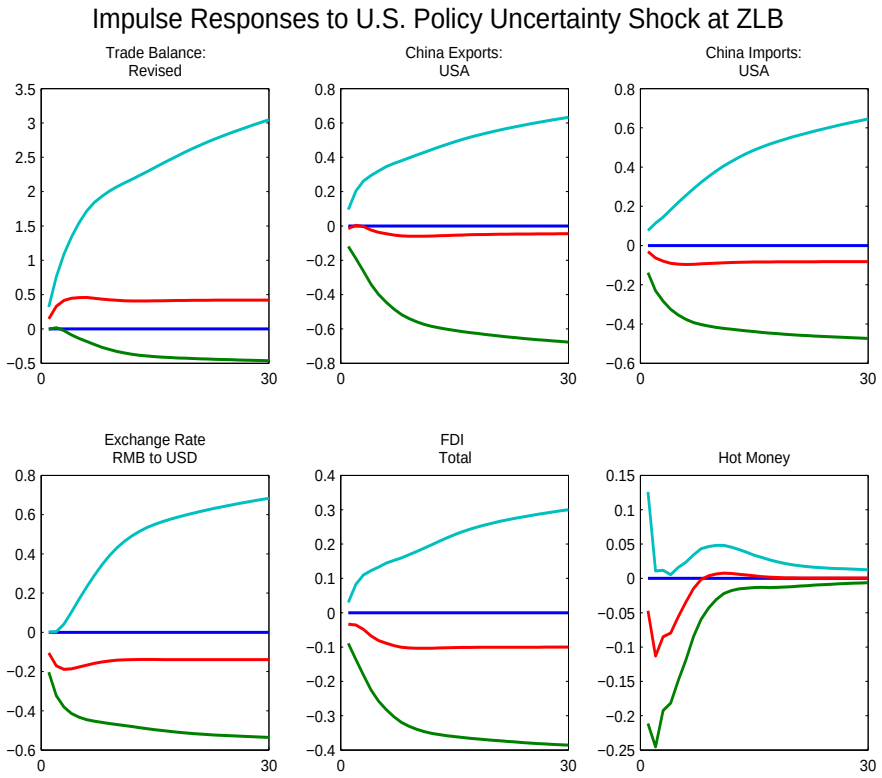

Figure 9: Impulse Responses to U.S. Policy Uncertainty Shock at the ZLB.

Impulse responses to a Policy Uncertainty shock from 0 to 30 months at the zero lower bound, estimated using data from January 2009 to February 2014. The solid lines are bootstrap median, and the dashed lines are 90 percent bootstrap confidence intervals. The Policy Uncertainty shock corresponds to an increase of U.S. Policy Uncertainty Index by 10% of standard deviation.

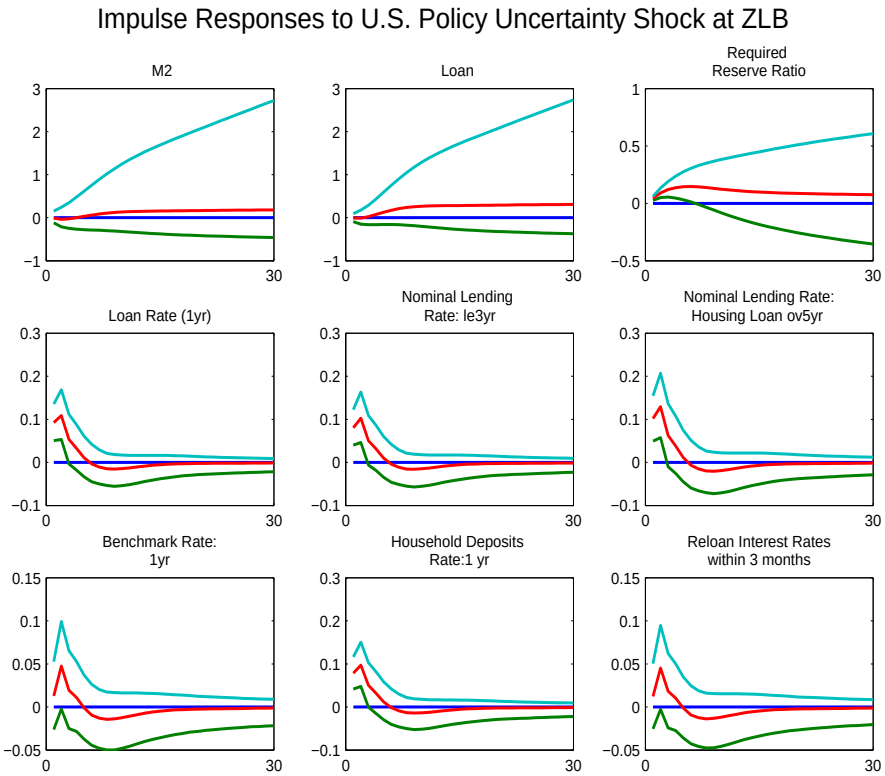

Figure 10: Impulse Responses to U.S. Policy Uncertainty Shock at the ZLB.

Impulse responses to a Policy Uncertainty shock from 0 to 30 months at the zero lower bound, estimated using data from January 2009 to February 2014. The solid lines are bootstrap median, and the dashed lines are 90 percent bootstrap confidence intervals. The Policy Uncertainty shock corresponds to an increase of U.S. Policy Uncertainty Index by 10% of standard deviation.

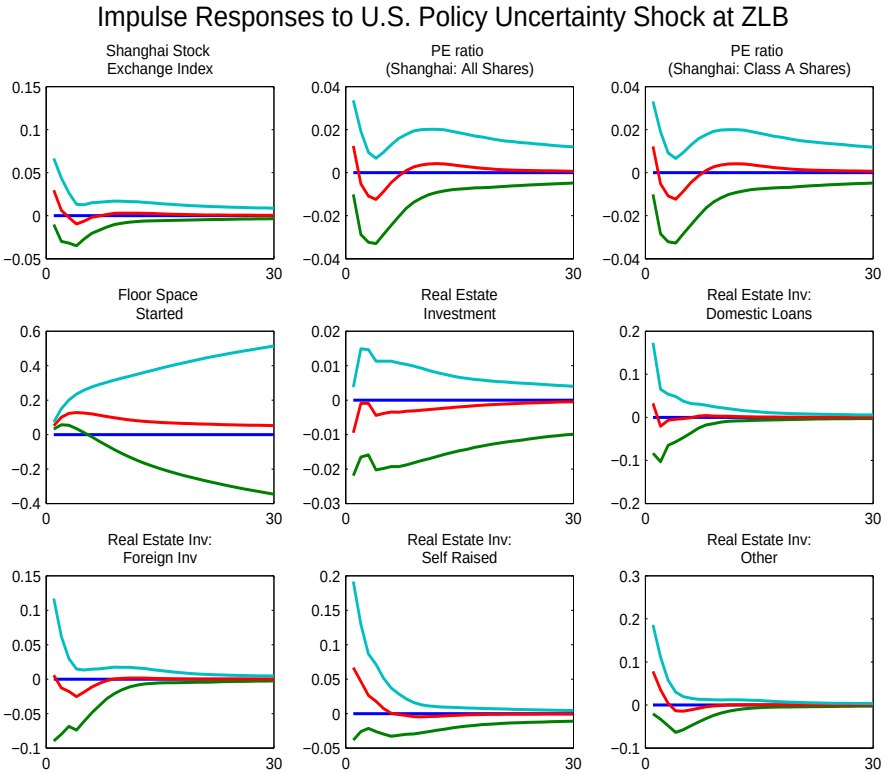

Figure 11: Impulse Responses to U.S. Policy Uncertainty Shock at the ZLB.

Impulse responses to a Policy Uncertainty shock from 0 to 30 months at the zero lower bound, estimated using data from January 2009 to February 2014. The solid lines are bootstrap median, and the dashed lines are 90 percent bootstrap confidence intervals. The Policy Uncertainty shock corresponds to an increase of U.S. Policy Uncertainty Index by 10% of standard deviation.

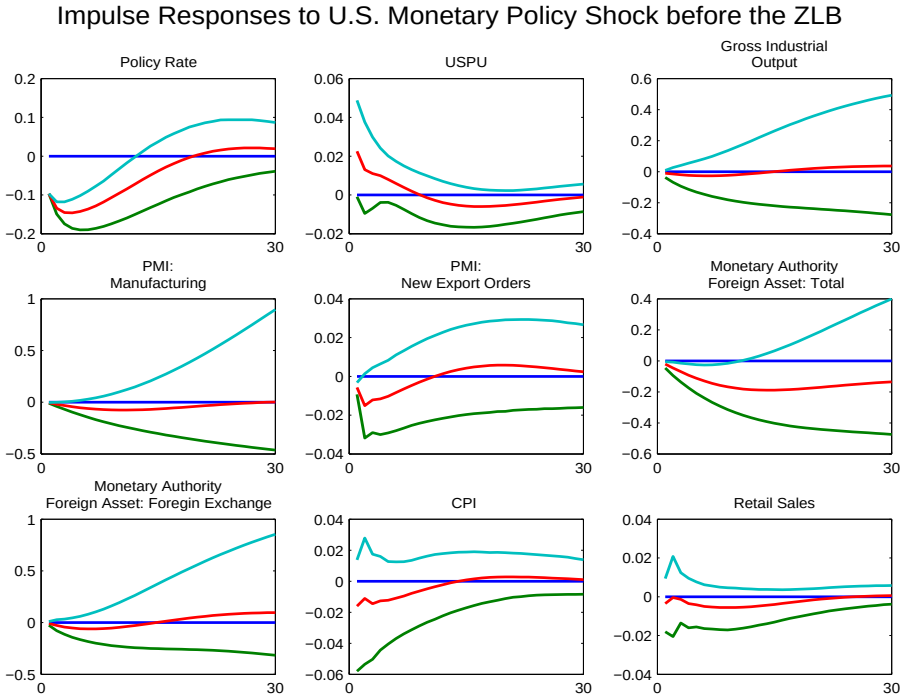

Figure 12: Impulse Responses to U.S. Monetary Policy Shock before the zero lower bound.

Impulse responses to a monetary policy shock from 0 to 30 months before the zero lower bound is binding, estimated using data from January 2000 to December 2008. The solid lines are bootstrap median, and the dashed lines are 90 percent bootstrap confidence intervals. The monetary policy shock corresponds to a decrease of the Effective Federal Funds Rate by 25 basis points.

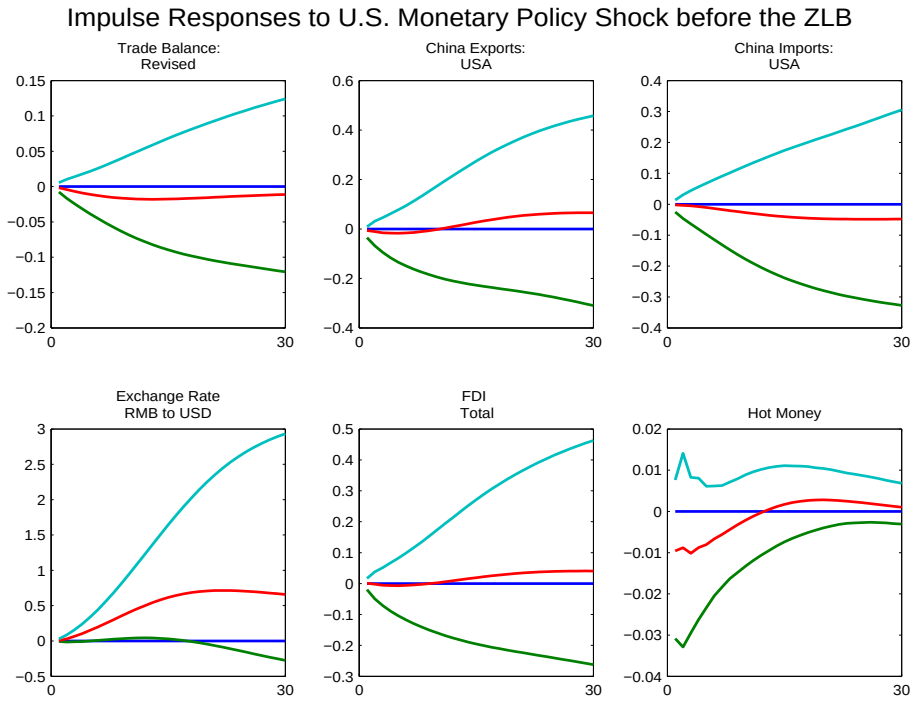

Figure 13: Impulse Responses to U.S. Monetary Policy Shock before the zero lower bound.

Impulse responses to a monetary policy shock from 0 to 30 months before the zero lower bound is binding, estimated using data from January 2000 to December 2008. The solid lines are bootstrap median, and the dashed lines are 90 percent bootstrap confidence intervals. The monetary policy shock corresponds to a decrease of the Effective Federal Funds Rate by 25 basis points.

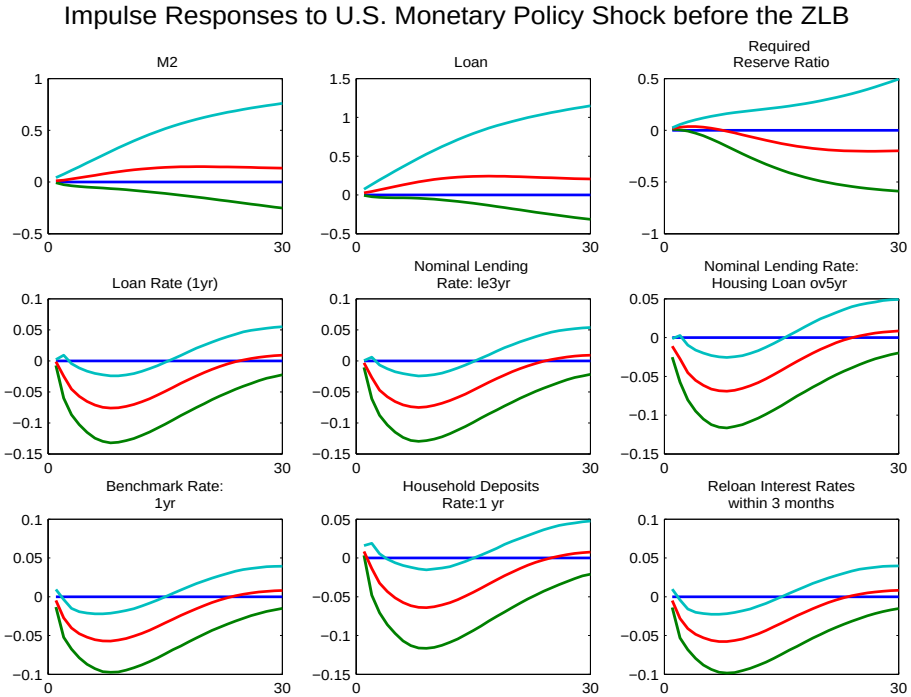

Figure 14: Impulse Responses to U.S. Monetary Policy Shock before the zero lower bound.

Impulse responses to a monetary policy shock from 0 to 30 months before the zero lower bound is binding, estimated using data from January 2000 to December 2008. The solid lines are bootstrap median, and the dashed lines are 90 percent bootstrap confidence intervals. The monetary policy shock corresponds to a decrease of the Effective Federal Funds Rate by 25 basis points.

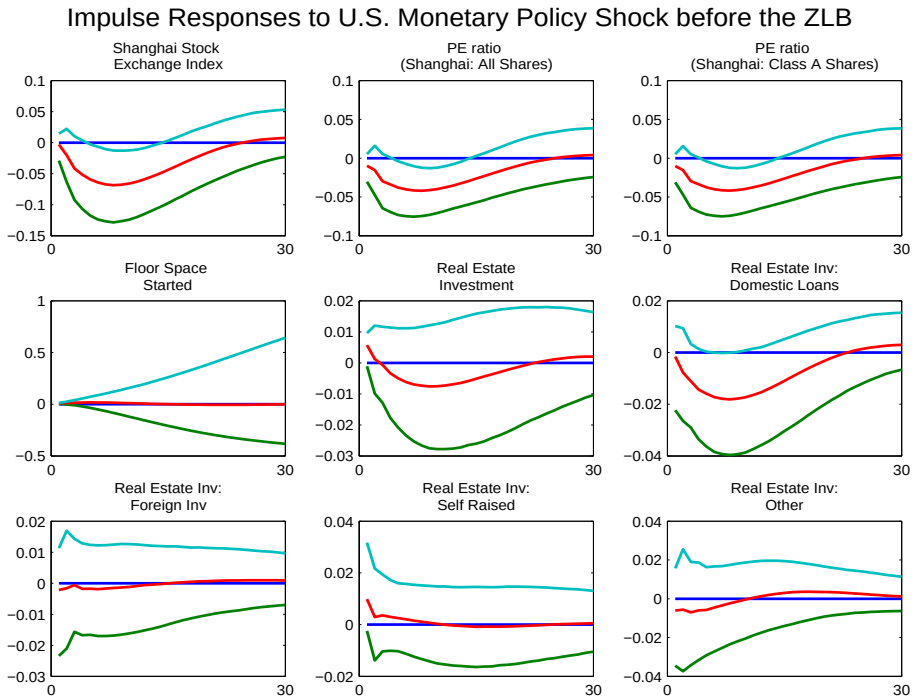

Figure 15: Impulse Responses to U.S. Monetary Policy Shock before the zero lower bound.

Impulse responses to a monetary policy shock from 0 to 30 months before the zero lower bound is binding, estimated using data from January 2000 to December 2008. The solid lines are bootstrap median, and the dashed lines are 90 percent bootstrap confidence intervals. The monetary policy shock corresponds to a decrease of the Effective Federal Funds Rate by 25 basis points.

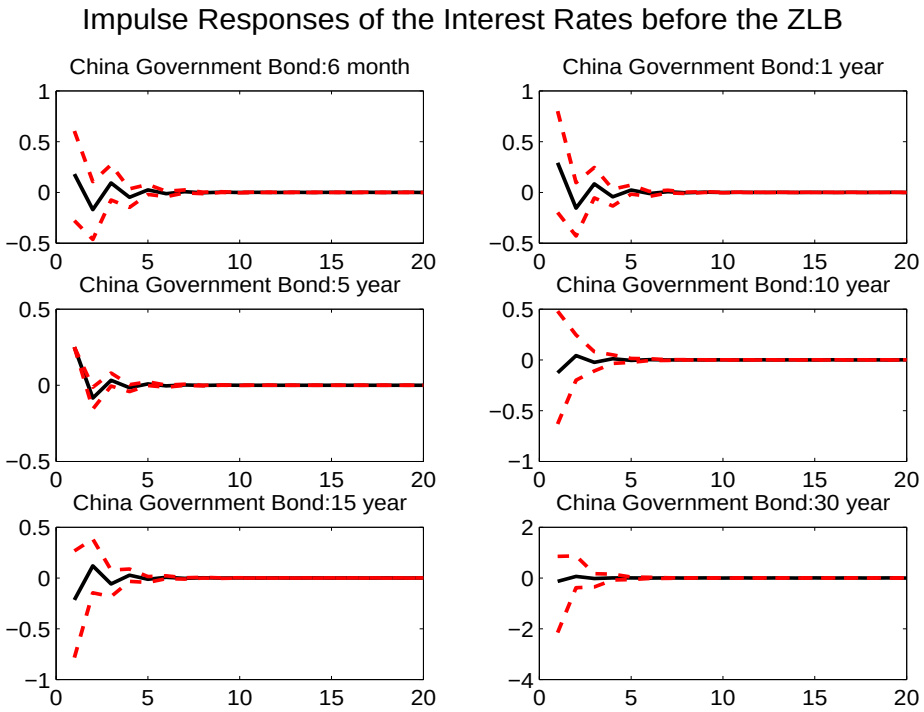

Figure 16: Impulse Responses to U.S. Monetary Policy Shock before the zero lower bound.

Impulse responses to a monetary policy shock from 0 to 20 days before the zero lower bound is binding, estimated using data from January 2000 to December 2008. The solid lines are bootstrap median, and the dashed lines are 90 percent bootstrap confidence intervals. The monetary policy shock corresponds to a decrease of the Effective Federal Funds Rate by 25 basis points.

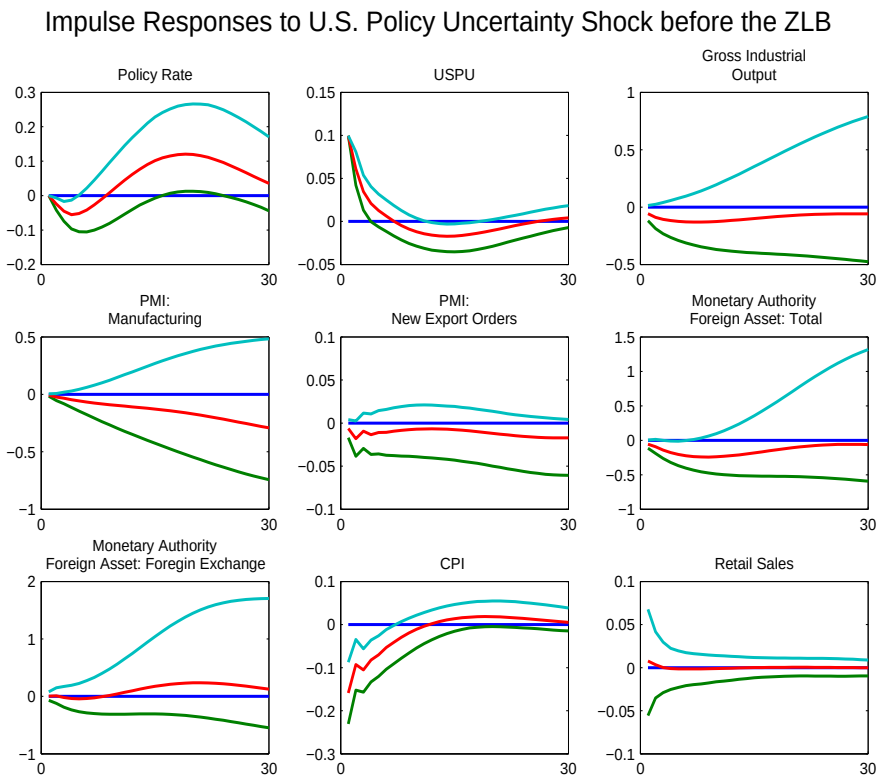

Figure 17: Impulse Responses to U.S. Policy Uncertainty Shock before the zero lower bound.

Impulse responses to a Policy Uncertainty shock from 0 to 30 months before the zero lower bound is binding, estimated using data from January 2000 to December 2008. The solid lines are bootstrap median, and the dashed lines are 90 percent bootstrap confidence intervals. The Policy Uncertainty shock corresponds to an increase of U.S. Policy Uncertainty Index by 10% of standard deviation.

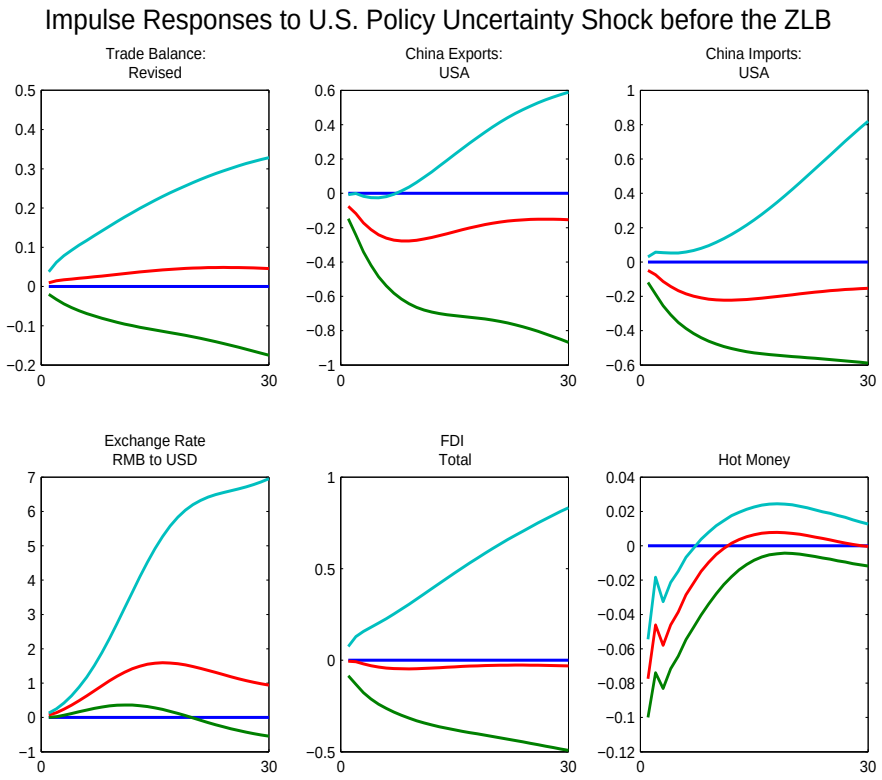

Figure 18: Impulse Responses to U.S. Policy Uncertainty Shock before the zero lower bound.

Impulse responses to a Policy Uncertainty shock from 0 to 30 months before the zero lower bound is binding, estimated using data from January 2000 to December 2008. The solid lines are bootstrap median, and the dashed lines are 90 percent bootstrap confidence intervals. The Policy Uncertainty shock corresponds to an increase of U.S. Policy Uncertainty Index by 10% of standard deviation.

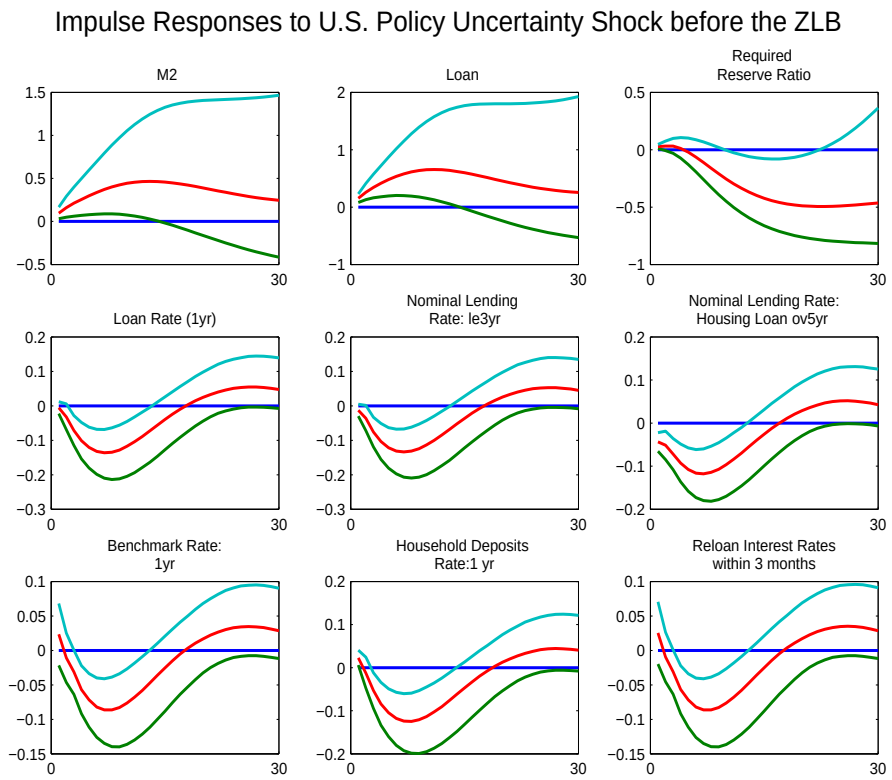

Figure 19: Impulse Responses to U.S. Policy Uncertainty Shock before the zero lower bound.

Impulse responses to a Policy Uncertainty shock from 0 to 30 months before the zero lower bound is binding, estimated using data from January 2000 to December 2008. The solid lines are bootstrap median, and the dashed lines are 90 percent bootstrap confidence intervals. The Policy Uncertainty shock corresponds to an increase of U.S. Policy Uncertainty Index by 10% of standard deviation.

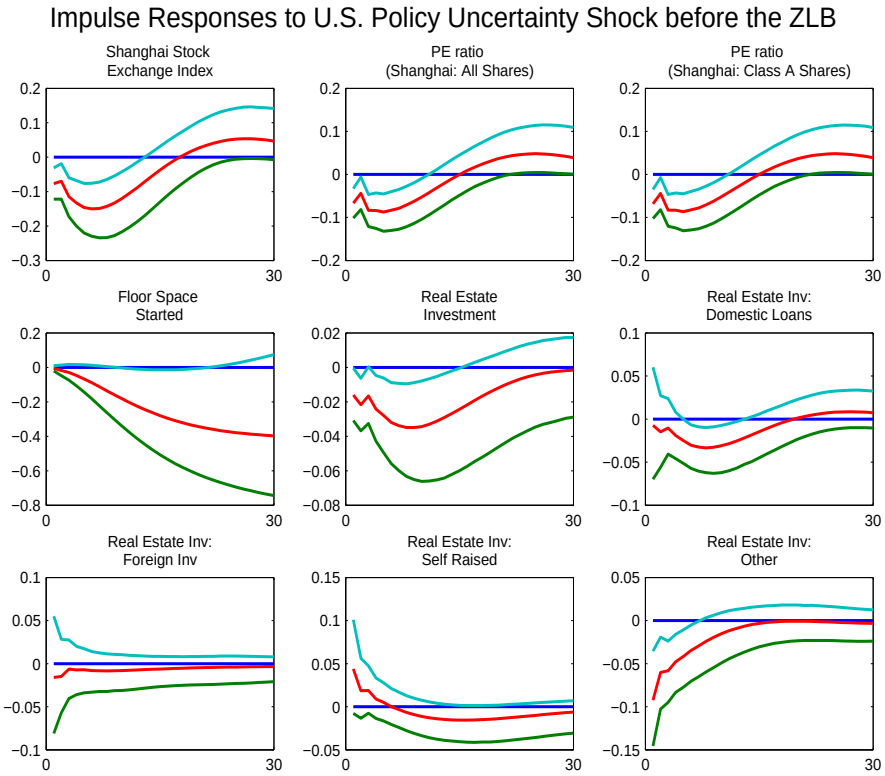

Figure 20: Impulse Responses to U.S. Policy Uncertainty Shock before the zero lower bound.

Impulse responses to a Policy Uncertainty shock from 0 to 30 months before the zero lower bound is binding, estimated using data from January 2000 to December 2008. The solid lines are bootstrap median, and the dashed lines are 90 percent bootstrap confidence intervals. The Policy Uncertainty shock corresponds to an increase of U.S. Policy Uncertainty Index by 10% of standard deviation.

Appendix I. Data Description

The series for Fuel, Diesel, Coal, and Pork price indices, as well as Nanhua Commodity Price Indices are taken from Wind Database. All other series are taken from CEIC China Premium Database and CEIC Global Database. All of the series are in monthly frequency, and data spans are shown. Each variable is assumed to be either fast-moving or slow-moving in the estimation. Seasonality adjustment is done using the U.S. Census Bureau's X-13 program; SA-seasonally adjusted, NS-no seasonal adjustment. The transformations are Δ-first difference; ln-logarithm; Δln-first difference of logarithm; *none*-no transformation.

Real Activities

1.	Retail Sales of Consumer Goods: Total	1999/12-2014/02	Slow	SA	Δln
2.	Gross Industrial Output	2003/03-2012/05	Slow	SA	Δln
3.	Industrial Sales	1999/12-2014/02	Slow	SA	Δln
4.	Industrial Sales: Delivery Value for Export	1999/12-2014/02	Slow	SA	Δln
5.	Industrial Sales: Light Industry	1999/12-2014/02	Slow	SA	Δln
6.	Industrial Sales: Heavy Industry	1999/12-2014/02	Slow	SA	Δln
7.	Industrial Sales Nominal Growth: Light Industry	1999/12-2013/02	Slow	SA	*none*
8.	Industrial Sales Nominal Growth: Heavy Industry	1999/12-2013/02	Slow	SA	*none*
9.	Industrial Sales Nominal Growth: Delivery Value for Export	2001/03-2013/12	Slow	SA	*none*
10.	Industrial Sales Nominal Growth: Same Period Last Year	1999/12-2014/02	Slow	SA	*none*
11.	Macro Index	1999/12-2014/02	Fast	SA	Δln
12.	Production of Primary Energy: Electricity	1999/12-2014/02	Slow	SA	Δln
13.	Transport: Passenger Traffic	1999/12-2014/02	Slow	SA	Δln
14.	Automobile Sales	1999/12-2014/02	Slow	SA	Δln
15.	Automobile Sales: Domestic Made	1999/12-2014/02	Slow	SA	Δln
16.	Automobile Production	1999/12-2014/02	Slow	SA	Δln
17.	Automobile Production: Domestic Made	1999/12-2014/02	Slow	SA	Δln
18.	Steel Production: Iron Ore	1999/12-2014/02	Slow	SA	Δln
19.	Steel Production: Pig Iron	1999/12-2014/02	Slow	SA	Δln

20.	Steel Production: Coke	1999/12-2014/02	Slow	SA	Δln
21.	Steel Production: Ferroalloy	1999/12-2014/02	Slow	SA	Δln
22.	Steel Production: Crude Steel	1999/12-2014/02	Slow	SA	Δln
23.	Steel Production: Steel Product	1999/12-2014/02	Slow	SA	Δln
24.	Petro Production: Natural Gas	1999/12-2014/02	Slow	SA	Δln
25.	Petro Production: Crude Oil	1999/12-2014/02	Slow	SA	Δln
26.	Petro Production: Crude Oil Processed	1999/12-2014/02	Slow	SA	Δln
27.	Petro Production: Oil Product: Coal Oil	1999/12-2014/02	Slow	SA	Δln
28.	Petro Production: Oil Product: Gasoline	1999/12-2014/02	Slow	SA	Δln
29.	Petro Production: Oil Product: Diesel Oil	1999/12-2014/02	Slow	SA	Δln
30.	Petro Production: Fuel Oil	1999/12-2014/02	Slow	SA	Δln
31.	Product Inventory	1999/12-2014/02	Slow	SA	Δln
32.	Purchasing Managers' Index: Manufacturing	2005/03-2014/02	Slow	SA	*none*
33.	Purchasing Managers' Index: New Export Orders	2005/03-2014/02	Slow	SA	*none*

Investments

34.	Fixed Assets Investment	1999/12-2014/02	Slow	SA	Δln
35.	FDI Utilized: Joint Ventures	1999/12-2014/02	Slow	SA	Δln
36.	FDI Utilized: Total	1999/12-2014/02	Slow	SA	Δln
37.	FDI Utilized: Cooperative Ventures	1999/12-2014/02	Slow	SA	Δln
38.	FDI Utilized: Foreign Enterprises	1999/12-2014/02	Slow	SA	Δln

International Accounts

39.	Foreign Reserve	1999/12-2014/02	Fast	SA	Δln
40.	Financial Institutions CF: Position for Forex Purchase	1999/12-2014/02	Fast	SA	Δln
41.	Exports (fob)	1999/12-2014/02	Slow	SA	Δln
42.	Imports (cif)	1999/12-2014/02	Slow	SA	Δln
43.	Trade Balance	1999/12-2014/02	Slow	SA	Δ
44.	Export FOB: Revised	1999/12-2014/02	Slow	SA	Δln
45.	Import CIF: Revised	1999/12-2014/02	Slow	SA	Δln
46.	Trade Balance: Revised	1999/12-2014/02	Slow	SA	Δ

47.	China Exports: USA	1999/12-2014/02	Slow	SA	Δln
48.	China Imports: USA	1999/12-2014/02	Slow	SA	Δln
49.	Monetary Authority: Asset: Total	1999/12-2014/02	Fast	NS	Δln
50.	Monetary Authority: Asset: Foreign Asset: Foreign Exchange	1999/12-2014/02	Fast	NS	Δln
51.	Monetary Authority: Asset: Foreign Asset: Gold	1999/12-2014/02	Fast	NS	Δln
52.	Monetary Authority: Asset: Foreign Asset: Foreign Exchange	1999/12-2014/02	Fast	NS	Δln
53.	Monetary Authority: Liab: Reserve Money	1999/12-2014/02	Fast	NS	Δln
54.	Monetary Authority: Liab: Reserve Money: Currency Issue	1999/12-2014/02	Fast	NS	Δln
176.	Hot Money	2000/01-2014/02	Fast	SA	*none*

Exchange Rates and Swaps

55.	Foreign Exchange Rate: PBOC: Month End: RMB to USD	1999/12-2014/02	Fast	NS	Δln
56.	Currency Swap: USD: 1 Week: Bid	2006/09-2014/02	Fast	NS	*none*
57.	Currency Swap: USD: 1 Week: Offer	2006/09-2014/02	Fast	NS	*none*
58.	Currency Swap: USD: 1 Month: Bid	2006/09-2014/02	Fast	NS	*none*
59.	Currency Swap: USD: 1 Month: Offer	2006/09-2014/02	Fast	NS	*none*
60.	Currency Swap: USD: 3 Month: Bid	2006/09-2014/02	Fast	NS	*none*
61.	Currency Swap: USD: 3 Month: Offer	2006/09-2014/02	Fast	NS	*none*
62.	Currency Swap: USD: 6 Month: Bid	2006/09-2014/02	Fast	NS	*none*
63.	Currency Swap: USD: 6 Month: Offer	2006/09-2014/02	Fast	NS	*none*
64.	Currency Swap: USD: 1 Year: Offer	2006/09-2014/02	Fast	NS	*none*
65.	Currency Swap: USD: 1 Year: Bid	2006/09-2014/02	Fast	NS	*none*

Government

66.	Government Expenditure	1999/12-2014/02	Slow	SA	Δln
67.	Govt Revenue	1999/12-2014/02	Slow	SA	Δln
68.	Govt Revenue: Tax	1999/12-2014/02	Slow	SA	Δln
69.	Govt Revenue: Tax: Tariffs	1999/12-2014/02	Slow	SA	Δln

70.	Govt Revenue: Tax: Value Added	1999/12-2014/02	Slow	SA	Δln
71.	Govt Revenue: Tax: Operation	1999/12-2014/02	Slow	SA	Δln
72.	Govt Revenue: Tax: Security Stamp	1999/12-2014/02	Slow	SA	Δln

Money Supply and Credits

73.	Money Supply M0	1999/12-2014/02	Fast	SA	Δln
74.	Money Supply M1	1999/12-2014/02	Fast	SA	Δln
75.	Money Supply M1: Demand Deposit	1999/12-2014/02	Fast	SA	Δln
76.	Money Supply M2	1999/12-2014/02	Fast	SA	Δln
77.	Money Supply M2: Quasi Money: Saving Deposit	1999/12-2014/02	Fast	SA	Δln
78.	Money Supply M2: Quasi Money: Time Deposit	1999/12-2014/02	Fast	SA	Δln
79.	Money Supply M2: Quasi Money: Other Deposit	1999/12-2014/02	Fast	SA	Δln
80.	Loan	1999/12-2014/02	Slow	SA	Δln
81.	Required Reserve Ratio	1999/12-2014/02	Slow	NS	*none*

Interest Rates

82.	Loan Rate (1yr)	1999/12-2014/02	Slow	NS	*none*
83.	Nominal Lending Rate: Medium and Long Term: 3 Year or Less	1999/12-2014/02	Slow	NS	*none*
84.	Nominal Lending Rate: Medium and Long Term: 5 Year or Less	1999/12-2014/02	Slow	NS	*none*
85.	Nominal Lending Rate: Medium and Long Term: Over 5 Year	1999/12-2014/02	Slow	NS	*none*
86.	Nominal Lending Rate: Housing Loan (Reserve Fund A/C): 5 Yr or Less	1999/12-2014/02	Slow	NS	*none*
87.	Nominal Lending Rate: Housing Loan (Reserve Fund A/C): Over 5 Year	1999/12-2014/02	Slow	NS	*none*
88.	Central Bank Benchmark Interest Rate: Loans to FI: 1 Year	1999/12-2014/02	Slow	NS	*none*
89.	Central Bank Benchmark Interest Rate: Loans to FI: 6 Month or Less	1999/12-2014/02	Slow	NS	*none*

90.	Central Bank Benchmark Interest Rate: Loans to FI: 3 Month or Less	1999/12-2014/02	Slow	NS	*none*
91.	Household Savings Deposits Rate: Time: 3 Month	1999/12-2014/02	Slow	NS	*none*
92.	Household Savings Deposits Rate: Time: 6 Month	1999/12-2014/02	Slow	NS	*none*
93.	Household Savings Deposits Rate: Time: 1 Year	1999/12-2014/02	Slow	NS	*none*
94.	Household Savings Deposits Rate: Time: 2 Year	1999/12-2014/02	Slow	NS	*none*
95.	Household Savings Deposits Rate: Time: 3 Year	1999/12-2014/02	Slow	NS	*none*
96.	Household Savings Deposits Rate: Time: 5 Year	1999/12-2014/02	Slow	NS	*none*
97.	Household Savings Deposits Rate: Demand	1999/12-2014/02	Slow	NS	*none*
98.	Reloan Interest Rates: within 20 days	1999/12-2014/02	Slow	NS	*none*
99.	Reloan Interest rates: within 3 months	1999/12-2014/02	Slow	NS	*none*
100.	Reloan Interest rates: within 6 months	1999/12-2014/02	Slow	NS	*none*
101.	Reloan InterestRrates: one year	1999/12-2014/02	Slow	NS	*none*
102.	Shanghai Interbank Offered Rate(SHIBOR): one day	2006/10-2014/02	Fast	NS	*none*
103.	Shanghai Interbank Offered Rate(SHIBOR): one month	2006/10-2014/02	Fast	NS	*none*
104.	Shanghai Interbank Offered Rate(SHIBOR): three months	2006/10-2014/02	Fast	NS	*none*
105.	Shanghai Interbank Offered Rate(SHIBOR): six months	2006/10-2014/02	Fast	NS	*none*
106.	Shanghai Interbank Offered Rate(SHIBOR): one year	2006/10-2014/02	Fast	NS	*none*
107.	Private Lending Rate: Wenzhou: Monthly Average	2012/06-2014/02	Fast	NS	*none*
108.	Bond index: Inter-bank: Treasury bonds: short-term	2009/06-2014/02	Fast	NS	*none*
109.	Bond Index: Interbank: Treasury Bond: Medium Term	2009/06-2014/02	Fast	NS	*none*
110.	Bond Index: Interbank: Treasury Bond: Long Term	2009/06-2014/02	Fast	NS	*none*
111.	Bond Index: Interbank: Policy Financial Bond	2009/06-2014/02	Fast	NS	*none*

Stock Markets

112.	Shanghai Stock Exchange Index	1999/12-2014/02	Fast	NS	*none*

113.	Index: Shenzhen Stock Exchange: Composite	1999/12-2014/02	Fast	NS	*none*
114.	Price to Earnings Ratio-Shanghai Stock Exchange: All shares	1999/12-2014/02	Fast	NS	*none*
115.	Price to Earnings Ratio-Shanghai Stock Exchange: Class-A shares	1999/12-2014/02	Fast	NS	*none*
116.	Price to Earnings Ratio-Shanghai Stock Exchange: financial industry	2001/04-2014/02	Fast	NS	*none*
117.	Price to Earnings Ratio-Shanghai Stock Exchange: the real estate industry	2001/04-2014/02	Fast	NS	*none*
118.	Price to Earnings Ratio-Shanghai Stock Exchange: the construction industry	2001/04-2014/02	Fast	NS	*none*
119.	Price to Earnings Ratio-Shanghai Stock Exchange: Manufacturing industry	2001/04-2014/02	Fast	NS	*none*
120.	Price to Earnings Ratio-Shenzhen Stock Exchange: All Share	1999/12-2014/02	Fast	NS	*none*
121.	Price to EarningsRatio-Shenzhen Stock Exchange: Class-A Share	1999/12-2014/02	Fast	NS	*none*

Price Indices

122.	Consumer Confidence Index	1999/12-2014/02	Fast	NS	*none*
123.	Consumer Expectation Index	1999/12-2014/02	Fast	NS	*none*
124.	Consumer Price Index	1999/12-2014/02	Slow	SA	Δln
125.	CPI: Food	1999/12-2014/02	Slow	SA	Δln
126.	CPI: Core (excl. Food & Energy)	2006/03-2014/02	Slow	SA	Δln
127.	CPI: non Food	2005/03-2014/02	Slow	SA	Δln
128.	Coking Coal Price: Monthly average, 36 cities	1999/12-2014/02	Slow	SA	Δln
129.	Shanghai Futures Exchange: Fuel Price	2004/08-2014/02	Slow	SA	Δln
130.	Diesel Price: Monthly average	2004/08-2014/02	Slow	SA	Δln
131.	Pork Price: Lean Meat: 36 city average	2001/03-2014/02	Slow	SA	Δln
132.	Nanhua Composite Index Monthly	1999/12-2014/02	Slow	SA	Δln
133.	Nanhua Industrial Index Monthly	2004/06-2014/02	Slow	SA	Δln
134.	Nanhua Agricultural Index Monthly	2004/06-2014/02	Slow	SA	Δln

135.	Nanhua Metal Index Monthly	2004/06-2014/02	Slow	SA	Δln

Employment

136.	No of Employee: Coal Mining & Dressing	1999/12-2012/12	Slow	SA	Δln
137.	No of Employee: Ferrous Metal Mining & Dressing	1999/12-2012/12	Slow	SA	Δln
138.	No of Employee: Food Manufacturing	1999/12-2014/02	Slow	SA	Δln
139.	No of Employee: Wine, Beverage & Refined Tea Manufacturing	1999/12-2012/12	Slow	SA	Δln
140.	No of Employee: Textile	1999/12-2014/02	Slow	SA	Δln
141.	No of Employee: Paper Making & Paper Product	1999/12-2014/02	Slow	SA	Δln
142.	No of Employee: Chemical Material & Product	1999/12-2014/02	Slow	SA	Δln
143.	No of Employee: Medical & Pharmaceutical Product	1999/12-2012/12	Slow	SA	Δln
144.	No of Employee: Electrical Machinery & Equipment	1999/12-2014/02	Slow	SA	Δln
145.	No of Employee: Computer, Communication & Other Electronic Equipment	1999/12-2014/02	Slow	SA	Δln

Real Estate

146.	Commodity Bldg Selling Price: YTD Average	1999/12-2014/02	Fast	SA	Δln
147.	Commodity Bldg Selling Price: YTD Average: Residential	1999/12-2014/02	Fast	SA	Δln
148.	Floor Space Started: Commodity Bldg	2000/01-2014/02	Slow	SA	ln
149.	Real Estate Investment	1999/12-2014/02	Slow	SA	ln
150.	Real Estate Inv: Source of Fund: Domestic Loans	2000/01-2014/02	Slow	SA	ln
151.	Real Estate Inv: Source of Fund: Foreign Inv	2000/01-2014/02	Slow	SA	ln
152.	Real Estate Inv: Source of Fund: Self Raised	2000/01-2014/02	Slow	SA	ln
153.	Real Estate Inv: Source of Fund: Other	2000/01-2014/02	Slow	SA	ln
154.	Building Sold	2000/01-2014/02	Slow	SA	ln
155.	Building Sold: Residential	2000/01-2014/02	Slow	SA	ln
156.	Building Sold: Residential: House in Advance	2009/01-2014/02	Slow	SA	ln
157.	Building Sold: Residential: Existing House	2009/01-2014/02	Slow	SA	ln
158.	Building Sold: Commercial: House in Advance	2009/01-2014/02	Slow	SA	ln
159.	Building Sold: Commercial: Existing House	2009/01-2014/02	Slow	SA	ln

160.	Real Estate Climate Index	2004/03-2014/02	Slow	SA	*none*

U.S. Variables

161.	US Consumer Confidence Index	1999/12-2014/02	Fast	SA	*none*
162.	US Consumer Confidence Index: Expectations	1999/12-2014/02	Fast	SA	*none*
163.	US Consumer Confidence Index: Present Situation	1999/12-2014/02	Fast	SA	*none*
164.	US Consumer Price Index: Urban	1999/12-2014/02	Fast	SA	Δln
165.	US Unemployment	1999/12-2014/02	Slow	SA	Δln
166.	US Retail Sales	1999/12-2014/02	Slow	SA	Δln
167.	US Industrial Production Index	1999/12-2014/02	Slow	SA	*none*
168.	US Purchasing Managers' Index	1999/12-2014/02	Slow	SA	*none*
169.	Nasdaq Composite	1999/12-2014/02	Fast	SA	Δln
170.	NYSE Composite	1999/12-2014/02	Fast	SA	Δln
171.	US Money Supply M1	1999/12-2014/02	Fast	SA	Δln
172.	US Money Supply M2	1999/12-2014/02	Fast	SA	Δln
173.	US Federal Government Receipts	1999/12-2014/02	Slow	SA	Δln
174.	US Federal Debt	1999/12-2014/02	Slow	SA	Δln
175.	US Federal Government Surplus or Deficit	1999/12-2014/02	Slow	SA	*none*

Appendix II. Factor Construction for the FA-VAR

The two-step principal component approach uncovers the space spanned by the common components $C_t = (F_t', Y_t')'$. The macro factors are constructed by first extracting 3 principal components $\hat{F}^*$ from the slow-moving variables indicated in Appendix I. All principal components are normalized to unit variance. We then run the following regression $\hat{C}_t = b_s \hat{F}_t^* + b_Y Y_t + e_t$ and $\hat{F}_t$ is constructed from $C_t - \hat{b_Y} \hat{Y}_t$. Then the VAR equation in $\hat{F}_t$ and Y_t are recursively estimated and identified with this ordering.