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Multiple Monetary Policy Instruments, Foreign Exchange Intervention, and Exchange Rate in China

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Abstract

This paper investigates the effects of monetary and foreign exchange policies on the exchange rate in China. In the empirical model, a multiple number of monetary and foreign exchange policy instruments, such as the short-term interest rate, reserve requirement ratio, lending and borrowing rates, and foreign exchange intervention, are considered to describe Chinese monetary and foreign exchange policy properly. In addition, the interactions among these instruments and their interactions with the exchange rate are modelled carefully to analyze the effects of monetary and foreign exchange policies on the exchange rate properly.

The main findings are as follows. First, (contractionary) monetary policy shocks lead to the exchange rate appreciation, which is statistically significant. It is particularly interesting that shocks to all popular monetary policy instruments, such as the short-term interest rate, reserve requirement ratio, lending and borrowing rates, have significant effects on exchange rate. Second, shocks to foreign exchange interventions have limited effects on the exchange rate. Shocks to foreign exchange interventions have significant effect on the exchange rate in the short-run at best, but not in the long run. Even a persistent (or permanent) foreign exchange intervention has a temporary effect on exchange rate. In addition, a temporary foreign exchange intervention does not have any significant effect on exchange rate. Sterilisation is likely to explain the limited effect of foreign exchange intervention on the exchange rate. The trend of exchange rate movements may mostly be determined by economic fundamentals, not by foreign exchange intervention, especially sterilised one. The presence of capital controls might be related to the weak effect.

Keywords: Monetary Policy, Foreign Exchange Policy, Exchange Rate, China, Multiple Policy Instruments

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1. Introduction

There have been growing empirical studies on monetary policy and foreign exchange intervention/policy in China. However, most past studies analyze two policies in a separate framework. On the one hand, some studies analyzed the effect and the conduct of monetary policy in China, for example, He and Pauwels (2008), Xiong (2012), Shu and Ng (2010), Sun (2015), Chen, Higgins, Waggoner, and Zha (2016), He, Leung, and Chong (2013), and Fernald, Spiegel, and Swanson (2014), Chen, Chow and Tilmann (2017), and Kim and Chen (2019). On the other hand, other studies discussed foreign exchange intervention/policy and the exchange rate, for example, He (2007), Lin (2010), Chenjia (2006), Qiming (2008), Zhang and Zuohong (2004), and Goldstein and Lardy (2006).

However, monetary and foreign exchange policy/intervention and the exchange rate are inter-related and should be analysed together. Foreign exchange intervention and monetary policy interact with each other. For example, foreign exchange intervention may affect monetary policy variables if it is not fully sterilised. In addition, foreign exchange intervention may signal future changes in monetary policy stance. Therefore, the effects of foreign exchange intervention need to be analysed jointly with the conduct of monetary policy. Similarly, monetary policy may affect foreign exchange intervention since monetary policy affects the exchange rate and foreign exchange intervention may respond to it in order to stabilize the exchange rate. Therefore, foreign exchange intervention needs to be modelled explicitly in order to clearly infer the effects of monetary policy on exchange rate. In addition, the conduct of both monetary and foreign exchange policies should be analyzed together to properly infer the exchange rate stabilization, because both policies can be used to stabilize the exchange rate.

In the case of China, when the PBoC conducts monetary policy, it often takes into consideration its impact on the exchange rate seriously. In essence, the exchange rate is one of its

monetary policy targets. For example, when the Fed changes the federal funds rate, in many occasions the PBoC followed with an interest rate change to maintain the interest rate differential to keep the RMB/USD exchange rate stable. In 2008-2014, the exchange rate policy actually dominated the PBoC's monetary policy. With large capital inflows from the four rounds of QEs by the Fed, the PBoC conducted the exchange rate intervention and at the same timesterilized capital inflows through monetary policy instruments such as the required reserve ratio (RRR). In both 2005 and 2015, when the PBoC made major changes of RMB exchange rate, it had to use monetary policy to mitigate the negative effects of exchange rate shocks. With the gradual liberalization of China's capital account and managed exchange rate, monetary policy, exchange rate policy and exchange rate are getting more intertwined. Therefore, it is crucial to analyze the interactions among monetary policy, foreign exchange intervention, and the exchange rate in China.

This paper empirically investigates the effect and conduct of monetary and foreign exchange policies in China. To investigate such issues, some past studies such as Kim (2003, 2005, 2016) and Kim and Kim (2019) developed a structural VAR model that incorporate both monetary and foreign exchange policy instruments and exchange rate. However, the Chinese case is far more challenging because the PBoC uses multiple monetary policy instruments, such as the short-term interest rate, reserve requirement ratio, and lending and borrowing rates, in addition to the foreign exchange intervention (see Kim and Chen, 2019). This paper develops an empirical framework that can systematically analyze the effects of multiple monetary and foreign exchange policy instruments on exchange rate and their interactions by using structural VAR model with sign restrictions imposed on impulse responses (Uhlig, 2005).

By estimating the model, this paper addresses the following questions. What are the effects of various monetary policy instruments and foreign exchange intervention on the exchange

rate? Which policy instruments have the most significant effect on exchange rate? Are most foreign exchange interventions sterilized? Is the sterilized intervention effective? What are the responses of monetary and foreign exchange rate policies to the exchange rate? What are the relative roles of various monetary policy instruments, and foreign exchange policies in stabilizing the exchange rate? What is the interaction among various monetary and foreign exchange policy instruments? Does foreign exchange intervention signal monetary policy in the future? Does monetary policy lead foreign exchange policy?

Section 2 discusses the conduct of monetary and foreign exchange policies and the interactions among various monetary and foreign exchange policy instruments and exchange rate in view of policy frameworks of the PBoC. Section 3 develops an empirical model for analysis. Section 4 reports the empirical results. Section 5 summarizes the empirical findings with policy implications.

2. Interactions of Monetary and Foreign Exchange Policy and Exchange Rate in China

The PBoC has always taken into consideration of the impact on the RMB exchange rate when conducting monetary policy. Traditionally, exchange rate is an important part of the monetary policy for an emerging market economy such as China. Most of the time, the PBoC has been trying to keep a stable exchange rate. The RMB US dollar exchange rate was fixed for more than 10 years from January 1994 to July 2005, before the PBoC started to let it gradually appreciate until January 2014. Within that period, the PBoC even managed to keep it stable during the Asian financial crisis in 1997-1998. After January 2014, the RMB gradually depreciated. In August 2015, in order for RMB to join the SDR basket, the PBoC engineered a one-time depreciation of 2%, which

set off a fast depreciation episode with a loss of foreign exchange reserve of about US$1 trillion within a year. In order to maintain a stable exchange rate, the PBoC has to intervene in the foreign exchange market from time to time. With the gradual liberalization of cross-border capital movement, the intervention sometimes was quite intensive, especially during the period of global financial crisis. With four rounds of QE by the Fed and the Fed fund rate close to zero for such a long period of time, the PBoC accumulated more than four trillion US dollar foreign exchange reserve by 2014. After that, with the gradual normalization of the Fed's monetary policy, the RMB exchange rate started to depreciate. The PBoC had to sell its foreign exchange reserve to slow down the RMB depreciation.

The RMB US dollar exchange rate is not only influenced by economic fundamentals such as current account surplus, cross-border capital flows, and monetary policy but also China-US economic policy negotiations. The US treasury would always like to push for RMB US dollar exchange rate appreciation. This provides a context for exogenous shock to exchange rate in our analysis. Of course, other factors such as RMB internationalization, trade shocks, demand and supply shocks in foreign exchange market can also be sources of exogenous exchange rate shocks. The PBoC's foreign exchange intervention is always trying to counter the market trend. This is also true in general for other central banks. If the market trend is driven by fundamentals, the impact of foreign exchange intervention is likely short-lived, or even not significant at all. This was true for the July 2005 RMB exchange rate regime change, and also truefor the August 2015 RMB exchange rate reform. In 2005, after China entered WTO, the economy had consistently run large current account surplus, the exchange rate faced appreciation pressure, the PBoC had to keep on accumulating foreign exchange reserve to slow down the RMB

appreciation. At the same time, the RMB US dollar exchange rate had appreciated for about ten years. This trend was reinforced by the Fed's QE during the global financial crisis. In 2015, with the Fed's monetary policy normalization and the slowdown of the Chinese economy, the RMB faced depreciation pressure, it cost the PBoC around 1 trillion US dollar in foreign exchange reserve to counter the RMB depreciation pressure. However, the RMB kept on depreciating. The PBoC eventually had to tighten the capital control. In the empirical analysis of the following sections, the accumulated foreign exchange purchase of the PBoC is used as a measure of the PBoC's foreign exchange intervention.

China had fully liberalised its current account and foreign direct investment (FDI) by 1996. Ever since then, the PBoC has gradually liberalised the capital account with the goal of eventual full capital account convertibility. This gradual capital account liberalization implied that the RMB exchange rate was increasingly affected by short-term capital flows. With the exchange rate stability as one of its objectives, this meant that PBoC faced constraints when making the monetary policy decisions and when choosing the monetary policy instruments. Therefore, monetary policy, foreign exchange intervention and exchange rate are inter-related. The main considerations are the following: when the PBoC adjusted policy rates such as benchmark deposit or lending rate, repo rate, it needed to keep the interest rate differential between domestic RMB interest rate and overseas US dollar interest rate in mind to avoid excessive cross- border capital flows and volatile exchange rate movement. Facing large capital inflows during the global financial crisis, the PBoC had to accumulate a large amount foreign reserve in a short time. Otherwise, the RMB exchange rate would appreciate dramatically. At the same time, the PBoC had to raise RRR to sterilize the money supply. The RRR was raised

to a historical high of 21% for large banks in 2011. To a certain extent, the exchange rate stability concern dominated the monetary policy consideration during global financial crisis. Other monetary policy instruments were used mainly to stabilise the monetary condition that was disrupted by large capital inflows during this period.

In the following section, we will analyse the interactions of different monetary policy instruments, foreign exchange intervention and exchange rate in structural VAR framework.

3. Empirical Model

To identify exogenous shocks to various monetary and foreign exchange policy instruments and examine their effects on the exchange rate, we employ structural VAR models with sign restrictions imposed on impulse responses (Uhlig 2005). Past studies on the effects of monetary policy often found puzzling responses (e.g. liquidity and the price puzzles).[1] By imposing proper sign restrictions on impulse responses, several puzzling responses can be eliminated by construction. The identification strategy that uses sign restrictions on impulse responses is appealing because puzzling responses are often regarded as failures in identifying proper monetary policy shocks. The methodology is extended to identify multiple structural shocks in some studies such as Mountford and

[1] An exogenous monetary expansion (contraction) is supposed to increase (decrease) monetary aggregates and price levels and decrease (increase) interest rates. However, in a model that uses innovations in broad monetary aggregates as monetary policy shocks, both monetary aggregates and interest rates increase. This phenomenon is called the "liquidity puzzle." On the other hand, in a model that uses innovations in interest rates as monetary policy shocks, both interest rates and price levels increase. This phenomenon is called the "price puzzle." These puzzles are often regarded as indications that exogenous shocks to monetary policy are not properly identified in the model. Sims (1992), Christiano, Eichenbaum, and Evans (1999), and Kim (2013) have provided a survey of the literature.

Uhlig (2009) by imposing sign restrictions on impulse responses and orthogonality restrictions among structural shocks. Following Mountford and Uhlig (2009), we impose sign restrictions on impulse responses and orthogonality restrictions among structural shocks to identify multiple shocks to policy instruments.

In the baseline model, we identify shocks to two most important monetary policy instruments of China, RRR and the short-term interest rate, in addition to shocks to foreign exchange intervention, to analyze the effects of these policy instruments on exchange rate and their interactions.

The data vector for endogenous variables is (RRR, REPO, M2, CPI, IP, ERA, FXP), where RRR is the required reserve ratio, REPO is the 7-day repo rate R007, M2 is used as a monetary aggregate, CPI is the consumer price index, and IP is the industrial production index, ERA is the exchange rate against the U.S. dollars, and FXP is accumulated foreign exchange purchase. The Federal Funds rate (FFR) and VIX are also included as exogenous variables.

Three policy instruments (RRR, REPO, and FXP) are included in the model, to identify shocks to these three policy instruments. For domestic monetary policy instruments, two most popular instruments, RRR and REPO are considered.[2] We also consider foreign exchange policy instrument, FXP. A liquidity measure, M2 has been an important intermediate target of the PBoC, which is also included to help identify monetary policy shocks. In addition, two key macro variables representing output and the price level (IP and CPI) are included because they are the main objectives of monetary

[2] Kim and Chen (2019) provides detailed explanations on these two most popular instruments of China. Kim and Chen (2019) also explains that the 7-day repo rate can represent the short-term interest rate policy instrument of China since 1990s.

policy. Finally, ERA is included since we are interested in the interactions among policy instruments and the exchange rate. We include the Federal Funds rate because the U.S. monetary policy and the interest rate likely affect the exchange rate of the RMB against the U.S. dollars. We treat FFR as an exogenous variable and allow FFR to affect all endogenous variables contemporaneously. VIX represents uncertainty and riskiness in international financial market and likely affects the exchange rate against the US dollars. We also include VIX as an exogenous variable.

Table 1 summarizes the sign restrictions imposed in the baseline model. First, as in previous studies such as Uhlig (2005), two (contractionary) monetary policy shocks are assumed to increase the monetary policy instrument (RRR or REPO) and decrease a monetary aggregate (M2) and the price level (CPI).

Foreign exchange intervention and foreign exchange market shocks are also identified. Foreign exchange intervention can affect the exchange rate but foreign exchange intervention can also react to the exchange rate changes. Therefore, a simultaneity between foreign exchange policy instrument (FXP) and the exchange rate (ERA) exists. To separate two types of shocks, we impose the following restrictions. Both FXP and ERA increase under foreign exchange intervention shocks, but ERA increases and FXP decreases under exchange rate shocks. That is, if the foreign exchange policy shock is an exogenous policy shock that increases FXP, it is unlikely to decrease ERA because foreign exchange purchase would not lead to appreciation of domestic currency. On the other hand, if foreign exchange policy does not destabilize the exchange rate, depreciation of exchange rate (an increase in ERA) would not lead to foreign exchange purchase (an increase in FXP) which would further depreciate the exchange rate.

By using these sign restrictions, shocks are identified in the following order. First, we identify RRR shocks, and then REPO shocks that is orthogonal to RRR shocks. Changes in reserve requirement ratio can affect the 7-day repo rate as the 7-day repo rate can reflect changes in market condition due to changes in reserve requirement ratio. Therefore, by first identifying RRR shocks and then REPO shocks orthogonal to RRR shocks, RRR shocks are more likely to reflect exogenous policy changes. Kim and Chen (2019) also used a similar identifying assumption when identifying two shocks together. Second, we identify FXP and ERA shocks that are orthogonal to RRR and REPO shocks. In this way, we can identify FXP and ERA shocks after controlling monetary policy shocks. Third, we identify FXP shocks that is orthogonal to ERA shocks. In this way, we can identify exogenous FXP shocks after excluding ERA shocks.

The model is estimated from August 2005 to December 2019 by using monthly data. Three lags are assumed. Sign restrictions on impulse responses are imposed up to six month horizon. For FXP, we use the data on the accumulated foreign exchange purchase in terms of U.S. dollars. For FFR, we use the shadow rate constructed by Wu and Xia (2016) to take account of monetary policy actions under the zero lower bound. All variables are in the form of logarithms (multiplied by 100), except for RRR, REPO, and FFR. We follow Uhlig (2005) and Mountford and Uhlig (2009) to construct probability bands for impulse responses. Given that we follow the Bayesian inference, our statistical inference is not problematic in the presence of unit roots and cointegrating relations. Sims (1988) and Sims and Uhlig (1991) present a general discussion on Bayesian inference in the presence of unit roots and cointegration relations.

4. Empirical Results

4.1. Baseline Model

Figure 1 reports the impulse responses over 36 months with 90% probability bands. Each column shows the impulse responses to each shock. The names of shocks are denoted at the top of each column, and the name of each responding variable is displayed at the far left of each row. For easy comparison, the scales of the graphs are the same for each row.

In response to RRR shocks, the RRR increases to approximately 0.09% points on impact, further increases up to approximately 0.18% point in nine months, and decreases over time and back to the initial level in 30 months. The increase is different from zero with more than 95% probability up to fifteenth month horizons. REPO increases over time and the increase is different from zero with more than 95% probability from the sixth to sixteenth month horizons. That is, the other monetary policy instrument also shows a contractionary movement. M2 decreases persistently and the decrease is different from zero with more than 95% probability at all horizons. Decline in CPI is also different from zero with more than 95% probability in most horizons. The responses of IP are not different from zero with 95% probability at any horizons. This shows that RRR change mostly affects the liquidity in the banking system. The real effect of RRR change is not significant. For most of the sample period in our analysis, the banking system has ample excess reserve, which makes the RRR change less of a constraint.

In response to such contractionary RRR shocks, the exchange rate appreciates over time. The appreciation is different from zero with more than 95% probability from eleventh to twenty-sixth month horizon. The appreciation following contractionary RRR shocks is consistent with the prediction of most theories. FXP responses are not different

from zero with 95% probability at any horizons.

In response to REPO shocks, REPO increases initially by 0.2% point and back to the initial level in approximately 20 months. The increase in REPO is significant up to sixth month horizon. RRR tends to increase but the response is not different from zero with 95% probability at any horizons. The responses of other variable are similar to those to RRR shocks. M2 and CPI decline significantly. IP does not change significantly.[3] ERA decreases over time, and the decrease is different from zero with more than 95% probability from sixth to thirteenth horizons, which is consistent with the prediction of most theories. FXP tends to increase, which can be interpreted as exchange rate stabilization, but the response is not different from zero with 95% probability at any horizons

In response to foreign exchange market shocks, ERA increases and FXP decreases, which can be interpreted as exchange rate stabilization. A decrease in FXP would provide appreciation pressure to stabilize exchange rate depreciation. Other variables respond insignificantly to the exchange rate shock.[4]

In response to foreign exchange policy shocks, FXP increases by approximately 0.4%, further increases up to 0.8% in three months. The increase is different from zero with more than 95% probability at all horizons. ERA increases but the increase is significant only up to six months horizon, for which sign restrictions are imposed. This

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[3] . Again, the real effect of REPO shock is not significant. This result is also found in Chen, Chen and Gerlach (2013). REPO shock mainly affects liquidity interbank in the interbank market. The monetary transmission from interbank market to real activity may not be very effective or efficient in China.

[4] The impact of exchange shock to IP or CPI is not significant. There are various potential explanations. First, the exchange rate shocks can be combinations of various structural shocks that can affect IP or CPI in opposite directions. Second, exchange rate shocks are short-lived and small probably because during the sample period, the exchange rate has been stabilized substantially.

result suggests that effect of FXP on ERA is quite limited. Even when the foreign exchange purchase is very persistent or permanent as shown in the impulse responses, the effect on the exchange rate is short-lived without having any significant effects for any horizons beyond the restrictions.

There are some potential explanations on the weak effect of foreign exchange intervention on the exchange rate. Foreign exchange purchase is mostly sterilized, which may explain the limited effect. M2 does not change much and the responses of M2 are not different from zero with 95% probability at any horizons, which suggests that the foreign exchange intervention is indeed sterilised. The long-term exchange rate trends may be mostly determined by fundamentals and the foreign exchange intervention, especially sterilized one, may not change the trend. In addition, the presence of capital controls might be related to limited movements of capital flows and the exchange rate.

4.2. Extended Models

The baseline model is extended in various ways. First, we include an additional monetary policy instrument, the benchmark lending or deposit rates (RLEND or RDEP). The benchmark lending and deposit rates were the most significant rates for commercial loans and retail deposits until August 2019 when the difference between the effective and the benchmark rates widen with interest rate liberalization.[5] The baseline model already includes many variables, so we include each rate one by one and only two lags are assumed for endogenous and exogenous variables, to save the degree of freedom. To identify additional shock to RLEND (or RDEP), the following sign restrictions are imposed: RLEND (or RDEP) increases but M2 and CPI decrease. Identifying

[5] See Kim and Chen (2019).

assumptions on other shocks are the same as those in the baseline model. Table 2 summarizes the identifying assumption. Figures 2 and 3 report the results in the model with the benchmark lending and deposit rates, respectively. Shocks to deposit or lending rate appreciate the exchange rate significantly, as the other two monetary policy instrument shocks (RRR and REPO shocks) do.

Second, we change the identifying assumption for foreign exchange intervention shocks. In the base line model, we assume that both FXP and ERA increase under foreign exchange intervention shocks, but now we assume that only FXP increases. In our identification procedure, foreign exchange market shocks (that increases ERA but decreases FXP) are first identified, and then foreign exchange policy shocks are identified as an orthogonal shocks to the foreign exchange market shocks. Therefore, even without imposing any restrictions on ERA responses to foreign exchange policy shocks, foreign exchange market shocks are excluded from foreign exchange policy shocks and the simultaneity problem weakens. In addition, the effects of foreign exchange policy shocks on exchange in the short-run are significant by construction in the baseline model but we would like to analyze the effects of foreign exchange policy shocks on exchange rate without restricting the responses of ERA to foreign exchange policy shocks. Figure 4 reports the results. Now the effects of foreign exchange policy shocks on exchange rate are not different from zero with 95% probability at any horizons. This result may suggest that foreign exchange policy intervention does not have significant effects on exchange rate even in the short-run.

Third, we add the global financial crisis dummy (2008:9—2009:8) in the model to check the robustness of the results. The results are reported in Figure 5. The results are qualitatively similar to the baseline model.

Finally, we consider an alternative assumption on orthogonality of monetary and foreign exchange policy shocks. In the baseline model, we first identify RRR and REPO shocks and then identify exchange rate market and foreign exchange policy shocks that are orthogonal to RRR and REPO shocks. Now we first identify exchange rate market and foreign exchange policy shocks, and then identify RRR and REPO shocks that are orthogonal to exchange rate market and foreign exchange policy shocks.

Figure 6 shows the results for the model with baseline sign restrictions. Figure 7 shows the results for the model with alternative sign restrictions in which no sign restrictions are imposed on impulse responses of exchange rate to foreign exchange policy shocks. The results are similar to those with the baseline assumption on orthogonality of shocks. In particular, the effect of foreign exchange policy shocks on exchange rate is weak.

5. Conclusion

This paper investigates the effects of monetary and foreign exchange policy shocks on exchange rate in China by using a structural VAR model with sign restrictions imposed on impulse responses. In particular, we consider a multiple number of monetary and foreign exchange policy instruments to model Chinese monetary and foreign exchange policy properly, and allow interactions among them and their interactions with exchange rate in the model.

The main findings are as follows. First, monetary policy shocks have significant effects on the exchange rate in China. It is particularly interesting that all of popular monetary policy instruments, such as RRR, REPO, RLEND and RDEP, have significant effects on exchange rate. Second, foreign exchange interventions have significant effect

on the exchange rate in the short-run at best, but not in the long run. This result is notable in that such results are obtained under persistent (or permanent) foreign exchange intervention. Sterilization is likely to explain the limited effect of foreign exchange intervention on the exchange rate. The trend of exchange rate movements may mostly be determined by economic fundamentals, not by foreign exchange intervention, especially sterilized one. In addition, the presence of capital controls might be related to the weak effect.

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Table 1. Sign Restrictions on Impulse Responses: Baseline Model

	RRR	REPO	M2	CPI	IP	ERA	FXP
Monetary Policy Shocks 1 (RRR)	+		-	-			
Monetary Policy Shocks 2 (REPO)		+	-	-			
Foreign Exchange Market Shocks						+	-
Foreign Exchange Policy Shock (FXP)						+	+

Table 2. Sign Restrictions on Impulse Responses: Model with RLEND or RDEP

	RRR	REPO	M2	CPI	IP	ERA	FXP	RLEND or RDEP
M Policy Shocks 1 (RRR)	+		-	-				
M Policy Shocks 2 (RLEND or RDEP)			-	-				+
M Policy Shocks 3 (REPO)		+	-	-				
Foreign Exchange Market Shocks						+	-	
Foreign Exchange Policy Shock (FXP)						+	+	

Table 3. Sign Restrictions on Impulse Responses: Extended Model

	RRR	REPO	M2	CPI	IP	ERA	FXP
Monetary Policy Shocks 1 (RRR)	+		-	-			
Monetary Policy Shocks 2 (REPO)		+	-	-			
Foreign Exchange Market Shocks						+	-
Foreign Exchange Policy Shock (FXP)							+

Figure 1: Impulse Responses in the Baseline Model

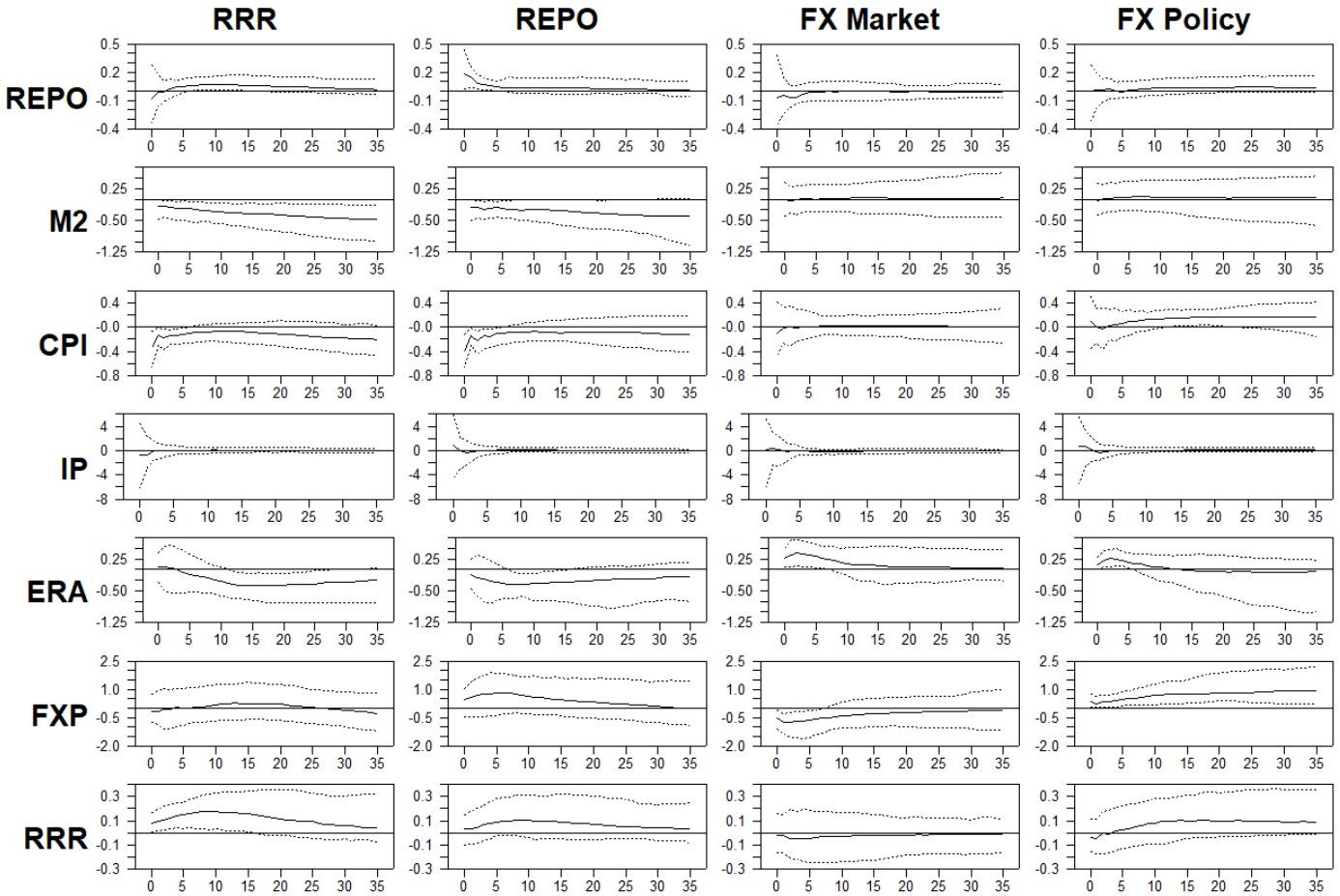

Figure 2: Impulse Responses in the Model with Lending Rate

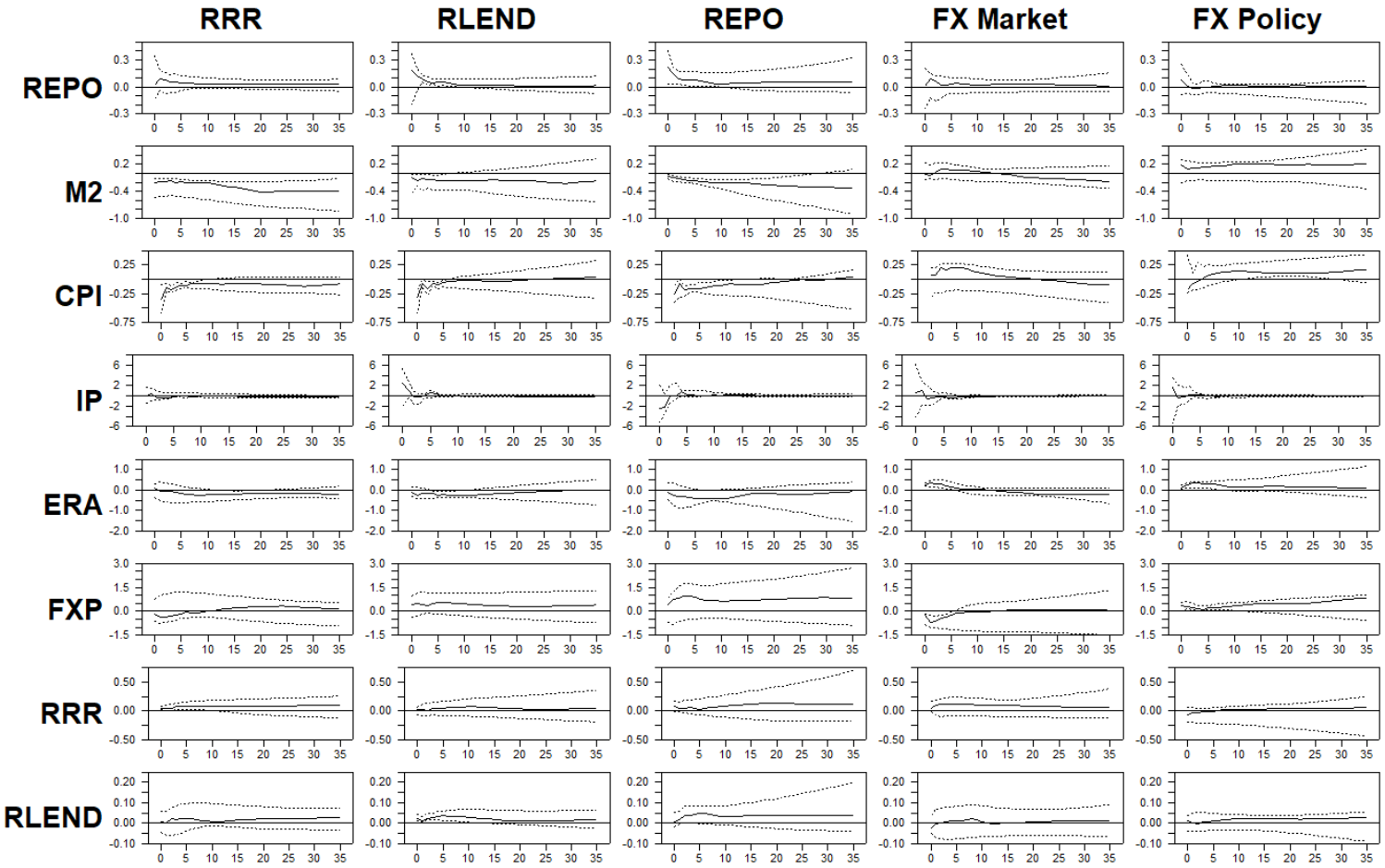

Figure 3: Impulse Responses in the Models with Deposit Rate

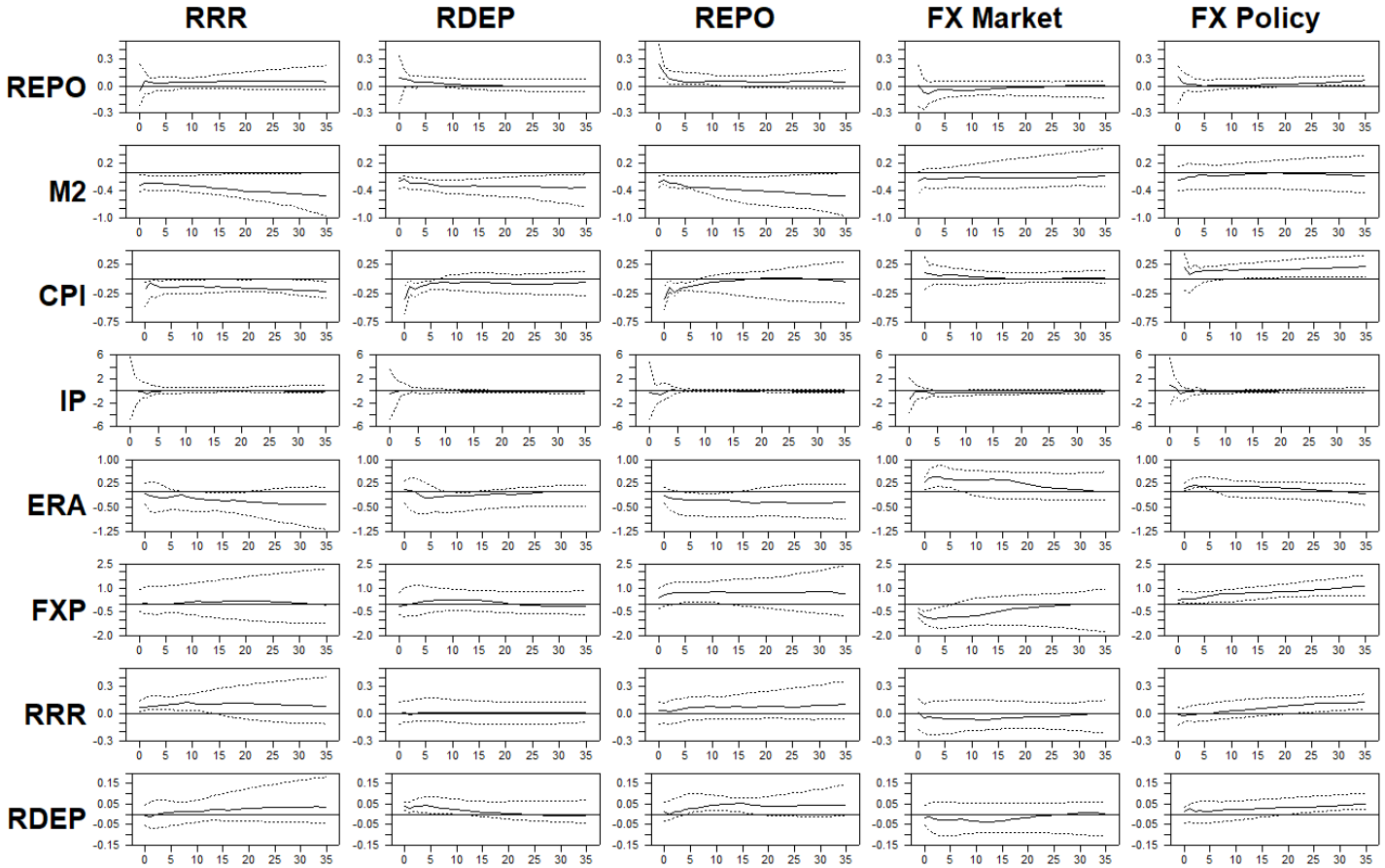

Figure 4: Impulse Responses in the Model of Alternative Identifying Assumption on Foreign Exchange Policy Shocks

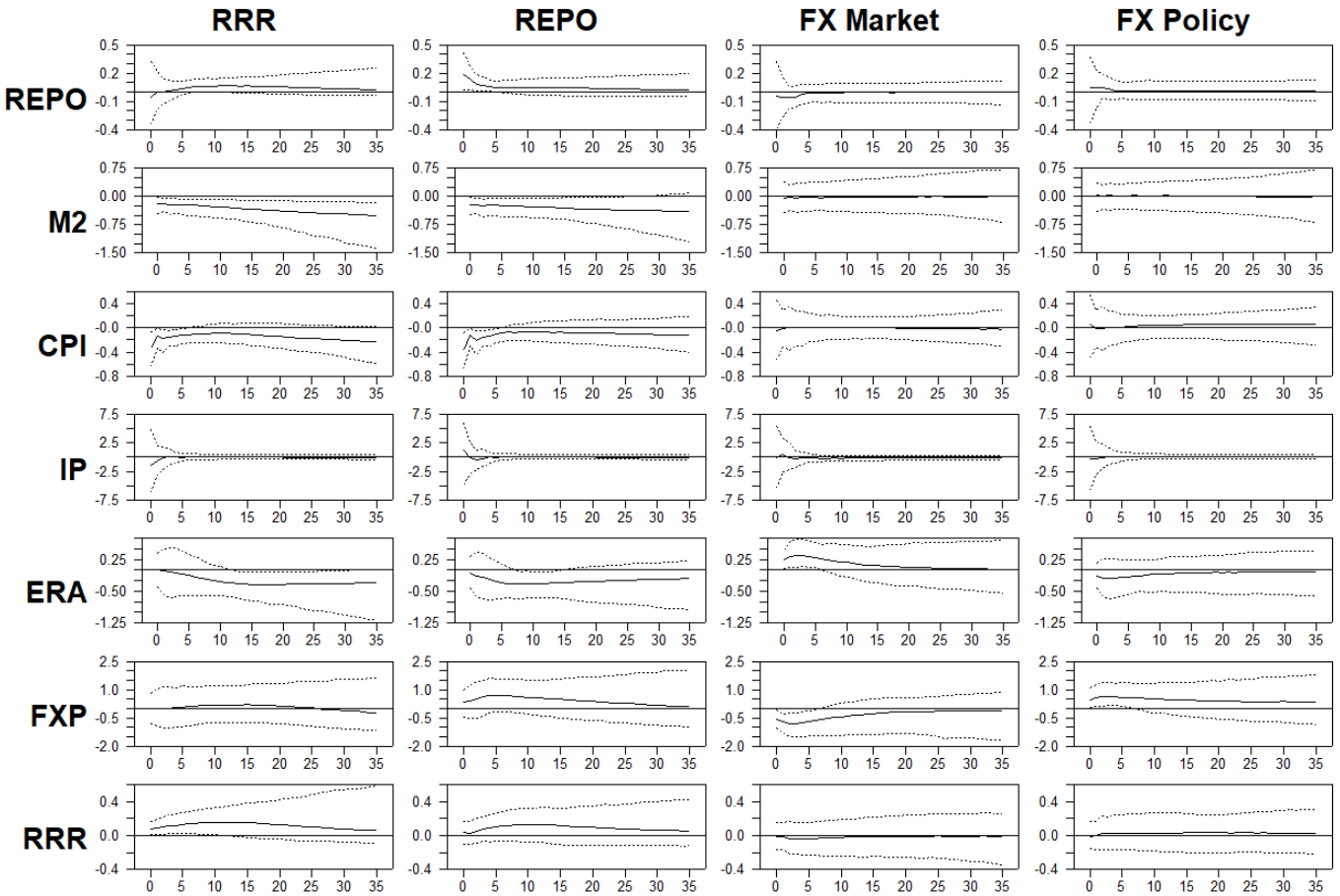

Figure 5: Impulse Responses in the Model with Global Crisis Dummy

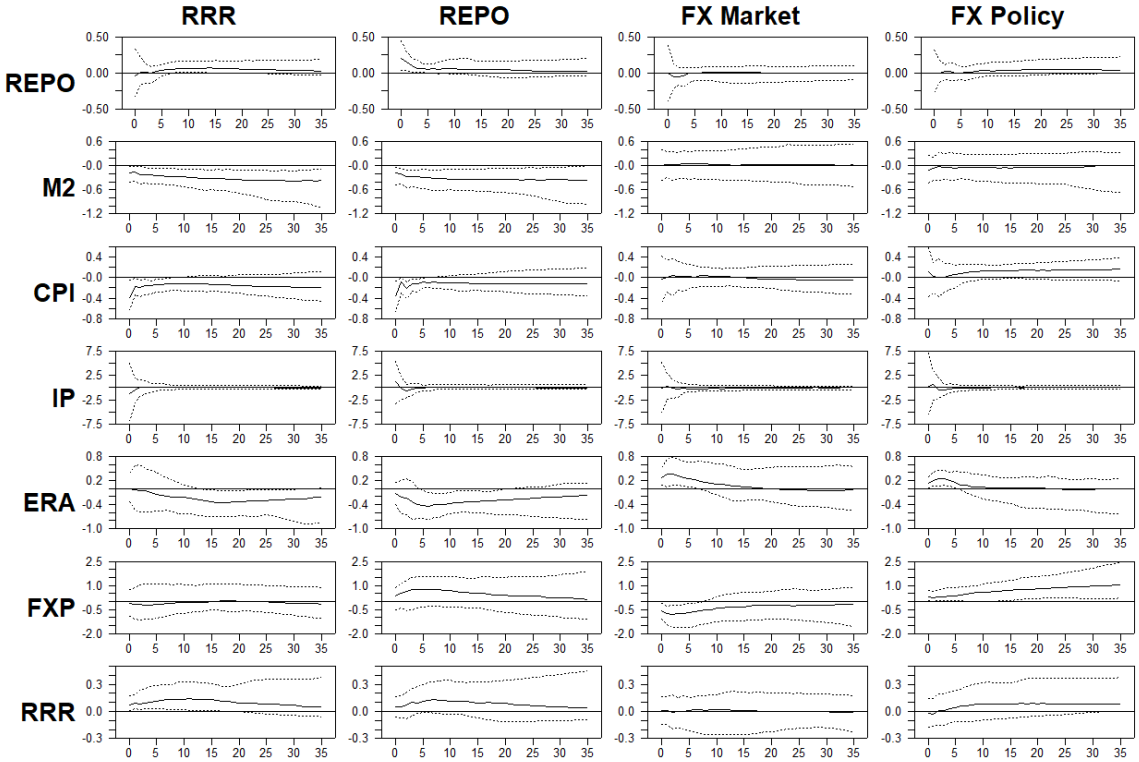

Figure 6: Impulse Responses in the Model with Alternative Orthogonality Assumption 1

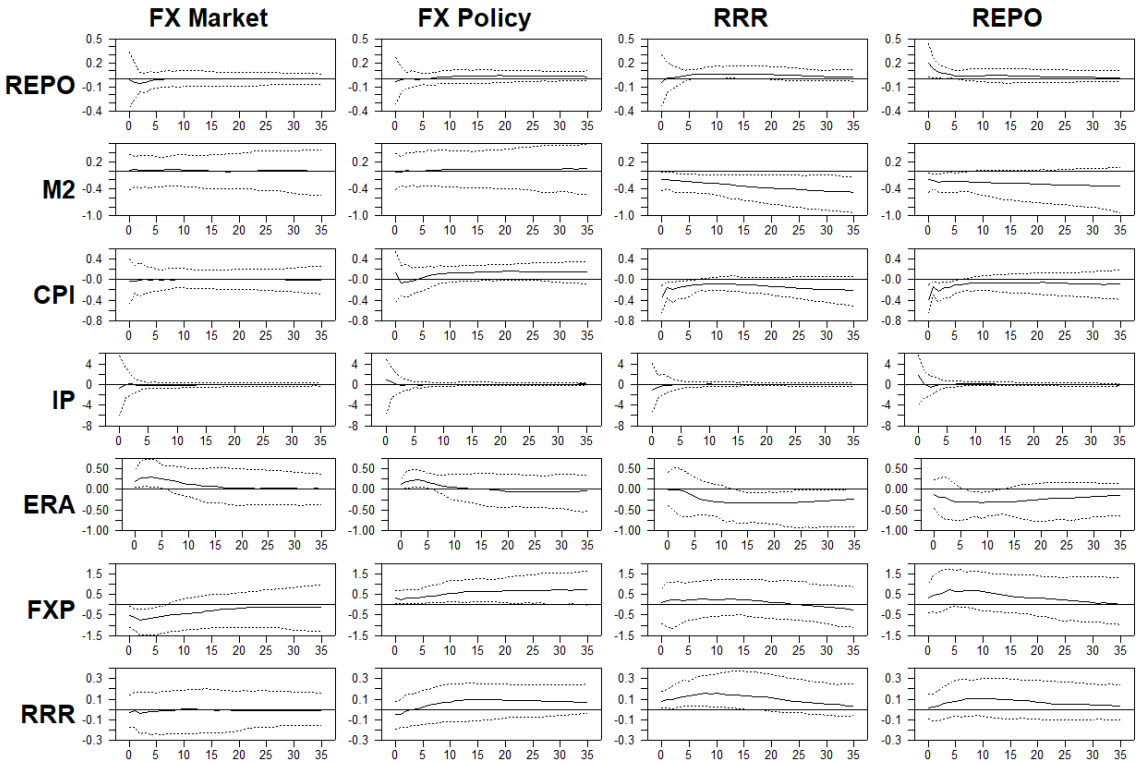

Figure 7: Impulse Responses in the Model with Alternative Orthogonality Assumption 2