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SPILLOVER EFFECT OF AMERICAN MONETARY POLICY ON CHINA AFTER THE SUBPRIME MORTGAGE CRISIS - BASED ON THE MUNDELL-FLEMING-DORNBUSCH MODEL

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ABSTRACT

This paper uses the Mundell-Fleming-Dornbusch model to theoretically analyze the spillover effects of the American monetary policy on China after the subprime mortgage crisis. The research finds that the traditional American monetary policy has little impact on its economic revival. The implementation of a quantitative easing policy affected China's macroeconomic development, capital flow, and import and export trade through the channels of interest rate, exchange rate, and trade flow. In the empirical part, this paper constructs a vector autoregressive model using data between the second quarter of 2007 and the fourth quarter of 2019. Based on the stability test, the Granger causality test preliminarily carries out the solution that exchange rate, interest rate, and trade mechanism all prominently show the spillover effect of US monetary policy on China. So do the macroeconomic variables. Through impulse response, it is found that the spillover of US monetary policy will cause overheating and strong liquidity in China's economy. In the future, China needs to adopt a prudent monetary policy, actively adjust its industrial structure, strengthen international cooperation, and continuously increase its international competitiveness to resist external shocks.

Contribution/Originality: This paper contributes to existing literature by combining the Mundell-Fleming-Dornbusch model and the subprime mortgage crisis and makes an empirical test to further verify the theory. What's more, the research also makes suggestions for China's future development.

1. RESEARCH BACKGROUND

The US subprime mortgage crisis began in 2007. Investors lost confidence in the value of mortgage securities, and the liquidity crisis escalated. In September 2008, the crisis evolved into a more serious financial one. The bankruptcy of Lehman Brothers and the acquisition of Merrill Lynch marked the total outbreak of the financial crisis. With the economic downturn being worldwide, the United States has since actively adopted a series of monetary policies designed to revive its domestic economy.

In the context of economic globalization, China and the United States, the largest global economies, are inextricably linked. The Chinese exchange currency, the people's renminbi (RMB)'s exchange rate, was pegged to the US dollar, showing that US monetary policy has a great impact on China's exchange rate system. After the outbreak of the crisis, the US federal fund rate fell rapidly, and so did China's benchmark interest rate. What's more, the interest rate in the US was close to zero since the implementation of a quantitative easing policy. Meanwhile, the interest rate gap between the two countries widened, resulting in a large influx of hot money flowing into China and increasing

China's output and export volumes. Consequently, China's monetary policy, inflation, exports, and economic development were affected by the subprime mortgage crisis and the monetary policy adopted by the United States. Therefore, the focuses of this paper are how the US monetary policy affects China and how to better resist foreign risks and enhance China's competitiveness in the future.

2. LITERATURE REVIEW

2.1. Development of Monetary Policy Theory

After the birth of monetary theory, scholars focused on price, total money, real and nominal interest rates, output, and inflation. According to the length of the effect of currency on the real economy, the research can be roughly divided into long-term and short-term monetary theories.

Long-term monetary theory is controversial. McCandless and Weber (1995) summarized long-term monetary theory through empirical analysis and proposed that inflation rates are significantly related to monetary growth. In the long term, inflation rates and monetary growth are independent of output growth. Boschen and Talbot (1991) also found that there is no long-term relationship between inflation and output in the American economy. However, other scholars disagreed. Bullard and Keating (1995) based their research on 58 countries after World War II and found a negative correlation between inflation rate and output through empirical analysis. Berentsen, Menzio, and Wright (2011) believe there is a positive relationship between inflation and employment.

It is more critical to pay attention to the impact of monetary policy on output in the short term for a country's macroeconomic sector. Most economists agree that short-term monetary policy can more efficiently affect the real economy (Bernanke, Gertler, & Gilchrist, 1999; Blanchard, 1997; and Friedman & Kuttner, 1996). Chinese scholars have also explored the relationship between China's monetary policy and economic development. Li (2001) found that China's monetary policy has short-term effects. Cao and Wen (2005) selected 21 samples of relevant economic variables from 1984 to 2004 and empirically showed that China's monetary policy has the characteristics of non-neutrality. Using vector autoregression and the Granger causality test, Zhou and Jiang (2002) found that China's monetary policy transmission was dominated by commercial banks, and the effectiveness of monetary policy should be improved.

2.2. Spillover Transmission Theory of Monetary Policy

Mundell (1963), Fleming (1962), and Marcus and Robert (1964) extended the closed IS-LM model to include open economy and constructed the Mundell-Fleming model. Dornbusch (1976) assumed sticky prices and perfect foresight and extended the Mundell-Fleming model to assert that a short-term monetary easing policy would cause the exchange rate to deviate from the long-term equilibrium value, resulting in large fluctuations in the exchange rate.

The regulation of monetary policy changes macroeconomic variables through its multiple transmission mechanisms and triggers endogenous changes in the economy through exogenous stimulation. Monetary policy has multiple transmission mechanisms or channels, and there were different views on these channels. The monetary school proposed that monetary policy played a transmission role through interest rate and exchange rate channels (Dornbusch, 1976 and Mishkin, 1995). The credit school believed that monetary policy was transmitted through the credit and balance sheet channels of the banking system (Bernanke & Gertler, 1995). Central bank regulation in most developed countries relies on interest rate transmission, which is achieved by controlling short-term interest rates. After China's economic system turned to a market economy, the interest rate transmission mechanism was not suitable. In the long term, the transmission of China's monetary policy depended more on credit (Song, 2002 and Weihong, 2003). With the continuous advancement of the reform of interest rate marketization, China's transmission channels are becoming more and more diversified, and the banking industry's risk-taking has attracted more attention (Deng, 2014; Liu & Wang, 2013, and Zhang & He, 2012).

2.3. Application and Influence of Monetary Policy Tools After the Subprime Mortgage Crisis

After the global financial crisis, major developed economies used more unconventional monetary policy tools. The central bank mainly uses rediscount and refinancing, deposit reserve, and open market operation policies to regulate capital supply and demand. Developed economies seldom use deposit reserve instruments, the central banks of which have implemented the "zero reserve" system. He (2011) used the partial equilibrium model to compare the implementation effects of different monetary policy tools in the context of the "two-track system" of interest rate and found that the deposit reserve could better adjust the market interest rate. Since the financial crisis began, central banks of various countries innovated the refinancing and rediscount policy tools. The Bank of England issued FLS, the financing for loan plan, the European Central Bank used TLTRO, the targeted long-term refinancing operation, and the Federal Reserve used the regular auction TAF (Lu & Deng, 2015). These innovative monetary policy tools can provide liquidity for the market in case of an emergency and improve conventional monetary policy tools (Ma & Liu, 2014).

In the innovative use of monetary policy tools by central banks, the quantitative easing policy in the open market has become a typical representative of unconventional monetary policy tools. During the financial crisis, the short-term interest rate fell to zero, and the economy reached a liquidity trap, which greatly reduced the effectiveness of monetary policy. The traditional monetary policy that reduced the short-term interest rate to stimulate economic growth was ineffective (Eggertsson & Krugman, 2012), while a quantitative easing policy could accelerate currency depreciation, increase exports, change inflation expectations, reduce real interest rates, promote investment and consumption, and repair the transmission mechanism of monetary policy, to a certain extent (Feldstein, 2016). After the financial crisis, various monetary instruments implemented by different countries were essentially used to transfer liquidity to the market and stimulate economic recovery. Li (2015) believed that China's innovative monetary policy tools implemented after the financial crisis have played a positive role in regulating market liquidity and industrial structure. Hu and Fan (2015) believed that the impact of price policy tools was greater than that of quantity policy tools. Yang and Duan (2016) pointed out that to meet the needs of economic development, monetary policy tools still needed to be innovated.

In conclusion, most researchers adopt an empirical approach for the spillover effect of monetary policy implementation after the financial crisis, while interpretations based on theoretical models are in the minority. Therefore, based on the Mundell-Fleming-Dornbusch model, this paper pays more attention to the theoretical interpretation of the effect of American monetary policy after the crisis and further explores the transmission mechanism of its spillover effect through empirical analysis.

3. REVIEW OF THE SUBPRIME MORTGAGE CRISIS

In August 2007, the US subprime mortgage crisis broke out. From September 2008, the crisis began to impose a loss of control, resulting in the bankruptcy or takeover of many financial institutions by the government, which gradually led to a global financial crisis. The crisis sharply reduced the growth rate of the US gross national product and rapidly increased the unemployment rate. According to data from the US Bureau of statistics, non-agricultural employment in the United States decreased by 240,000 in 2008. Nearly two decades before the crisis, the unemployment rate in the United States never exceeded 6.5%. However, the unemployment rate was as high as 9.9% in December 2009. The large-scale unemployment in the United States showed that the economic recession had gradually spread to the financial and service industries.

The recession also affected the job market, which directly affected domestic consumption and national disposable income, weakening the consumption demand of American residents. After the financial crisis, the level of risk premium in the US market increased, and the phenomenon of loans was rampant. The decline of money multipliers led to the failure of the Federal Reserve to double the money supply and to a lack of vitality in the real US economy. In this context, the United States implemented a series of monetary policies to revive the economy.

3.1. Traditional Monetary Policy Tools

After the crisis broke out in August 2007, the Federal Reserve took measures to reduce the federal benchmark interest rate ten consecutive times to stimulate the economy. As shown in Figure 1, from the second quarter of 2007, the United States continued to reduce the federal benchmark interest rate. By the second quarter of 2009, the Federal Reserve's benchmark interest rate fell to 0.15%. In addition, the Federal Reserve issued a statement in 2012 that it would continue to maintain the existing loose monetary policy and control the federal benchmark interest rate within the range of 0% to 0.25%.

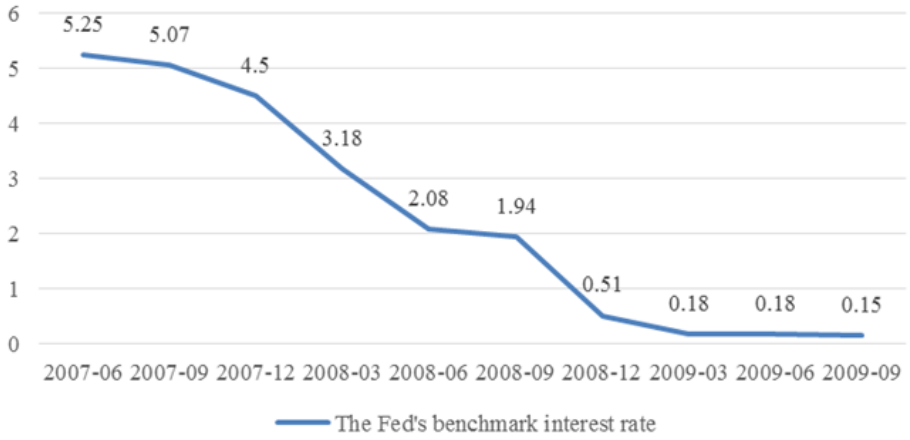

Figure 1. US benchmark interest rate from the second quarter of 2007 to the second quarter of 2009.

As the crisis further deepened in September 2008, the Federal Reserve lowered the discount interest rate in both October and December that year with a cumulative reduction of 175 basis points. In addition, in October 2008, the Federal Reserve announced that it would pay interest to the deposit and excess deposit reserves, maintaining the interest margin between the statutory deposit reserve ratio and the federal fund interest rate in the same period at ten basis points. What's more, the interest rate for paying excess reserve was 0.75%. After cutting the benchmark interest rate basis point, the Federal Reserve lowered the excess deposit reserve interest rate to 0.6%, narrowing the interest rate gap between them.

3.2. Implementation of a Quantitative Easing Policy

The subprime mortgage crisis introduced major trauma to the US credit market, and traditional monetary policy tools had little effect on economic revival. The increased bad debt rate of financial institutions, the lower federal benchmark interest rate, and the deposit reserve ratio did not stimulate the real economy as the Federal Reserve had expected. At this time, financial institutions tightened credit and controlled credit risk. Overall, the Federal Reserve's monetary policy at the beginning of the financial crisis did not have a great impact on the economy. Therefore, the United States adopted a quantitative easing monetary policy. In the four years from 2008 to 2012, the United States implemented four rounds of quantitative easing to continuously inject liquidity into financial institutions.

The first round of quantitative easing was implemented on November 24, 2008. The Federal Reserve launched a total asset acquisition plan of $2.8 trillion, including $1.25 trillion in mortgage-backed securities, $0.25 trillion in government agency bonds, $0.3 trillion in long-term Treasury bonds, and $1 trillion in short-term asset-backed securities loans. The second round was implemented from November to December 2010. The Federal Reserve once again planned to inject $600 billion into the market by purchasing Treasury bonds. During this period, it conducted 18 open market operations in a month and purchased $300 billion of Treasury bonds, mainly from the recovery of institutional securities and mortgage-backed securities. The third round was launched in September 2012. The Federal Reserve purchased $40 billion in mortgage loans each month, continued to buy long-term Treasury bonds while selling short-term Treasury bonds, and reinvested the principal of maturing institutional bonds and

institutional mortgage-backed securities. The fourth quantitative easing policy was implemented in December 2012. The Federal Reserve purchased $45 billion of Treasury bonds per month as an alternative plan. Coupled with the $40 billion per month purchase in the third round, the Federal Reserve's monthly asset purchase reached $85 billion. The Federal Reserve also proposed using quantitative data indicators to clarify the implementation period of ultra-low interest rates.

4. THEORETICAL MODEL AND RESEARCH HYPOTHESIS

This money spillover effect research mainly focuses on the impact of changes in a country's money supply or interest rate on its own economic activities, which affects the economic activities of other countries through interest rate, exchange rate, and trade channels. To explore the spillover effect of monetary policy implemented in China, this paper tests the theoretical hypothesis of the interest rate, exchange rate, and trade channel based on the Mundell-Fleming-Dornbusch model.

It is assumed that the output consists of four sectors: consumers, enterprises, government, and foreign, i.e., $Y = C + I + G + (X - M)$, where y represents output; C stands for consumption, which depends on the disposable income of consumers Y_h^d, disposable income is a function of income Y_h, domestic tax T_h, and government transfer payment T_{rh}, i.e $Y_h^d = Y_h - T_h + T_{rh}$. I stands for investment, which is related to the domestic interest rate level, $I = I(i)$, G purchases on behalf of the government, and X and M represent import and export quantities, respectively. BP represents the balance of payments, which is mainly composed of current account CA and capital account CF. The current account depends on net exports which depend on domestic and foreign income levels and real exchange rates, i.e., $CA = (X - M)(Y_h - T_h + T_{rh}, Y_f, \varepsilon)$, and satisfied $(X - M)_{Y_h} < 0$, $(X - M)_{Y_f} > 0$, $(X - M)_{\varepsilon} > 0$, $\varepsilon = E\frac{P_f}{P_h}$, ε is the real interest rate, E is the exchange rate level under the direct pricing method. Capital and financial accounts are determined by the interest rate margin between the two countries, i.e., $CF = CF(i - i_f)$. When the commodity market achieves balance, the total output can be expressed as:

$$Y = C(Y_h - T_h + T_{rh}) + I(i) + G + (X - M) \quad (1)$$

When the balance of payments is balanced, the balance of payments is 0, which is expressed as:

$$BP = (X - M)(Y_h - T_h + T_{rh}, Y_f, \varepsilon) + CF(i - i_f) = 0 \quad (2)$$

The money supply of a country is determined by the central bank, which is an exogenous given variable, if the actual supply is $\frac{M_h}{P}$. Money demand consists of transactional demand $L(Y)$ and speculative demand $L(i)$, i.e.,

$= L_y + L_i$. The demand for transactional money increases with the increase of income, and the demand for speculative money decreases with the increase of interest rate. When the money market is balanced, and the money supply is equal to the money demand, then $\frac{M_h}{P} = L_y + L_i$ (3).

Assuming that the domestic fiscal policy remains unchanged and the monetary policy is adjusted, that is $dG = 0,\ dM \neq 0$. First, the author investigated the relationship between monetary policy adjustment and interest rate change, then fully differential Equations 1, 2 and 3 with, respectively, Equations 4, 5 and 6.

$$\frac{di_h}{dM_h} = \frac{1-C_{hy}}{L_y P_h (I_h - CF_h) + L_i P_h (1-C_{hy})} < 0 \quad (4)$$

$$\frac{di_f}{di_h} = \frac{CF_f}{CF_f - I_f - (1-C_{fy})(L_{fi}/L_{fy})} > 0 \quad (5)$$

$$\frac{di_f}{dM_h} = \frac{di_h}{dM_h} \cdot \frac{di_f}{di_h} < 0 \quad (6)$$

From the above three formulas, it is obvious that when the United States implements loose monetary policies, the money supply $\frac{M_h}{P}$ increases, US domestic interest rate i_h decreases, and China's interest rate i_f also decreases.

Monetary policy adjustment plays a spillover role through interest rate channels. Due to profit-seeking, American capital would obtain interest margin income in the short term, and the capital stock in China's capital market would gradually increase. When there is no restriction on the flow of capital, it would lead to the decline of foreign interest rates. This situation would continue until the interest rates were equal at home and abroad, and the interest margin would disappear. Therefore, hypothesis 1 is put forward: American monetary policy will have a spillover effect on China through interest rate channels, and a change in American interest rates will lead to a change of China's interest rate in the same direction. Next, we examine the relationship between monetary policy adjustment and exchange rate changes:

$$\frac{dE}{di_h} = \frac{P_h\left[CA_{hy}(I_h - CF_h) + (1-C_{hy})CF_h\right]}{-CA_{he} \cdot P_f \cdot (1-C_{hy})} < 0 \quad (7)$$

$$\frac{dE}{dM_h} = \frac{dE}{di_h} \cdot \frac{di_f}{dM_h} > 0 \quad (8)$$

We can see, in Equations 7 and 8, that when the Federal Reserve implemented a loose monetary policy, the money supply increased, the US domestic interest rate decreased, the US dollar flew out, the demand for RMB increased, the US dollar depreciated, and the E under the direct pricing method increased. Conversely, it was easier for enterprises to obtain external funds, and the use cost of funds was reduced, which would not only increase US domestic imports but also increase foreign investment, and the RMB would appreciate relatively. Therefore, this paper puts forward hypothesis 2: the adjustment of US monetary policy would have a spillover effect on China through

the exchange rate channel, and the decline of interest rates would lead to the appreciation of RMB and the increase of exports to China.

5. VARIABLE SELECTION AND RELATED DATA

5.1. Variable Selection

Based on the literature analysis and previous theoretical section, the traditional monetary policy implemented by the United States had little effect. Therefore, this paper selects the American broad money supply (m2us) as the proxy variable of monetary policy. Similarly, domestic broad money supply (m2cn) is selected as the proxy variable of domestic monetary policy. According to the above transmission mechanism analysis, we also select China's export volume (ex) to the United States as the variable of the trade channel, the Sino US exchange rate (e) under the direct pricing method as the variable of the exchange rate transmission channel, China's deposit interest rate (r) and foreign exchange reserve (res) as the variable of the interest rate transmission channel, and the domestic price change (CPI index) and productivity change (GDP index) as macroeconomic variables. Logarithmic processing is performed for m2us, m2cn, ex and res. The samples selected in this paper are quarterly variables, and the time span is from the second quarter of 2007 to the fourth quarter of 2019.

5.2. Descriptive Statistics

Table 1. Descriptive statistics of variables.

Variable	Sample	Average	Standard Deviation	Minimum	Maximum
cpi	51	1.0277	0.1982	0.9848	1.0804
m2us	51	9.2807	0.2248	8.8934	9.6444
m2cn	51	10.7031	0.5295	9.5831	11.3352
ex	51	7.4873	0.6255	6.1206	8.4731
gdp	51	1.0841	0.0221	1.061	1.144
e	51	6.6273	0.3753	6.09	7.68
r	51	2.4655	0.8712	1.5	4.14
res	51	10.2427	0.2968	9.3944	10.5949

Table 1 shows the descriptive statistics of the variables. To eliminate heteroscedasticity, we treated the m2us, m2cn, ex, GDP, and res logarithmically.

6. EMPIRICAL ANALYSIS

6.1. Empirical Model

The empirical model selected in this paper is the vector autoregressive model (VAR) proposed by Christopher (1980). The model mainly regresses the endogenous variables through multiple equations to obtain the dynamic relationship between all endogenous variables. Since the vector autoregressive model did not need strict economic theory as a basis, this paper applies the relevant economic variables supported by the Mundell-Fleming-Dornbusch model analyzed above to the VAR model, which also has strong economic explanatory power.

6.2. Stationarity Test of Model Variables

The stationarity test is required for time series variables. The unit root test is a common method used to investigate the stationarity of time series. The specific test results are as follows:

As shown in Table 2, the original variables can't make the P value significant at the significance level of 1%. After the first-order lag of all variables, the P value of lag variables is totally significant at the significance level of 1%. Therefore, we can draw a preliminary conclusion that the variables selected in this paper are of the same order of simple integer, which meets the requirements of the VAR model test.

Table 2. Stability test of variables.

Variable	T value	Critical value			P value	Stability
		1%	5%	10%		
cpi	-1.823	-3.580	-2.930	-2.600	0.3691	Unstable
m2us	1.486	-3.580	-2.930	-2.600	0.0075	Unstable
m2cn	-0.589	-3.580	-2.930	-2.600	0.8735	Unstable
ex	-2.800	-3.580	-2.930	-2.600	0.0583	Unstable
gdp	-2.681	-3.580	-2.930	-2.600	0.0773	Unstable
e	-2.822	-3.580	-2.930	-2.600	0.0551	Unstable
r	-1.184	-3.580	-2.930	-2.600	0.6804	Unstable
res	-1.196	-3.580	-2.930	-2.600	0.7221	Unstable
cpi1	-3.929	-3.587	-2.933	-2.601	0.0018	Stable
m2us1	-5.472	-3.587	-2.933	-2.601	0.0000	Stable
m2cn1	-6.241	-3.587	-2.933	-2.601	0.0000	Stable
ex1	-7.617	-3.587	-2.933	-2.601	0.0000	Stable
gdp1	-5.936	-3.587	-2.933	-2.601	0.0000	Stable
e1	-4.679	-3.587	-2.933	-2.601	0.0001	Stable
r1	-6.311	-3.587	-2.933	-2.601	0.0000	Stable
res1	-3.295	-3.587	-2.933	-2.601	0.0151	Stable

6.3. Lag Order Determination and Model Stability Test

When using VAR for empirical analysis, it is necessary to ensure the strong interpretability of model parameters and the autocorrelation of errors under reasonable degrees of freedom to determine the lag order of the model. Generally, AIC, SC, HQ, and FPE criteria are used to determine the VAR model. Here, CPI, m2us, m2cn, ex, GDP, and e are investigated. The lag order results of the model are shown in the table below:

Table 3. Results of lag order.

Lag	LR	df	P	FPE	AIC	SIC
1	885.410	32	0.000	8.8e-25	-32.730	-29.896
2	169.490	32	0.000	4.6e-25	-33.613	-28.259
3	375.790	32	0.000	4.7e-27	-38.885	-31.012
4	394.720*	32	0.000	9.2e-29*	-44.560*	-34.167*

Note: * represents the data is significant at the significance level of 10%.

According to the AIC, FPE and SIC criteria in Table 3, it can be determined that the optimal lag of the VAR model in this paper is order 4. The stability test of the model is shown in Figure 2. The modules of the characteristic roots of all variable lag terms are within the unit element. Therefore, it can be concluded that the VAR model is robust.

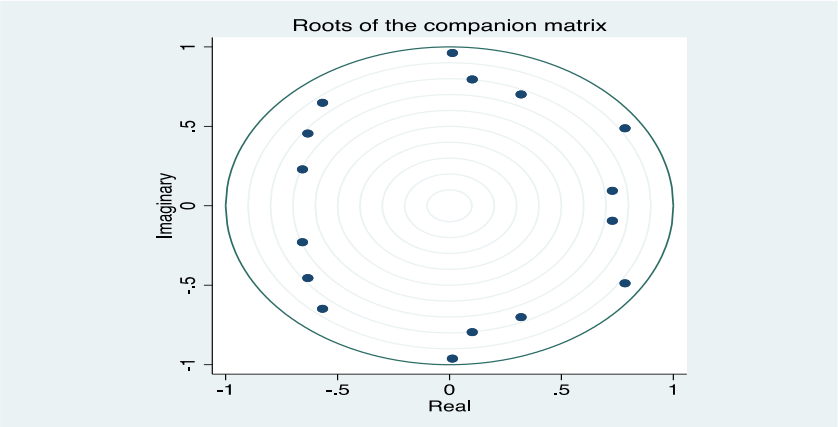

Figure 2. Model stability test.

6.4. Granger Causality Test

According to the above test, all the variables are first-order single integers and have significant stationarity, and thus on the premise of ensuring that the model is robust, the Granger causality test can be conducted.

Table 4. Granger causality test results.

Null Hypothesis	F statistic	P value
m2us does not Granger cause cpi	54.125	0.000
cpi does not Granger cause m2us	2.8157	0.589
m2us does not Granger cause gdp	18.188	0.001
gdp does not Granger cause m2us	4.1724	0.383
m2us does not Granger cause ex	15.022	0.005
ex does not Granger cause m2us	3.7916	0.435
m2us does not Granger cause e	14.33	0.006
e does not Granger cause m2us	7.1175	0.130
m2us does not Granger cause r	206.91	0.000
r does not Granger cause m2us	5.8844	0.208
m2us does not Granger cause res	34.05	0.000
res does not Granger cause m2us	4.4974	0.343

According to the results of the Granger causality test shown in Table 4, the p value of null hypothesis that m2us is not the Granger cause of China's CPI is 0.000, which means it is strongly rejected. Initially, it concluded that the US monetary policy would affect China's CPI index. Similarly, when analyzing the impact of US monetary policy on China's GDP, we also reject m2us as the Granger cause of China's GDP. In terms of China's exports and the exchange rates, they also strongly reject the null hypothesis, that is, trade and exchange rate channels can strongly explain the spillover effect of US monetary policy on China. US monetary policy affects the exchange rates of both China's exports and China's foreign exchange reserves. In all, this paper will continue to explore the spillover effect of American monetary policy on China's economic development.

6.5. Impulse Response Analysis

6.5.1. Macroeconomic Fluctuation

Figure 3, below, shows the impulse response of China's GDP to US monetary policy (m2us). With the grey part as the confidence interval, US monetary policy (m2us) is the impulse variable, and China's GDP is the response variable. It mainly investigates how China's GDP responds to the impact of the impulse variable of US monetary policy. It is not difficult to find that after the United States began to implement quantitative easing policies in 2008, it first had a positive impact on China's GDP for three periods, that is, from the first period to the third period, China's GDP showed an upward trend. From phase 5 to phase 8, China's GDP fluctuated greatly, which may be related to the continuous adjustment of monetary policy by the United States at that time. From the third period to the sixth period, China's GDP showed an obvious downward trend and gradually rebounded after the sixth period. In general, US monetary policy had a spillover effect on China's GDP, which showed some sustainability. It had a positive impact in the short term, and a fluctuating impact in the long term, and the negative impact was more obvious.

Figure 4 shows the impulse response of China's CPI index to US monetary policy m2us. US monetary policy is also an impulse variable, and China's CPI index is a response variable. In the long term, China's CPI index was positively impacted by US monetary policy. In terms of time, China's CPI was impacted by US monetary policy in the early stage with a weak positive impact. In the second to the fourth period, there was a certain negative impact. The positive effect in the fifth period was more obvious as China's price level rose, and this trend continued until the eighth period. Overall, as the United States continued to adjust its monetary policy, the positive impact on China's price level was more significant. With the policy adjustment, there was a short-term negative effect, but on the whole, the spillover effect of the US monetary policy on China's price index was a sustained positive impact.

Figure 3. Impulse response of China's GDP to US monetary policy m2us.

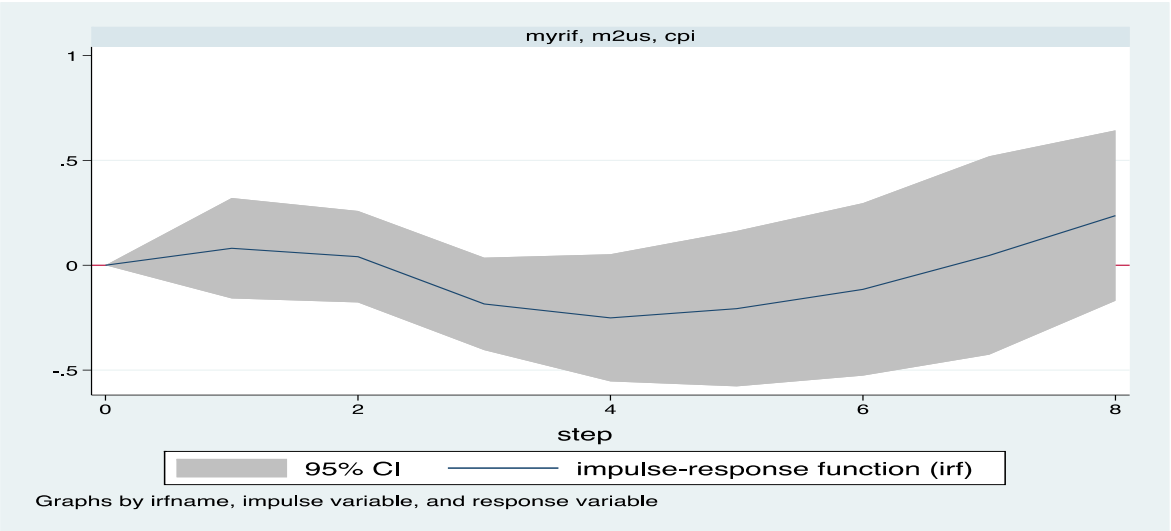

Figure 4. Impulse response of China's CPI to US monetary policy m2us.

6.5.2. Interest Rate Channel Analysis

Figure 5 shows the impulse response of China's benchmark interest rate to US monetary policy. In the short term, affected by the crisis, China's benchmark interest rate could not give rapid feedback, so it presented a brief upward trend. With the continuous implementation of US quantitative easing, China's benchmark interest rate showed negative feedback, that is, with the adjustment of US monetary policy, China's benchmark interest rate presented a downward trend, which was in line with the previous theoretical hypothesis.

6.5.3. Analysis of the Exchange Rate and Trade Channels

Figure 6 shows the impulse response of the China-US exchange rate to US monetary policy. By the impact of US monetary policy, the exchange rate generally fluctuated and finally converged to the horizontal state. At first, US monetary policy had a certain positive impact on the exchange rate. At the beginning of the policy issuance, due to the obvious interest rate difference between China and the United States, hot money poured into China, resulting in the depreciation of the US dollar to a certain extent. However, in the middle period, US monetary policy implementation had a short negative impact on the exchange rate, which was significant in the third stage and showed a certain positive impact in the fluctuation from the fourth to the eighth stage. Overall, the response of the exchange rate to US monetary policy was in line with theoretical expectations.

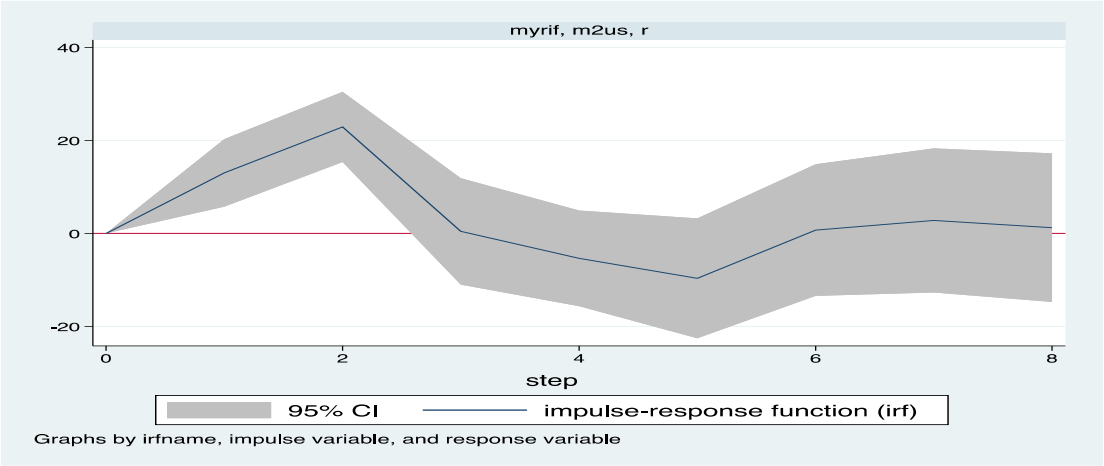

Figure 5. Impulse response of China's base interest rate r to US monetary policy m2us.

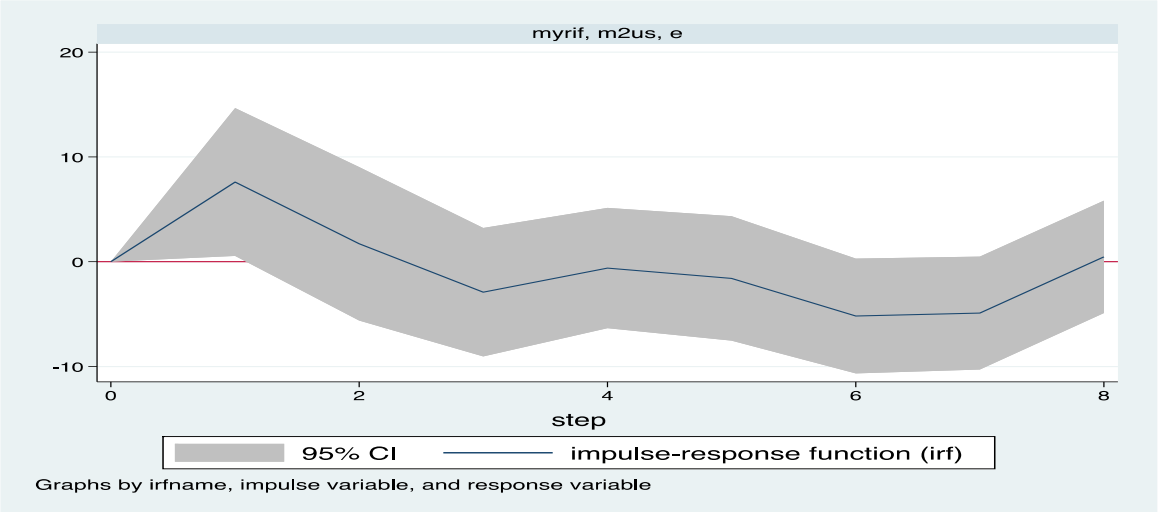

Figure 6. Impulse response of exchange rate to US monetary policy m2us.

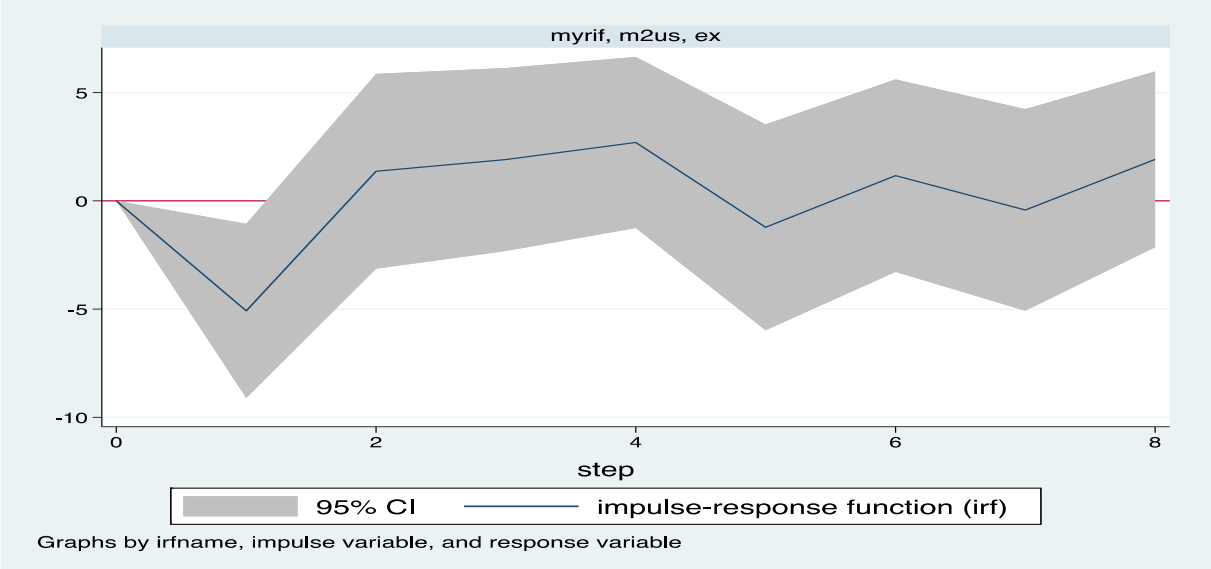

Figure 7. Impulse response of China's export ex to US monetary policy m2us.

Figure 7 shows the impulse response of China's exports (ex) to US monetary policy. At the beginning of the crisis, China's exports to the United States decreased. After being impacted by US monetary policy, China's exports to the United States showed an upward trend. Although the export volume fluctuated in the fifth period with the

adjustment of US monetary policy, overall, it still showed positive feedback of growth, which verified the previous hypothesis.

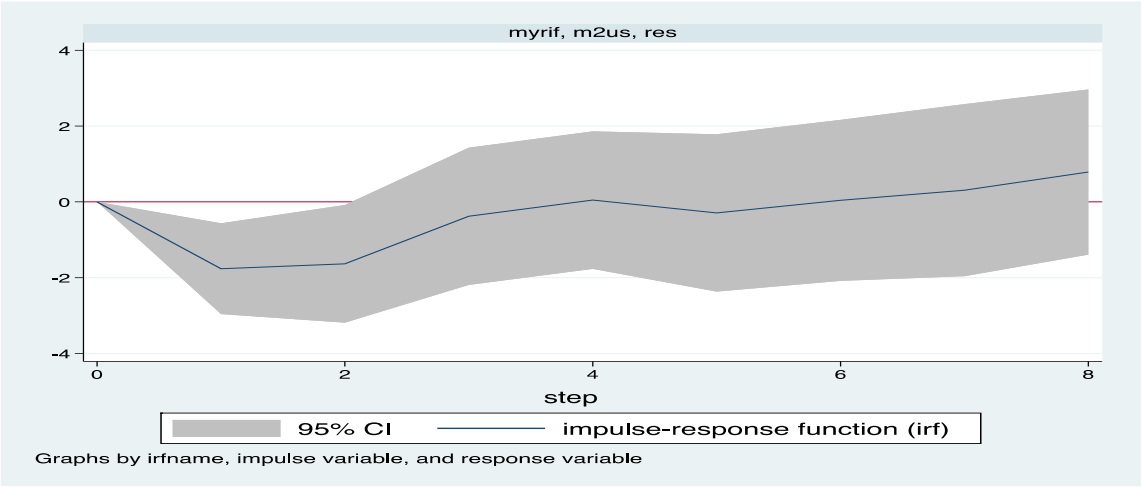

Figure 8. Impulse response of China's foreign exchange reserve res to US monetary policy m2us.

Figure 8 shows the impulse response of China's foreign exchange reserves (res) to US monetary policy. In the early stage of the implementation of US monetary policy, there was a certain negative impact on China's foreign exchange reserves. But, in the long-term, it was a positive impact, which means China's foreign exchange reserves increased and liquidity strengthened. Like China's export surplus to the United States, the implementation of the United States' loose monetary policies reduced the effective exchange rate of the US dollar, worsened the terms of trade of the United States, and increased China's share of foreign exchange.

7. CONCLUSION AND ENLIGHTENMENT

7.1. Research Conclusion

This paper uses the Mondale-Fleming-Dornbusch model to analyze the economic impact of the subprime mortgage crisis on China and the spillover effect on China of a series of monetary policies adopted by the United States. After the subprime mortgage crisis, the United States implemented a revive economy through traditional monetary policy tools, such as adjusting interest rates, increasing money supply, and adopting quantitative easing. Through theoretical model analysis, American monetary policy mainly affected China's economic development by affecting interest rate, exchange rate, and trade channels.

In the empirical part, the article constructs a vector autoregressive VAR model. Based on the case of single integer data of the same order, through the Granger causality test, it found that the US monetary policy had a significant impact on China's macro-economy. At the same time, it affected the exchange rate fluctuation, which led to the change of export trade and the increase of China's foreign exchange reserves. The US policy fluctuation would also lead to the change of China's basic interest rate.

In the analysis of macroeconomic fluctuations, the proxy variable of US monetary policy is taken as the impulse variable, and China's GDP and CPI indexes are taken as the response variables, respectively. The results show that the spillover effects of American monetary policy on China's GDP and CPI were sustainable. In the short term, the impact of US monetary policy brought a certain positive impact on the GDP and CPI indexes but had a negative impact from the third period. The impact on the CPI index showed a positive effect for a long time, which meant that US monetary policy brought certain pressure on China's price rise and inflation.

In the analysis of the interest rate channel, China's benchmark interest rate presented positive feedback in the short term. However, with the continuous adjustment of US monetary policy, China's benchmark interest rate finally showed negative feedback, which confirmed hypothesis 1 of this paper. In the trade channel, the Sino-US exchange

rate responded with significant negative feedback that was the depreciation of the US dollar. Therefore, it was not difficult to deduce the deterioration of the US terms of trade, the increase of China's exports, and the increase of foreign exchange reserves.

Overall, the US monetary policy had a certain impact on China's productivity and price level, and the positive spillover effect on prices easily brought some inflationary pressure to China. This hypothesis was verified in terms of interest rate, exchange rate, and trade channels. American monetary policy did have a significant spillover effect on China's economic development, changed China's foreign exchange reserves and export trade volume, and affected China's economic liquidity. The below suggestions address how to coordinate economic development and domestic inflation balance and counter the risks brought by the influx of foreign funds.

7.2. Suggestions

After the subprime mortgage crisis evolved into a global financial crisis, China adopted a series of loose monetary policies to repair the economy and stabilize the economic growth rate in the short term. However, with the continuous expansion of the implementation of quantitative easing policies in the United States, China faced the situation of excess liquidity and the pressure of inflation. China should examine its monetary policy, adopt a more stable monetary policy, adjust the economic structure, and curb inflation while maintaining steady economic growth. In addition, a prudent monetary policy is conducive to the adjustment of banks' credit structure and the improvement of the asset scale and structure of financial institutions. In the face of the complex and changeable international environment, the central bank can adjust monetary policy in a timely manner to ensure the smooth operation of the domestic economy, comprehensively adopt a variety of monetary tools, and strengthen policy coordination.

Capital flow control needs to be strengthened. According to the model analysis, due to the interest rate difference between China and the United States after the implementation of quantitative easing policies by the United States, hot money had an impact on China's capital market which easily aggravated the volatility of the financial market. Therefore, China needs to do a better job with its early warning mechanism and strengthen its access and investment direction monitoring of international capital. When the domestic financial market speeds up the pace of internationalization, a stable market can better resist external risks by increasing the thickness of the market.

In the face of the outbreak of the financial crisis, in the case of insufficient domestic demand, the driving force to encourage external demand to stimulate economic growth is insufficient. To maintain the stability of the RMB exchange rate and increase the competitiveness of the Chinese market on the international stage, China should actively adjust its economic structure, actively encourage the transformation, upgrading, and optimization of industries, and develop products with high added value. China can also increase strategic cooperation with emerging economies and magnify China's international voice.

7.3. Shortcomings and Future Improvement

The Mondale-Fleming-Dornbusch model selected in this paper is slightly stronger than, and has limited explanatory power to, the actual situation. The applicability of this model to China needs to be further investigated. In future research, the derivation process of the Mundell-Fleming-Dornbusch model can also be deeply analyzed to study under more relaxed assumptions.

In addition, the data selected in this paper are quarterly and the time span is large. Although the spillover effect of quantitative easing policies in the United States on China had some sustainability, we should also consider whether there are other factors affecting China's economic development in the selected time cycle and further focus on the time cycle and refine the variables in future research.

Finally, in the empirical section, it is found that the exchange rate and trade factors have not passed the Granger causality test. Considering that they may be related to the time cycle of selection, the variables selected in the trade

field may be slightly less representative. In the future, when selecting variables, consider whether the measurement caliber of variables is consistent and consider selecting more representative variables in many aspects.

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