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# **An Empirical Analysis of Factors Influencing China's Real Estate Prices-Based on the VAR Model**

*Pan XIAO*

## **Abstract**

The real estate industry has an increasingly significant position in our national economy. It is important for real estate investment and national macro-control to analyze the main factors that affect its prices, in order to predict its future movements. In this paper, the dynamic econometric analysis method was used to analyze these macroeconomic factors that influence the real state prices on a empirical research. And the results show that the expected prices of real estate, money supply, real estate development investment and household income are the dominant factors influencing them.

**Keywords:** Real estate, real estate investment, dynamic econometric analysis method

## **1. Introduction**

With the rapid development of the real estate market, the real estate industry in the Chinese economy has shown tremendous growth, which affects at the same time the other industries that are linked to it. Therefore the rapid rise in its prices has become a prominent issue that affects the stability of the economy.

The housing prices have continued to grow, and the rate of growth of income lags behind badly. Such situation could lead to a series of social problems that could destabilize the society.

It is for this reason the relevant departments need to accurately grasp the reasonable equilibrium housing price through the analysis and comparison of the actual price. It not only will help control the actual problem, but also effectively predict the development trend of its prices, and guarantee the stable development of the market once the respective policies have been adjusted.

This article builds a framework that will include macroeconomic factors and econometric analysis tools, such as regression analysis, impulse response function and variance decomposition. An empirical research is done by distributing a VAR model to analyze dynamic effects of macroeconomic factors influencing real estate prices.

## **2. Literature Review**

It is generally believed that the country's level of economic development, financial situation, exchange rates, interest rates and other changes in macroeconomic factors will affect the real estate prices. To verify this belief, some research was done, and the results are:

- Yu Xiao (2006). He analyzed the impact of national policies, the economic cycle and income factors on real estate prices. Where one of his conclusions indicated that macroeconomic factors have direct or indirect impacts on the real estate market supply and demand, thereby affecting the price of real estate.
- Liu Limin (2008). He studied the formation and determinants of real estate prices. One of his ideas what that changes in development policy and economic environment are a decisive factor in real estate prices.
- Qu Wen (2010). He found that there is a close relationship between real estate prices and the presence of these macroeconomic variables by linear regression analysis of the relationship between real estate prices and a number of economic variables.
- Guo Bin, Wang Ying (2010). He studied the factors that housing prices in Xi'an based on the impact of urban housing dynamic econometric model through the establishment of a dynamic econometric model.
- Luo Pengfei (2012). He considered the factors that lead to housing prices fluctuations in the economy, which shows that the expected factors of real estate prices are related to macroeconomic variables, especially money supply and GDP.

### **3. Data Description**

#### **3.1 Variables Description**

##### **3.1.1 Dependent Variable**

The average sales price of real estate in the country ( $p$ ) refers to the average price in a certain year of commercial residential buildings, office buildings, business buildings and other houses, which is a price index reflecting a national comprehensive variety of real estate prices. Considering the theme of this article, it is reasonable to choose the average sales price of real estate as the dependent variable.

##### **3.1.2 Independent Variables**

Urban residents' disposable income per capita ( $c$ ) is an important measure of purchasing power of residents, but also an important indicator of residential real estate prices. This index can truly reflect the actual purchasing power of urban households.

Gross domestic product ( $g$ ) has an important influence on the development of the real estate industry. The demand for real estate will increase when macroeconomic is positive, thereby has a positive effect on real estate prices.

The consumer price index ( $s$ ) indicates the relative number of goods and services prices changes, prices trends in a period of time. From this index, we can observe the effects of the price changes of goods and services on the actual residents living expenses.

Quasi money supply ( $m_2$ ) is the transaction currency ( $m_1$ : the total amount of currency in circulation plus deposits) and time deposits and savings deposits. Money supply is still the basis of factors determining the price level.

Area of completed housing ( $a$ ) has a certain influence on real estate prices. When housing area rises, real estate supply will naturally rise, then prices will fall; on the contrary, if the area declined, the supply will drop, then real estate prices will naturally rise.

National real estate development investment ( $i$ ) is the workload and related costs of housing construction and land development completed in general in the form of currency  $s$  in a given period. It will determine the real estate prices partly.

#### **3.2 Data Source**

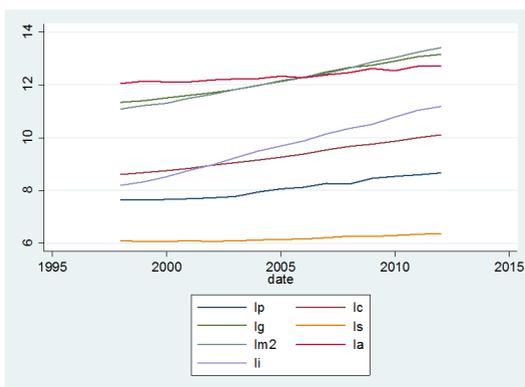
In this paper, the selected data are from National Bureau of Statistical of China. In order to ensure the validity and consistency of data, we selected data from year 1998 to 2012 as the primary data for econometric analysis. The main reason for starting from 1998 is because on July 3<sup>rd</sup> of 1998, the State Council issued a document which officially reformed the housing policy by the abolition of welfare housing distribution to achieve residential privatization, and "market" has become a keyword of housing construction. Meanwhile, a series of housing finance services helped the Chinese people to get more space and freedom in the housing market.

#### 4. Empirical Analysis

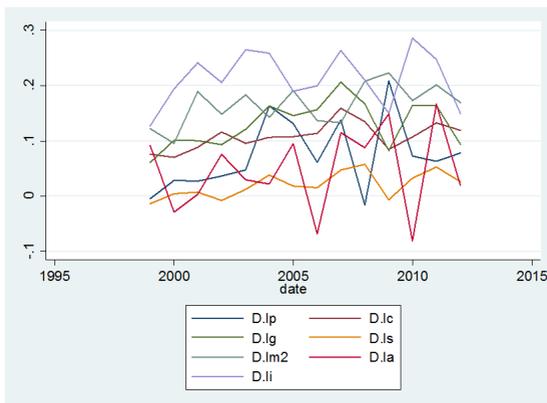
The main purpose of this article is to analyze the causal relationship between variables, impulse response function and variance decomposition. All the data used in the analysis is the macroeconomic data log of variables.

##### 4.1 Plot Time-series to Identify Constant and Trend

To estimate a VAR-model properly, stationary data was needed. The first step is to plot the series in order to identify whether constant or trends should be included in the tests of nonstationarity. Both the levels and differences are plotted.



Graph 1 Regression of variables



Graph 2 Regression of difference of variables

From these two graphs above, the level series appear to be trending. The differences show no obvious trend, but the mean of the series appears to be greater than zero, suggesting that a constant should be included in the Augmented Dickey-Fuller (ADF) regression.

#### 4.2 Stationary Test (ADF test)

ADF test method is used to test the logarithmic sequence and logarithmic difference sequence of the model. From the above analysis, it is better to choose no constant term, no trend and one-lag integration for the ADF test. Test results (Table 1) show that no one of the number sequence is stationary, but the logarithmic sequence of p, c, g, s, m2, a and i are all one-lag integration. So a single integer variable can meet the requirements of the regression equation.

Table 1 ADF test

Variables	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
lnp	0.760	-3.750	-3.000	-2.630
lnc	0.954	-3.750	-3.000	-2.630
lng	0.161	-3.750	-3.000	-2.630
lns	1.090	-3.750	-3.000	-2.630
lnm2	1.753	-3.750	-3.000	-2.630
lna	1.313	-3.750	-3.000	-2.630
lni	-0.383	-3.750	-3.000	-2.630

#### 4.3 Cointegration Test

Cointegration theory and methodology proposed by Engle and Granger provides another way for modeling non-stationary series. Although some economic variables themselves are non-stationary sequence, their linear combination might be stationary sequences. If that is true, then it is considered that there are a cointegrated relationships between these non-stationary time series. The cointegration test includes two specific steps:

First: to distribute regression equations and derive residuals:

$$\begin{aligned} \ln(p) = & -0.9873 - 1.8485 \ln(c) + 1.96 \ln(g) - 0.61 \ln(s) + 0.6133 \ln(m2) \\ & + 0.1813 \ln(a) - 0.3705 \ln(i) \end{aligned}$$

Second: to determine whether the residual sequence is stationary series. There is a cointegration relationship between variables if the residuals are stationary.

Table 2 ADF test results

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.926	-2.660	-1.950	-1.600

Test results (see Table 2) showed that the residual sequence reject the null hypothesis at 1% significance level, to accept the conclusion there is no unit root, which means there is a cointegration relationship between the variables.

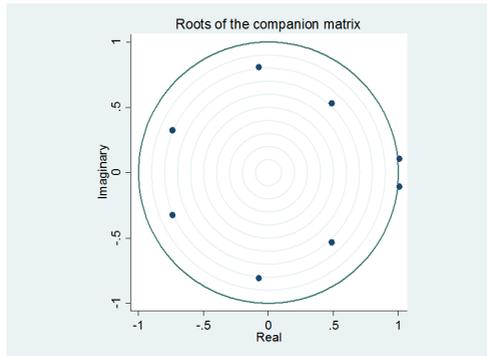
#### 4.4 Establishing VAR Model

VAR models are usually used to analyze the impact of system-related time series correlation and random disturbances on the system dynamics. Because it avoids the need for each endogenous variable modeling of all the endogenous in the structural equation system. Using variables  $\ln(p)$ ,  $\ln(c)$ ,  $\ln(g)$ ,  $\ln(a)$ ,  $\ln(s)$ ,  $\ln(m2)$ ,  $\ln(i)$  to establish VAR (2) model:

$$\begin{aligned} \ln(p)_t = & 3.4978 + 0.3121\ln(p)_{t-1} - 0.0393\ln(p)_{t-2} + 0.983\ln(c)_{t-1} \\ & + 6.7748\ln(c)_{t-2} - 4.8738\ln(g)_{t-1} + 3.7818\ln(a)_{t-1} \\ & + 1.8311\ln(s)_{t-1} + 0.0322\ln(s)_{t-2} - 1.977\ln(m2)_{t-1} \\ & - 1.3066\ln(m2)_{t-2} - 2.9462\ln(i)_{t-1} + 1.3423\ln(i)_{t-2} \end{aligned}$$

#### 4.5 Stability Test of VAR Model

For a stable VAR-model it is necessary to eigenvalues to be less than one. From the graph of roots of the companion metrics (Graph 3), the results show that this VAR model is stable. Because almost all the roots in less than 1.



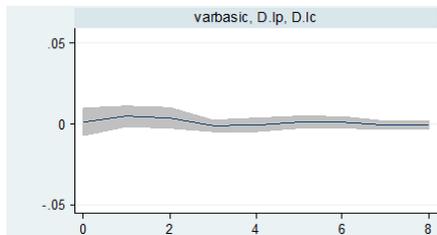
Graph 3 Stability test of VAR model

#### 4.6 Impulse Response Function

Impulse response function describes the impact on the endogenous variables and the current value of future values when a one-time shock is added to the disturbance term. The endogeneity of variables are not considered, and each model contains the same lag structure.

##### 4.6.1 Impulse Response Function of Household Disposable Income (c)

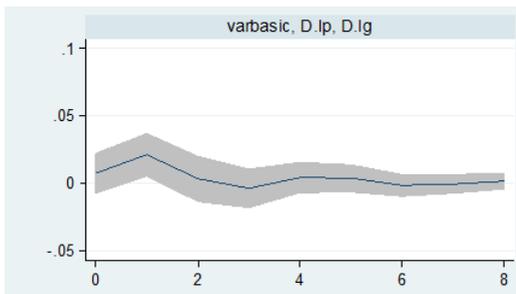
Graph 4 shows the effects of the disposable income on housing price fluctuations. Under a positive impact of disposable income, a small rise in prices, then leveled off, indicating little effect on the price of disposable income.



Graph 4 Impulse response function of household disposable income (c)

##### 4.6.2 Impulse Response Function of GDP (g)

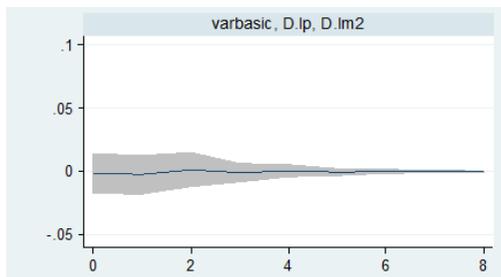
Graph 5 reflects the dynamic impact on the price of GDP. In the forward shock GDP, positive housing prices fluctuate in the first period, then continue to decrease in the period 1-3, and stay steady after the first 4 periods. GDP has a positive impact on prices in a short time, the long term impact on prices is not significant.



Graph 5 Impulse response function of GDP (g)

#### 4.6.3 Impulse Response Function of the Money Supply (m2)

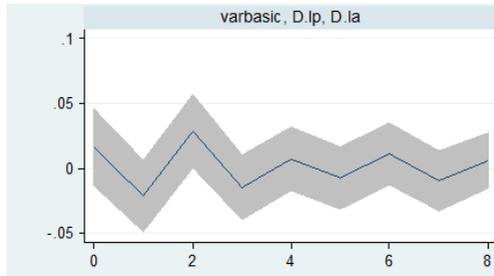
Graph 6 illustrates the dynamic impact of money supply on the prices. Positive impact on the money supply showed the central bank implements expansionary monetary policy. In a positive impact of the money supply, real estate prices rose slightly, and finally become stable.



Graph 6 Impulse response function of the money supply (m2)

#### 4.6.4 Impulse Response Function of the Area of Completed Housing (a)

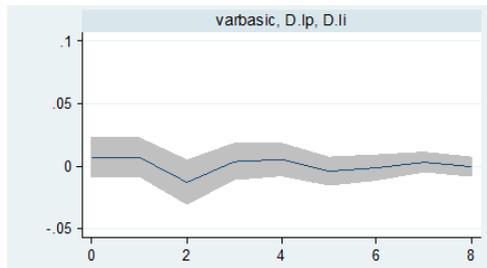
Graph 7 reflects the dynamic effects of the area of completed housing on the price. Positive impact on the completion of the housing area, the first decline in prices can be seen, then rises, and prices followed the positive and negative fluctuations. Area of completed housing has greater impact on prices, and has long-term effects on real estate prices.



Graph 7 Impulse response function of the area of completed housing (a)

#### 4.6.5 Impulse Response Function of Real Estate Development Investment (i)

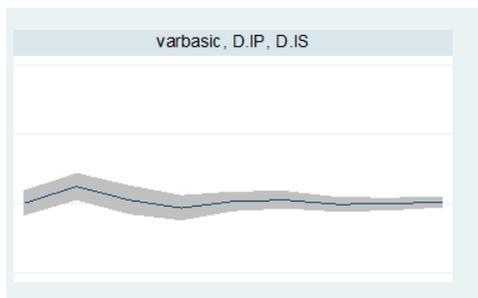
Graph 8 reflects the dynamic impact of the national real estate development investment on prices. In a positive impact investment, house prices remain unchanged in the first period, and then declined slightly and then rose again, and finally maintain a stable level. The impact on the price of real estate development investment is short-term, and slight.



Graph 8 Impulse response function of real estate development investment (i)

#### 4.6.6 Impulse Response Function of CPI (s)

Graph 9 reflects the dynamic effects of the consumer price index for prices. If the consumer price index has a positive impact on house prices, the prices will rise, then fall, finally remained stable.



Graph 9 Impulse response function of CPI (s)

#### 4.7 Variance Decomposition

Impulse response function describes the impact of the impact of a VAR model to other endogenous variables. The variance decomposition evaluates the importance of different structural shocks by analyzing the impact of each structure shock on endogenous variables.

Variance decomposition of VAR model is able to give the relatively important information of the random fluctuations in samples. The results showed that among the source of variance in price fluctuations, the impact itself is the first source of variance, which is the most obvious in the first period, accounted for 100%. With prolonged periods, the price fluctuations gradually reduced the impact on its own, and in the long-term it seems there is 90% rely on their own internal development. With prolonged periods, the impact of per capita disposable income and housing area enhance in early periods, post-reduce, and ultimately are stable at 8.68%, 0.077%. The impacts of GDP, CPI, money supply and real estate development investment increase by period, and are stable at 0.032%, 0.035%, 0.059% and 0.053% respectively.

#### 5. Conclusion

In this paper, the vector auto regression model (VAR) was used to study the impact of macroeconomic factors on real estate prices by cointegration test and the impulse response. The results of this study show that:

Firstly, from the perspective of the macroeconomic factors affecting China's real estate market prices, the per capita disposable income, the consumer price index and real estate development investment are major factors affecting prices. The per capita disposable income has the largest impact, followed by the completion of the housing area.

Secondly, from the perspective of the short-term factors affecting China's real estate prices, the expected price is a very important factor. The past-1-period price has maximum impact on current prices.

Thirdly, from the perspective of the dynamic impact on the real estate prices, the promotion of the completed housing area on the price is the most effective and longest one. While the effect of the money supply lasts the shortest period, and the promotions of real estate development investment, GDP and the consumer price index for housing prices are between them.

Fourthly, from the perspective of real estate prices contribution rate, the contribution rate of the expected price is the largest, but shows a gradual downward trend, followed by residents' per capita disposable income, whose contribution rate decreases. While the money supply and real estate development investment have the minimum contribution rate.

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**Appendix**

## 7.1 Data source:

year	p	g	c	s	m2	a	i
1998	2063	84,402.28	5,425.10	438.4	65,544.90	170,904.75	3,614.23
1999	2053	89,677.05	5,854.00	432.2	74,060.60	187,357.07	4,103.20
2000	2112	99,214.55	6,280.00	434	81,463.10	181,974.44	4,984.05
2001	2170	109,655.17	6,859.60	437	98,430.30	182,437.05	6,344.11
2002	2250	120,332.69	7,702.80	433.5	114,125.20	196,737.87	7,790.92
2003	2359	135,822.76	8,472.20	438.7	137,104.30	202,643.73	10,153.80
2004	2778	159,878.34	9,421.60	455.8	158,137.20	207,019.08	13,158.25
2005	3167.66	184,937.37	10,493.00	464	191,476.91	227,588.65	15,909.25
2006	3366.79	216,314.43	11,759.50	471	219,568.46	212,542.15	19,422.92
2007	3863.9	265,810.31	13,785.80	493.6	250,882.10	238,425.31	25,288.84
2008	3800	314,045.43	15,780.80	522.7	308,949.47	260,306.98	31,203.19
2009	4681	340,902.81	17,174.60	519	386,223.50	302,116.53	36,241.81
2010	5032	401,512.80	19,109.40	536.1	459,230.30	278,564.54	48,259.40
2011	5357.1	473,104.05	21,809.80	565	561,743.22	329,073.26	61,796.89
2012	5790.99	519,470.10	24,564.70	579.7	665,486.47	335,503.55	71,803.79

## 7.2 Stata do.file

```
** Define time-series
```

```
gen date = y(1998)+_n-1
```

```
format %ty date
```

```
tsset date
```

```
gen lp=ln(p)
```

```
gen lc=ln(c)
```

```
gen lg=ln(g)
```

```
gen ls=ln(s)
```

```
gen lm2=ln(m2)
```

```
gen la=ln(a)
```

```
gen li=ln(i)
```

```
** Plot time-series
```

```
tsline lp lc lg ls lm2 la li
```

```
tsline d.lp d.lc d.lg d.ls d.lm2 d.la d.li
```

```
** ADF test
```

```
dfuller lp, lags(1)
```

```
dfuller lc, lags(1)
```

```
dfuller lg, lags(1)
```

```
dfuller ls, lags(1)
```

```
dfuller lm2, lags(1)
```

```
dfuller la, lags(1)
```

```
dfuller li, lags(1)
```

```
** Cointegration test
```

reg lp lc lg ls lm2 la li  
predict ehat, residual  
dfuller ehat, noconstant lags(1)

\*\* Contribute VAR model  
var lp lc lg ls lm2 la li

\*\* Stability test of VAR model  
varstable, graph

\*\* Impulse response function  
varbasic d.lp d.lc  
irf graph d.lp d.lc

varbasic d.lp d.lg  
irf graph d.lp d.lg

varbasic d.lp d.la  
irf graph d.lp d.la

varbasic d.lp d.li  
irf graph d.lp d.li

varbasic d.lp d.ls  
irf graph d.lp d.ls

varbasic d.lp d.lm2  
irf graph d.lp d.lm2

\*\* Variance decomposition  
irf creat order1, set(order1) order(lp lc lg ls lm2 la li) step(3) replace  
irf table fevd, noci std