

Analysis of the Correlation between Bank of China Credit and Real Estate Prices

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ABSTRACT

This paper mainly analyses the credit factors that affect China's real estate price. Firstly, it introduces the significance of the research. Secondly, four indicators are selected from the total amount of domestic real estate loans, real estate company's loans, the proportion of real estate investment in the total domestic real estate development investment, the central bank lending rate and other credit factors. Finally, it adopted stationary analysis to examine the four credit factors, and use it to establish the VAR model, conduct Granger causality test and impulse response research.

Keywords: Chinese real estate prices; Bank credits; VAR model; Cointegration test; Granger test

1. INTRODUCTION

The potential risks brought by the rapid growth of real estate prices to banks may even become hidden dangers leading to the collapse of Chinese banking system and affect the stable development of Chinese economy[7]. In this respect, China needs to control the scale of bank credit and strengthen supervision in order to control the overheating of the real estate market[1]. The significance of this paper is to find out and test the correlation between bank credit and real estate price. It helps to control the scale of credit and curb the overheating of real estate.

2. FOUR INDICATORS OF CREDIT

2.1. Total real estate investment loans

According to the China Banking Regulatory Commission, the proportion of China's real estate loan balance in the total loan increased to 27.4% in 2021, indicating that real estate loan has become an important part of bank credit in China. According to the definition of China's National Bureau of statistics, China's domestic loans refer to the funds borrowed from banks or other financial institutions during the reporting period. Due to the large amount of money borrowed by the real estate industry, we speculate that there may be a correlation between the total loans of the real estate industry and the average real estate price[2].

We select total amount of investment loans in the real estate industry as the research object. This indicator

covers the total amount of funds applied to the bank for real estate investment loan approval every month.

We use the monthly data of the total domestic real estate investment loans and real estate prices from 2010 to 2020. We found that the total amount of domestic real estate investment loans has increased year by year, but decreased slightly in 2015. The loan amount has reached RMB 12.42 trillion in March 2021. By comparing with housing prices, we found that in the rising stage of housing prices, the total amount of real estate investment loans is also rising, indicating that there may be a positive correlation. Rising housing prices may lead to the expansion of bank loans and investment in the real estate industry[3]. In addition, the scale of loans may be expanded, which will increase the number of housing construction and promote the rise of housing prices.

2.2 Domestic loans for real estate development companies

Domestic loans of real estate development enterprises refer to the funds that real estate developers borrow from banks to develop the real estate industry within a certain period of time. As the suppliers of real estate, real estate development enterprises require huge amounts of money, so the loans they need may affect the supply of China's real estate industry, and even affect the estimation of developers and consumers on the prospects of the real estate industry [4]. With the increase of corporate loans, real estate developers may have more funds to develop and build more houses. Besides, people may remain optimistic about the future of the real estate industry.

We found that despite the fluctuation of loan amount, the overall trend of housing price and domestic loan amount of real estate development enterprises is increasing year by year. We infer that there may be a positive correlation between the two.

2.3. Proportion of total domestic real estate investment loans to total real estate development investment

We divide the total real estate investment loans in indicator one by the total amount of real estate investment to obtain indicator three. We found that, in February of each year, that is, the first month of the start of statistical data, the total domestic loans for real estate investment accounted for the largest proportion of the cumulative value of real estate investment. In the following year, this proportion will gradually decline. This reflects that domestic loans of real estate development companies will borrow a lot of funds at the beginning of each year, and the loan proportion will gradually decline the next year[5].

2.4. Loan interest rate of People's Bank of China

The loan interest rate of the People's Bank of China refers to the ratio of interest to principal during the loan period promulgated by the People's Bank of China. As one of the monetary policies, the People's Bank of China regulates the changes of China's interest rates by setting loan interest rates. We found that the change of loan interest rate is basically synchronous. In 2012 and 2015, the loan interest rates have fallen. At the same time, housing prices have risen to varying degrees. Therefore, we infer that the loan interest rate may be negatively correlated with housing prices. When the loan interest rate rises and the loan cost becomes higher, the money supply of the real estate industry may decrease, thus slowing down the rise of housing prices[6]. On the contrary, when the loan interest rate drops and the loan cost decreases, the capital of the real estate industry increases, encouraging people to build and buy houses, then the housing price rises.

3. VAR MODEL ANALYSIS

3.1. Analysis of housing price stability and four credit indicators

Table 1 Integration of stationarity test of housing prices and credit indicators

Variable	ADF statistics	P value	Stable or not
LNPRICE	1.921618	0.9863	NO

D (LNPRICE)	-2.315899	0.0209	YES
LNLOAN1	1.827359	0.9828	NO
D(LNLOAN1)	-2.148886	0.0315	YES
LNLOAN2	0.761477	0.8762	NO
D(LNLOAN2)	-8.654724	0.0000	YES
LNratio	-0.050061	0.6624	NO
D(LNratio)	-15.63248	0.0000	YES
LNINTEREST5	-0.678003	0.4201	NO
D(LNINTEREST5)	-3.108693	0.0023	YES

In order to reduce the dimensionality of the data, the logarithm of the four credit index series and real estate price series was used for stability analysis. The test results are shown in the figure above, where LNPRICE is the logarithmic value China's average real estate price, D(LNPRICE) is the sequence of its first-order difference, LNLOAN1 is the logarithm of the total domestic real estate investment loans, where D(LNLOAN1) is the first-order difference. LOAN2 is the domestic loans series of real estate development enterprises, D(LNLOAN2) is the series of its first-order difference, LNratio is the proportion of loans in the total investment, D(LNratio) is the series of its first-order difference, LNINTEREST5 is the loan interest rate of the People's Bank of China for more than five years, and D (LNINTEREST5) is the sequence of its first-order difference.

The ADF test is mainly used for time series data, because the time series will have an unstable process, and the unstable time series data may cause problems such as pseudo-regression. The regression results obtained are not very reliable.

According to the test results, we found that:

First, the stationarity test (ADF test) is carried out for the average real estate price. The P value of the average real estate price level series is 0.9863, so the real estate price data is unstable. Furthermore, the result of the first-order difference indicated that the first-order difference P value is 0.0209, and the sequence is stable at the 5% confidence level.

The same as the housing price, based on the above test results, the housing price level and the four credit indicators are unstable, but the first-order difference series are stable.

3.2 Results and analysis of VAR model

The four credit index series and real estate price series are modelled by logarithms. According to the lag discrimination length test in EViews, it was determined that the best lag order is 4 orders. When the lag order is 4th, the specific structure of VAR model is discussed as follows:

$$\begin{bmatrix} \text{LNPRICE} \\ \text{LNLOAN1} \\ \text{LNLOAN2} \\ \text{LNRATIO} \\ \text{LNINTEREST5} \end{bmatrix} = \begin{bmatrix} -0.022657 \\ -9.137308 \\ 26.12694 \\ 2.321436 \\ -0.916225 \end{bmatrix} + \begin{bmatrix} 0.237164 & -554.224 & -280.896 & -36.2228 & -3.37421 \\ -7.96E-05 & -1.64491 & -0.55415 & 0.026977 & -0.00887 \\ 0.000208 & 3.182806 & 0.314247 & 0.077499 & 0.042787 \\ -0.000328 & -1.91773 & -0.66193 & 0.777031 & -0.01662 \\ 0.002034 & -1.40958 & 17.43648 & -3.96658 & -0.50095 \end{bmatrix} \begin{bmatrix} \text{LNPRICE}(-1) \\ \text{LNLOAN1}(-1) \\ \text{LNLOAN2}(-1) \\ \text{LNRATIO}(-1) \\ \text{LNINTEREST5}(-1) \end{bmatrix} + \\
 \begin{bmatrix} 0.371277 & 111.5095 & 370.0145 & 114.1001 & 2.700899 \\ 1.65E-05 & -0.20049 & -0.17239 & 0.04428 & 0.0092 \\ 7.67E-05 & 1.012683 & -0.1099 & 0.040461 & 0.008988 \\ 0.000524 & 0.801245 & 0.551861 & 0.134354 & 0.000446 \\ -0.003314 & -50.9832 & -11.2319 & -3.1777 & -0.86796 \end{bmatrix} \begin{bmatrix} \text{LNPRICE}(-2) \\ \text{LNLOAN1}(-2) \\ \text{LNLOAN2}(-2) \\ \text{LNRATIO}(-2) \\ \text{LNINTEREST5}(-2) \end{bmatrix} + \\
 \begin{bmatrix} -8.83E-02 & 402.4498 & -98.3551 & -54.21 & -0.54421 \\ -1.30E-05 & 0.511044 & -0.12229 & 0.066784 & 0.014813 \\ 7.36E-05 & -0.52147 & -0.08188 & -0.00472 & -0.01123 \\ -0.000181 & 1.689844 & 0.904678 & 0.007812 & 0.007403 \\ 0.00115 & -42.6338 & -3.63119 & -2.66064 & -0.55245 \end{bmatrix} \begin{bmatrix} \text{LNPRICE}(-3) \\ \text{LNLOAN1}(-3) \\ \text{LNLOAN2}(-3) \\ \text{LNRATIO}(-3) \\ \text{LNINTEREST5}(-3) \end{bmatrix} + \\
 \begin{bmatrix} 1.03E-01 & -218.841 & 37.35077 & -134.35 & -6.8484 \\ 7.75E-05 & 1.026387 & 0.271119 & 0.025282 & 0.015903 \\ -2.57E-05 & -1.26449 & -0.62928 & -0.00775 & -0.01695 \\ 0.000233 & -0.85478 & -0.94105 & -0.05179 & 0.009864 \\ -0.006119 & -42.5363 & -10.8855 & 1.148626 & -0.5563 \end{bmatrix} \begin{bmatrix} \text{LNPRICE}(-4) \\ \text{LNLOAN1}(-4) \\ \text{LNLOAN2}(-4) \\ \text{LNRATIO}(-4) \\ \text{LNINTEREST5}(-4) \end{bmatrix}$$

Table 2 Significance test table of VAR model

	LNPRICE	LNLOAN1	LNLOAN2	LNRATIO	LNINTEREST5
R-squared	0.534105	0.597943	0.583442	0.788872	0.484622
Adj. R-squared	0.331542	0.423136	0.40233	0.697077	0.260544
F-statistic	2.636735	3.420589	3.22144	8.59387	2.16274

LNPRICE is the logarithm of the average real estate price in China, LNLOAN1 is the logarithm of the total domestic real estate investment loans, LNLOAN2 is the domestic loans of real estate development enterprises, LNRATIO is the proportion of domestic real estate investment loans in the total real estate development investment, and LNINTEREST5 is the loan interest rate of the People's Bank of China for more than five years.

After completing the VAR model, we conducted AR root test to check whether the VAR model is stable. The test results are as follows:

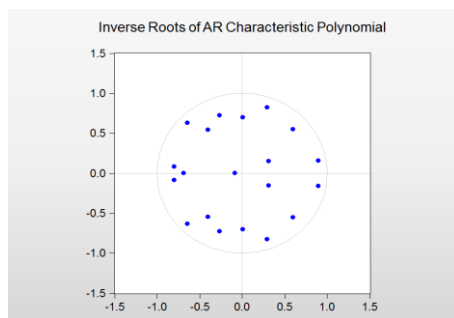


Figure 1 AR root test distribution

According to the AR test results to judge the stability of the system all the points fall within the circle, and the modulus of the largest characteristic root is less than 1. Therefore, this VAR model is stable and can be applied to study the impulse response.

4. COINTEGRATION RELATIONSHIP AND GRANGER CAUSALITY TEST

4.1. Cointegration test

The cointegration test studies the long-term stable equilibrium relationship between variables. Johansen's test is conducted to verify the cointegration relationship and explore the long-term stable relationship between housing prices and credit factors. The test results are as follows:

Table 3 Johansen test results

Null hypothesis H0	Eigenvalues	Trace statistics	Critical value	P value	Whether to accept the null hypothesis
No cointegration relationship	0.452015	106.6196	69.81889	0	reject
At least one cointegration relationship	0.353761	65.11551	47.85613	0.0006	reject
There are at least two cointegration relations	0.312628	34.99112	29.79707	0.0115	reject
There are at least three cointegration relations	0.099564	9.124427	15.49471	0.354	accept

Non-stationary series have possibility to appear pseudo-regression, the reason why we use cointegration test is to figure out whether the causal relationship is pseudo-regression and whether there is a stable relationship between variables.

We choose not to add intercepts and trend items during the check. According to the results in Table 4, the null hypothesis H_0 is that there is no cointegration relationship between housing prices and credit factors, at

Table 4 Johansen test equation

LNPRICE	LNLOAN1	LNLOAN2	LNRATIO	LNINTEREST5
1	-2.491383	2.13024	1.005514	0.022337
Standard deviation	-0.59373	-0.59298	-0.14565	-0.14591

In the cointegration test results, LNPRICE is the logarithm of China's average real estate price, LNLOAN1 is the logarithm of total domestic real estate investment loans, LNLOAN2 is the loan of real estate development enterprises, and LNRATIO is the total investment of real estate development loans. LNINTEREST5 is the loan interest rate of the People's Bank of China for more than five years. We found that there is a long-term stable and balanced relationship between these four credit indicators and the average real estate price. Indicator one (total domestic loans for real estate investment) has a negative impact on housing prices. Indicator two (domestic loans of real estate development enterprises). Indicator three (proportion of

least one cointegration relationship and at least two cointegration relationships. The P value is less than 0.05, so the value of 5% rejects the invalid hypothesis at the confidence level. When the null hypothesis has at least three cointegration relationships, the P value is 0.354, greater than 0.05, so the null hypothesis is accepted at the 5% confidence level. Through the test results, we found that there are at least three cointegration relationships, and the cointegration equation is as follows:

loans to total investment) and indicator four (loan interest rate of the People's Bank of China) have a positive impact on average real estate price.

4.2. Granger causality test

The results of cointegration test proved the long-term balanced relationship between variables. Next, we discussed the causality between variables and discussed the causality using Granger causality test. The Granger causality test is a statistical method of hypothesis testing that tests whether one set of time series x is the cause of another set of time series y . The test results are as follows:

Table 5 Granger causality test results of the four credit indicators

Null hypothesis H_0	Lag term	F statistic	P value	Whether to accept H_0
The total amount of domestic loans for real estate investment is not the Granger reason for housing prices	3	0.46787	0.7058	accept
Housing prices are not the Granger reason for the total amount of domestic loans for real estate investment	3	2.91388	0.0413	reject
Domestic loans of real estate development companies are not Granger reasons for housing prices	1	0.00094	0.9756	accept
Housing prices are not the Granger reason for domestic loans of real estate development companies	1	11.8593	0.0009	reject
The proportion of loans to total investment is not the Granger reason for housing prices	1	5.41564	0.0232	reject
Granger reason why housing prices are not the proportion of loans to total investment	1	1.36398	0.2473	accept
The loan interest rate over 5 years is not the Granger reason for the housing price	2	7.72597	0.0009	reject
Housing prices are not Granger reasons for loan interest rates over 5 years	2	4.00988	0.0224	reject

4.2.1. Indicator 1: Total domestic loans for real estate investment

The first null hypothesis is that indicator 1 is not the Granger reason for housing prices. The P value of the test result is 0.7058, and the null hypothesis is accepted.

Therefore, the total amount of real estate investment loans is not the Granger reason for housing prices.

The second hypothesis is that housing price is not the Granger reason for indicator 1, and the P value of the test result is 0.0413. Under the 5% confidence level, the null hypothesis is rejected. Therefore, the housing price is the

Granger reason for the total amount of domestic real estate investment loans. The conclusions are applicable to the first stage to the third stage.

This is different from the previous theoretical analysis results. The result of the model test is that housing prices have a unilateral impact on domestic loans, and loans cannot be the cause for the change of housing prices. However, when the average real estate price rises, the credit scale of banks will expand, and the supply of funds will increase to support real estate developers and investors to build and buy houses. On the contrary, when housing prices fall, the scale of bank credit will shrink, the money supply is insufficient, real estate developers do not have enough funds to build houses, and investors do not have loans to buy houses.

4.2.2. Indicator 2: Domestic loans of real estate development enterprises

The null hypothesis H_0 is that indicator 2 is not the Granger reason for real estate prices. After conducting Granger test through EViews, we found that, in the first-order test, the P value of the test result is 0.9756, and the null hypothesis is accepted. The domestic loans of real estate development enterprises are not the causes for the change of real estate prices. The expansion of domestic loans of real estate development enterprises will not directly reflect the real estate price.

The null hypothesis H_0 is the Granger reason that real estate prices are not the second indicator. After conducting Granger test through EViews, we found that, when first order is tested, the P value of the test result is 0.0009, and the null hypothesis is rejected at the 5% confidence level. Therefore, the real estate price is the Granger reason for the loan of domestic real estate development enterprises.

4.2.3. Indicator 3: Proportion of domestic real estate loans to the total real estate development investment

The original hypothesis H_0 is the Granger reason that Index 3 is not the real estate price. After conducting Granger test through EViews, we found that, when first order is tested, the P value of the test result is 0.0232, which rejects the null hypothesis at the 5% confidence level. Indicator three is the reason for the changes of real estate prices. The change of indicator three will have an impact on housing prices.

The original hypothesis H_0 is the Granger reason that real estate prices are not indicator threes. After conducting Granger test through EViews, we found that, when first order is tested, the P value of the test result is 0.2473, and the null hypothesis is accepted. Therefore, the real estate prices are not the Granger reason for

indicator three, that is, the rise of real estate price has no impact on indicator 3.

4.2.4. Indicator 4: Loan interest rate of the People's Bank of China

We take the loan interest rate of more than 5 years as the research object.

The original hypothesis H_0 is the Granger reason that the loan interest rate over 5 years is not the real estate price. The null hypothesis was rejected in stages 1 to 6. The P value of the sixth stage is 0.0453. The confidence level at 5% of the loan interest rate for more than 5 years is the reason for the change of real estate prices. From the sample we have taken, in the test here, the loan interest rate has increased for more than 5 years, and the real estate price will be directly reflected in the data. The scale of bank credit is reduced, and the money supply is reduced to reduce housing prices.

The original hypothesis H_0 is the Granger reason that real estate prices are not the proportion of loan interest rates over 5 years. After conducting Granger test through EViews, we found that, when first order is tested, the P value of the test result is 0.0224, which rejects the null hypothesis at the 5% confidence level. Therefore, the real estate price is the Granger reason for the changes of loan interest rates over 5 years.

5. IMPULSE RESPONSE FUNCTION

5.1. Indicator 1: Total domestic loans for real estate investment

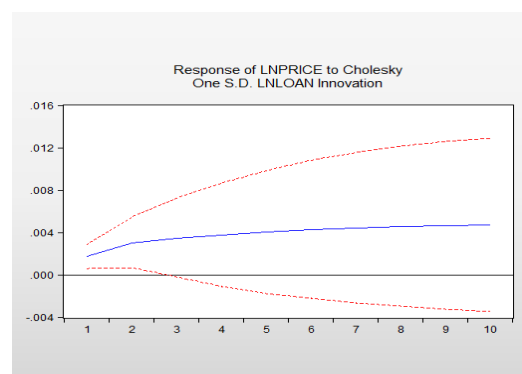


Figure 2 Impulse response of housing price to the total amount of domestic loans

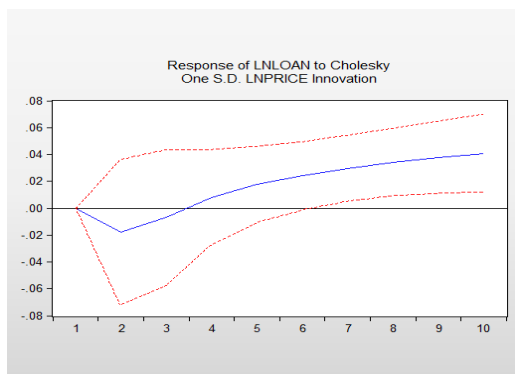


Figure 3 Impulse response of housing price to the total amount of domestic loans

As shown in Figure 2 above, LNPRICE is the response variable and LNLOAN is the impact variable. We found that the average real estate price has a positive effect. According to the corresponding data table of the pulse, every increase in the standard deviation of the loan quantity in the first period will produce a response of 0.0017. The results of the first three cycles are significant, because the 95% confidence interval of the fourth cycle is less than 0, so the results after the third period are not significant. Figure 2 shows that the impact of total domestic real estate investment loans on average real estate prices can be seen quickly.

According to Figure 3, we found that the total domestic loans had a negative impact in the first three periods. After the third period, it will have a positive impact. It can be concluded that the positive impact of real estate prices on the total domestic real estate investment loans lags behind, and lags behind three periods, and finally has a positive impact.

5.2. Indicator 2: Domestic loans of real estate development enterprises

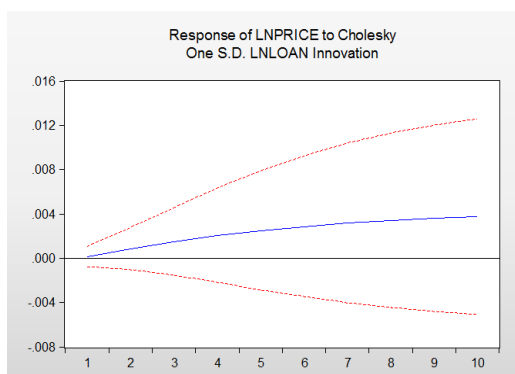


Figure 4 Impulse response of housing prices to real estate development loans

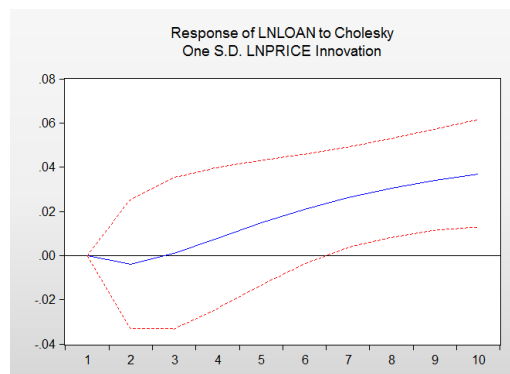


Figure 5 Impulse response of housing prices to real estate development loans

As shown in Figure 4 above, real estate price is the response variable and real estate development enterprise loan is the influencing variable. We found that average real estate price has a positive effect. The results indicate that there is almost no response in the first period, but the positive response in each subsequent period has been increasing steadily. Figure 4 illustrates that the effect of domestic loans of real estate development enterprises on average real estate price is gradually increasing.

According to Figure 5, we found that the second indicator is the response function, and the housing price is the impact variable. In the first three periods, indicator two had a negative impact. Then it had a positive impact and gradually increased. It can be concluded that the impact of real estate prices on indicator 2 lags behind. This means that the rise in real estate prices will not have a significant impact on the domestic loans of real estate development companies in the short term. The scale of bank loans to real estate developers will take some time to expand.

5.3. Indicator 3: The proportion of domestic real estate loans to the total real estate development investment

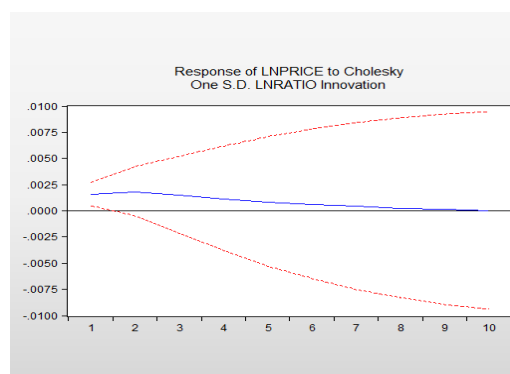


Figure 6 Impulse response of housing prices to the proportion of loans and investment

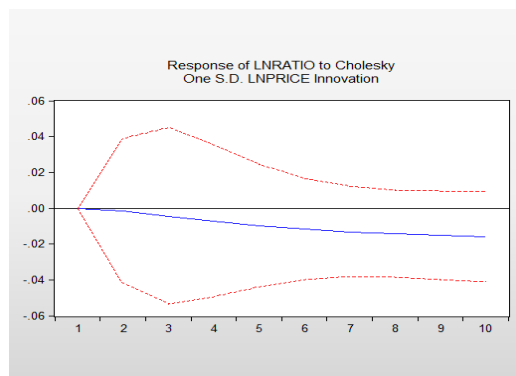


Figure 7 Impulse response of housing prices to the proportion of loans and investment

As shown in Figure 6 above, real estate price is the response variable, and the proportion of real estate loans in the total real estate development investment is the impact variable. The average real estate price has a positive impact in 10 periods, but the subsequent positive effect gradually weakens. Overall, the increase of indicator 3 and the increase of the proportion of loan will lead to the rise of the average real estate price, but the response of housing prices will gradually weaken.

As can be seen from Figure 7, the proportion of domestic real estate loans in the total investment in real estate development is a response variable, and the average real estate price is a shock variable. Due to the impact of real estate prices, domestic real estate loans have had a negative impact on the proportion of total real estate development investment, and the negative impact is gradually increasing. It can be concluded that real estate prices have a negative impact on domestic real estate loans. The negative impact on the proportion of total real estate development investment will become more pronounced.

5.4. Indicator 4: Loan interest rate of the People's Bank of China

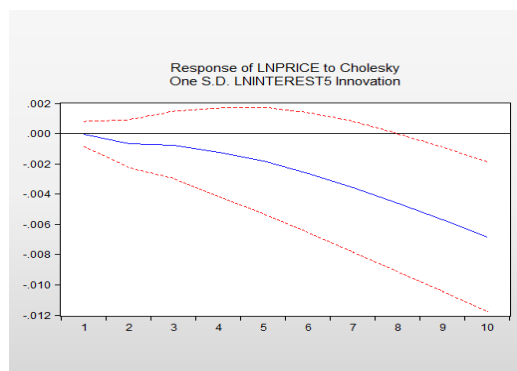


Figure 8 Impulse response function of housing price to long-term loan interest rate

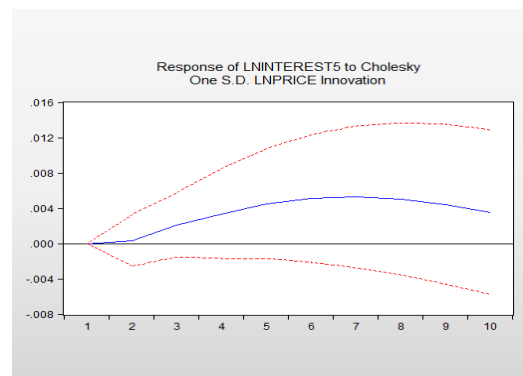


Figure 9 Impulse response function of housing price to long-term loan interest rate

As shown in Figure 8 above, LNPRICE is the real estate price as the response variable, LNINTEREST5 is the loan interest rate for more than 5 years as the shock variable. We found that the average real estate price has a negative impact in 10 periods. Figure 8 illustrates that the negative impact of average real estate prices on the loan interest rates will fluctuate over 5 years. However, in general, although there is a certain time lag in the growth of loan interest rate for more than 5 years, with the passage of time, the number of loans decreases and the funds held by real estate developers decrease, which will lead to the decline of the average price of real estate.

As can be seen from Figure 9, the loan interest rate for more than 5 years is the response function, and the average real estate price is the shock variable. Due to the impact of real estate prices, the data in the first period is 0, which has no effect temporarily. However, the loan interest rate of the People's Bank of China for more than 5 years has a positive effect, and the positive effect gradually increases, followed by a downward trend. This means that with the rise of real estate prices, the loan interest rate of the People's Bank of China will increase accordingly. Although there is a time lag, the impact will continue to increase for a period of time, and then the impact will weaken.

6. CONCLUSION

This paper is the first to take the logarithm of the data housing price and credit index factors to analyse the stability. The VAR model is constructed using the first-order difference to obtain the results. After establishing the model, we discussed whether there is a long-term balanced relationship between the variables and conducted a cointegration test on the series to prove that there is a cointegration relationship between the variables. The impact of average prices is positive. Then the causal relationship between variables is discussed, and the Granger causality test is conducted on the variables. Finally, the impulse response function between housing price and credit factors was studied.

Taken together, it can be understood that the higher the loan interest rate, the smaller people's willingness to lend, the smaller the scale of bank credit, the less funds, the less funds held by real estate developers and investors, and the decline in housing prices increases.

This article simply uses the real estate prices announced by the Bureau of Statistics for estimation. The defect that should be noted is that the economic development status and policies of different cities in China are quite different. Similarly, the housing prices also have great differences. The results estimated by the average value cannot be applied to a single city or region.

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