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EMPIRICAL TESTING OF EXCHANGE RATE AND INTEREST RATE TRANSMISSION CHANNELS IN CHINA

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ABSTRACT

This paper examines the exchange rate and interest rate volatility transmission channels in China by applying Granger causality, Johansen cointegration, and the VAR model. Empirical results taken from the exchange rate channel favor the exchange rate and the Shanghai composite index return volatility pass-through in imports and exports; those taken from the interest rate channel favor the deposit and lending rates as well as the Shanghai composite index return volatility pass-through in PPI. Our empirical evidence supports the presence of exchange rate and interest rate transmission channels in China. By manipulating the exchange rate and through its monetary policy, the China government can cool down the country's overheating economy.

Keywords: Exchange rate channel, Interest rate channel, Volatility transmission, Granger, Cointegration, VAR.

JEL Classification: C22, C40, F30.

Contribution/Originality

The contribution of this paper by applying Granger causality, Johansen cointegration, and VAR model to examine the exchange rate and interest rate volatility transmission channels in China. Our empirical evidence supports the presence of exchange rate and interest rate transmission channels in China.

1. INTRODUCTION

Ever since 1978, China has been undergoing major economic reforms. China's monetary policy is playing quite a significant role in this process. Indeed, the monetary policy of China is one of the most important instruments for the Central Bank (CB) and the People's Bank of China (PBC) Monetary policy works through the exchange rate channel and interest rate channel. is upheld by

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the bank lending channel and the balance sheet channel. The asset price channel is the wealth effect of a monetary policy, and the expectation channel is determined by the rational expectations of the public (Sun *et al.*, 2010).

Koivu (2009) used a VEC model to study credit demand in China and found that interest rates have become a more important factor in the credit demand equation. Sun *et al.* (2010) applied VAR and VEC models to identify cointegrating relationships. VEC models suggest that there are long-run relationships between the indicators of China's monetary policy, bank balance sheet variables (deposits, loans, and bank securities), and real economic variables (output, CPI inflation, export, import, and foreign exchange reserves).Oskooe (2010) empirically investigated the causal links between stock prices and economic growth in Iran within the VEC model framework. The results from the Johansen cointegration test indicate that stock price movements in Iran are influenced by the level of real economic activities in the long run.

In this paper we chiefly investigate the exchange rate and interest rate channels in China. We identify and test the existence of an exchange rate channel, using Granger causality, Johansen cointegration, vector autoregression, and VAR model studies of the exchange rate and the Shanghai composite Index return pass-through in China's imports and exports.

The remainder of this paper is organized as follows. Section 2 describes the estimation methodology. Section 3 provides the data summary and empirical results, Finally, we draw our conclusions in Section 4.

2. DATA AND EMPIRICAL RESULTS

2.1. Data Summary

Our empirical analysis takes into consideration the exchange rate (ER), imports (IM), exports (EX), 1-year deposit rate (DR), 1-year lending rate (LR), Producer Price Index (PPI), and the Shanghai composite index return (SI). All data are given on a monthly basis and run from January 2000 to September 2009, except for the exchange rate, where the sample starts in July 2005 and runs to September 2009. Data are obtained from the Taiwan Economics Journal database. The Shanghai composite index is subsequently transformed into returns, with the returns defined in their logarithmic form as $SI_t = \ln(p_t/p_{t-1}) \times 100$, where p_t is the closing prices at time t.

Table 1 reports the preliminary statistics, which indicate that the values of skewness all exceed the normal value of zero, except those for ER, PPI, and SI. The Kurtosis statistics all exceed three, except for ER, IM, and EX. The Jarque-Bera tests reject normality for all variables.Table 1 presents the results from the ADF unit root tests for the level series and the first-difference series. For the first-difference series, the ADF tests show that all the first-difference series are stationary.

2.2. Granger Causality Tests

In order to explore the causal relationships between variables, we apply Granger (1969) causality, as shown in Table 2. We find unidirectional causality from ER to EX at the 10% level of significance, and from SI to EX at the 5% level of significance, implying that ER and SI affect EX and that the exchange rate transmission channels are present in China.

We also note unidirectional causality from LR to PPI at the 10% level of significance. At the 1% level, there is Granger causality PPI, implying LR and SI both affect PPI. For DR, at both the 1% and 5% levels of significance, SI Granger causes PPI, indicating that there is a feedback system between DR and PPI. This finding denotes that both DR andSI affect PPI, and that there are interest rate transmission channels in China.

2.3. Cointegration Tests

We conduct cointegration tests by means of the method developed by Johansen (1988) and Johansen and Juselius (1990). Table 3 summarizes the results from the Johansen cointegration test. In the trace and maximum eigenvalue tests, EX and SI are cointegrated in IM. This implies a long-run equilibrium relationship between EX and imports and one between SI and IM. Because EX, ER, and SI returns are cointegrated with EX in the trace and maximum eigenvalue tests, ER and EX have their own long-run equilibrium relationship, which implies the existence of exchange rate channels in China.

In the DR and SI return pass-through PPI, the trace and maximum eigenvalue tests are cointegrated with PPI. We find that both deposits and SI have a long-run equilibrium relationship with PPI. In the LR and SI pass-through PPI, both the trace and maximum eigenvalue tests are cointegrated with PPI, implying a long-run equilibrium relationship for both the LR and SI returns with PPI, as well as the presence of interest rate transmission channels in China.

2.4. Vector Autoregression (VAR)

Sims (1980) developed VAR in macro-econometrics. The VAR methodology provides a multivariate framework where changes in a particular variable are related to the autoregressive process of all dependent variables, as well as to the contemporaneous values of all exogenous variables.

2.4.1. Impulse Response Analysis

The impulse response function shows the dynamic behavior of a variable as given by its time path in response to exogenous random shocks and other variables. A sustained negative shock to the levels of ER and SIinduces a sustained decrease in the level of imports (Figure1). Figure2 illustrates that a sustained negative shock to the levels of ER andSI induces a sustained decrease in the level of EX. Our empirical results support the ER and SIpass-through in IM and EX, implying the presence of an exchange rate channel in China.

For the interest rate pass-through (Figure 3), we find that a 1.5-year positive shock converts to 0.5 years at the level of DR, thereby inducing a sustained decrease in the level of PPI, while a negative shock at the level of SI induces a sustained decrease in the level of PPI. It is evident from Figure 4 that a 1.5-year positive shock converts to 0.5 years at the level of LR, thereby inducing a sustained decrease in the level of PPI, while a negative shock at the level of SI induces a sustained decrease in the level of PPI. Our empirical results support the DR, LR, and SIpass-through in PPI, implying the presence of an interest rate transmission channel in China.

2.4.2. Variance Decomposition

Table 4 presents a variance decomposition analysis of this full VAR version for forecast horizons from one to ten months. In Panel A of Table 4, IM explains 100% of the forecast error variance for the change in IM in the first month. This percentage increases considerably and reaches 69.32 and 53.09% at the fourth- and sixth-month forecast horizons, respectively. For EX,Panel B shows that EX explains 100% of the forecast error variance for the change in itself in the first month. This percentage increases considerably and reaches91.23% and 87.01% at the fourth- and sixth-month forecast horizons, respectively. In Panel C of Table 4, PPI explains 89.07% of the forecast error variance for the change in PPI in the first month. This percentage increases considerably and reaches 72.60% and 69.58% at thefourth- and sixth-month forecast horizons, respectively. The change in the overall LR as a percentage of IM represents the second source of variation in PPI, hitting27.05% and 30.14% in the fourth- and sixth-month forecast horizons, respectively. At the fourth- and sixth-month horizons, the variances are 0.34% and 0.27%, respectively, in SI. In Panel D of Table 4, PPI explains 87.35% of the forecast error variance for the change in PPI in the first month. This percentage increases considerably and reaches 75.55% and 73.80% at the fourth- and sixth-month forecast horizons, respectively.

3. CONCLUSION

In this paper we have studied the exchange and interest rate pass-through channels in China. First, the Granger causality test results show that the exchange rate and the Shanghai composite index return have a causal effect on both imports and exports. As to the interest rate channel, the results show that the deposit rate, lending rate, and Shanghai composite index return have causal effects on PPI. Second, the results of Johansen’s cointegration show a long-run relationship between the exchange rate and exports. On the other hand, we also find that both the deposit rate and the Shanghai composite index have a long-run equilibrium relationship with the Producer Price Index. Third, in the impulse response function, a sustained negative shock to the level of the exchange rate and the Shanghai composite index return induces a sustained decrease in the level of imports and exports. A sustained positive shock to the level of the deposit rate, lending rate, and the Shanghai composite index return induces a sustained decrease in the level of PPI. On the other hand, in the variance decomposition, we note that the exchange rate affects the variance of imports and exports. The deposit and lending rates also affect the variance of PPI.

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Table1. Preliminary statistics and ADF test

Statistic	Exchange rate	Import	Export	1-year Deposit Rate	1-year Lending Rate	PPI	Stock Index Return
Mean	7.4435	51187.27	60677.99	2.4531	5.8485	102.1248	0.5079
Max.	8.1056	111412.0	136837.0	4.1400	7.4700	110.1000	24.2526
Mini.	6.8228	13428.00	14779.00	1.9800	5.3100	91.8000	-28.2780
S.D.	0.5091	27086.48	35340.49	0.6459	0.6594	4.0633	8.7391
Skewness	-0.0742	0.3894	0.4501	1.8280	1.4265	-0.5686	-0.6372
Kurtosis	1.3302	1.9969	1.9104	4.9523	3.9647	3.0345	4.3486
Jarque-Bera	5.9721	7.8620	9.7393	83.7440	44.2176	6.3100	16.7835
J-B probability	0.0505*	0.0197**	0.0077***	0.0000***	0.0000***	0.0427**	0.0002***
$L-BQ(10)$	72.3400***	32.4230***	33.6680***	35.1200***	36.6970***	99.4960***	22.0070**
$L-BQ^2(10)$	19.5920**	37.9690***	32.2980***	8.0902	8.0100	48.7780***	48.9000***
ARCH-LM	9.6376**	55.0308***	26.66370***	7.3874***	6.8007***	37.6864***	41.5780***
Level	-0.8698	-0.9522	-0.9778	-1.9080	-1.8717	-2.8344*	-5.2831***
First difference	-2.2130**	-12.4645***	-9.5342***	-6.4385***	-6.4934***	-4.4202***	-10.7849***
Sample Periods	2005/07/31-2009/09/30	2000/01/31-2009/09/30	2000/01/31-2009/09/30	2000/01/31-2009/09/30	2000/01/31-2009/09/30	2000/01/31-2009/09/30	2000/01/31-2009/09/30
Observation	51	117	117	117	117	117	117

Note: (1) S.D represents standard deviation; $L-BQ(k)$ and $L-BQ^2(k)$ are Ljung-Box statistics for the level and squared terms for autocorrelations up to k lags, respectively. The measures of skewness and kurtosis are normally distributedas N(0,6/T) and N(0,24/T), respectively, where T (=51 or 117) equals the sample size. (2) ***, **, *: statistically significant at the 1%, 5% and 10% levels,respectively.

Table2. Granger causality test

	Null Hypothesis	F-Statistic
	ER does not Granger cause IM	3.5418***
	IM does not Granger cause ER	0.7147
	SI does not Granger cause IM	3.2126***
	IM does not Granger cause SI	1.1945
	SI does not Granger cause ER	2.0471*
	ER does not Granger cause SI	0.9913
	ER does not Granger cause EX	2.2020*
	EX does not Granger cause ER	0.9958
	SI does not Granger cause EX	2.2218**
	EX does not Granger cause SI	1.0055
	IM does not Granger cause EX	8.1548***
	EX does not Granger cause IM	4.7760***
	LR does not Granger cause PPI	1.7508*
		Continue

	PPI does not Granger cause LR	1.4350
	SI does not Granger cause PPI	2.5223***
	PPI does not Granger cause SI	1.1411
	SI does not Granger cause LR	2.3099***
	LR does not Granger cause SI	1.4815
	DR does not Granger cause PPI	2.6479***
	PPI does not Granger cause DR	1.8585**
	SI does not Granger cause DR	1.9147**
	DR does not Granger cause SI	1.8980**
	LR does not Granger cause DR	1.6217*
	DR does not Granger cause LR	1.9558**

Note: ***, **, * indicatestatistically significant at the 1%, 5% and 10% levels, respectively.

Table3. Johansen cointegration test

	H_0	λ_{Trace}	λ_{Max}
Import-Exchange Rate-Stock Index	$\gamma = 0$	42.1792***	23.7363**
	$\gamma \leq 1$	18.4429**	16.3084**
	$\gamma \leq 2$	2.1345	2.1345
Export-Exchange Rate-Stock Index	$\gamma = 0$	62.3749***	48.5386***
	$\gamma \leq 1$	13.8363*	10.9180
	$\gamma \leq 2$	2.9184*	2.9184*
Deposit Rate-PPI-Stock Index	$\gamma = 0$	136.7896***	88.2358***
	$\gamma \leq 1$	48.5538***	29.8514***
	$\gamma \leq 2$	18.7024***	18.7024***
Lending Rate-PPI-Stock Index	$\gamma = 0$	135.9927***	88.1712***
	$\gamma \leq 1$	47.8215***	29.5708***
	$\gamma \leq 2$	18.2507***	18.2507***

Note: ***, **, *denote rejection of the hypothesis at the 1%, 5% and 10% levels,respectively.

Table4. Variance decomposition of exchange rate and interest rate channels

Panel A: Variance Decomposition of Import					**Panel B: Variance Decomposition of Export**				
Period	S.E	Import	Exchange Rate	Stock Index Return	Period	S.E	Export	Exchange Rate	Stock Index Return
1	6971.697	100.0000	0.0000	0.0000	1	10214.81	100.0000	0.000000	0.0000
4	10750.96	69.3233	12.9709	17.7059	4	15311.04	91.2291	8.1269	0.6440
6	12399.01	53.0910	26.1293	20.7797	6	16385.34	87.0123	12.4109	0.5768
8	14906.47	39.7505	32.7922	27.4574	8	17082.60	84.3976	15.0603	0.5421
10	15728.00	37.8341	33.6369	28.5290	10	17558.62	82.6346	16.8324	0.5330
Panel C: Variance Decomposition of PPI					Panel D: Variance Decomposition of PPI				
Period	S.E	PPI	Lending Rate	Stock Index Return	Period	S.E	PPI	Deposit Rate	Stock Index Return
1	0.5976	89.0739	10.9261	0.0000	1	0.6067	87.3512	12.6488	0.0000
4	2.3626	72.6006	27.0516	0.3478	4	2.3739	75.5546	24.0359	0.4094
6	3.2487	69.5849	30.1432	0.2719	6	3.2519	73.7981	25.8991	0.3028
8	3.8133	68.4864	31.2782	0.2354	8	3.8109	73.3485	26.4067	0.2448
10	4.1150	68.3283	31.4622	0.2094	10	4.1100	73.5061	26.2816	0.2223

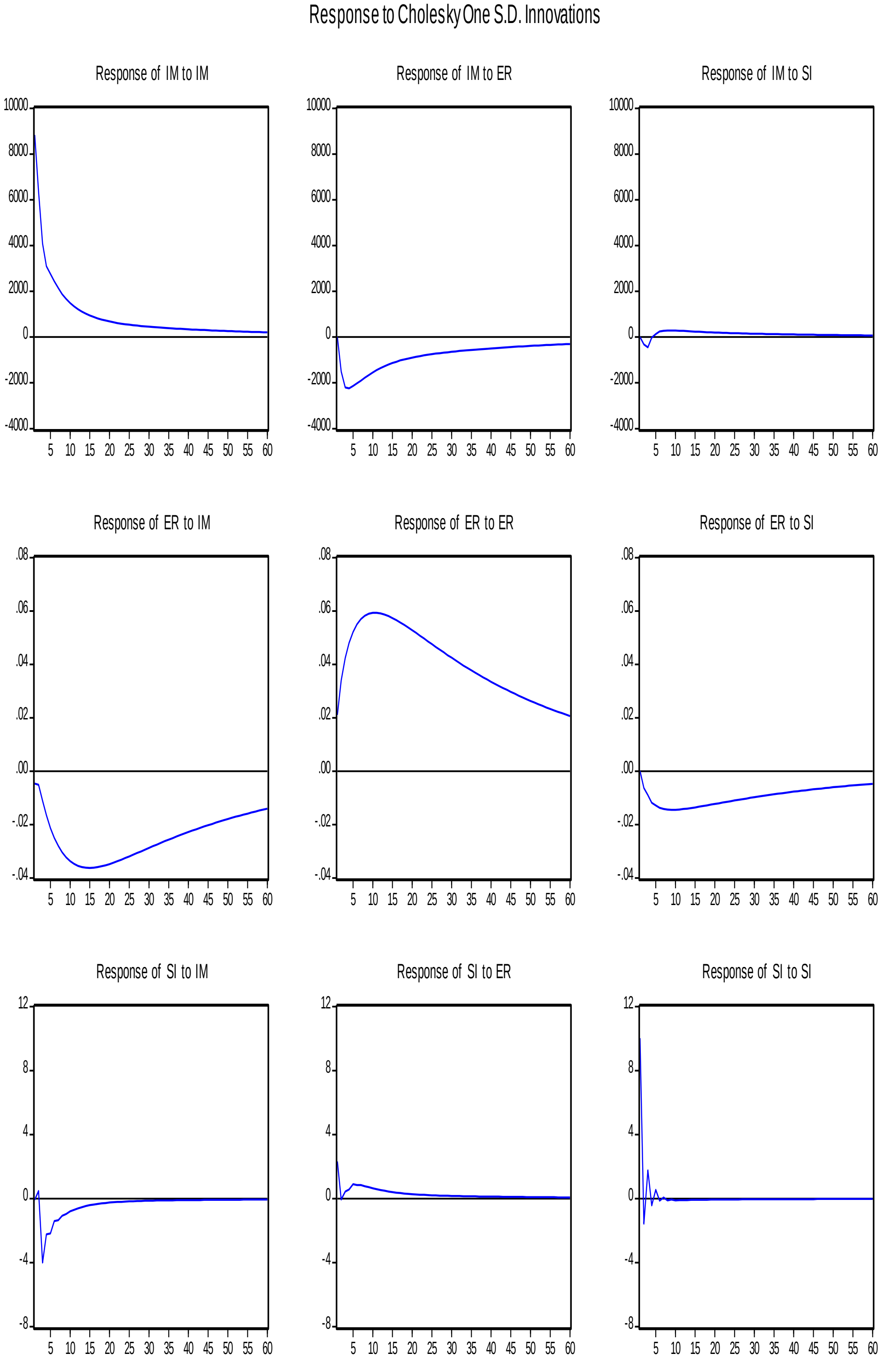

Figure-1. The impulse responses of China's imports, exchange rate, and Shanghai composite index return

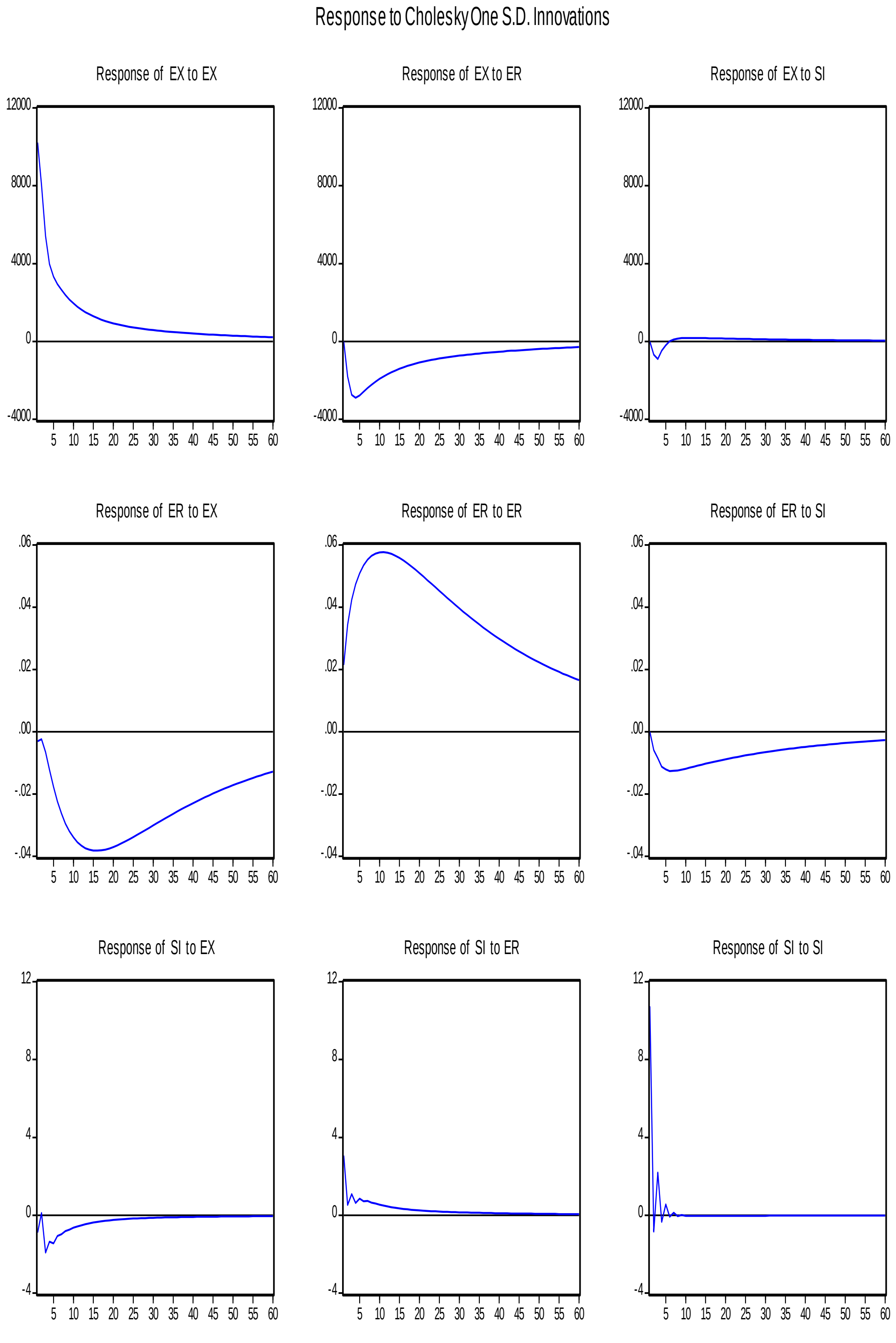

Figure-2. The impulse response of China's exports, exchange rate, and Shanghai composite index return.

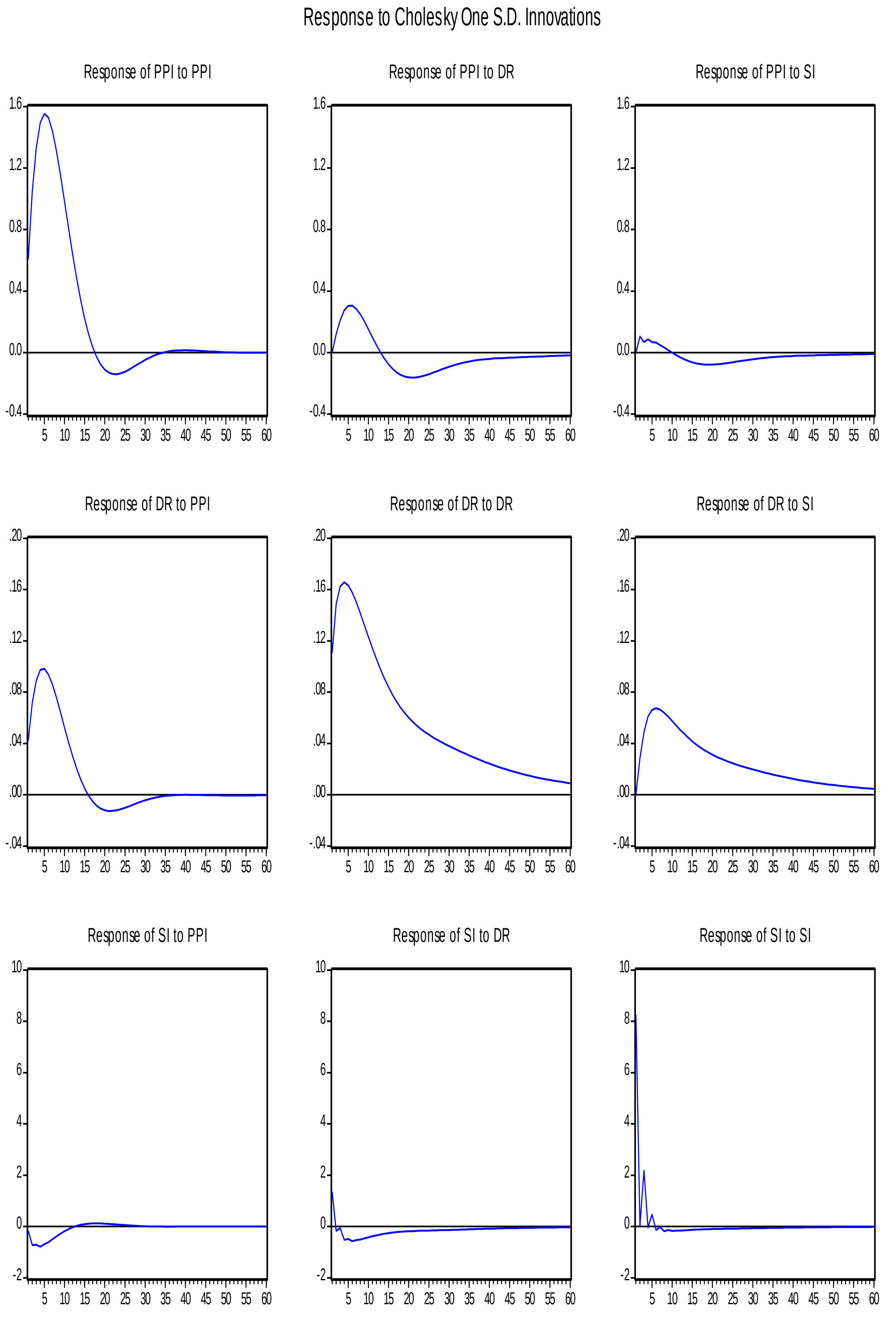

Figure-3. The impulse response of China's PPI, deposit rate, and Shanghai composite index return.

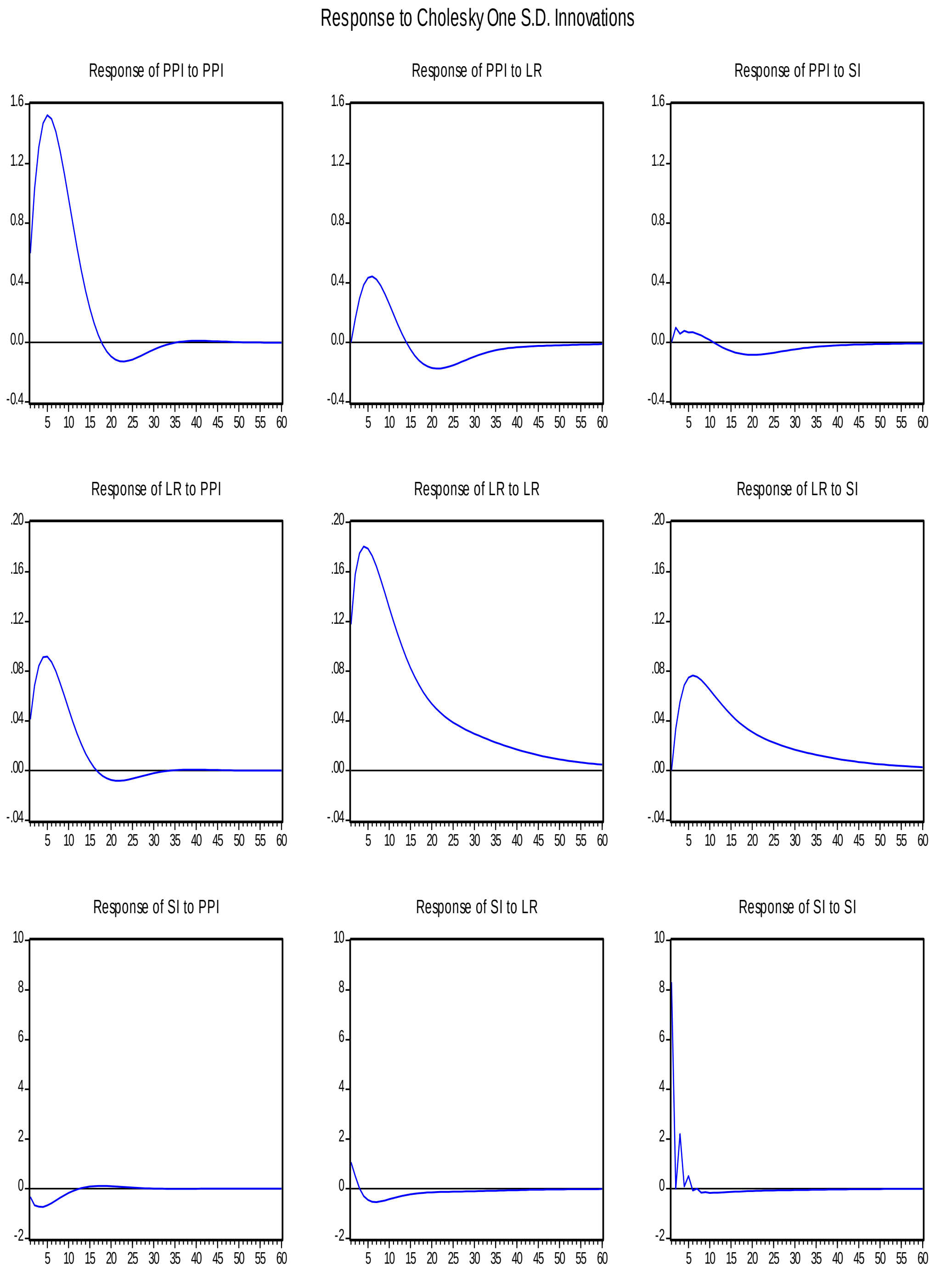

Figure-4. The impulse response of China's PPI, lending rate, and Shanghai composite index return.