From a Quantity to an Interest Rate-Based Framework: Multiple Monetary Policy Instruments and Their Effects in China

Soyoung Kim
Seoul National University

Hongyi Chen
Hong Kong Institute for Monetary and Financial Research

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Outline

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- Empirical Results
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Motivation

- Analyzing the effects of PBoC's monetary policy can be challenging. The main challenge originates from China using various monetary policy instruments.

- Reserve requirement ratio; benchmark lending and deposit rates; repo or reverse repo rates; differentiated, dynamic and target reserve requirements; central bank bills; repo or reverse repo amount; total loan growth; M2 growth; and total social financing (TSF).

- Recently, the PBoC has lifted the deposit rate ceiling and introduced instruments, such as short-term liquidity operations (SLO), standing lending facility (SLF), medium-term lending facility (MLF) and pledged supplementary lending (PSL), to build an interest rate corridor system.

Motivation

- This research empirically investigates the effects of various types of monetary policy instruments by modeling the interactions and relationship among monetary policy instruments, and try to draw implications for the PBoC's attempt to change the monetary policy framework to an interest rate-based framework in recent years.
- **First, we analyze the effects of each monetary policy instruments.** What are the effects of each monetary policy instrument on key macro variables? What is the relative effectiveness of various monetary policy instruments in achieving traditional objectives as well as the new financial stability objective?
- **Second, we investigate the relationship among various monetary policy instruments and intermediate targets.** What are the relationships and interactions among various monetary policy instruments? Is a large portion of fluctuations in the traditional intermediate targets, such as growth in total loan and M2, subject to non-policy shocks?
- **Third, we are also interested in the changes over time.** How do the effects and dynamic interactions of different policy instruments change over time with the shift in the monetary policy framework of the PBoC? What can be expected when the monetary policy framework fully changes to an interest rate-based one?

Literature Review

- To address the challenge of multiple policy instruments, past studies on Chinese monetary policy usually develop a synthetic indicator of different policy instruments to measure the monetary policy stance. He and Pauwels (2008), Xiong (2012), Shu and Ng (2010), Sun (2015), Chen, Chow, and Tillmann (2016), Chen, Higgins, Waggoner, and Zha (2016).

- A few studies analyze the effects of a few policy instruments but do not explicitly consider the realistic interactions among these policy instruments. He, Leung and Chong (2013) and Fernald, Spiegel and Swanson (2014).

- Fan, Yu, and Zhang (2011) and Sun, Ford and Dickinson (2010) investigate the effects of intermediate targets by directly treating intermediate targets such as M2 growth as policy variables.

Literature Review

- We use structural vector autoregression (VAR) models, following many past studies analysing effects of monetary policy. We uses short-run, non-recursive zero restrictions introduced by Bernanke (1986) and Sims (1986).

- Bernanke and Mihov (1998) and Kim (2003, 2005), develop empirical models of multiple policy instruments that allow interactions with one another and investigate the effects of each policy instrument shock.

Evolution of Monetary Policy Framework

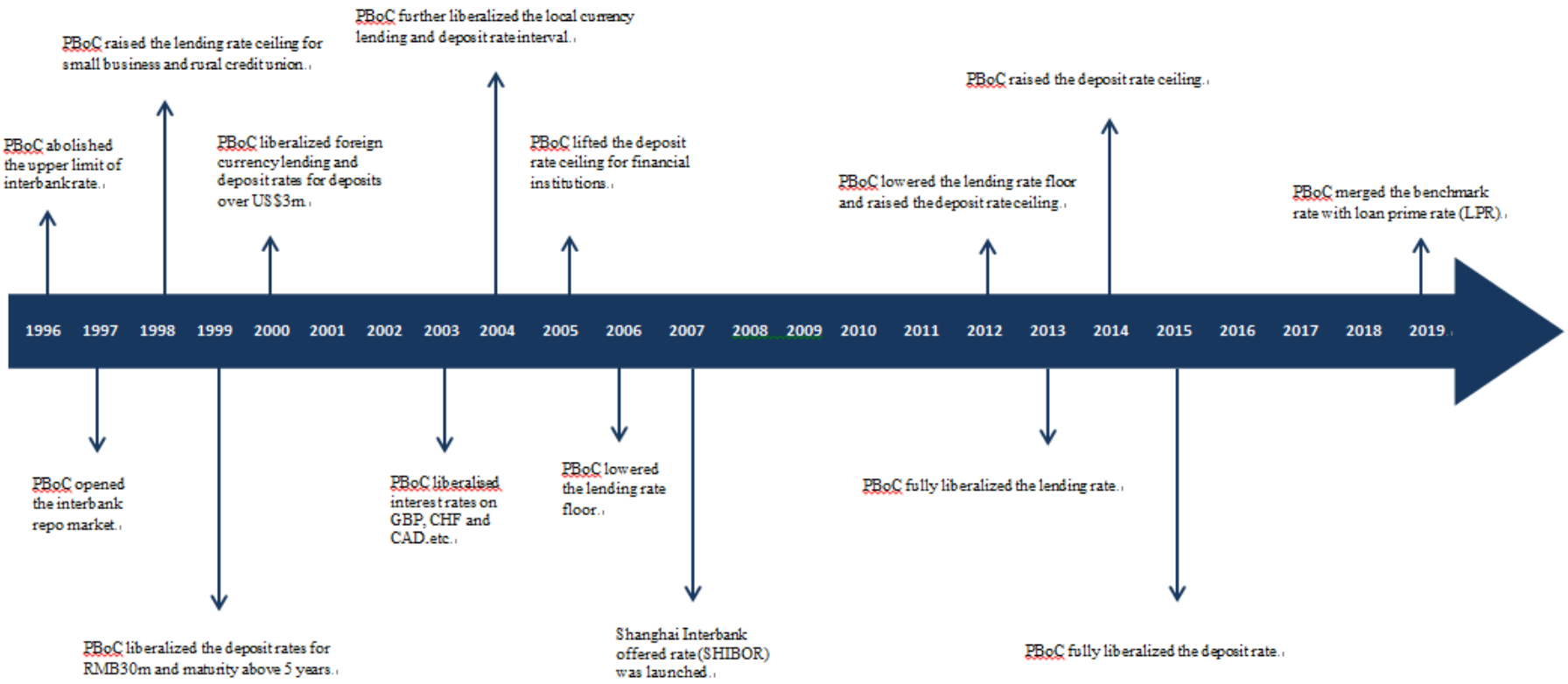
- From 1984 to 1997, China's monetary policy focusing on managing the credit scale. In 1998, credit quota was abolished and an indirect management of growth of credit and monetary aggregates was established.

- Since 1996, the PBoC gradually liberalized interest rates. In June 1996, the interbank rate was liberalized. From 1997 to 2004, the PBoC gradually expanded the interest rate range on benchmark lending and deposit rates. In October 2004, the PBoC removed the upper bound of lending rates and lower bound of the deposit rate. In July 2013, the PBoC removed the lending rate floor. Finally, in October 2015, the PBoC removed the deposit rate ceiling. This last step completes the liberalization of retail lending and deposit rates.

- Fully liberalized interest rates have led the PBoC to try to establish an interest rate corridor around a short-term policy rate, with the rate on excess reserve as the lower bound and the rate on 7-day SLF as the upper bound.

- The two main intermediate targets are the growth of monetary aggregates and bank loans, such as M2 and loan growth. Since 2011, the PBoC has used TSF growth as an intermediate target and stopped using loan growth. TSF refers to the aggregate volume of funds provided by China's domestic financial system to the real economy in a given period. TSF includes indirect finance through the banking system, as well as direct finance through issuing stocks and bonds in the capital markets.

Figure 1: Timeline of China's interest rate liberalization



Source: Liu, Jin and Yu (2019) and Author's Research

Evolution of Monetary Policy Framework

- With the development of domestic financial markets, growth of shadow banking and interest rate liberalisation, the PBoC finds the correlations of quantity targets, such as M2, loan and TSF growth, with inflation are rather weak.

- The PBoC starts to establish an interest rate-based system. However, as the interest rate transmission from the repo market, interbank market towards bond market, the credit market is not efficient and effective. The PBoC subsequently develops different lending facilities to guide interest rates at different maturities.

- Currently, the PBoC uses OMOs, which are mainly repos and reverse repos at 7, 14, 28 and 63 days; SLF at overnight, 7 days and 1 month; temporary lending facility at 28 days; MLF at 3, 6, and 12 months; and Pledged Supplementary Lending (PSL) for long-term, large-scale financing to policy banks tasked with financing government projects to renovate city slums. SLO was introduced in 2013 but has not been used since January 2016.

Evolution of Monetary Policy Framework

- The interest rates on OMOs, SLFs, PSLs and MLFs are policy rates. The PBoC uses MLFs and PSLs as monetary policy instruments to manage the balance sheet of the banking system (see Yi, 2017). The 7-day repo market is the most liquid market. However, the repo market has participants other than banks. The PBoC aims to target a 7-day interest rate for transactions between banks.

- For the interest rate corridor that the PBoC tries to establish, the target 7-day interest rate (DR007) is the key policy rate. The interest rate on excess reserve serves as the lower bound of the "corridor". The 7-day interest rate SLF serves as the upper bound. The interest rates on MLFs are for longer maturities. Besides that, MLFs serve as balance sheet instruments. To build credibility of its policy target, the PBoC encourages market participants to price credit based on its policy target and tries to smooth the interest rate transmission from its short-term policy rate to rates on long-term maturities. Most recently, the PBoC required all banks to price new loans based on loan prime rate(LPR), which is based on interest rate on MLF.

Evolution of Monetary Policy Framework

- We use the RRR, benchmark lending and deposit rates, and 7-day repo rate in the interbank market (R007) as the monetary policy instruments.

- The role of RRR as a monetary policy instrument has changed over the past two decades. RRR is an important policy instrument for the PBoC and traditionally functions as a loosening or tightening monetary policy tool. Over the past few years, the PBoC has used RRR change to differentiate sectors, such as providing relief to the agricultural sector or small businesses. Currently the PBoC maintains a three-tier RRR system with two additional incentives to support bank lending to SMEs.

- The PBoC adjusts RRR more often than policy rates. From January 2000 to June 2018, the PBoC has adjusted RRR 49 times; policy rates, 26 times. Only when the PBoC found it necessary, then it adjusts the RRR and benchmark rates at the same time

Evolution of Monetary Policy Framework

- Chen, Chen and Gerlach (2013) study the effectiveness of benchmark interest rates. Interest rate liberalization and growth in shadow banking activity mean the benchmark interest rates play less significant roles in total social financing activities. The gap between the effective lending rate and benchmark lending rate is widening.

- However, a large part of bank loans is still priced based on benchmark interest rates. For example, good SOEs obtain loans with a discount on the benchmark lending rate. In addition, mortgage lending is mostly priced based on benchmark rate.

- Even if the lending rate floor or deposit rate ceiling is not binding, the adjustment of benchmark interest rates continues to affect commercial lending significantly. Since October 2015, when the PBoC lifted the deposit rate ceiling, it has not changed benchmark rates. However, the PBoC endorsed an industry-wide disciplinary system to set the deposit rate ceiling until the system was abolished in April 2018. In August 2019, the PBoC required banks to use LPR to price new loans

Evolution of Monetary Policy Framework

- In the empirical analysis, we consider benchmark lending and deposit rates separately. We first analyze the effect of the benchmark lending rate (RL) in the baseline mode. In the extended model, we add benchmark deposit rate (RD).

- The PBoC tries to maintain a stable gap between benchmark lending and deposit rate in order for banks to earn a healthy profit, which helps to maintain financial stability. That is why, most of the time, the PBoC makes both rate adjustments simultaneously.

- The 7-day repo rate (R007) is sometimes very volatile. Certain spikes are driven by events, such as big IPOs, holiday liquidity demand, tax payment, government fiscal outlays, change in RRR and MLF. The high volatility of R007 drives the PBoC to choose DR007 as its policy target. Given the need for a longer series, our study uses R007, which reflects liquidity conditions in the interbank market.

- To summarize, we use three policy instruments in our baseline model: RRR, RL and R007. We include RES, M2 and LOAN as liquidity measures, and CPI and IP as the two key macro variables.

The Empirical Model

- $G(L)y_t = e_t,$ (1)
- where G(L) is a matrix polynomial in the lag operator L, y_t is an n×1 data vector, and e_t is an n×1 structural disturbance vector. e_t is serially uncorrelated and $var(e_t)=\Lambda$. Λ is a diagonal matrix where diagonal elements are the variances of structural disturbances. Hence, structural disturbances are assumed mutually uncorrelated.
- For simplicity, we present the model without the vector of constants. Alternatively, we can regard each variable as a deviation from the steady state.

The Empirical Model

- We estimate a reduced form equation (VAR)
- $y_t = B(L)y_{t-1} + u_t$ (2)
- where B(L) is a matrix polynomial in lag operator L and var(u_t)= Σ
- Let G_0 be the contemporaneous coefficient matrix in the structural form and $G^0(L)$ be the coefficient matrix in G(L) without the contemporaneous coefficient G_0.
- $G(L) = G_0 + G^0(L)$ (3)
- Then, the parameters in the structural and reduced form equations are related by
- $B(L) = - G_0^{-1} G^0 (L)$ (4)
- In addition, the structural disturbances and the reduced form residuals are related by
- $e_t = G_0 u_t$ (5)
- which implies $\Sigma = G_0^{-1} \Lambda G_0^{-1'}$ (6)

The Empirical Model

- In the VAR modeling with Cholesky decomposition, G_0 is assumed triangular. However, in the generalized structural VAR approach, G_0 can be any structure (non-recursive).
- Sims (1986), Bernanke (1986)…

Empirical Model

- The data vector is (RRR, RL, REPO, LOAN, RES, M2, CPI, IP)

- The model is estimated from October 1997 to December 2016 using monthly data. The earliest monthly date for the 7-day repo rate R007 is October 1997. All data is from the CEIC database. Three lags and a constant term are assumed. All variables are in the form of logarithms (multiplied by 100), except for RRR, RL and REPO. We follow Sims and Zha (1999) to construct posterior probability bands for impulse responses. Sims (1988) and Sims and Uhlig (1991) present a general discussion on Bayesian inference in the presence of unit roots and cointegration relations.

The Empirical Model

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & g_{17} & g_{18} \\ 0 & 1 & 0 & 0 & 0 & 0 & g_{27} & g_{28} \\ g_{31} & g_{32} & 1 & 0 & 0 & 0 & g_{37} & g_{38} \\ g_{41} & g_{42} & 0 & 1 & 0 & 0 & g_{47} & g_{48} \\ 0 & g_{52} & 0 & 0 & 1 & 0 & g_{57} & g_{58} \\ 0 & 0 & g_{63} & 0 & 0 & 1 & g_{67} & g_{68} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & g_{78} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} RRR \\ RL \\ REPO \\ RES \\ LOAN \\ M2 \\ CPI \\ IP \end{bmatrix} = -G^{0}(L) \begin{bmatrix} RRR \\ RL \\ R \\ RES \\ LOAN \\ M2 \\ CPI \\ IP \end{bmatrix} + \begin{bmatrix} e_{RRR} \\ e_{RL} \\ e_{REPO} \\ e_{RES} \\ e_{LOAN} \\ e_{M2} \\ e_{CPI} \\ e_{IP} \end{bmatrix}$$

Identification

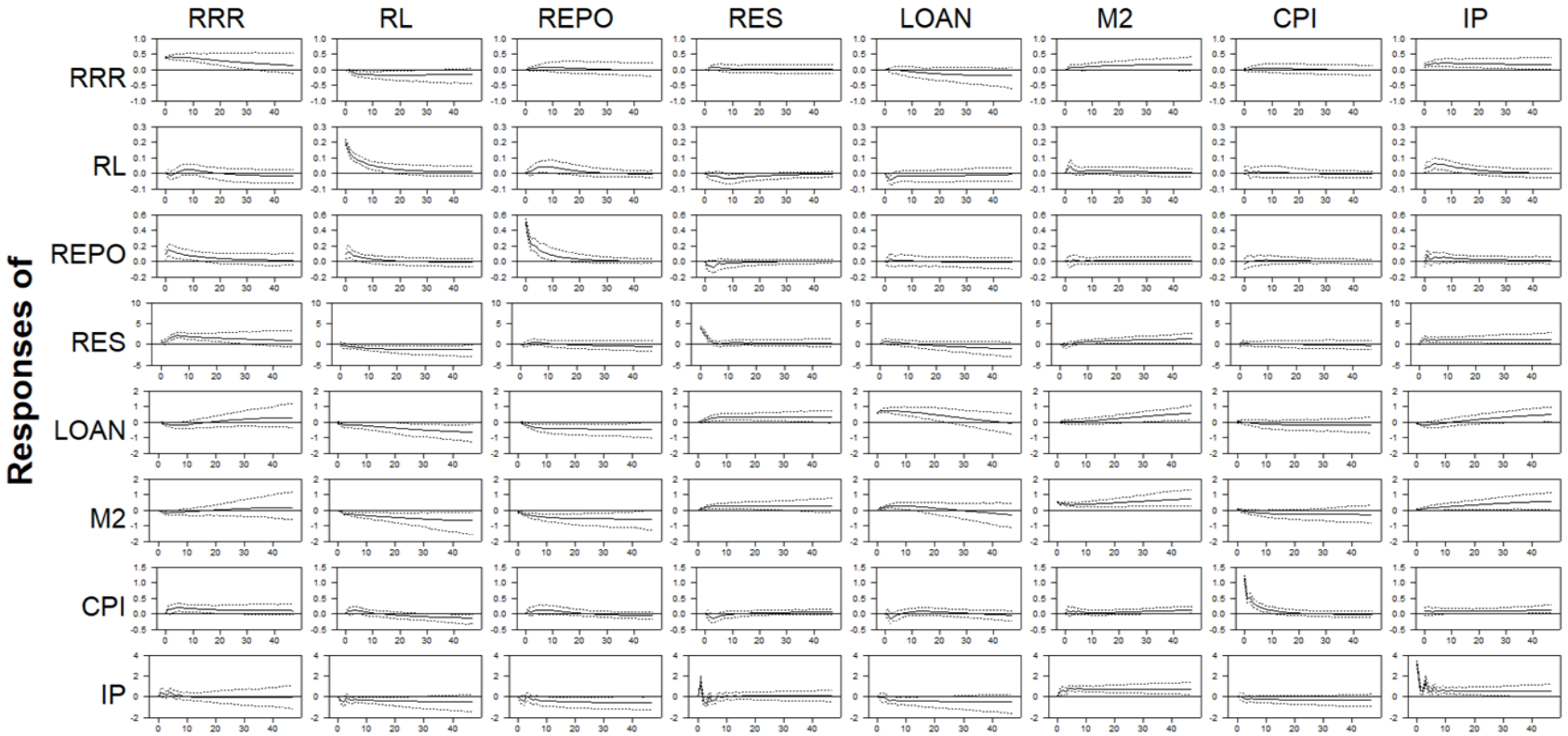
- The first three equations represent the monetary policy sector (policy reaction functions).
- In the first and the second equations, the monetary authority is assumed to set policy instruments after observing current and lagged values of two key macro variables (CPI and IP) and lagged values of all other variables in the model. Christiano, Eichenbaum, and Evans (1996, 1999)
- In the third equation, the monetary authority is assumed to set a 7-day repo rate after observing current values of reserve requirement ratio and lending rate in addition to CPI and IP. changes in policy instruments, including various repos and reverse repos from OMOs, other than reserve requirement ratio and lending rate are modeled in the third equation.
- The fourth equation shows how bank reserves are determined by commercial banks while the fifth and sixth equations show the demand (or equilibrium) for loan and M2 markets.
- The last two equations represent the sluggish real sector. Real activity is assumed to respond to monetary policy and liquidity variables only with a lag. Sims and Zha (2006), Kim (1999)

The Empirical Result

$$
\begin{bmatrix}
1 & 0 & 0 & 0 & 0 & 0 & -.017 & -.039^{**} \\
 & & & & & & (.023) & (.008) \\
0 & 1 & 0 & 0 & 0 & 0 & -.0165 & -.007 \\
 & & & & & & (.012) & (.004) \\
-.19^{*} & -.47^{**} & 1 & 0 & 0 & 0 & .035 & .016 \\
(.09) & (.18) & & & & & (.031) & (.011) \\
-1.37^{*} & .03 & 0 & 1 & 0 & 0 & .10 & -.034 \\
(.72) & (1.28) & & & & & (.24) & (.090) \\
0 & .25 & 0 & 0 & 1 & 0 & -.030 & .022 \\
 & (.20) & & & & & (.036) & (.013) \\
0 & 0 & .19^{**} & 0 & 0 & 1 & -.020 & -.008 \\
 & & (.07) & & & & (.033) & (.012) \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & -.030 \\
 & & & & & & & (.024) \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1
\end{bmatrix}
\begin{bmatrix} RRR \\ RL \\ REPO \\ RES \\ LOAN \\ M2 \\ CPI \\ IP \end{bmatrix}
= -G^{0}(L)
\begin{bmatrix} RRR \\ RL \\ R \\ RES \\ LOAN \\ M2 \\ CPI \\ IP \end{bmatrix}
+
\begin{bmatrix} e_{RRR} \\ e_{RL} \\ e_{REPO} \\ e_{RES} \\ e_{LOAN} \\ e_{M2} \\ e_{CPI} \\ e_{IP} \end{bmatrix}
$$

The Empirical Result

Figure 2. Impulse Responses in the Baseline Model



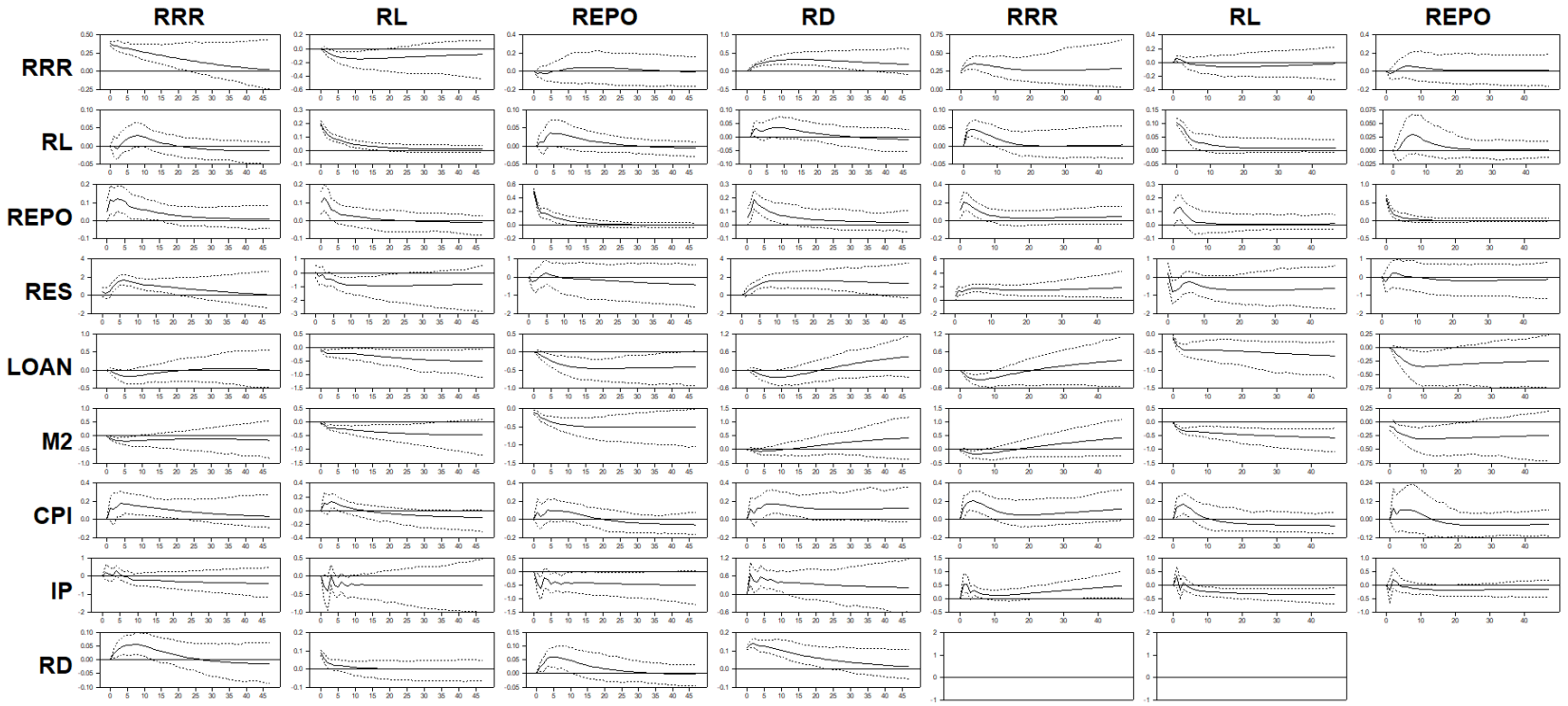
The Empirical Result

- Among three shocks to policy instruments, the REPO and RL shocks have stronger effects on loan, M2 and IP than RRR shocks. The negative effects of these two shocks on loan, M2 and IP are different from zero with more than 90% probability for most horizons up to four years. However, the effects of RRR shocks are relatively small and short-lived. In response to RRR shocks, significant declines in loan and M2 are found only in the short-run. Significant negative effects on IP are not observed at any horizon.
- Non-policy shocks, such as demand shocks, have substantial effects on loan and M2. This finding may suggest that controlling intermediate targets tightly at the desired levels may not be an easy task. In addition, The impulse responses of CPI to shocks to loan or M2 are not significant. This shows for controlling inflation purpose, the PBoC targets loan or M2 might not work. This also confirm Governor Yi's view that the link between these quantity variables to inflation is getting weaker. However, M2 still has significant impact on industrial production.

The Empirical Result

Figure 3: Impulse Responses in the Model with Deposit Rate and the Model for the period from 2005:8

Deposit Rate **From 2005:8**



The Empirical Result

- The model is extended to include deposit rate. It is assumed that IP, CPI and lending rate are allowed to contemporaneously affect deposit rate, whereas deposit rate is allowed to contemporaneously affect 7-day repo rate.

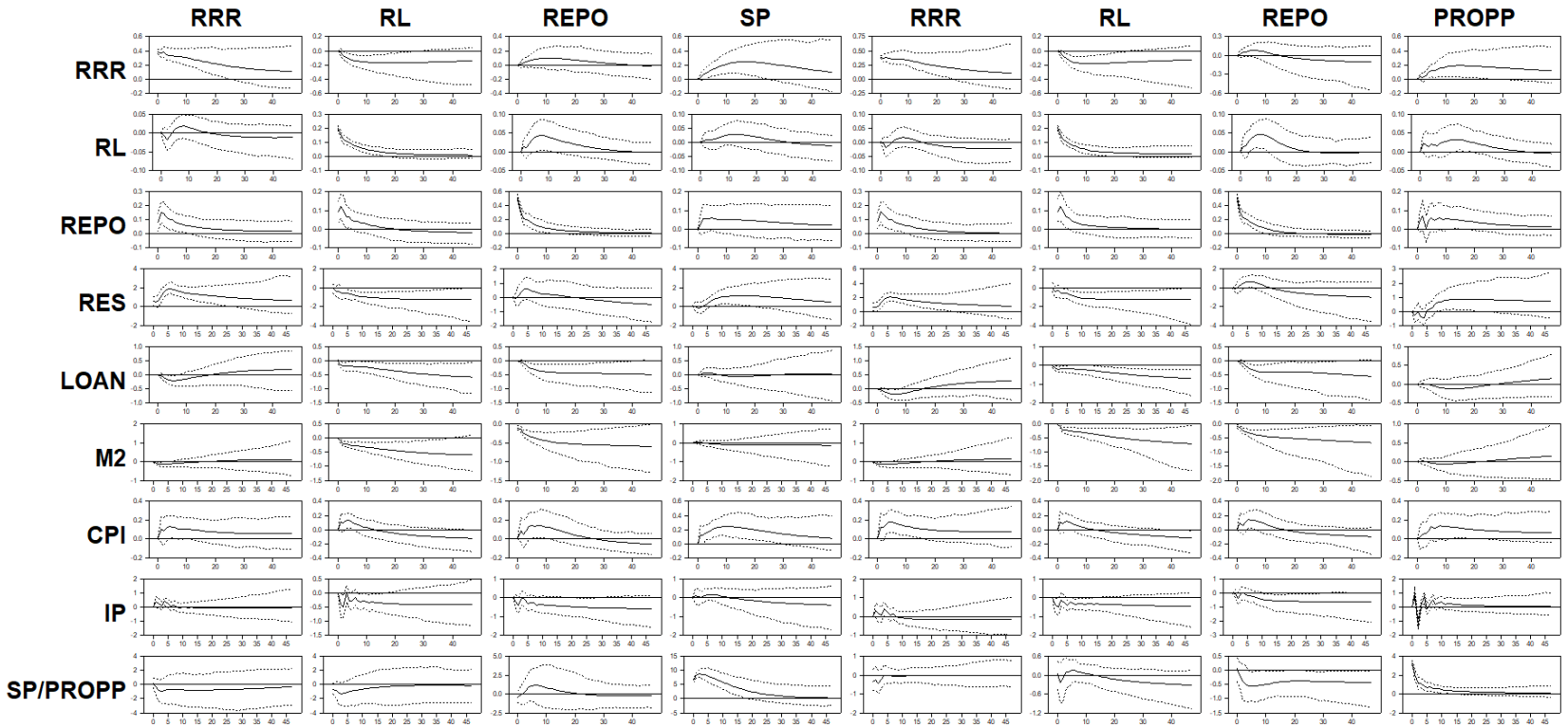
- Deposit rate shocks tend to increase reserves, loan, M2, CPI and IP over time. Given lending rates, an increase in deposit rate is likely to increase deposit and reserves, which may lead to increases in reserves and liquidity.

- The results using data after August 2005 are similar to the baseline model.

The Empirical Result

Figure 4: Impulse Responses in the Models with Stock Price and Property Price

Stock Price **Property Price**

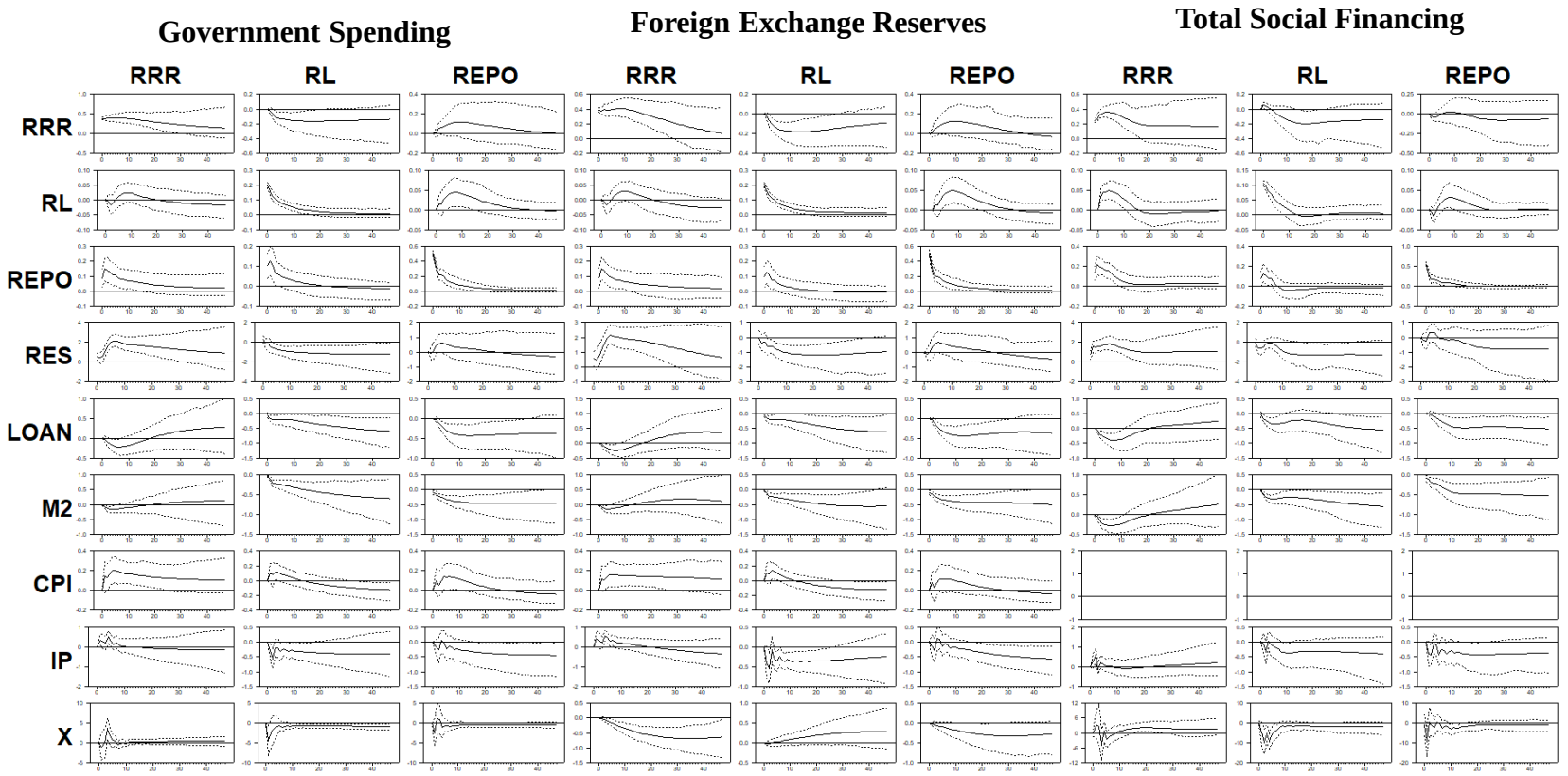


The Empirical Result

- In response to positive stock price shocks, three policy variables tend to increase but not significant, which may be interpreted as stabilizing attempts by the PBoC.
- The 7-day repo rate shocks have significant negative effects on property price for many horizons, but the other two shocks tend to have insignificant effects on property price.
- In response to positive property price shocks, three policy variables increase. This result may suggest that the PBoC has been trying to stabilize the housing market by adjusting these policy instruments.

The Empirical Result

Figure 5: Impulse Responses in the Model with Government Spending, Foreign Exchange Reserves, and Total Social Financing



The Empirical Result

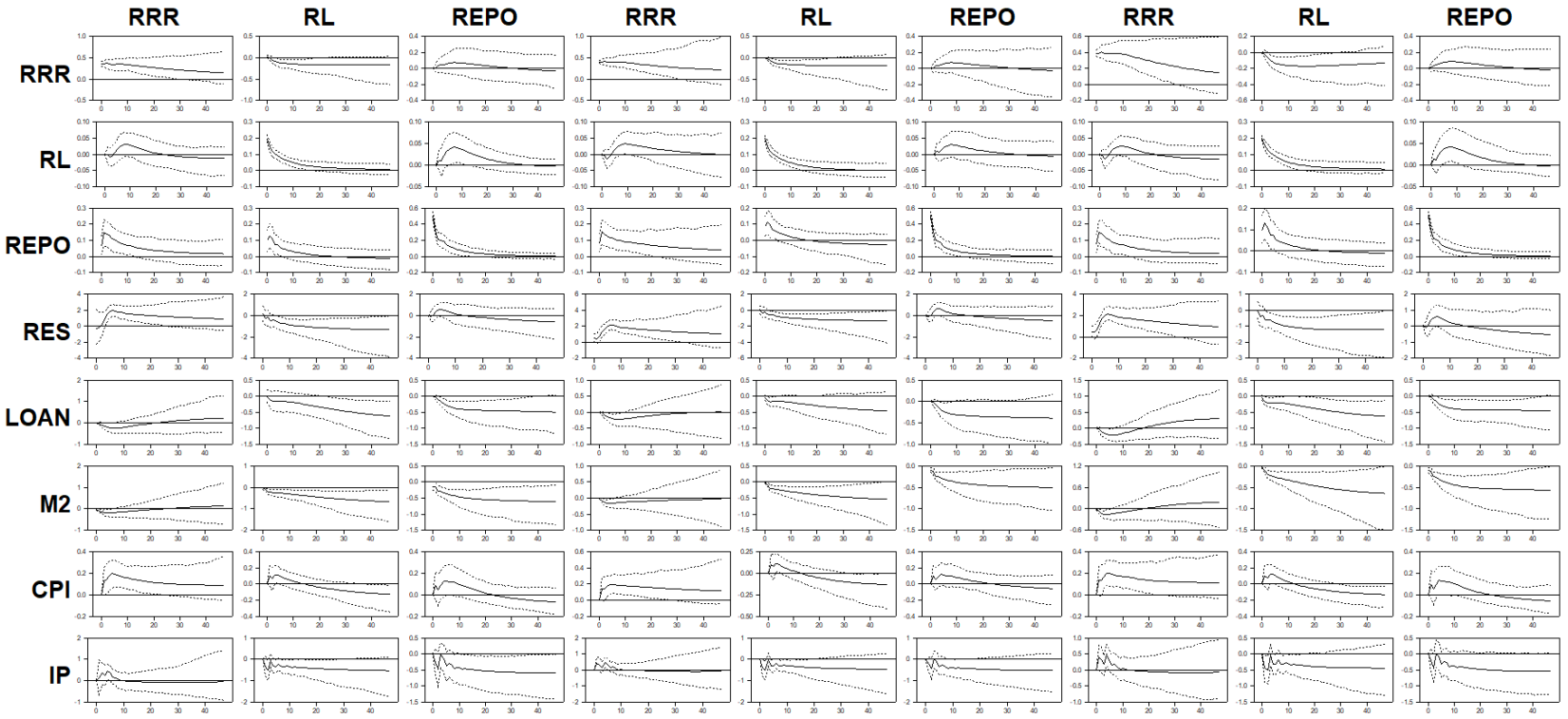
- We control for fiscal policy, foreign exchange reserve and total social finance

- The result are qualitatively similar to those of the baseline model

The Empirical Result

Figure 6: Impulse Responses for the Models with Alternative Identifying Assumption, Global Crisis Dummy, Interest Rate Liberalization Dummy

Alternative Identifying Assumption **Global Crisis Dummy** **Interest Rate Liberalization Dummy**

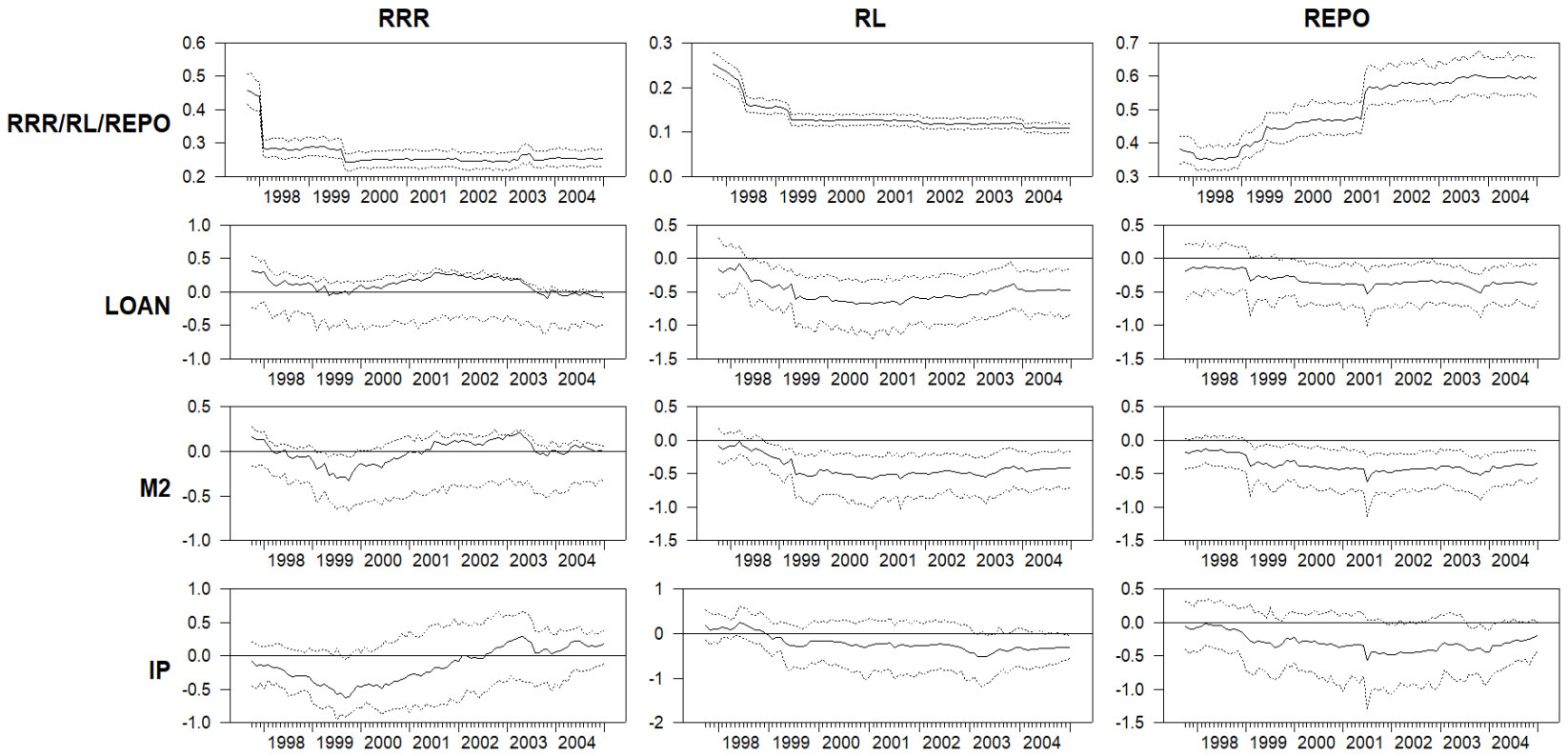


The Empirical Result

- we consider three additional cases: an alternative identifying assumption (monetary policy instruments are allowed to be contemporaneously affected by the corresponding liquidity measures), a global financial crisis dummy, and interest rate liberalization dummy. Figure 6 reports the results, which are similar to the results of the baseline model.

The Empirical Result

Figure 7: Rolling Regression: Impulse Responses over Various Sub-Sample Periods



The Empirical Result

- Rolling Regression: 12 year window

- These changes may reflect changes in monetary policy framework in China. As China shifts from a quantity to an interest rate-based framework, the effects of changes in policy interest rates on the economy become stronger.

Conclusion 1

- This study constructs a structural VAR model that explicitly considers interactions of a variety of policy instruments and liquidity measures, to analyze the effects of various monetary policy instruments in China, such as reserve requirement ratio, benchmark lending and deposit rates, and short-term interest rate.
- The effects of the benchmark lending rate and the short-term interest rate on output as well as liquidity measures, such as loan and M2, are stronger than those of reserve requirement ratio.
- The PBoC's transition to an interest rate-based policy framework in recent years may have increased the size and effect of short-term interest rate shocks.

Conclusion 2

- Third, the short-term interest rate has the strongest effect on property price. In recent years, the PBoC introduced the financial stability objective. This result, together with significant and persistent effects of the short-term interest rate shocks on loans, may suggest that an interest rate-based policy framework is likely to be more effective in achieving financial stability objectives than quantity-based policy framework.
- Overall, the empirical result supports the idea that a new interest rate-based policy framework seems more effective in achieving not only traditional macroeconomic objectives but also new financial stability objective.

Thank you