Empirical Research on the Impact of China' s Monetary Policy on Stock Market Based on VAR Mode

Jiaxiang Ji[1], Ziqi Yang[2]
jji57@wisc.edu, k1926378@kcl.ac.uk

[1]Mathematics, University of Wisconsin-Madison, Madison, Wisconsin, United States, 53706

[2]King's Business School, King's College London, London, England, United Kingdom, WC2R 2LS

Abstract-The stock market plays an increasingly significant role in the transmission of China's monetary policy. As an important way for the central bank to regulate the national economy, the announcement and implementation of the monetary policy will inevitably cause the fluctuation of the stock prices. Referring to Qu Jing 's paper [2], this essay adopts the vector autoregressive model (VAR), selects monthly data from 2010 to 2020, empirically analyzes the impact of China's monetary policy on the stock market, and uses impulse response analysis and variance decomposition to further study the effects of monetary policy on the real economy. Narrow measures of money supply (M1) and Shanghai interbank offered rate (Shibor) are selected as the monetary policies variable indicators while the monthly closing price of the Shanghai and Shenzhen 300 Index is regarded as the representation of the entire stock market. All of the mentioned data is from the CSMAR database [1]. The study shows that the changes in the economic indicators, have an impact on the stock market, but not significant and have a time lag. An increase in the money supply will cause stock prices to rise, and an increase in interest rates will cause stock prices to fall. Based on the empirical results, suggestions for formulating monetary policies are put forward.

Keywords-Stock market, interest rate, money supply, VAR model, monetary policy

1 INTRODUCTION

Stock market has a close relationship with national policies. The state would regulate the economy through issuing fiscal and monetary policies, which will affect the speed of economic growth and economic benefits of enterprises, as well as would have an impact on the stock market [2]. Yong Tang's previous research reports that "a central bank can lower or raise benchmark rates to adjust the economy, which is similar to the interest rate" [3]. Within the continuous development of China's capital market, coupled with the completion of non-tradable shares reform, structural changes have taken place in the stock market and it has entered into the era of full circulation [2]. The relationship between the stock market and the national economy has become closer and closer. In recent years, China's national economy has "encountered deep structural problems policy uncertainty, which would affect stock market performance" [4]. Yong Tang collected various papers and he found that "stock markets respond differently to different policy actions and types" [2]. Additionally, whether the global economic crisis caused by the "subprime mortgage"in the United States[2] or "the impact of the COVID-19 pandemic on the transmission of monetary policy to financial markets"[6], displaying that macroeconomic

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policies would have significant impacts on stock market. In this situation, this essay would focus on the study of the relationship between China's monetary policy and stock market, which has become one of the most popular topics in present research in finance. Various tests will be performed in the following displaying that if the changes of the monetary policy would cause variation in the stock market. Several indicators are selected for further calculation in the research, including narrow mearsure of money supply and Shanghai interbank offered rate which represents China' s monetary policy while Shanghai and Shenzhen Index 300 stands for the entire stock market.

Only by understanding how macroeconomic policies impact the securities market, can we anticipate the movement trend of the entire securities market and the changes in the investment value of different securities. The monetary authority can therefore control the abnormal fluctuations of the stock market, effectively monitoring the operation of the stock market and decrease the illegal offence

2 RESULT AND ANALYSIS

In this paper, the vector autoregressive model, a commonly used econometric model for the analysis of multivariate time series model, is adopted for the research.

In order to operate the empirical analysis, the variables selected in this article, Shanghai-Shenzhen 300 stock index (CSI300) is represented by x_1, the 7-day Shibor is represented by x_2, and the narrow measure of money supply (M1) is represented by x_3. Take the logarithm to eliminate heteroscedasticity in the time series. The following figures are the plots for the time series.

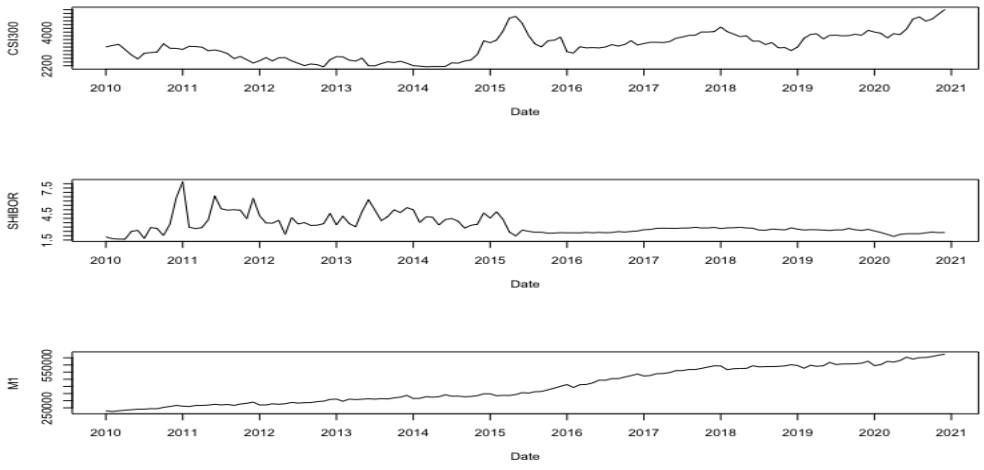

Figure 1. Time series plot of logarithmic processed data

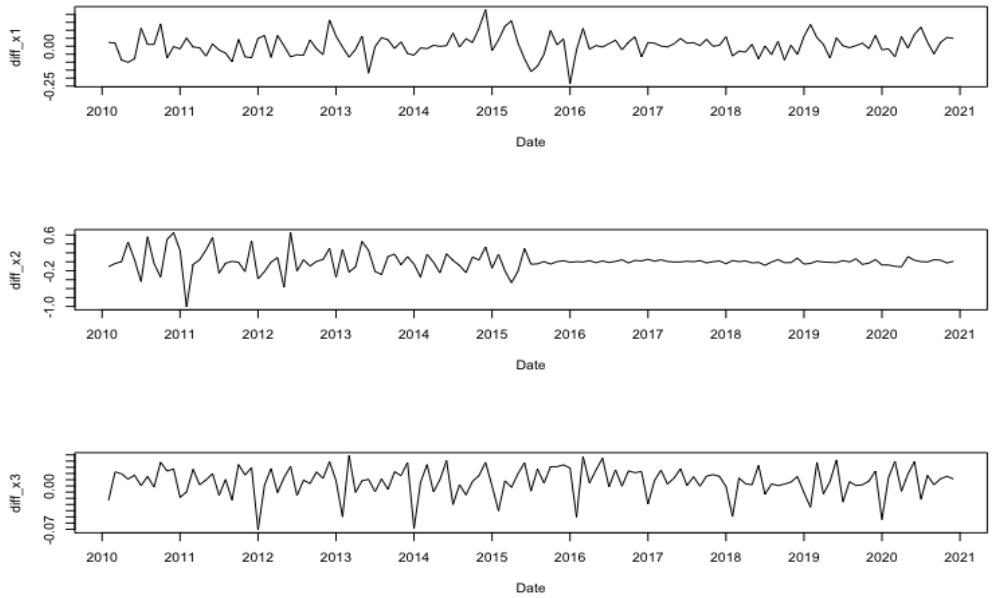

Figure 2. Time series plot of data after logarithm and difference

3 UNIT ROOT TEST

In order to avoid pseudo-regression problems, a smoothness test should be carried out before the VAR model is established. The first one is the unit root test and ADF test is adopted . The results are shown below in Table 1.

Table 1 Results of Augmented Dickey-Fuller test

Variable	ADF Test Value	P Value	Conclusion
$lnx1$	-2.3947	0.4124	Unstable
$lnx2$	-3.4444	0.05024	Unstable
$lnx3$	-1.2469	0.8897	Unstable

Table 1 displays that the P Value of the three variables are all greater than 0.05, which represents that the null hypothesis can be accepted at the 95% significance level. The variable has a unit root and therefore, the data is a non-stationary time series. Within this test, the first-order difference between the variables can be calculated. The results are shown in Table 2.

Table 2 Results of Augmented Dickey-Fuller test

Variable	ADF Test Value	P Value	Conclusion
$dlnx1$	-4.5954	0.01	Stable
$dlnx2$	-5.9559	0.01	Stable

$dlnx3$	-4.3847	0.01	Stable

Table 2 demonstrates that the null hypothesis can be rejected at a 95% significance level. Each variable is integrated of the first order, which meets the premise condition of the cointegration test.

4 COINTEGRATION TEST

According to the previous tests, the variables are all integrated of one order and meet the condition of the Cointegration test. Use Johanson Cointegration test method to examine the cointegration relationship. The results are presented in Table 3.

Table 3 Results of Cointegration test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value
$r \leq 2$	0.0001	0.01	8.18
$r \leq 1$	0.0629	8.46	17.95
$r = 0$	0.2193	40.65	31.52

By comparing the trace statistics and 0.05 critical value, the results given in Table 3 display that the previous hypothesis which the rank of the matrix is 0 can be rejected. This means that the cointegration relationship exists.

5 GRANGER CAUSALITY TEST

After determining that there is a co-integration relationship between the tested three variable series, further tests are done to examine whether the long-term equilibrium relationship between the series constitutes a causal relationship. Granger causality test is adopted to evaluate the statistical causality of variables. The results are shown in Table 4. Only the results of the variables that pass the test at the 5% significance level are listed below.

Table 4 Results of Granger causality test

Null Hypothesis	F Value	P Value	Conclusion
$lnx2\ does\ not\ Granger\ Cause\ lnx1$	3.6258	0.02947	*Reject the null hypothesis*
$lnx1\ does\ not\ Granger\ Cause\ lnx2$	0.0221	0.9781	*Accept the null hypothesis*
$lnx3\ does\ not\ Granger\ Cause\ lnx1$	2.197	0.1154	*Accept the null hypothesis*
$lnx1\ does\ not\ Granger\ Cause\ lnx3$	3.8831	0.02312	*Reject the null hypothesis*

By comparing the P Value and 0.05, the results display that both SHIBOR and M1 are the Granger cause of CSI300 while CSI300 is not the Granger cause of SHIBOR and M1.

6 CONSTRUCT THE VAR MODEL

In order to verify the hypothesis, vector autoregressive model is adopted for investigation. First, use some information criteria to determine the lag order of the model. The results given by different information criterion methods are shown in Table 5.

Table 5 Lag order determined by information criterion

Information criterion	AIC(n)	HQ(n)	SC(n)	FPE(n)
Lag order	2	1	1	2

The order is chosen based on the Akaike information criterion (AIC). After that, the VAR (2) model is bulit. From the VAR (2) model, the estimation results for equation x_1 is demonstrated below.

$$x_1 = 1.068x_{1_{l_1}} + 0.004x_{2_{l_1}} - 0.253x_{3_{l_1}} - 0.162x_{1_{l_2}} - 0.003x_{2_{l_2}} + 0.316x_{3_{l_2}} - 0.056$$

From the equation, it can be seen that the Shibor which is lagging for the first period has a positive impact on stock price while the Shibor which is lagging for the second period has a negative impact. M1 which is lagging for the first period has a negative impact on stock prices while that which is lagging for the second period has a positive impact.

After that, impulse response analysis and variance decomposition method should be performed since they are the important part of the model. Use the Cumulative sum test (CUSUM) to check the stationarity of the model parameters before running the impulse response analysis. The figures are as follows. A, B and C represents CSI300, SHIBOR and M1 respectively on the graphs.

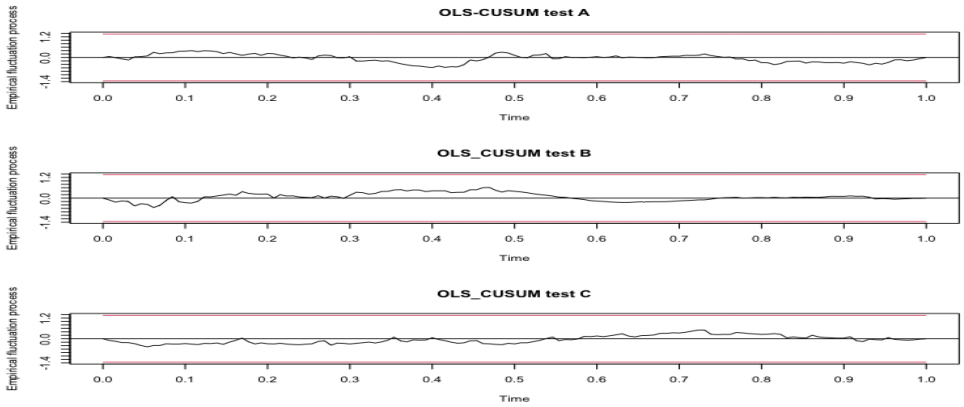

Figure 3. Plots of the results of the CUSUM test

From Figure 3, the black lines are always between the red lines, displaying that the built model is stationary. Therefore, further tests can be performed.

7 IMPULSE RESPONSE ANALYSIS

Impulse response analysis is performing for observing the dynamic impact of the model on the system when the model is impacted. The figures are as follows.

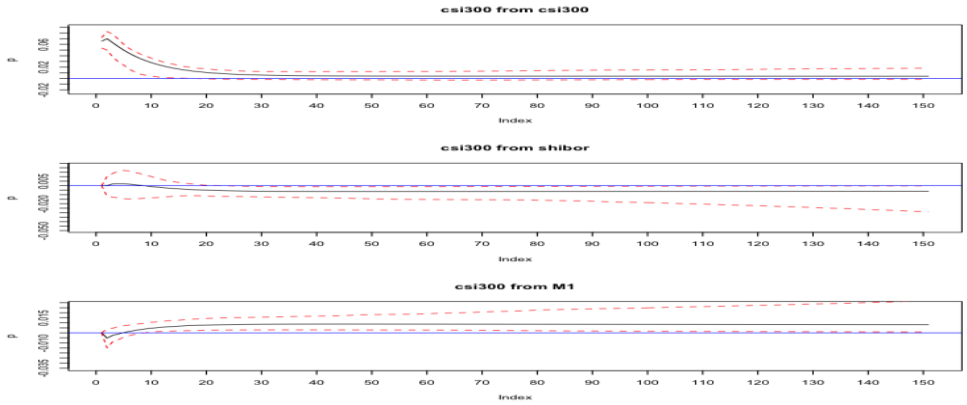

Figure 4. Plots of the impulse response

From Figure 4, CSI300 reacts more obviously to itself. For a standard deviation shock of shibor, the response path of CSI300 is positive and small in the short-term, and negative in the long-term. In general, rising interest rates will cause the stock price to fall. For a standard deviation impact of M1, the response path of CSI300 is negative for a short time but then changes to positive later. In general, the increase in money supply will raise up the stock price.

8 VARIANCE DECOMPOSITION

Variance decomposition evaluates the importance of different structural shocks by analyzing the contribution of each structural shock to the change of endogenous variables. The plots of the variance contribution rate and the period are shown in Figure 5.

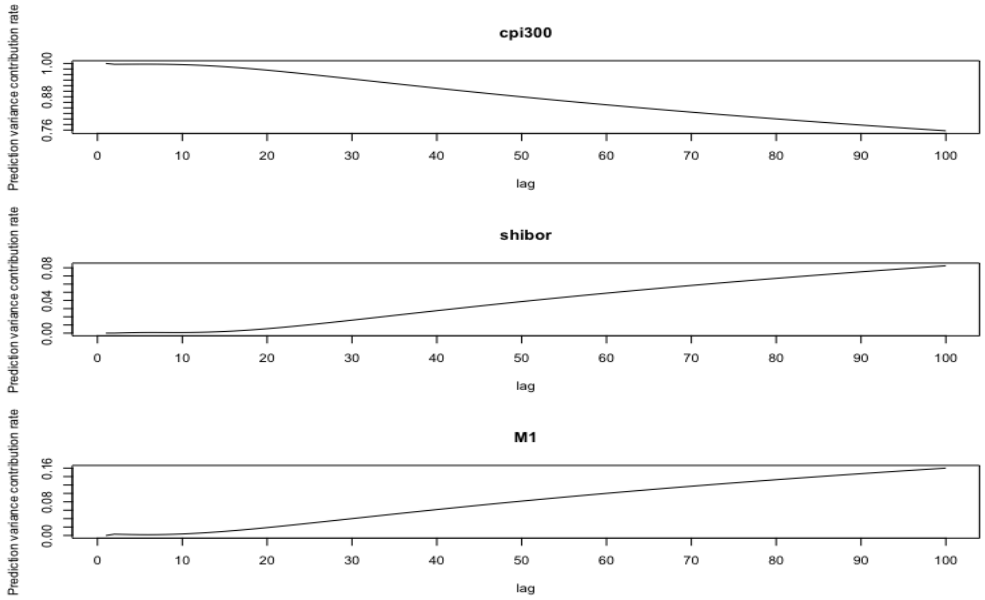

Figure 5. Plots of variance contribution rate and period

From Figure 5, CSI300 contributes the most. Both Shibor and M1 rose slowly after the tenth period, which also shows that there is a time lag in regulating the stock market. Changes in current stock prices versus changes in stock prices in subsequent period's contribution rate is getting smaller and smaller.

9 FORECAST TO FUTURE

After all the steps above, the forecast for the future is also an interesting field that could be investigated. Use the VAR model to make predictions, the figures are as follows. The blue lines are the predicted direction.

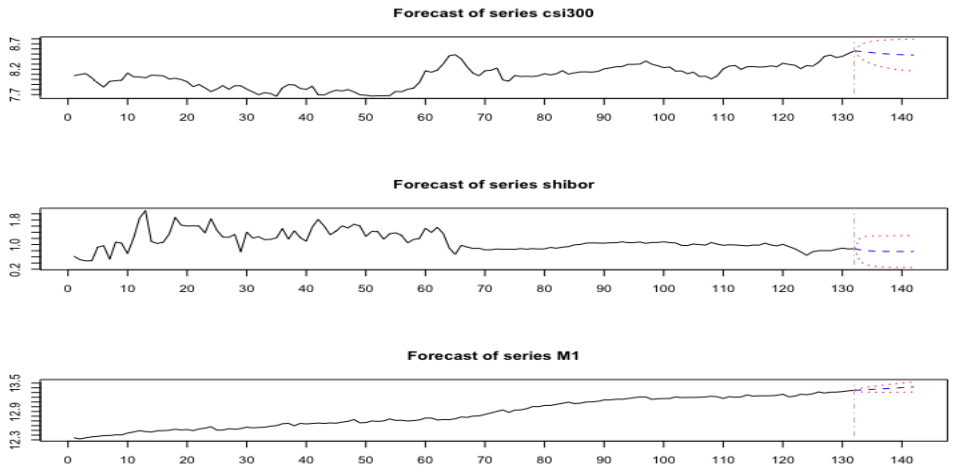

Figure 6. Plots of the prediction

From the results of the unit root test, it can be concluded that the variables are first-order single integral. There is a cointegration relationship between the variables given by the cointegration test. Through the Granger causality test, it can be known that Shibor is the Granger cause of the Shanghai and Shenzhen 300 Index while SHIBOR is not the Granger cause of Shibor. The narrow measure of money supply (M1) is not the Granger cause of the CSI300 index, but the CSI300 index is the Granger cause of M1. Through establishing the VAR model and conducting the CUSUM test, it can be found that the model remains stable. From the variance decomposition, the contribution rate of each variable to the change of the Shanghai and Shenzhen 300 Index is displayed. The CSI300 index always has the greatest impact on itself when M1 and Shibor both have a relatively weak impact on the CSI300 index. In comparison, the influence of money supply is greater than that of Shibor.

10 CONCLUSION

This paper studies the relationship between China's monetary policy and the entire stock market. By analyzing the results of various tests, a conclusion can be drawn, which is consistent with the previous hypothesis —— China's monetary policy has an impact on the stock market. The increase in Shibor will cause the stock price to fall, and the increase in the narrow measure of money supply will lead to the increase in stock price. From an economic perspective, there are more currencies in circulation in the market as the money supply increases. People's purchasing power increases, and more funds flow into the stock market, resulting in the increase in stock prices. On the other hand, more people are willing to deposit their money in the bank when the interest rate rises. Some of the funds in the stock market would flow to the money market, coupled with the reduction in the amount of money circulating in the stock market, causing stock prices to fall. Additionally, the variance decomposition test displays that there is a time lag in regulating the stock market by the monetary policy. The main reason is that interest rate liberalization is not achieved in China. The change of the interest rate does not accurately reflect the supply and

demand of the funds in China's market, and therefore the stock price lacks elasticity to the change of interest rate [5]. It shows that China’s monetary policy has an impact on the stock market, but these effects are weak and have a time lag. It is due to the imperfection of the monetary policies which are required for further improvements. Firstly, Monetary authorities should pay more attention to the stock market when formulating monetary policies, such as stock price fluctuations, total market value of stocks, and market value in circulation. Even though China’s monetary authorities have considered part of the stock market information when formulating monetary policies, the strength of reflecting information related to the stock market is still relatively weak. Secondly, setting up a well-established policy disclosure system. A standardized, timely, and transparent announcement about policy changes will slow down the volatility of the stock market, improve the efficiency of the monetary policy and promote more fair trades in the market. Comparing to several western developed countries, the formulation and implementation of some policies in China are more secretive. The public has limited access to obtain related information, which causes some information insiders to use the information in exchange for money. A sound information disclosure system should therefore be established, and the insider trading for self benefits should be severely punished. Finally, it is necessary to gradually achieve the marketization of interest rates combined with considering the actual situation. At present, China's interest rate has not been fully liberalized, and the marketization is still in progress. The People's Bank of China has not yet been able to change the interest rate structure through monetary policy, and changes in interest rates can not effectively affect the stock price. With the continuous development of the market economy and the deepening of financial reform, indirect regulation will establish a more important role on the impact of stock market. Therefore, pushing on the reform of interest rate marketization is necessary, increase the transmission effect of interest rate changes on asset price variation, and attach the importance to the key role of interest rates in the transmission of monetary policy.

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REFERENCES

[1] CSMAR Database, https://www.gtarsc.com/

[2] Jing Qu, Empirical Analysis on the Impact of China's Monetary Policy on Stock Market, Economic Problems, Issue 1, 2015, China Academic Journal Electronic Publishing House, Page 55. Issued in January, 2015.

[3] Yong Tang, Yong Luo, Jie Xiong, Fei Zhao, Yi-Cheng Zhang, Impact of Monetary Policy Changes on the Chinese Monetary and Stock Markets, Physica A: Statistical Mechanics and its Applications, Volume 392, Issue 19, 2013, Pages 4435-4449, ISSN 0378-4371. Issued on October 1st, 2013, https://doi.org/10.1016/j.physa.2013.05.023.

[4] Deng-Kui Si, Bing Zhao, Xiao-Lin Li, Hui Ding, Policy Uncertainty and Sectoral Stock Market Volatility in China, Economic Analysis and Policy, Volume 69, Pages 557-573, ISSN 0313-5926. Issued on January 13th 2021, https://doi.org/10.1016/j.eap.2021.01.006.

[5] Shu-jun Ding, Su-wen Shao, Jin-peng Huang, Li Shen, Empirical Analysis on the Impact of China's Monetary Policy on Stock Market, Statistics and Decision, Issue 3, 2018, 34(3), China Academic Journal Electronic Publishing House, Page 156. Issued in March, 2018.
[6] Xiaoyun Wei, Liyan Han, The impact of COVID-19 pandemic on transmission of monetary policy to financial markets, International Review of Financial Analysis, Volume 74, 2021, 101705, ISSN 1057-5219. Issued in March 2021. https://doi.org/10.1016/j.irfa.2021.101705.