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The Transmission of U.S. Monetary Policy Shocks to the China's Output and Inflation: An Empirical Analysis

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Abstract

We employ the SVAR model to examine the impact of U.S. monetary policy shock on the Chinese real output and inflation. Our main result shows that the effect of transmission of short-term international capital flows is stronger than the balance of trade and the world commodity prices index. The exchange rate of RMB has the weakest transmission effect. Expansionary monetary policy shocks of the United States will increase real output and consumer price index of China and the United States; but the U.S. real output growth is higher than that of China; China's consumer price index rise higher than that of United States. Based on this, China should gradually adjust economic growth model, increased the per capita disposable income and strengthen regulate the speculative short-term international capital flows.

Key words: Monetary policy shock; Transmission channel; SVAR model; Impulse response

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INTRODUCTION

Over the past decade, the Fed frequently used monetary policy instruments to intervene the market to ensure that the U.S. economy was able to maintain low inflation and sustained stable growth. During 2008 financial crisis, the Fed maintained the federal funds rate in the range of 0-0.25% to ensure market liquidity and boost market confidence. The frequent changes in Fed monetary policy would affect the China's economy. So, what's kind of the impact of U.S. monetary policy shocks on China's real output and inflation? What are the main transmission channels of the impact? How does the People's Bank of China deal with the impact of U.S. monetary policy shocks? The study of these issues can provide theoretical support for China in response to external economic shocks.

Foreign empirical studies (Kim, 2001; Holman & Neumann, 2002; Miniane & Rogers, 2003; Nils & Melanie, 2011) suggested that U.S. monetary policy shocks on the output of the developed countries had a positive effect. The monetary policy shocks of the developed countries had a negative output effect for the emerging economies (Mackowiak, 2006 & 2007). There are some differences in the reach conclusions of the domestic scholars about the impact of U.S. monetary policy shock on the Chinese output. ZHUANG (2009) considered that the expansion of the U.S. monetary policy through the balance of trade channels had a positive spillover effect to China's output, but the effect is less than its in G-7 countries. LI & LIANG (2011) believes that China's output has a negative effect in the short-term and long-term under the impact of U.S. monetary policy through exchange rate and trade balance channel. In these empirical studies, researchers mostly focused on the transmission channels of trade balance and exchange rate. They less considered the transmission channels of short-term international capital flows and international commodity prices.

In this paper, we employed the block structure vector autoregression (Structure VAR, SVAR) model to analyze the impact of U.S. monetary policy shocks on the real output and inflation of China. The remainder of this paper is structured as follows: Section 2 describes the model identification; Section 3 is empirical test; Section 4 is the empirical results. The conclusions and policy recommendations are in the Section 5.

1. THE MODEL IDENTIFICATION

In this paper, we impose the same period non-recursive constraint to simulate the Sino-US economic operation. The SVAR model must have to estimate more parameters. We need to constrain the relationship between variables to be able to identify monetary policy shocks and estimate the corresponding parameters.

Constraints I: The U.S. economy variables satisfied that U.S. current actual output is limited only by their own influence. The U.S. consumer price index is limited by the U.S. real output and the impact of itself in the current period. The U.S. federal funds rate in the current is limited by itself, the broader monetary aggregates and the world commodity price index. the USA broader monetary aggregates is limited by itself, the U.S. real output in the current period, the impact of the U.S. consumer price index and the U.S. federal funds rate.

Constraints II: The China economy variables satisfied that China's real output in the current period is limited only by its own impact. The China's consumer price index in the current is limited by itself, the actual output of China and the U.S. federal funds rate. The narrow monetary of China in the current period is limited by the actual output and the consumer price index.

Constraint III: The impact of monetary policy transmission variables satisfied that the impact of world commodity price index in the current is limited by itself and all the remaining variables. The nominal exchange rate of U.S. dollar against the RMB is limited by itself and all the remaining variables in the current period. Sino-US trade balance is limited by itself and the U.S. real output, the U.S. federal funds rate, the nominal exchange rate, world commodity price index, China's actual output and the impact of the narrow monetary aggregates. Sino-US spreads is limited by itself, the U.S. federal funds rate and the United States monetary aggregates.

From above three constraints, we get the matrix of the constraints among variables. The expression of SVAR model is equation (1). Among them, NA represents the parameters which are to be estimated. $\mathbf{u}$ represents the structural shock vector. $\hat{a}$ represents the disturbance vector.

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ NA & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & NA & 0 & NA & 0 & 0 & 0 & 0 & 0 \\ NA & NA & NA & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ NA & NA & NA & NA & 1 & NA & NA & NA & NA & NA & NA \\ NA & NA & NA & NA & NA & 1 & NA & NA & NA & NA & NA \\ NA & 0 & NA & 0 & NA & NA & 1 & 0 & NA & 0 & NA \\ 0 & 0 & NA & NA & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & NA & 0 & 0 & 0 & 0 & 0 & NA & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & NA & NA & 1 \end{bmatrix} \begin{bmatrix} \mathbf{u}_{y_{usa}} \\ \mathbf{u}_{cpi_{usa}} \\ \mathbf{u}_{r_{usa}} \\ \mathbf{u}_{m_{usa}} \\ \mathbf{u}_{exr} \\ \mathbf{u}_{p_{world}} \\ \mathbf{u}_{trb} \\ \mathbf{u}_{r_{spreads}} \\ \mathbf{u}_{y_{prc}} \\ \mathbf{u}_{cpi_{prc}} \\ \mathbf{u}_{m_{prc}} \end{bmatrix} = \begin{bmatrix} \varepsilon_{y_{usa}} \\ \varepsilon_{cpi_{usa}} \\ \varepsilon_{r_{usa}} \\ \varepsilon_{m_{usa}} \\ \varepsilon_{exr} \\ \varepsilon_{p_{world}} \\ \varepsilon_{trb} \\ \varepsilon_{r_{spreads}} \\ \varepsilon_{y_{prc}} \\ \varepsilon_{cpi_{prc}} \\ \varepsilon_{m_{prc}} \end{bmatrix} \quad (1)$$

2. EMPIRICAL TEST

2.1 Description and Processing of Empirical Data

The data sample is form the first quarter of 1996 to the fourth quarter of 2011. China and the U.S. macroeconomic data come from the CEInet OECD database and the U.S. Department of Commerce and Economic Analysis Department. The world commodity price index comes from the IMF database. We adjust the data by means of quarter X12. In the calculation of the variable's real value, we use the value of 2005 as the base period price index variables to adjust the variable. The Sino-US spreads is used to measure the short-term international capital flows.

In line with the treatment variable, R_USA represent the U.S. federal funds rate, M2_USA represent the United States of nominal monetary aggregates M2, Y_USA represent the U.S. real GDP, CPI_USA represent the United States Consumer Price Index, P_WORLD represent the world commodity price index, EXR represent the U.S. nominal exchange rate against the RMB, TBR represent the Sino-US trade balance, R_SPREADS represent the Sino-US interest rate differential, M1_PRC represent narrow monetary aggregate M1, Y_PRC represent China's actual output, CPI_PRC represent China's consumer price index.

2.2 Unit Root Tests

In this paper, we take the ADF method to test the stationary of the time series. The test results of the variable stability are shown in Table 1. Based on test results, the time series are non-stationary in the 95% level of significance. By taken the first-order differential, time series pass the stationary test.

Table 1
Variable ADF Test Results

Variable	(C,T,L)	ADF test values (5%critical value)	Variable (difference)	(C,T,L)	ADF test values (5%critical value)
R_USA	(C,T,2)	-1.63 (-2.91)	R_US	(0,0,1)	-4.19 (-2.91)
M2_USA	(C,0,3)	-1.72 (-3.48)	M2_US	(C,0,2)	-5.14 (-3.48)
Y_USA	(C,T,4)	-1.29 (-3.48)	Y_US	(C,0,3)	-5.07 (-3.48)
CPI_USA	(C,T,0)	-1.45 (-3.48)	CPI_US	(0,0,0)	-5.14 (-3.48)
P_WD	(C,0,2)	-2.94 (-3.48)	P_WD	(0,0,1)	-6.34 (-3.48)
EXR	(C,0,4)	-0.63 (-2.91)	EXR	(0,0,3)	-3.82 (-2.91)
TBR	(C,T,3)	-2.25 (-3.48)	TBR	(C,0,2)	-9.97 (-3.48)
R_SDS	(0,0,1)	-2.511 (-3.48)	R_SDS	(0,0,0)	-3.04 (-2.91)
M1_PRC	(C,T,5)	-0.27 (-3.48)	M1_PRC	(C,0,4)	-7.55 (-3.48)
Y_PRC	(C,T,3)	-0.88 (-3.48)	Y_PRC	(C,0,1)	-7.12 (-3.48)
CPI_PRC	(0,0,6)	-1.62 (-3.48)	CPI_PRC	(0,0,4)	-3.63 (-3.48)

Note: (C, T, L) for the inspection forms, respectively, the constant term in the unit root test equation, the time trend and lag order.

2.3 Johansen Cointegration Test

We test the cointegration among the variable R_USA, EXR, TRB, P_WORLD and R_SPREADS to determine the existence of long-term stability of the U.S. monetary policy shocks impact on the Chinese economy. We obtain the lag order of 4 by the LR statistic, the AIC criteria and the SC criteria. Johansen cointegration test results shown in Table 2.

Table 2
Johansen Test Results

Johansen cointegration test				
H0:Cointegration equation number	critical value	trace statistics	5% critical value	P-value
No equation *	0.547	85.694	60.061	0.0001
At most a cointegration equation	0.291	36.578	40.175	0.1100
At most two cointegration equation	0.130	15.283	24.276	0.4334

Note: The trace test indicate that a cointegration equation at the 5% confidence level.
* On behalf of the 5% confidence level to reject the null hypothesis.

At 95% confidence level, the number of cointegration equation r = 1. There exists only one cointegration relationship between these four variables. The cointegration equation is equation (2):

$$R\_USA = 53.936EXR + 2.208TRB - 2.048R\_SPREADS - 0.957P\_WORLD \quad (2)$$

According to the equation (2), we found that the U.S. federal funds rate, the nominal exchange rate and the Sino-US trade balance are in the same direction. The Sino-US interest spreads and world commodity price index showed changes in the opposite direction with the U.S. federal funds rate.

2.4 Impulse Response Results

We assume that the Federal Reserve cut the federal funds rate by 100 basis points. We can get the response of the Sino-US economic variables. All cumulative responses of the variables are shown in Figure 1 to Figure 10.

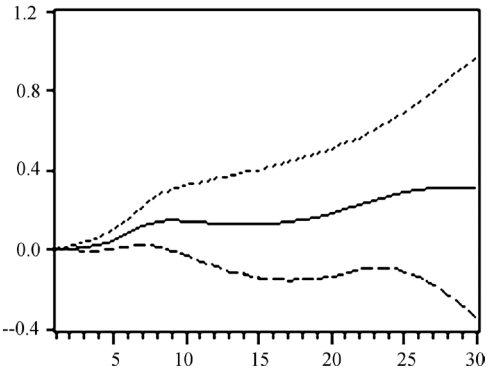

Figure 1
Response of Y_US

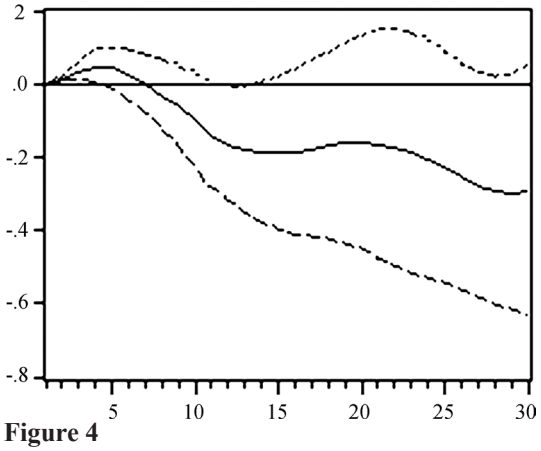

Figure 4
Response of EXR

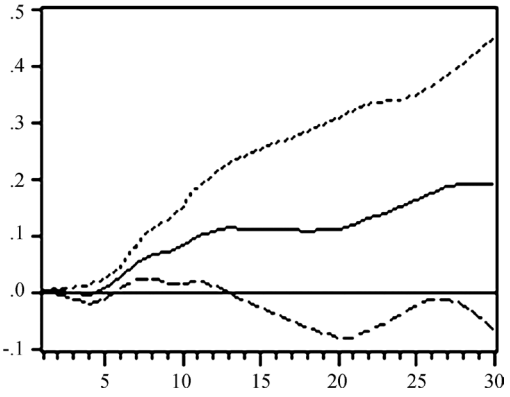

Figure 2
Response of CPI_USA

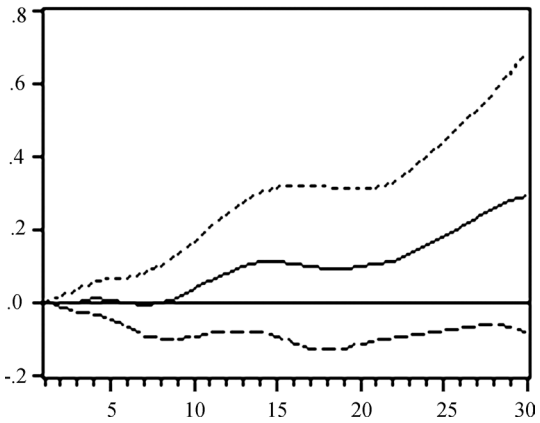

Figure 3
Response of M2_USA

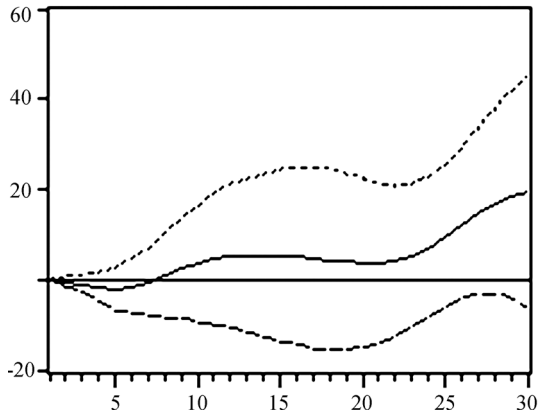

Figure 7
Response of R_SPRDS

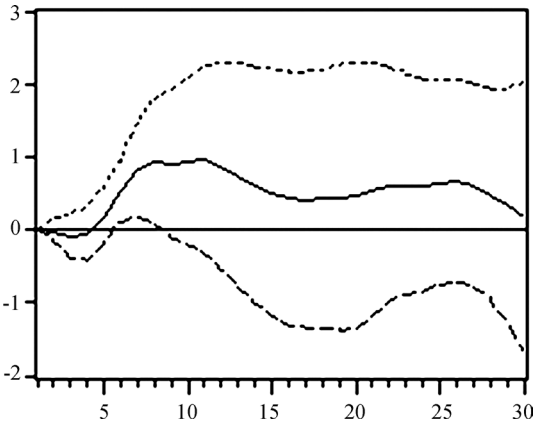

Figure 5
Response of P_WORLD

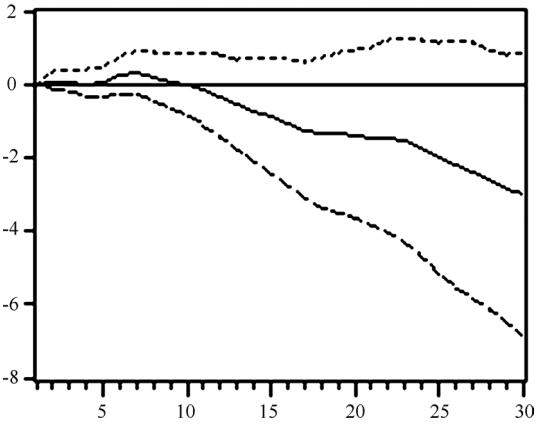

Figure 6
Response of TRB

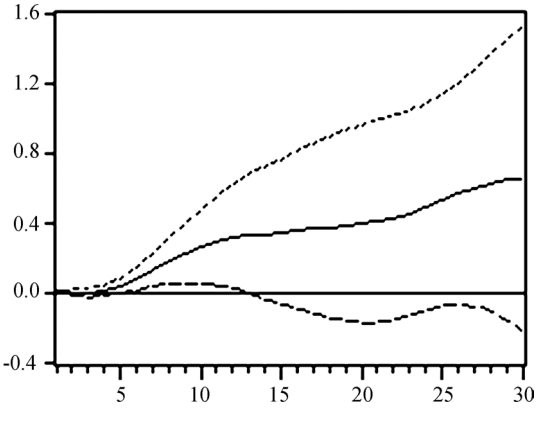

Figure 9
Response of CPI_PRC

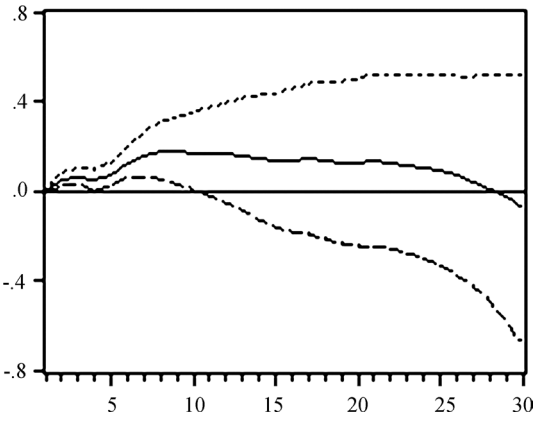

Figure 8
Response of Y_PRC

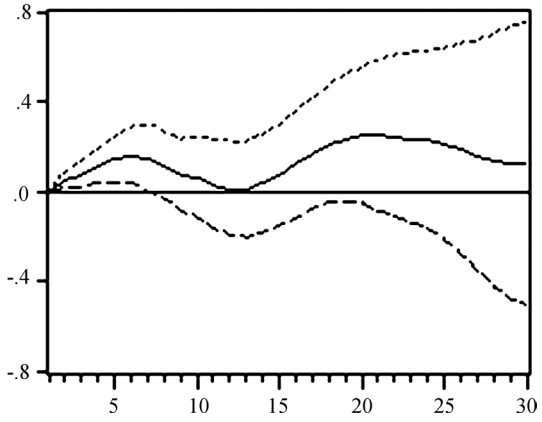

Figure 10
Response of M1_PRC

3. THE EMPIRICAL RESULTS

3.1 The Analysis of U.S. Monetary Policy Shocks on Their Own Economic

From the Figure 1 to Figure 3, the response of real output and consumer price index lagged three quarters. The nominal money supply response lagged eight quarters. Expansionary monetary policy can increase the actual output of the United States, the U.S. consumer price index and the nominal money supply. During the observation period, the largest U.S. real output increased by nearly 0.4 percentage points, the largest U.S. consumer price index increased by nearly 0.2 percentage points, the nominal money supply increased by nearly 0.3 percentage points. The percentage of growth of real output in the United States more than the percentage increase in the consumer price index.

3.2 The Transmission Channel Analysis of U.S. Monetary Policy Shocks on Real Output and Inflation in China

The U.S. monetary policy transmission channel included the exchange rate, trade balance, international commodity prices and international capital flows. During the observation period, we found that the nominal exchange rate of U.S. dollar against the RMB and U.S. interest rate rapid response the U.S. monetary policy shocks. It almost has no time lag. The world commodity prices and the Sino-US trade balance have four quarters and six-quarter lag response, respectively. This suggests that U.S. monetary policy shocks in the early transform mainly depended on the channel of RMB exchange rate and short-term international capital flows. The RMB nominal exchange rate show a phenomenon of short-term depreciation and medium or long-term appreciation. The highest increase is less than 0.1 percentage points and then began to decline. The biggest drop is 0.3 percentage points in the previous four quarters. Sino-US trade balance in the previous six quarters has almost no response, mainly due to international trade in commodity prices are mostly ahead of the signing of the contract. After six quarters, with the gradual appreciation of the nominal exchange rate, it increased the Chinese imports and exports. The Sino-US trade balance gradually reduced. During the observation period, the Sino-US trade balance reduced the highest rate of nearly 3 percentage points. Sino-US spreads change from negative to positive after five quarters. After five quarters, the interest rate spread during the observation period came up 200 basis points. World commodity prices increased gradually after five quarters. The increase of the world commodity price will lead to add the domestic cost of production of goods and improve the China's inflation expectations. We found that the most important policy transmission channels is the short-term international capital flows.

3.3 The Analysis of the Impact of U.S. Monetary Policy Shocks on Real Output and Inflation in China

There is a positive spillover effect about the U.S. expansionary monetary policy shocks on China's real output, but in the long term this positive effect gradually will be weakened. From the Figure 8 to Figure 10, we found that during the first 28 quarters of U.S. monetary policy shocks on real output in China, it has a positive spillover effects. The real output of China is the highest increase of 0.2 percentage points. After 28 quarters, China's real output started to decline. China consumer price index lagged response to the U.S. monetary policy shock. After three quarters, China's consumer price index began to rise, and rise up to 0.6 percentage points.

To compare with the U.S. monetary policy on the real output of the United States and the United States consumer price index, the highest rise in the proportion of China's actual output is lower than the highest rise in the proportion of the U.S. real output, but above the highest rise in the proportion of the Chinese Consumer Price Index is

larger than U.S. consumer Price Index over the proportion. This suggests that the role of the Federal Reserve's expansionary monetary policy shocks on U.S. real output is over the role in promoting China's actual output; the impact of the Fed's expansionary monetary policy shocks on the U.S. consumer price index is less than on the Chinese consumer price index.

THE CONCLUSIONS AND POLICY RECOMMENDATIONS

Dynamic analysis of the impact of U.S. monetary policy shocks on real output and inflation of China, we get several conclusions: First, the impact of the U.S. expansionary monetary policy increase the U.S. real output and China's real output, but the increases in real output in China are less than the increase in U.S. real output. Second, the U.S. expansionary monetary policy shocks increase the U.S. consumer price index and consumer price index of China, China's consumer price index rises higher than the U.S. consumer price index. Third, the most significant channel is the short-term international capital flows, followed by the Sino-US trade balance channel and the international commodity price channel, the exchange rate channel is not significant.

Based on this, China should gradually improve interest rate formation mechanism and enhance exchange rate flexibility, the adjustment of economic structure, transform the economic growth mode, improve residents' disposable income, boost domestic demand market, gradually reduce the proportion of foreign trade in GDP and strengthen regulate speculative short-term international capital flows.

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