The Spillover Effects of U.S. Monetary Policies on China's Stock Market

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Abstract

This study examines the global spillover effects of conventional and unconventional monetary policies of the U.S. Fed on the Chinese stock market. We apply the structural vector autoregressive (SVAR) model to monthly data from Jan 1998 to March 2023, using monetary policy instruments, stock indexes, and macroeconomic variables to study the impulse response of stock indexes to monetary policy shocks. In addition, we will study the impact of the implementation of U.S. monetary policy on China's stock market in different periods through different transmission channels. The most important part is that we will examine and analyze whether there are important structural breaks in the relationship between stock returns and monetary policy changes.

Theoretical Analysis

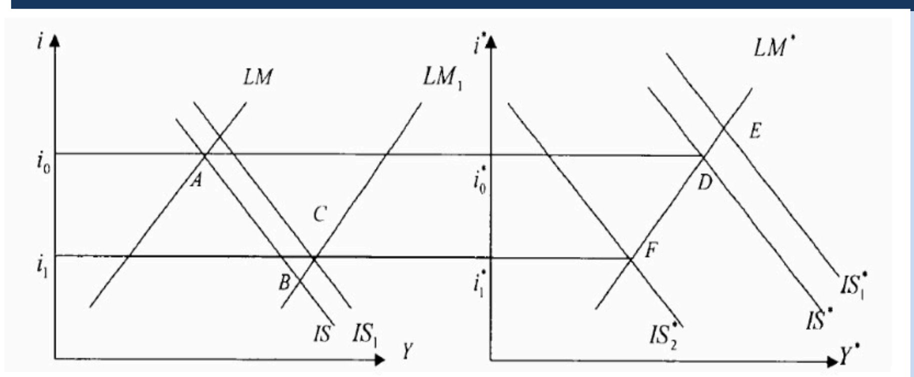


Figure 1.1

- Figure 1.1 illustrates how a country's expansionary monetary policy affects both its own economy and that of another country under a floating exchange rate system. Initially, both countries have equal interest rates, reaching equilibrium at points A and B. When the domestic country implements expansionary monetary policy, its LM curve shifts rightward to LM1 due to increased money supply, leading to lower interest rates, increased credit, and output.
- This stimulates imports in the domestic country, boosting exports and income in the foreign country. Consequently, the foreign IS* curve shifts to IS*1, and its equilibrium point moves from D to E. However, neither B nor E represents long-term equilibrium. Capital flows from low-interest-rate countries to high-interest-rate countries, causing short-term balance of payments deficits and domestic currency devaluation, enhancing domestic product competitiveness and increasing exports.
- This devaluation decreases imports, shifting the domestic IS curve to IS1 and the foreign IS1 to IS2, restoring equilibrium at points C and F, where interest rates equalize again. Thus, under a floating exchange rate system, expansionary monetary policy increases money supply and domestic income while decreasing interest rates, subsequently affecting foreign income and world interest rates.

Data

1. Three variables that represent the monetary policies of the U.S.

USM2: M2 in US, seasonally adjusted, annual growth rate

USFFR: the Effective federal funds rate

FED BALANCE SHEET: The annual growth rate of the total assets of the Federal Reserve's balance sheet.

2. Six variables were selected through various influence channels of monetary policy

CPI: The Consumer Price Index of China, base year=2015 (Price level/inflation channel)

M2: M2 in China, seasonally adjusted, annual growth rate (Money supply channel)

r: Interbank interest rate in China, % (Interest rate channel)

FX: Exchange rate, 1 US dollar to RMB (Exchange rate channel)

CCI: Consumer confidence index in China, seasonally adjusted (Mental expectation channel)

S&P500: The log returns of A stock market index tracking the stock performance of 500 of the largest companies listed on stock exchanges in the United States. (Stock market channel)

3. Explained variable

SSE index: The log returns of A stock market index tracking the changes in stock prices listed on the Shanghai Stock Exchange.

Empirical Model

The basic expression of the P-order lag SVAR model can be expressed as follows:

$$A_0Y_t = c_0 + A_1Y_{t-1} + A_2Y_{t-2} + \ldots + A_pY_{t-p} + u_t \quad (1)$$

where p represents the lag order, and Yt = (USFFR, USM2, FED BALANCE SHEET, CHINACPI, CHINAM2, CHINAr, SP500, SSE INDEX, FX, CCI), that is, a 10 x 1-order endogenous variable vector. c0 represents 10 x 1-order constant term, A0 represents 10 x 10- order contemporaneous relation matrix, A1 and others represent 10 x 10-order lag relation matrix. ut represents 10 x 1-order structural stochastic disturbance term vector, capturing any factors that are not explained in the equation. The structural disturbances have a Gaussian distribution with

$$E(u_t \mid Y_{t-1},\ldots,Y_{t-p}) = 0 \quad (2)$$

$$E(u_t u_t' \mid Y_{t-1}, \ldots, Y_{t-p}) = I \quad (3)$$

We assume that errors in (1) are assumed to be zero mean, i.e., $E(ut) = 0$, and homoscedastic in covariance, i.e., $E(ut\ ut')=I$. Zero means conveys that it is expected that any unexplained factors do not affect the variables in the equation. The structural disturbances in (3) are normalized to have an identity covariance matrix, and this homoscedastic covariance means that it is expected that these unexplained factors are independent of each other. In this study, in order to have a better version of the structural model in (1), both parts of the equation were multiplied A_0^{-1}, and the new equation is as follow:

$$Y_t = a_0 + B_1Y_{t-1} + B_2Y_{t-2} + \ldots + B_pY_{t-p} + \varepsilon_t \quad (4)$$

where $a_0 = A_0^{-1}c_0$, $B_k = A_0^{-1}A_k$, $\varepsilon_t = A_0^{-1}u_t$, and ε_t can be seen as linear combinations of the structure error u_t, which captures any factors that are not explained in the equations. We assume that these unexplained factors do not affect the variables in the equation, i.e.,$E(ut) = 0$, but are correlated with each other, of which the covariance matrix is: $E[\varepsilon t\ \varepsilon t\ '] = A_0^{-1}\, I\, (A_0^{-1\prime})$.

To obtain the unique estimated parameter of the structural formula model, it is necessary to apply sufficient constraints to the matrix A_0. In general, Cholesky restrictions are imposed on matrix A_0. That is, matrix A is set to be a lower triangular matrix with all principal diagonal elements being 1. At this time, the SVAR model is recursive and exactly identifiable, which also means that the causal chain relationship between variables is a Wold-causal chain. That is to say, the synchronous influence of any two variables is unidirectional, and the variable in the front position has the current influence on the variable in the back position, while the reverse position does not. To do so, I impose restrictions on A_0 matrix by using economic theory, economic reasoning, and Granger Causality Test. Then, the relation between structural shocks and reduced disturbances is implied as follows:

$$\begin{bmatrix} u_{1,t}\ \text{foreign interest rate shock} \\ u_{1,t}\ \text{foreign total asset shock} \\ u_{1,t}\ \text{foreign money supply shock} \\ u_{1,t}\ \text{domestic interest rate shock} \\ u_{1,t}\ \text{domestic money supply shock} \\ u_{1,t}\ \text{domestic price shock} \\ u_{1,t}\ \text{foreign stock market shock} \\ u_{1,t}\ \text{doestic stock market shock} \\ u_{1,t}\ \text{foreign exchange rate shock} \\ u_{1,t}\ \text{consumer expectation shock} \end{bmatrix} = \begin{bmatrix} a_{11} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & 0 & 0 & 0 & 0 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{66} & 0 & 0 & 0 & 0 \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & a_{77} & 0 & 0 & 0 \\ a_{81} & a_{82} & a_{83} & a_{84} & a_{85} & a_{86} & a_{87} & a_{88} & 0 & 0 \\ a_{91} & a_{92} & a_{93} & a_{94} & a_{95} & a_{96} & a_{97} & a_{98} & a_{99} & 0 \\ a_{101} & a_{102} & a_{103} & a_{104} & a_{105} & a_{106} & a_{107} & a_{108} & a_{109} & a_{110} \end{bmatrix} \times \begin{bmatrix} \varepsilon_{1,t}\text{USFFR} \\ \varepsilon_{1,t}\text{Balance Sheet} \\ \varepsilon_{1,t}\text{USM2} \\ \varepsilon_{1,t}\text{CHINAr} \\ \varepsilon_{1,t}\text{CHINAM2} \\ \varepsilon_{1,t}\text{CHINACPI} \\ \varepsilon_{1,t}\text{SP500} \\ \varepsilon_{1,t}\text{SSEINDEX} \\ \varepsilon_{1,t}\text{FX} \\ \varepsilon_{1,t}\text{CCI} \end{bmatrix}$$

Stationary Test

Table 3: Unit Root Test Results/ Augmented Dickey-Fuller Test. (with trend)

Variables	T-Statistic	1% Critical Value	5% Critical Value	P-Value	Results
ffr_us	-0.029	-3.988	-3.428	0.9939	Non-stationary
m2_us	-2.947	-3.988	-3.428	0.1474	Non-stationary
cpi_ch	-3.814	-3.988	-3.428	0.0158	Non-stationary
m2_ch	-2.326	-3.988	-3.428	0.4196	Non-stationary
ir_ch	-5.600	-3.988	-3.428	0.0000	Stationary
fx	-0.944	-3.988	-3.428	0.9511	Non-stationary
cci_ch	-2.668	-3.988	-3.428	0.2496	Non-stationary
stock_us	-13.178	-3.988	-3.428	0.0000	Stationary
stock_ch	-10.500	-3.988	-3.428	0.0000	Stationary
fedbal_us	-4.198	-3.988	-3.428	0.0045	Stationary

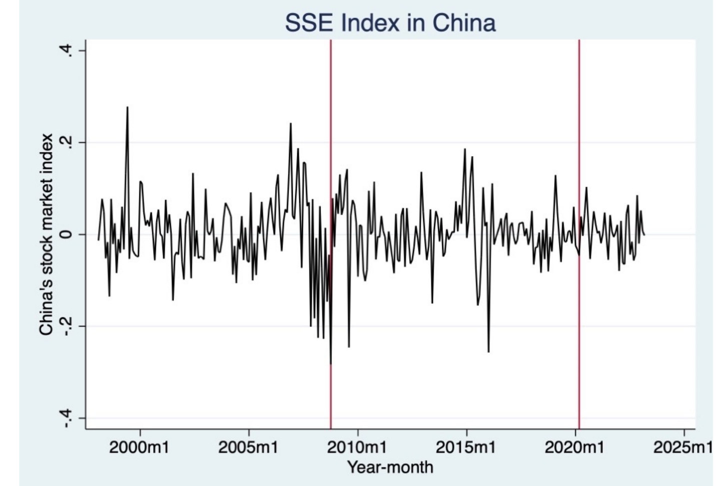
Note: Here is a simplified explanation of the ADF test results: 1. Test statistic: If the absolute value of the test statistic is less than the critical value, the null hypothesis cannot be rejected. A larger negative test statistic is usually a better representation of stationarity. 2. Critical value: The threshold value depends on the level of significance selected (for example, 1%, 5%, or 10%). The null hypothesis can be rejected if the test statistic is more negative than the critical value at the selected significance level. 3. P-value: The null hypothesis can be rejected if the P-value is less than the significance level (e.g., 5%).

Table 4: Augmented Dickey-Fuller Test after First Difference

Variables	T-Statistic	1% Critical Value	5% Critical Value	P-Value	Results
d1ffr_us	-11.343	-3.988	-3.428	0.0000	Stationary
d1m2_us	-8.937	-3.988	-3.428	0.0000	Stationary
d1cpi_ch	-12.593	-3.988	-3.428	0.0000	Stationary
d1m2_ch	-10.312	-3.988	-3.428	0.0000	Stationary
d1fx	-10.281	-3.988	-3.428	0.0000	Stationary
d1cci_ch	-12.438	-3.988	-3.428	0.0000	Stationary

Note: Here is a simplified explanation of the ADF test results: 1. Test statistic: If the absolute value of the test statistic is less than the critical value, the null hypothesis cannot be rejected. A larger negative test statistic is usually a better representation of stationarity. 2. Critical value: The threshold value depends on the level of significance selected (for example, 1%, 5%, or 10%). The null hypothesis can be rejected if the test statistic is more negative than the critical value at the selected significance level. 3. P-value: The null hypothesis can be rejected if the P-value is less than the significance level (e.g., 5%).

Visualization of Data



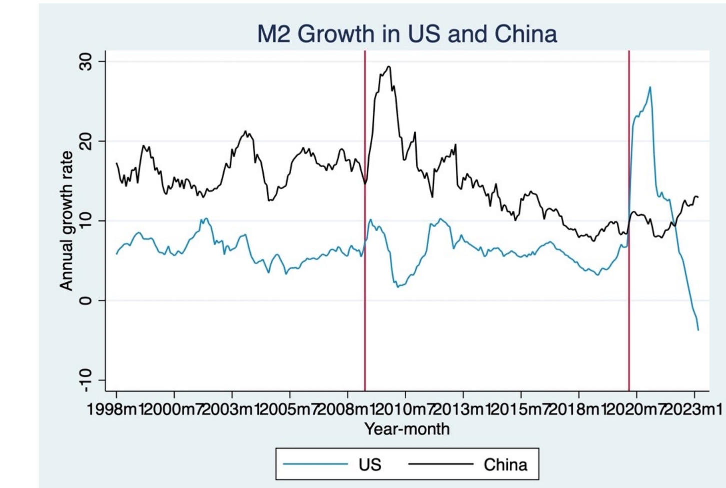


Figure 2.1

Figure 2.1 illustrates the logarithmic returns of the Shanghai Composite Index from January 1998 to March 2023. The graph shows that two significant market crashes occurred in 2008 and 2016, corresponding to two major stock market crises in China's history. In 2008, the government raised the reserve requirement ratio and deposit and loan interest rates for commercial banks to alleviate inflationary pressures in the market. The introduction of stock index futures products in the same year also brought significant negative sentiment to the market, contributing to the stock market crash of 2008. Scholars hold different views regarding the reasons for the 2016 stock market crash. Key factors include overvaluation of stock prices, exit of leveraged funds, insider selling by listed company executives, and short-selling mechanisms in stock index futures. The stock market crash in 2016 resulted in substantial losses for most investors. Moreover, compared to the troughs in 2008 and 2016, the impact of the pandemic in 2020 can be considered relatively minor in China.

Results--Impulse Response Functions

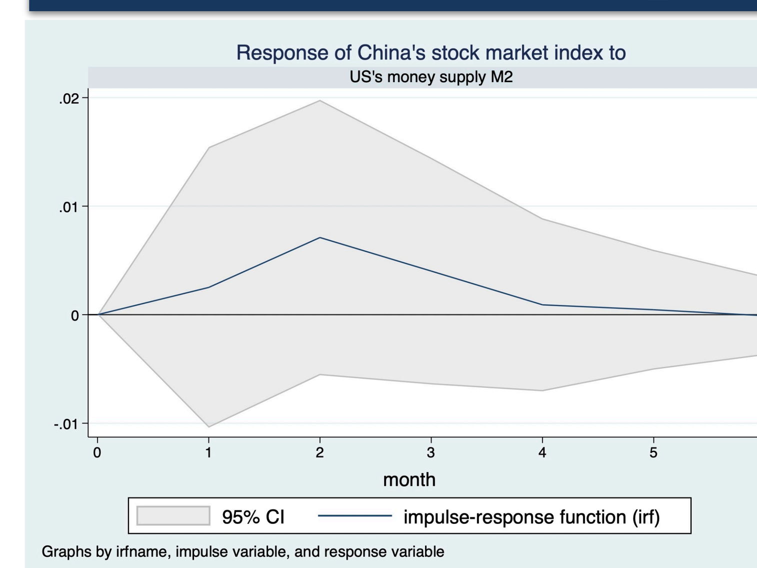


Figure 3.1

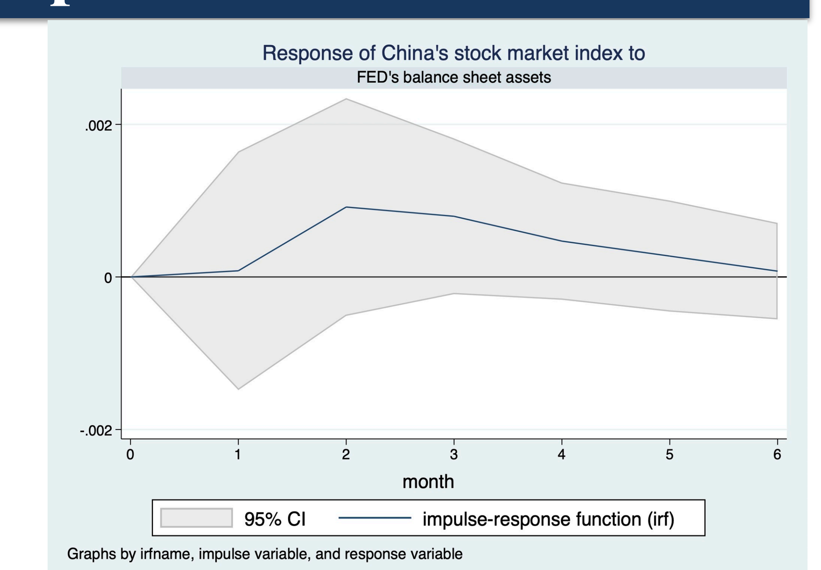


Figure 4.1

From Figure 3.1 that US monetary policy has spill-over effects on Chinese stock prices. The positive impact of the US quantity-based monetary policy on Chinese stock prices is more pronounced in the short term. The peak of the impact occurs approximately 2 to 3 months after the shock. When the US conducts open market operations to increase the supply of US dollars, it not only enhances liquidity domestically but also globally. This influx of international capital into China and other emerging market countries stimulates the rise of Chinese stock prices. Additionally, the increase in domestic liquidity in the US helps stimulate domestic consumption. In the long term, this benefits China's export trade, thereby further boosting stock prices.

From As Figure 4.1 shows, a one-standard-deviation disturbance in the Fed's balance sheet has a positive impact on the Chinese stock market. There was almost no effect in the lagging stage 1, but the positive effect expanded after the first stage and reached a peak in the 2-3 stages. This suggests that the shock to the US Federal Reserve's balance sheet has had a delayed positive effect on the Chinese stock market. That could be because an expansion of the Fed's balance sheet typically increases global liquidity. This lead international investors to seek higher returns and put their money into emerging markets such as China, including equities. And the Fed's action could lift market sentiment, especially if investors see it as a positive sign for the economy. That optimism could lead investors to increase demand for risky assets, including Chinese stocks. Moreover, the growth of the U.S. economy is usually closely correlated with the rest of the global economy. As a result, the Fed's monetary policy changes could affect expectations for the global economy and boost China's economy and stock market to some extent.

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