

# An Empirical Analysis of the Impact of Macroeconomics on Real Estate Market

-Based on the data in China (2006Q1~2017Q4)

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**Abstract**—This paper sets up a VAR(1) model by collecting the quarterly data on China's macroeconomic and real estate industry. By means of Granger Casualty Test, impulse response function and variance decomposition, the paper studies the impact of macroeconomic variables on real estate variables. The conclusions are as follows: changes in the macroeconomic system have a significant impact on the investment in the real estate development investment and the domestic lending; and the fluctuations of housing price, to some extent, are short of the support of macroeconomic fundamentals and effective demands.

**Keywords**—Macro-economic; Real Estate; Vector Auto-regression; Granger Casualty Test; Dynamic Effects

## I. INTRODUCTION

The real estate market is an important part of the macro-economy, its performance is supported by the monetary policy and the macroeconomic fundamentals. So it is particularly important to keep the real estate market stable. Our country has experienced several real estate regulation, but because "the tune rising more" and has been criticized. How does the macro economy affect the real estate market, and what is the mechanisms of action? It is obviously of crucial importance to make these questions clear for our government actively to formulate policies on real estate market regulation.

## II. LITERATURE REVIEWS

Scholars at home and abroad proceed a great research on the Macroeconomic impact on real estate. Ben S. Bernanke & Mark Gertler's study shows that real estate investment usually responds strongly and consistently to short-term interest rate shocks, while the response to long-term rates is smaller and is recovering quickly (1995) [1]. Using the quarterly data from 1974 to 2002, the VAR model was established by Iacoviello & Minetti(2003) through the related variables such as interest rate, inflation, output and real estate price, and it was concluded that the monetary policy had a significant impact on the real estate price [2]. Mikhed and Zemcik(2014) think that rental price, loans to buy homes, household disposable income, house cost and the demographic factors have a greater impact on the housing price by 22 cities for 30 years in the United States[3].

Chinese scholars also have a lot of research. Yunfang Liang,

etc. (2006) build the VAR model and variable-parameter model and study empirically by using the data from the first quarter of 1998 to the third quarter of 2005. Their conclusion is that GDP is elastic to real estate investment, which is an important factor to determine the growth of real estate investment [4]. Laifu Wang & Guofeng (2007) use the impulse response function to analyze the dynamic effect of the change of money supply and interest rate on the housing price. The conclusion is that the change of money supply has a long lasting positive effect on housing price, the changes in interest rates have a negative effect on house prices and the dynamic effect gradually weakens in the long term [5]. Guangcan Cui (2009) studies the influence factors of real estate price by building the panel data model, finds that the real estate price is obviously affected by interest rate and inflation rate, and real estate supply, income and other basic macroeconomic variables also determine real estate prices in the medium and long term [6]. Xilong Jiang & Zhaowei (2016) analyze the reason why China's housing prices continue to rise by adopting the data from the provinces of China in 1999-2011. The conclusion is that the economic structure has a decisive impact on housing price [7].

Above all, VAR is widely used in the published literatures. It is obtained that the influence degree of macroeconomic indicators on real estate index: previous prices, money supply, price level, GDP, real interest rate and disposable income. While the other indicators has a slight impact. We don't think it's comprehensive enough that the state of the real estate industry is represented only by price indicators. This paper intends to make some amendments.

## III. SELECTION OF INDEXES AND DATA SOURCES

Macroeconomic indicators selected in this paper include: gross domestic product(GDP), money supply (M2), real interest rate(RR), Consumer Price Index(CPI), disposable income of urban residents; Real estate indices include average sale price of commercial house(HP), real estate investment(RINV), domestic loan amount(LOAN). Using the data of sample period (2006Q1~2017Q4). First, we make seasonal adjustment to all indexes by use of Census X12. To reduce heteroscedasticity, the logarithm of each index is processed after seasonal adjustment (except RR), and abbreviated as ln(GDP), ln(M2), and so on.

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#### IV. VAR MODEL ANALYSIS

##### A. Test of data stability

First, as an important tool of testing time series stationarity, unit root test is used. The testing result shows that it is stationary that the first and second order difference of  $\ln(\text{GDP})$ ,  $\ln(\text{M2})$ ,  $\text{RR}$ ,  $\ln(\text{INC})$ ,  $\ln(\text{HP})$ ,  $\ln(\text{RINV})$ ,  $\ln(\text{CPI})$ ,  $\ln(\text{LOAN})$  at 10% level.

So the first order difference sequences of these variables are used throughout for analysis.

##### B. Construction of VAR model

According to the LR test, Information criteria for AIC and SC, and so on, we determine the lag order of VAR model as shown in Table 1 below.

TABLE I TEST OF VAR MODEL LAG ORDER

Lag	LogL	LR	FPE	AIC	SC	HQ
0	556.3559	NA	3.96e-21	-24.27634	-23.95832	-24.15721
1	986.7146	676.2292*	7.69e-28*	-39.77020*	-36.90798*	-38.69799*
2	1049.202	78.78824	1.06e-27	-39.70443	-34.29801	-37.67915

Table 1 shows that the optimal lag order is 1, so the model VAR(1) is obtained as follows:

$$y_t = \varphi_1 y_{t-1} + \varepsilon_t, \quad t = 1, 2, \dots, 24$$

$$y_t = [D \ln(\text{HP}), D \ln(\text{RINV}), D \ln(\text{LOAN}), D \ln(\text{GDP}), D \ln(\text{M2}), \text{RRR}, D \ln(\text{CPI}), D \ln(\text{INC})]$$

Lutkepohl(1991) thought that the estimated VAR model is stable if the inverse of the module of all the roots is less than 1, otherwise, some results are invalid. We get the test results as

Figure 1. The VAR model is stable for all points fall within the unit circle.

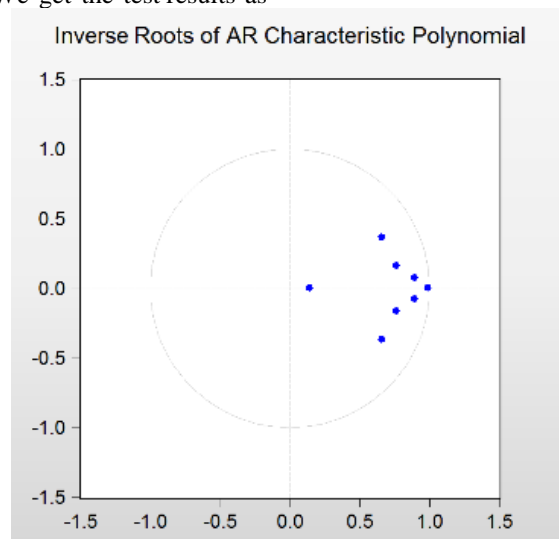


Fig. 1 The test result of the Model stability

The estimated coefficients of the model are:

$$y_t = \begin{bmatrix} 3.807223 \\ -1.711464 \\ 6.861913 \\ -2.488337 \\ 2.605830 \\ -11.05252 \\ -0.493614 \\ -2.282715 \end{bmatrix} + \begin{bmatrix} 0.517330 & 0.395404 & 0.4665703 & 0.174211 & -0.131333 & 5.667689 & 0.186589 & -0.021251 \\ 0.030880 & 0.652528 & -0.022236 & -0.179812 & 0.063524 & 1.169333 & -0.074996 & -0.104880 \\ -0.098295 & 0.038203 & 0.696570 & 0.030531 & -0.043140 & 0.562684 & 0.048473 & -0.033120 \\ 0.717270 & -0.173116 & 0.789307 & 0.534754 & 0.605988 & -5.105214 & -0.311904 & -0.135162 \\ -0.083822 & 0.644955 & -0.424349 & 0.502741 & 0.658500 & -1.307298 & 0.153184 & 0.462233 \\ -0.024183 & 0.050718 & 0.016611 & 0.027637 & -0.017964 & 0.922457 & 0.015951 & 0.014987 \\ -0.811949 & -0.076642 & -2.119486 & 0.438133 & -0.569603 & 4.294081 & 1.060046 & 0.415245 \\ -0.324335 & -0.500522 & -0.232433 & -0.052434 & -0.207013 & 0.750370 & 0.076926 & 0.719271 \end{bmatrix} y_{t-1} + \varepsilon_t$$

### C. Granger causality test

One important use of VAR model is to analyze the causal relationship between variables. The test results are shown in Table II.

TABLE II THE RESULTS OF GRANGER CAUSALITY TEST

Equation	Null hypothesis	$\chi^2$ statistics	P-value
Dln(HP) equation	D ln(GDP) is not the Granger cause for Dln(HP)	6.018006	0.0142
	Dln(M2) is not the Granger cause for Dln(HP)	0.141337	0.7070
	DRR is not the Granger cause for Dln(HP)	4.218459	0.0400
	Dln(CPI) is not the Granger cause for Dln(HP)	4.634876	0.0313
	Dln(INC) is not the Granger cause for Dln(HP)	1.886114	0.1696
Dln(RINV) equation	Dln(GDP) is not the Granger cause for Dln(RINV)	0.437044	0.5086
	Dln(M2) is not the Granger cause for Dln(RINV)	10.43198	0.0012
	DRR is not the Granger cause for Dln(RINV)	23.13272	0.0000
	Dln(CPI) is not the Granger cause for Dln(RINV)	0.051484	0.8205
	Dln(INC) is not the Granger cause for Dln(RINV)	5.600019	0.0180
Dln(LOAN) equation	Dln(GDP) is not the Granger cause for Dln(LOAN)	2.688300	0.1011
	Dln(M2) is not the Granger cause for Dln(LOAN)	1.336251	0.2477
	DRR is not the Granger cause for Dln(LOAN)	0.734214	0.3915
	Dln(CPI) is not the Granger cause for Dln(LOAN)	11.65037	0.0006
	Dln(INC) is not the Granger cause for Dln(LOAN)	0.357333	0.5500

Table II shows that national economic level, interest rates, price levels, money supply, per capita disposable income have significant Granger effect on real estate price at 5% level, so macroeconomic factors have significant effects on the real estate price, real estate investment, domestic loan amount.

### D. Impulse response functions

Figure II, Figure III and Figure IV are the impulse response of HP, RINV and LOAN to impact of macroeconomic factors respectively. The unit of x axis is quarter.

1) The impulse response of HP caused by macroeconomic shock

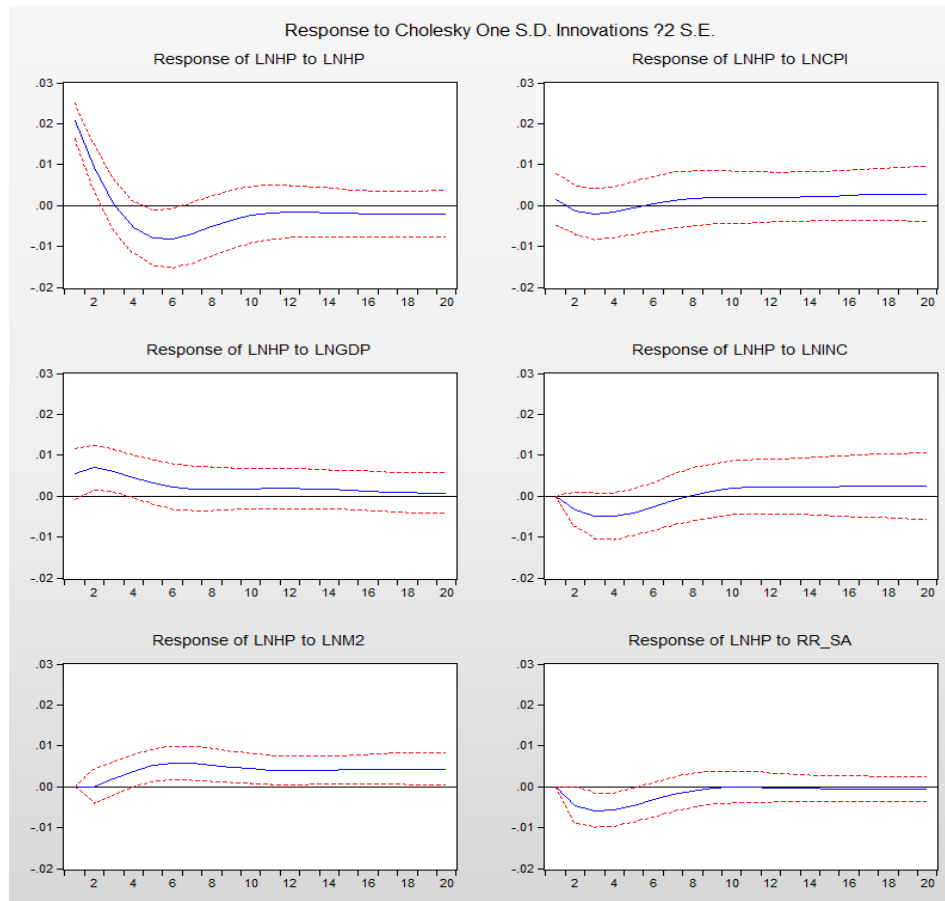


Fig. II The impulse response of HP caused by macroeconomic shock

It is not hard to see from Figure II:

To a positive shock of GDP in the Current period, the increment of HP is always positive and the second period reaches the maximum. Then it gradually weakens to zero in the period 20. This means that the acceleration of macro-economy pushes up housing prices

To a positive shock of INC in the Current period, the housing price increment is negative in the first eight periods, it reaches the minimum in the third period and changes from negative to positive in the eighth period and goes up slowly, and then it reaches the maximum and converges in the eleventh period.

To a positive shock of M2 in the Current period, the increment of HP is always positive and the fifth period reaches the maximum. It tends to converge after the eleventh period. This means that the money supply pushes up the housing price.

To a positive shock of CPI in the Current period, the housing price growth is briefly positive in the first period, it presents negative fluctuations in the second period and reaches the minimum in the third period, then the impact tends to zero in the fifth period. After that, it becomes positive again and tends to converge after the ninth period. It indicates that the impact of CPI increment is negative in the short term and positive in the long term.

To a positive shock of RR in the Current period, the housing price increment is negative at first, it reaches the minimum in the third period, and then the negative effect gradually goes to zero. So the increase of interest rate level has negative effect on the rise of housing price in the short term, but not obvious in the long term.

## 2) The impulse response of RINV caused by macroeconomic shock

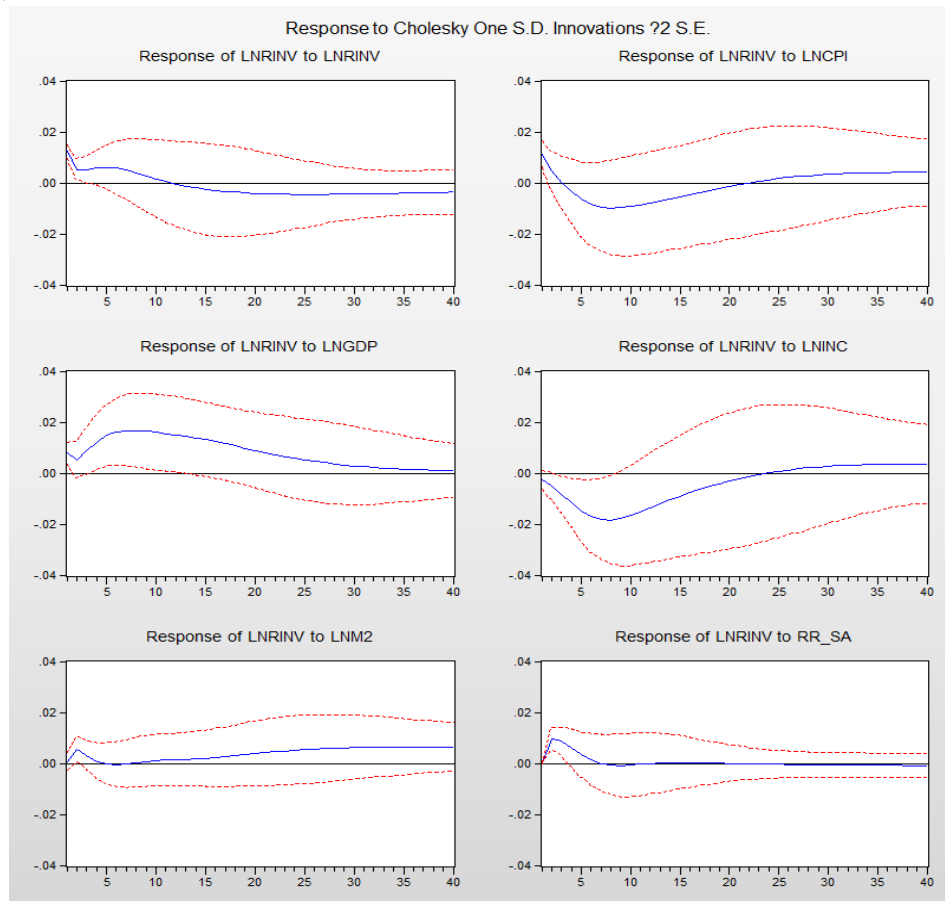


Fig. III The impulse response of RINV caused by macroeconomic shock

We can conclude from Figure III:

To a positive shock of GDP in the Current period, it has positive influence on RINV and reaches the maximum in the seventh period. Then it gradually weakens to zero in the period 40. The improvement of the national economic level will push up RINV for a period of time, but in the long run, the impact is almost zero.

To a positive shock of CPI in the Current period, the impact to RINV is positive at first, but it gradually weakens to zero in the period 3. After then, it becomes negative, reaches the minimum in the eighth period, and it gradually weakens to zero in the twenty-first period. Then it becomes positive once again and tends to converge after the 40th period. It shows that raising prices will curb RINV growth in short terms, but is the opposite in the long-term.

To a positive shock of INC in the Current period, the negative fluctuation is obvious and it increases gradually. It reaches the minimum in the eighth period and gradually weakens to zero in the period 23, and then Increasing household income has a weak positive effect on RINV.

To a positive shock of M2 in the Current period, the impact to RINV is positive at first, but it gradually weakens to zero in the period 5. After that, it becomes positive and reaches steady after the thirtieth period. It shows that it is positive correlation between M2 and RINV.

To a positive shock of RR in the Current period, it has positive influence on RINV and reaches the maximum in the second period. Then it gradually weakens to zero in the period 7. It indicates that there is a positive correlation between interest rate and RINV in the short-term, but in the long run, it has no effect on RINV.

### 3) The impulse response of LOAN caused by macroeconomic shock

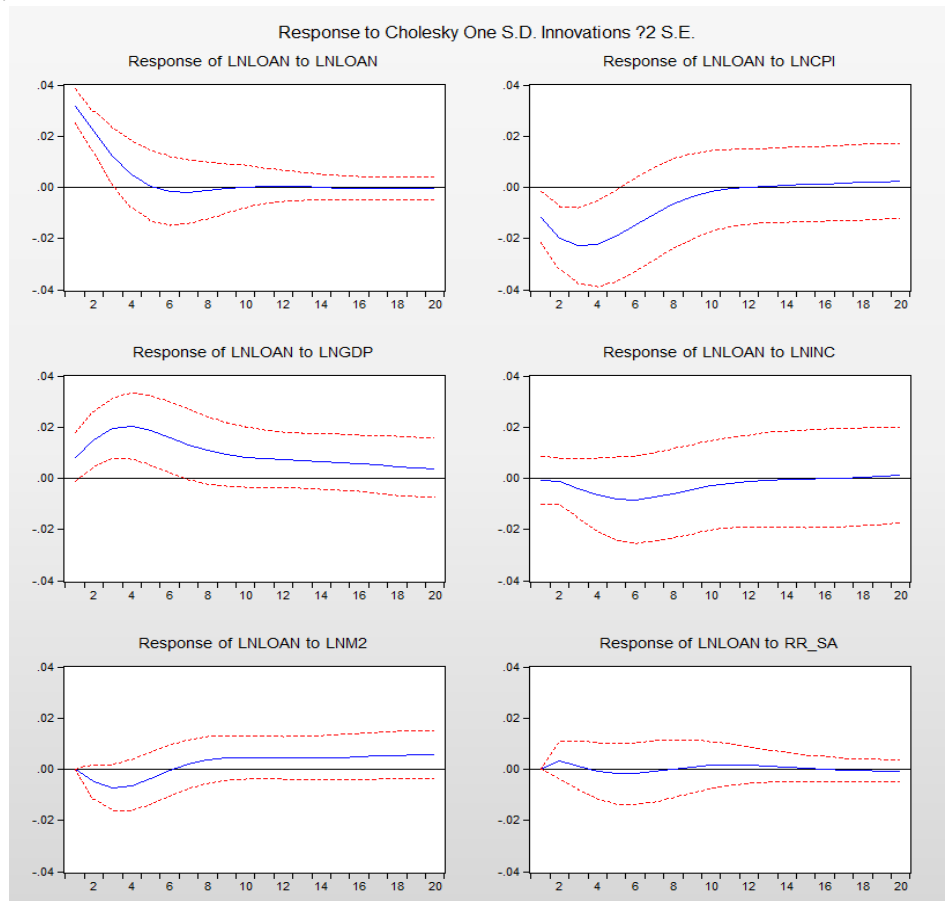


Fig. IV The impulse response of LOAN caused by macroeconomic shock

We can conclude from Figure IV:

To a positive shock of GDP in the Current period, it has positive influence on LOAN and it reaches the maximum in the fourth period. Then it gradually wanes. It shows that the growth of GDP can significantly boost LOAN, but in the long run, is weakly linked with LOAN.

To a positive shock of CPI in the Current period, LOAN increment is negative at first, it reaches the minimum in the third period, and then the negative effect gradually goes to zero in the eleventh periods. It shows that raising CPI will curb the LOAN growth in short terms, but the long-term effect is not obvious.

To a positive shock of INC in the Current period, the LOAN increment is negative at first, it reaches the minimum in the sixth period, and then the negative effect gradually goes to zero in the thirteenth period. It indicates that increasing INC will restrain the increase of LOAN to some extent.

To a positive shock of M2 in the Current period, similar to the above, the LOAN increment reaches the minimum in the sixth period, it goes to zero after that, and then the LOAN increment shows positive response. It indicates that increasing M2 will restrain the increase of LOAN in the short term, but will boost it in the long run.

To a positive shock of RR in the Current period, it has positive influence on LOAN in the first three periods, then up and down the zero axis, it goes to zero in the fifteenth period by the alternatively positive and negative variations. This shows that the effects of rising interest rates on LOAN is: "early positive, then weak".

### V. CONCLUSIONS

(1) Granger causality test shows that HP, RINV and LOAN are all affected by the macroeconomic system. It follows that the changes of macroeconomic system have significant influence on the changes of real estate industry. By use of variance decomposition, the impact effects on HP, RINV and LOAN from the macroeconomic system are 47.39%, 75.91% and 69.13% respectively. The changes of macroeconomic system have a significant impact on the changes of real estate industry, especially on RINV and LOAN. It is suggested that the special attention should be paid to RINV and LOAN in the macro-regulation policies, for their monetary policies have obvious effects.

(2) Pulse response analysis displays that the impact of macro-economic variables on real estate is time-varying: in the long run, the price level, money supply and household income can push up the housing price, but in the short term, GDP, RR,

household income level and price level have negative effects on the rise of housing prices. Increasing the money supply will boost the real estate development investment, and in the long run, the price level and the per capita income level of residents have a promoting effect, while in the short run, they also have a inhibiting effect. In the long run, increasing the money supply will boost domestic loan amount, but in the short term, the price level, money supply and income level will restrain the increase of domestic loan to some extent. We recommend implementing dynamic monitoring of the key indicators by use of the monetary policy to regulate the real estate industry, and controlling the real estate market with systematic thinking.

(3) The fluctuation of GDP contributes only 9.73% to HP's variance by use of variance decomposition, so the fluctuations of housing price, to some extent, are short of the support of macroeconomic fundamentals. The fluctuation of INC contributes to HP's and LOAN's variance as 7.65% and 4.00% respectively. It shows that INC has less impact on HP and LOAN and the fluctuations of housing price are short of the support of effective demands. It is suggested that the real estate market should undergo structural adjustment as soon as possible.

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