

# Analysis on the correlation between credit scale of financial institutions and stock market price data

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**Abstract:** This paper analyzes the degree of association between credit size of financial institutions and stock market prices in China based on monthly data from November 2006 to November 2016 using impulse response function because of VAR time series model. The results show that there is a two-way Granger causality between the credit size of financial institutions and stock market prices when the lag order is 2. The impact of credit size of financial institutions on stock market price shocks is larger in the short-term, and this effect rapidly decreases to near zero after the med-long term. Conversely, the med-long term shocks to the credit size of financial institutions are larger than the short-term shocks by stock market prices.

**Keywords:** credit scale; stock market prices; digital finance; financial big data; fintech

## 1. Introduction

A country's credit development has a positive and strong long-term effect on its economic growth, and there is also a short-term effect of stock market development on economic growth<sup>[1]</sup>. In February 2017, Pan Gongsheng, vice governor of the People's Bank of China, pointed out at the financial market work conference that it is necessary to further play the guiding role of credit policy, regulate the development of financial markets, and guard the bottom line of no The bottom line of systemic risk. As an important part of the financial market, the development of the stock market requires a large amount of capital support, and loans from financial institutions are one of the important sources of social capital. The balance of RMB loans of China's financial institutions grew from 2,331.41 billion yuan in November 2006 to 1,055,596 billion yuan in November 2016. Meanwhile, as the per capita income of China's residents has increased, the participation rate of China's residents in the stock market is also gradually increasing up to May 29, 2015, the effective stock accounts in China's securities market have reached 1.75 billion. The above data shows that the correlation between the credit scale of financial institutions and stock market prices in China is worth studying.

There are several novel methods based on machine learning model for stock market price forecasting, such as transparent models, neural network algorithms, deep learning models<sup>[2-6]</sup>. The VAR model is one of the machine learning models for economic predication such as stock price and bond rate.

## 2. Related Work

Through the reference and research of the existing literature, it can be proved that there is a relatively close relationship between GDP and stock market price changes. First of all, through the regression study of transnational economic growth<sup>[7]</sup>, found that long-term economic growth has a positive impact on the development of the stock market. At the same time, there is a very stable correlation between these two aspects. By collecting and studying data from seven different

countries<sup>[8]</sup>, have come to the conclusion that when a stock market is sufficiently developed, it can effectively optimize the allocation of resources. At the same time, from the perspective of long-term development, we can ensure stable economic growth. In addition<sup>[9]</sup>, has studied and verified the relationship between the credit scale of financial institutions and the stock market, Through the integrated analysis of several stock market crashes and financial crises that have occurred in history, many examples have proved that the reduction and expansion of bank credit scale has a significant amplification effect on the stock market price, and there is a significant correlation between the change of bank credit scale and the sharp fluctuation of the stock market price. This is also a major inducement to financial instability, stock market collapse and banking crisis. Therefore, it is necessary to take measures to dredge the connection between the money market and the stock market and strengthen the management of commercial banks.

When discussing the relationship between the credit scale of financial institutions and the stock market price in depth, scholars have given different views on the direction of the causal relationship between these two aspects. Among them, some scholars pointed out that the causal relationship between the two is one-way<sup>[10]</sup>, used Granger causality test method to measure the relationship between bank credit and real estate prices, and the results confirmed that there is a one-way causal relationship between bank credit and asset prices. Moreover, the direction of this relationship is often related to the degree of urban development<sup>[11]</sup> comprehensively used the vector autoregressive model and the error correction model to study the relationship between bank credit and stock price of China during the post-financial crisis, and found that the changes in the stock market were the one-way Granger cause of the fluctuations in the credit market, and vice versa. On the contrary, another part of scholars believe that there is a two-way causal relationship between the credit scale of financial institutions and the stock market price<sup>[12]</sup>, summarized the mechanism of the interaction between market price and bank credit, and proposed two types of causal relationship assumptions. Using short-term dynamic analysis of the given data, it is found that there is an interactive relationship between the scale of bank credit and the stock market price, and the expansion of bank credit has a more significant impact on the market price.

On the basis of the above research, this paper will conduct an in-depth discussion on the correlation between the credit scale of financial institutions and the stock market price from the following two directions: on the one hand, how the linkage between the credit scale of financial institutions and the stock market in China is specifically distributed, whether it is two-way causality or one-way causality; Based on the impulse response function, whether the impact effect between the credit scale of financial institutions and the stock market price is stable in different time periods.

### 3. Model, Data and Variables Selection

#### 3.1. Model Design

This paper mainly studies the degree of correlation between the credit scale of financial institutions and stock market prices. Considering the availability of data, this paper selects the relevant data of the balance of various RMB loans of financial institutions as research samples, and the sample period is from November 2006 to November 2016. In this paper, the VAR model is used to test whether there is a short-term and long-term equilibrium relationship between bank credit and stock market price fluctuations, impulse response function method is used to test the impact of bank credit, stock market price, consumer price index, interbank offered rate, and industrial added value, and variance decomposition is used to verify the degree of their mutual influence.

#### 3.2. Model Construction

The boiling stage of the VAR model was calculated based on AIC and SC criteria, and it was found that the values were optimal when the lag period was 2, so it was appropriate to choose the lag period of 2 for the model. The VAR model of the relationship between the stock market and credit is established by using Python software.

$$LNSZ = \alpha + \beta_1 LNL + \beta_2 LNQ + \beta_3 LNCPI + \beta_4 I + \varepsilon \quad (1)$$

#### 3.3. Data Sources and Variables

In this paper, monthly data from November 2006 to November 2016 are selected for empirical

research. The balance of RMB loans of financial institutions L is chosen to represent the credit scale of financial institutions, and the monthly closing price of Shanghai Composite Index SZ is used to represent the stock market price. The change of interest rate is closely related to the change of the credit scale of financial institutions. Among various interest rate types, the representative seven-day inter bank offered rate I is chosen to represent the interest rate variable. The consumer price index (the base period value is 100) and the monthly industrial added value Q are selected to replace GDP. The data comes from the official website of the People's Bank of China, the official website of the Shanghai Stock Exchange, the official website of the National Bureau of Statistics, the Shibor official website. In order to avoid the inaccuracy and heteroscedasticity existing in direct modeling with the original data, logarithmic processing (logarithmic normalization processing) was carried out on the original data, and seasonal adjustment was made on the industrial added value. Therefore, this paper takes logarithm of variables except interest rate I, and defines the generated new variables as LNL, LNSZ, LNQ, LNCPI and I.

### 3.4. Experimental Process and Method

In this paper, panel vector autoregressive model (PanelVAR model) and impulse response function analysis are adopted. Various loan data of 25 types of large financial institutions from 2006 to 2016 are selected to test whether there is a short-term and long-term equilibrium relationship between bank credit and stock market price fluctuations. Impulse response function method is used to test the impact of bank credit, stock market price, consumer price index, inter bank offered rate and industrial added value. And verify the degree of mutual influence by variance decomposition.

The specific process is as follows: Firstly, Augmented Dickey-Fuller test (ADF) is used to verify whether InL, InVC, InQ and InCPI are stable, and Johansen co-integration test is carried out to find that there are multiple co-integration relationships among variables. Granger causality test is used to illustrate the causality of variables. Secondly, AIC and SC criteria are used to calculate the optimal lag order of the model is 2. When the lag order is 2, there is a two-way Granger causality relationship between the credit scale of financial institutions and the stock market price. In the short term, the credit scale of financial institutions has a great impact on the stock market price, and in the medium and long term, the impact rapidly decreases to near 0. On the contrary, the stock market price has more impact on the credit scale of financial institutions in the medium and long term than in the short term. The unit roots of calculation are all in the unit circle, which verifies that the VAR model is stable and can be analyzed for impulse response function.

## 4. Analysis of Empirical Results

### 4.1. Test for Smoothness

From the ADF test results in Table 1, we can see that LNL, LNSZ and LNQ are non-stationary time series, so they cannot be used directly to construct VAR models. We use the first-order difference to process the original series, and the obtained first-order difference series is stable.

Table 1: Unit root test

variable	ADF (the value of t)	the value of P	test result	ADF (the value of first order difference of t)	the value of P	test result
LNSZ	-2.1300	0.2344	not stable	-10.8540	0.0000	stable
LNQ	-1.2305	0.6596	not stable	-10.3838	0.0000	stable
LNCPI	-2.8971	0.0487	stable			
I	-3.9108	0.0027	stable			

### 4.2. Granger causality test

Based on the AIC information criterion and the SC criterion, the model is optimal when the lag time is 2. The Granger causality results between LNL, LNSZ, LNQ and LNCPI were obtained as shown in Table 2.

Table 2: Causality test

samples interval: 2006.11-2016.11 lag phase: 2		
original assumption	statistical magnitude: F	the value of P
LNL is not the Granger reason of LNSZ	2.8409	0.0625*
LNSZ is not the Granger reason of LNL	5.0149	0.0082***
LNL is not the Granger reason of LNQ	3.5011	0.0334**
LNQ is not the Granger reason of LNL	8.7139	0.0003***
LNCPI is not the Granger reason of LNSZ	3.3908	0.0371**
LNSZ is not the Granger reason of LNCPI	8.2680	0.0004***
I is not the Granger reason of LNSZ	0.8194	0.4433
LNSZ is not the Granger reason of I	0.4604	0.6321
LNCPI is not the Granger reason of LNL	8.3403	0.0004***
LNL is not the Granger reason of LNCPI	0.8118	0.4466

Note: \*\*\*, \*\*, \* denote significance at 1%, 5% and 10% significance levels respectively.

The results of the tests in Table 2 show that at a 10% significance level, the size of financial institutions' credit is the Granger cause of stock market prices. At 1% level of significance, stock market price is the Granger cause of credit size of financial institutions.

4.3. Impulse response function

Since Granger causality test reflects the static relationship among the above variables, in order to analyze the short-term dynamic interaction between the credit scale of financial institutions and stock prices, impulse response function analysis is added on the basis of the VAR model. The impulse response generated by Eviews7.0 software is shown in the following figure 1:

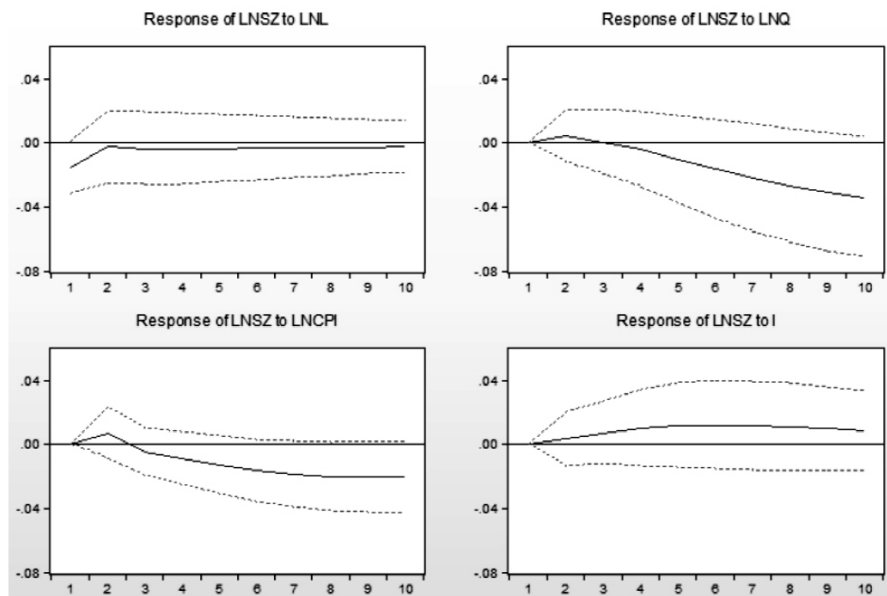


Figure 1: Response function of stock market price to other variables

Figure 1 is the pulse response function of stock market price to other variables obtained by using the generalized pulse method. The figure reflects the influence of the credit scale of financial institutions on the stock market price under different lag periods. When a positive impact is given to the credit scale of financial institutions and other factors remain unchanged, the credit scale of financial institutions has the largest negative impact on the stock market price in the first period, and then the negative impact decreases rapidly, and approaches 0 in the second period, and keeps near 0 thereafter. It shows that the credit scale of financial institutions has little influence on the stock market price change after the second period. In the short term, the credit scale of financial institutions has a great influence on the change of stock market price, and in the medium and long term, the influence rapidly decreases

to near 0.

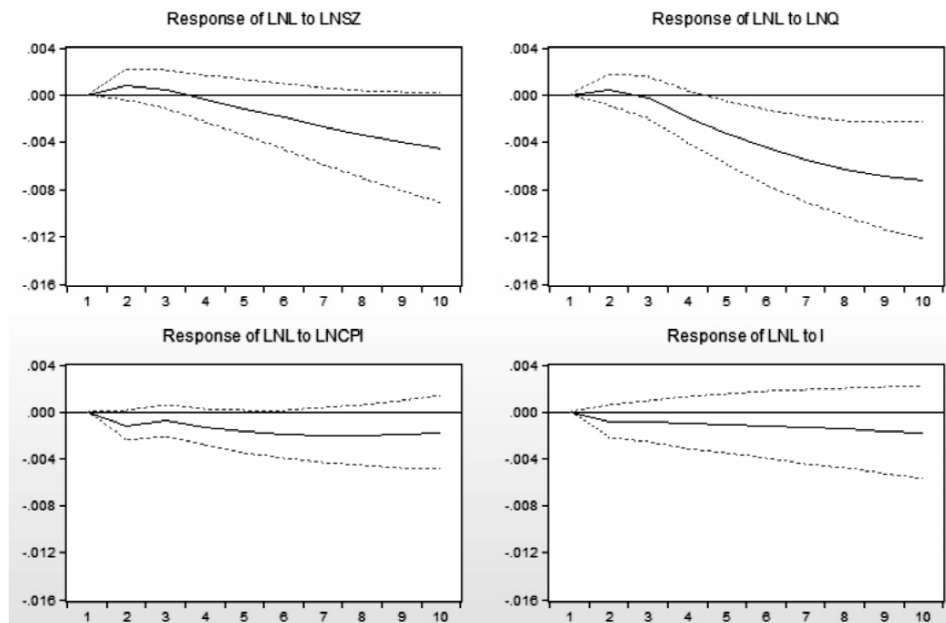


Figure 2: Response function of credit scale of financial institutions to other variables

Figure 2 shows the response function of credit scale of financial institutions to other variables. We can see the impact of stock market price and other variables on the credit scale of financial institutions under different lag periods. If there is a positive impact on the stock market price and other factors remain unchanged, the stock market price will have a positive impact on the credit scale of financial institutions in the first to third periods, but after the fourth period, it will become a negative impact, and the negative impact will gradually increase until the tenth period. This shows that during the sample period, the stock market price has a positive impact on the credit scale of financial institutions for about three months, and over three months, the stock market price will have a negative impact on the credit scale of financial institutions and the impact will continue to increase. In other words, the impact of stock market prices on the credit scale of financial institutions in the medium and long term is greater than that in the short term, and the longer the impact time is, the larger the impact scale is.

## 5. Conclusion

With the information aforementioned, generally speaking, we investigate all the information through five variables, respectively, the credit quota of financial institution, market value of stocks, industrial added value, consumer price index and interest rate. After that we use the granger and data management, respectively, causality test, establish VaR module and impulse response function to come to a conclusion. Here the author would like to draw following conclusions.

First of all, we choose the sample which lag phase is selected as 2. We surprisingly find that under the circumstances that the significance level of 10% there is a bidirectional granger causality between the credit scale of financial institutions and the stock market prices. The change of the credit scale of financial institutions has a certain influence on the stock market price, however the impact is fragile, the stock market has a more significant effect on the credit scale of financial institutions. Secondly, the credit scale of financial institutions has a great impact on the stock price in a short term, according to the impulse response function, in the medium and long term this influence rapidly decreases to approximately zero. In other words the short-term impact of the credit scale of financial institutions on stock market price is greater than that of the long term perspective. Conversely, the stock market price has more effect on the credit scale of financial institutions in medium and long term than in the short term. In this conception, the government authorities should considered the influence of stock market prices on credit scale when making credit policies. This paves the way for government to actively response for the stock crisis, provide a possible instruction for the society to deal with stock market disaster.

So in the light of above statement, when the stock market crash occurred the monetary policy authorities should not prevent the stock market price from plummeting only by cutting the reverse ratio and the interest rates, simultaneously, expanding credit scale. When dealing with the crisis in the stock market the government used to take several methods to cooperate with the credit policy, such as reducing the market transaction cost expanding the financial channels of brokerages, etc. However, the top priority is to stabilize the market expectations, guide rational investment and crackdown the behavior of market manipulation. Another, at the prosperous stages of the stock-market, the more attention to the current of credit funds should be paid, established a prevention to the phenomenon of a large number of credit funds out of the supervision and sneaking into the market.

## References

- [1] Banerjee P K, Ahmed M N, Hossain M M. *Bank, Stock Market And Economic Growth: Bangladesh Perspective*[J]. *The Journal of Developing Areas*, 2017, 51(2): 17 -29.
- [2] C. Ebenesh and K. Anitha, "A Novel Approach to Minimize the Mean Square Error in Predicting Stock Price Index using Linear Regression in Comparison with LSTM Model," 2022 International Conference on Sustainable Computing and Data Communication Systems (ICSCDS), Erode, India, 2022, pp. 1365-1370, doi: 10.1109/ICSCDS53736.2022.9760764.
- [3] L. Lindsay, D. Kerr, S. Coleman and B. Gardiner, "Transparent Models for Stock Market Price Forecasting," 2022 IEEE Symposium Series on Computational Intelligence (SSCI), Singapore, Singapore, 2022, pp. 860-866, doi: 10.1109/SSCI51031.2022.10022089.
- [4] Y. Wei and V. Chaudhary, "The Directionality Function Defect of Performance Evaluation Method in Regression Neural Network for Stock Price Prediction," 2020 IEEE 7th International Conference on Data Science and Advanced Analytics (DSAA), Sydney, NSW, Australia, 2020, pp. 769-770, doi: 10.1109/DSAA49011.2020.00108.
- [5] R. -C. Chen, W. -I. Yang and K. -C. Chiu, "Transfer Learning and LSTM to Predict Stock Price," 2022 International Conference on Machine Learning and Cybernetics (ICMLC), Japan, 2022, pp. 165-169, doi: 10.1109/ICMLC56445.2022.9941296.
- [6] J. H. Moedjahedy, R. Rotikan, W. F. Roshandi and J. Y. Mambu, "Stock Price Forecasting on Telecommunication Sector Companies in Indonesia Stock Exchange Using Machine Learning Algorithms," 2020 2nd International Conference on Cybernetics and Intelligent System (ICORIS), Manado, Indonesia, 2020, pp. 1-4, doi: 10.1109/ICORIS50180.2020.9320758.
- [7] Levine R, Zervos S. *Stock market development and long -run growth* [J]. *World Bank Economic Review*, 1996, 10 ( 2) : 323 - 39.
- [8] Caporale G M, Howells P G A, Soliman A M. *Stock market development and economic growth: the causal linkage*[J]. *Journal of economic development*, 2004, 29( 1) : 33-50.
- [9] Du Junshan. *Theoretical and empirical analysis of the impact of stock price fluctuations on bank stability*[J]. *Financial Forum*, 2006, 06: 53-57.
- [10] Song Bo, Lei Hong. *Bank credit shock and real estate price fluctuation: 1999-2014--Based on panel data analysis of China's first-tier and second-tier cities*[J]. *Financial science*, 2016, 05: 12-19.
- [11] Zhang Ying, Yuan Huijie. *Research on the Relationship between Bank Credit and Stock Price -- Retesting Based on the Data in the Post-financial Crisis Era* [J]. *Finance and Finance*, 2016, No.161(03):7-13.
- [12] Ma Yaming, Shao Shiyuan. *Asset Price Fluctuation, Bank Credit and Financial Stability* [J]. *Journal of the Central University of Finance and Economics*, 2012(01):45-51.