Empirical Analysis on the Relationship between Monetary Policy and Real Estate Market Price in China

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Abstract. This Paper analyzes the impact of monetary policy on the real estate market prices based on data from 2001 to 2014 by using the VAR model. The results show that there is a significant relationship between the money supply and the real estate price. And an increase in the money supply will cause the real estate prices to rise in the long run. But the negative relationship between loan interest rate and real estate price is not statistically significant. The central bank may adjust the trend of real estate prices through the change of money supply in the long run.

Introduction

With the acceleration of China's social development and the process of globalization, the price fluctuation of real estate market is widely concerned by investors and consumers. China's real estate market reform began in 1998. Before that, residential housing mainly came from unit welfare housing distribution, and the planned supply mechanism was implemented. Since the abolition of the welfare housing system in 1998, the housing of urban residents mainly comes from the market supply mechanism of the commercial housing model. With the development of society and economy, China's real estate market has made great progress, both in scale and transaction price.

With the acceleration of China's urbanization process, large numbers of migrant workers have entered and settled in cities. And the real estate market is booming because of the rigid demand of urban population. The real estate industry has become a pillar industry of China's economic development. The rapid development of the real estate market has a far-reaching impact on China's economy. Economic growth is determined by consumption, investment and imports and exports. Due to the real estate market is both an investment market and an investment market, the real estate market has a dual nature. By the end of 2013, China's total sales of commercial housing were 8.14 trillion yuan, at 13.8\% of that year's GDP. At the same time, the development of the real estate market will promote the rapid development of the enterprises and industries of the steel, cement, non-ferrous metals, household appliances and others. And the real estate market can also solve the employment problem of a large number of migrant workers. Thus, the real estate industry has become a pillar industry of the country.

Corresponding to the booming of china's real estate, the real estate prices in China are also rising rapidly. Taking the national commercial housing sales price as an example, the average sales price of commercial housing in China was 2063 yuan per sq.m. in 1998, and the average sales price of commercial housing rising to 6237 yuan per sq.m. in 2013. The sales price of commercial housing in China increased by 202\% in 16 years. A steady rise in housing prices will promote economic development, but if housing prices rise too fast, it will have a negative impact on the economy.

Research Status of Domestic Assessment Methods and Foreign Evaluation Methods

On the topic of how monetary policy affects the price fluctuation of the real estate market, domestic and foreign scholars have never stopped arguing. And the complicated mechanism has not reached a consensus. The relationship between monetary policy and the real estate market has been
extensively studied by scholars at home and abroad. From the literature review, foreign scholars mainly focus on the correlation between monetary policy and real estate market. They use the intermediate variables such as money supply, credit quantity and federal benchmark interest rate. Matteo Iacoviello (2004) study the relationship between monetary policy and the real estate market by using the intermediate variable financial institutions credit amount and interest rate monetary policy. They find that European countries’ (Finland, Germany, Norway and Britain) real estate market is affected by the monetary supply. And they prove that the credit channel is closely related to the characteristics of the national financial market structure. Davis and Gerlach (2005) studied the correlation between monetary policy and the real estate market based on the USA market. They found that there was a significant relationship between the supply level of monetary policy and the real estate price. This conclusion is basically consistent with that of our paper.

Domestic scholars have done a lot of research on the correlation between monetary policy and the real estate market. Compared with foreign studies, the chinese research is relatively short for time span (mainly because the housing reform in China's real estate market began from the year of 1998). Wei wei (2008) used the intermediate variable of monetary policy to empirically analyze the relationship between monetary policy and the real estate market. The empirical analysis results showed that interest rate policy had the most significant impact on the real estate market, and it was the most effective monetary policy tool to regulate the real estate market. However, the effect of money supply on the real estate market is not significant. Song zhongquan (2010) found that money supply has no difference in effect on the real estate market in both the long and short term. The increase of money supply can promote the development of the real estate market. Wang Qing (2009) calculate the relations among the money supply, the real estate prices, and the economic growth by using the mean of BEKK models and GARCH model. The study found that fluctuations in prices and changes in the money supply has a significant influence on the growth rate of GDP. The house prices is significantly impact on the money supply, but has no significant influence on the volatility of economic growth.

To sum up, studies mainly focus on the effects of monetary policy on real estate market price, and mostly concentrated on the intermediate such as the money supply, interest rates on deposits and the bank credit. In addition to using conventional monetary policy intermediate variable, we also used the loan interest rates, exchange rates and other variables to study the influence on real estate prices.

Variable Selection and Statistical Description

In order to test the impact of monetary policy on the price of real estate market, this paper selects money supply (M2), loan interest rate (R) and real estate price. We choose the selling price of commercial housing (HP) as the substitute. The selling price of commercial housing = the sales volume of commercial housing/the sales area of commercial housing. We selected monthly data from January 2001 to December 2014 for correlation study. At the same time, in order to eliminate heteroscedasticity, the logarithm of all data was taken simultaneously in this paper, and the X12 seasonal adjustment of M2, R and HP was made to eliminate the influence of seasonal factors.

Empirical Analysis and Testing

The Effect of Money Supply on Real Estate Prices

We use the VAR model to test the relationship between money supply and real estate price index. The first-order difference between among each variable is stable, so the co-integration test can be conducted with first-order difference data. In this paper, the Johansen co-integration test is used to test whether co-integration equations exist among variables. According to AIC criterion, when the lag period of the model is 2 period, the value of AIC is the minimum.
Table 1. Johansen co-integration test results of sequence.

| The null hypothesis          | characteristic | trace statistic     | Max-Eigen statistic |
|------------------------------|----------------|--------------------|--------------------|
| 0 cointegration vectors      | 0.1241         | 24.0299*** (0.0020) | 21.8647 (0.0026)   |
| At most one co-integration   | 0.0130         | 2.1651 (0.1412)    | 2.1651 (0.1412)    |
| vector vector                |                |                    |                    |

Note: the Numbers in brackets in the statistics are the respective P values, and *** means reject the null hypothesis at the 1% level. The co-integration equation is:

\[ \text{Lnhp} = 0.54* \text{LnM2} + 0.0009 \]

\[ \text{(0.0150)} \quad \text{(0.0069)} \]

It can be seen from the co-integration equation that money supply has a significant positive impact on real estate prices in the long run, and a 1% change about M2 will cause a 0.54% rise in real estate prices.

**Granger Causality**

According to the granger causality test, money supply is the cause of the rise in real estate prices, but housing price is not the cause of the change in money supply. The increase of money supply can lead to the rise of real estate price, while the decrease of money supply can lead to the decline of real estate price. In other words, there is a positive correlation between money supply and real estate price. For real estate developers, the money supply increases, Banks and other financial institutions increase their loans to the real estate industry, and the real estate developers increase their investment in land, which makes the real estate price rise. For ordinary residents, the increase of money supply, the household loans or the disposable income may rise the demand for the real estate market, which will lead to the booming of real estate prices. So the money supply is the reason why house prices are going up.

Table 2. Results of granger causality test.

| Null hypothesis                  | F statistic | P value | yes or no |
|----------------------------------|-------------|---------|-----------|
| LNM2 is not Granger cause of LNHP | 17.0016***  | 0.0000  | yes       |
| LNHP is not Granger cause of LNM2| 0.1579      | 0.8540  | no        |

Note: *means significant at the 10% level, **means significant at the 5% level, and *** means significant at the 1% level.

**Real Estate Price Variance Decomposition**

From the results of variance decomposition of real estate, it can be seen that the main factor which influences the change of real estate price is itself. However, the influence of money supply on real estate price should not be underestimated. The contribution rate of money supply to real estate price reached 11.09% in the 30th period. This result shows that the money supply has a great influence on the real estate price, and the central bank needs to consider the influence of the money supply, based on the real estate market price, when formulating the monetary policy.
Table 3. Real estate price variance decomposition.

| PHASE | S.E.  | LNHP   | LNM2   |
|-------|-------|--------|--------|
| 1     | 0.044932 | 100.0000  | 0.000000  |
| 2     | 0.051174 | 98.16594 | 1.834062  |
| 3     | 0.053833 | 98.21895 | 1.781048  |
| 4     | 0.054888 | 98.28609 | 1.713907  |
| 5     | 0.055363 | 98.26107 | 1.738931  |
| 6     | 0.055608 | 98.12410 | 1.875903  |
| 7     | 0.055767 | 97.89131 | 2.108688  |
| 8     | 0.055897 | 97.58797 | 2.412034  |
| 9     | 0.056019 | 97.23613 | 2.763874  |
| 10    | 0.056141 | 96.85281 | 3.147190  |
| 11    | 0.056264 | 96.45014 | 3.549861  |
| 12    | 0.056389 | 96.03641 | 3.963586  |
| 13    | 0.056514 | 95.61718 | 4.382820  |
| 14    | 0.056641 | 95.19607 | 4.803928  |
| 15    | 0.056768 | 94.77545 | 5.224553  |
| 16    | 0.056895 | 94.35681 | 5.643186  |
| 17    | 0.057021 | 93.94112 | 6.058876  |
| 18    | 0.057148 | 93.52897 | 6.471032  |
| 19    | 0.057273 | 93.12070 | 6.879299  |
| 20    | 0.057399 | 92.71653 | 7.283474  |
| 21    | 0.057524 | 92.31655 | 7.683450  |
| 22    | 0.057648 | 91.92082 | 8.079184  |
| 23    | 0.057772 | 91.52933 | 8.470674  |
| 24    | 0.057895 | 91.14206 | 8.857939  |
| 25    | 0.058018 | 90.75898 | 9.241020  |
| 26    | 0.058140 | 90.38004 | 9.619963  |
| 27    | 0.058262 | 90.00518 | 9.994822  |
| 28    | 0.058383 | 89.63435 | 10.36565  |
| 29    | 0.058504 | 89.26749 | 10.73251  |
| 30    | 0.058624 | 88.90453 | 11.09547  |
In order to understand the influence of monetary policy on real estate market price in detail, this paper will discuss the influence of one-year loan rate on real estate price.

Analysis of the Impact of Interest Rate on the Real Estate Market

Co-integration Test

Since the time series after the difference is a stable sequence, then the co-integration test of loan interest rate and commercial housing sales price is carried out. This paper use the Johansen co-integration test, and finds that when the model lags behind by order 3, AIC is the smallest, so the optimal lag order of the model is order 3.

\[
\begin{array}{|c|c|c|c|}
\hline
\text{The null hypothesis} & \text{characteristic} & \text{trace statistic} & \text{Max-Eigen statistic} \\
\hline
0 \text{ cointegration vector} & 0.0839 & 22.0543** (0.0028) & 14.2747* (0.0882) \\
\hline
\text{At most one} & 0.0466 & 7.7796* (0.0910) & 7.7796* (0.0910) \\
\text{cointegration vector} & & & \\
\hline
\end{array}
\]

*Note: * means significant at the 10% level, ** means significant at the 5% level, and *** means significant at the 1% level.

The co-integration test shows that the trace statistics reject the null hypothesis, means that there is no co-integration equation under the significance of 5%, and the maximum eigenvalue statistics reject it at the significance level of 10%. So the model has at least one co-integration equation. And the standardized co-integration equation can be expressed as:

\[
\text{Lnhp} = -0.7145 \times R + 6.0300
\]

\[
(0.9641) \quad (5.8334)
\]

The co-integration equation shows that there is a negative relationship between the loan interest rate and the selling price of commercial housing, but the coefficient is not statistically significant.

Granger Causality

From the results of granger causality, the loan interest rate is not the granger reason for the rise of house prices, nor is the house price the granger reason for the loan interest rate. Loan interest rates have no direct causal effect on the rise in house prices, which is not the granger cause of interest rate changes.

\[
\begin{array}{|c|c|c|c|}
\hline
\text{Null hypothesis} & F \text{ statistic} & P \text{ value} & \text{yes or no} \\
\hline
\text{LR is not Granger cause of LNHP} & 0.10099 & 0.9040 & \text{no} \\
\text{LNHP is not Granger cause of LR} & 0.24800 & 0.7807 & \text{no} \\
\hline
\end{array}
\]

Variance Decomposition of Real Estate Market Prices

From the perspective of variance decomposition of real estate price, the main factor that affects the real estate price is the house price itself, and the loan interest rate has almost no effect on the real
estate price. Generally speaking, the increase of loan interest rate will cause the rise the loan cost of real estate developers, which will correspondingly reduce the investment in real estate development and lead to the decline in real estate prices. From the perspective of residents, the rising loan interest rate discouraged residents from taking out loans. With the reduction of loans, residents' demand for real estate decreased and the real estate price fell. For investors in mortgage loans, loan interest rates rising will lead to increase of the investors' interest expenses. It will lead to the decline of consumption and investment, and the falling of the real estate prices. From the analysis above, in the long run, the interest rate is negatively correlated with the housing price. The loan interest rate goes up, the housing price goes down, the loan interest rate goes down, and the real estate price goes up. But the relationship was not significant. Because the real estate market price in China is sticky and the interest rate is not market-oriented, the loan interest rate hardly affects the change of the real estate market price.
Table 6. Variance decomposition of real estate prices.

| PHASE | S.E.  | LNHP    | R       |
|-------|-------|---------|---------|
| 1     | 0.046192 | 100.0000 | 0.000000 |
| 2     | 0.054131 | 99.97838 | 0.021624 |
| 3     | 0.058847 | 98.36319 | 1.636807 |
| 4     | 0.062579 | 98.46125 | 1.538746 |
| 5     | 0.063561 | 98.05948 | 1.940520 |
| 6     | 0.065848 | 96.78883 | 3.211168 |
| 7     | 0.069562 | 96.18280 | 3.817200 |
| 8     | 0.072549 | 95.48145 | 4.518550 |
| 9     | 0.076056 | 95.13402 | 4.865975 |
| 10    | 0.078682 | 95.07694 | 4.923063 |
| 11    | 0.080615 | 94.87571 | 5.124294 |
| 12    | 0.082786 | 94.78752 | 5.212484 |
| 13    | 0.084898 | 94.78040 | 5.219597 |
| 14    | 0.087095 | 94.80108 | 5.198915 |
| 15    | 0.089429 | 94.92340 | 5.076600 |
| 16    | 0.091516 | 95.05998 | 4.940017 |
| 17    | 0.093494 | 95.19796 | 4.802045 |
| 18    | 0.095429 | 95.34940 | 4.650596 |
| 19    | 0.097289 | 95.49537 | 4.504628 |
| 20    | 0.099189 | 95.64521 | 4.354790 |
| 21    | 0.101088 | 95.79622 | 4.203780 |
| 22    | 0.102936 | 95.93931 | 4.060691 |
| 23    | 0.104755 | 96.07606 | 3.923936 |
| 24    | 0.106525 | 96.20415 | 3.795850 |
| 25    | 0.108258 | 96.32414 | 3.675862 |
| 26    | 0.109980 | 96.43819 | 3.561805 |
| 27    | 0.111678 | 96.54572 | 3.454276 |
| 28    | 0.113355 | 96.64714 | 3.352864 |
| 29    | 0.115008 | 96.74269 | 3.257307 |
| 30    | 0.116630 | 96.83237 | 3.167626 |
Further Discussion on the Real Estate Market

Shocks from Currency Movements

In order to show the robustness of the conclusion, we excluded the effects of multicollinearity among variables on the regression results. Based on the model proposed above, this paper further introduces a series of variables into the equation for analysis and explanation. It will lead to a more reasonable result.

The Robustness of Money Supply Shocks

The relationship between money supply and real estate prices, the domestic and foreign scholars have done a lot of research in this field. From the perspective of the conclusion of existing, different scholars can draw different conclusions. This paper mainly use the broad money supply (M2) to study the relation with real estate prices in the money supply. Exchange rate is also an important factor influencing the real estate market. Scholars generally believe that international capital is also the main factor influencing the drastic change of domestic real estate prices. In order not to omit variables, we added the exchange rate as the explanatory variable to study how the exchange rate affects the real estate price.

1. VAR model and variance decomposition of real estate market

Table 7 and table 8 respectively show the correlation tests of variable exchange rates. The conclusion is that the exchange rate is a non-stationary time series in order zero, but stable in order one. Further Johansen co-integration test shows that there is a significant co-integration relationship among the three. According to AIC criterion, when the lag period of the model is 2, the value of AIC is the minimum.

| Variable | test | AIC  | SC  | ADF test | threshold value (5%) | Stable or not |
|----------|------|------|-----|----------|----------------------|--------------|
| Log(E)   | C, 0, 3 | -8.528 | -8.415 | -2.359 | -3.437 | no |
| DLog(E)  | 0, 0, 3 | -8.500 | -8.443 | -3.245*** | -1.943 | yes |

Note: the Numbers in brackets in the statistics are the respective P values, and ** indicates rejection of the null hypothesis at the level of 5%.

From the relationship between exchange rate and real estate price, exchange rate is not the cause of real estate price rise, but the cause of exchange rate change. The exchange rate depreciates, the real estate price falls, the exchange rate appreciates, the real estate price rises, namely the exchange rate and the real estate price become the negative correlation. The rise or decline of real estate prices will increase or decrease the loan interest rate of Banks to real estate developers, which will indirectly cause the inflow and outflow of hot money and the appreciation or depreciation of the exchange rate. Therefore, the real estate price is the cause of the exchange rate change.
Table 9. Results of granger causality test.

| Null hypothesis            | F statistic | P value | yes or no |
|----------------------------|-------------|---------|-----------|
| LNE is not Granger cause of LNPH | 2.45829*    | 0.0649  | 否        |
| LNPH is not the Granger cause of LNE | 3.09601**   | 0.0286  | 是        |

Note: * means significant at the 10% level, ** means significant at the 5% level, and *** means significant at the 1%.

From the results of variance decomposition of real estate, the main factor influencing the change of real estate price is itself, but the influence of money supply and exchange rate on the real estate price should not be underestimated. In the 30th phase, the contribution rate of money supply to real estate price reached 10.2%, and the contribution rate of exchange rate to real estate reached 9.56%. This shows that both money supply and exchange rate contribute a lot to the real estate price, so the central bank needs to consider the impact of money supply and exchange rate on the real estate price when formulating monetary policy.

Table 10. Real estate price variance decomposition.

| PHASE | S.E.   | LNHP   | LNM2   | LNE    |
|-------|--------|--------|--------|--------|
| 1     | 0.044171 | 100.0000 | 0.000000 | 0.000000 |
| 2     | 0.050190 | 97.27584 | 1.886026 | 0.838131 |
| 3     | 0.052616 | 96.38234 | 1.729606 | 1.888058 |
| 4     | 0.055083 | 94.32903 | 2.226239 | 3.444728 |
| 5     | 0.055845 | 92.83665 | 2.766110 | 4.397241 |
| 6     | 0.056656 | 90.38045 | 3.472332 | 6.147217 |
| 7     | 0.057340 | 88.39942 | 4.231817 | 7.368767 |
| 8     | 0.057799 | 87.06844 | 4.889248 | 8.042316 |
| 9     | 0.058165 | 86.04007 | 5.368016 | 8.591912 |
| 10    | 0.058478 | 85.23423 | 5.827681 | 8.938091 |
| 11    | 0.058740 | 84.59272 | 6.271686 | 9.135595 |
| 12    | 0.058974 | 84.03592 | 6.680728 | 9.283351 |
| 13    | 0.059198 | 83.51077 | 7.105655 | 9.383578 |
| 14    | 0.059411 | 83.00590 | 7.546595 | 9.447504 |
| 15    | 0.059613 | 82.51777 | 7.987936 | 9.494297 |
| 16    | 0.059811 | 82.03726 | 8.437349 | 9.525395 |
| 17    | 0.060003 | 81.56554 | 8.890869 | 9.543591 |
| 18    | 0.060191 | 81.10553 | 9.340424 | 9.554043 |
| 19    | 0.060374 | 80.65503 | 9.786534 | 9.558441 |
| 20    | 0.060555 | 80.21359 | 10.22791 | 9.558493 |
Summary

In the long run, the effect of money supply on real estate prices is positive, because the central bank increases the money supply. Since real estate prices are sticky in the short run, real estate prices will move in the original direction. With the easing of monetary policy, the amount of loans between Banks will increase. When real estate developers increase the amount of loans, they will also increase their investment in real estate, which will promote the rise of real estate prices. On the other hand, the increase of money supply leads to the increase of residents’ disposable income. With the increase of income, residents will increase their investment and consumption. Due to the duality of real estate (investment and consumption), the demand for real estate will increase, leading to the rise of real estate prices.

At present, the loan interest rate has little effect on the real estate market price. This is mainly because the sticky of chinese related estate market prices in short-term. On the other hand, China's interest rate is not market-oriented.

Different variables of monetary policy have different effects on the price of the real estate market. Some variables have greater effects on the real estate market, while others have no effect on the real estate market in the short or long term. Central Banks need to consider the impact of different variables on property shocks when making monetary policy. Specifically, whether in the long term or the short term, money supply is in direct proportion to the real estate market, and the increase of money supply will lead to the rise of real estate prices, and vice versa. Loan rates are inversely related to real estate prices, but not significantly. Therefore, when formulating the monetary policies the central bank needs to consider the real estate market, which may have effect on the economy by specific mechanisms.

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