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# **Analysis for Real Estate Investment of China**

**-Based on the Warning System of Monitoring Macro Economy Prosperity**

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## Master of Science thesis

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### Abstract

Real estate industry plays a significant role in high speed of economic development in China. However, with increasingly high housing price and scare land resources, real estate development is caught in a vicious circle. A large number of families could not afford their housing while housing prices have no trend to decrease which leads to huger gap between the rich and the poor and causes indirectly instability of society. Therefore, creating a healthy and stable real estate investment market is extremely urgent. The purpose of the thesis is to research the relationship between leading index of macro economy prosperity and real estate investment based on the reality. We found that leading indicator Granger causes real estate investment while real estate investment Granger causes leading indicator at the same time. Based on that, this paper also forecasts the real estate investment with VAR models in the following 7 years which was proved to a circle of real estate market. In the light of our research, some target suggestions are pointed out at last.

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# 1. Introduction

## 1.1 Background

China's rapid growth in the past years has been witnessed, even though the period of global financial crisis. The total GDP increased from 364.5 billion RMB in 1978 to 3006.7 billion RMB in 2008, which was 82.5 times to 30 years ago. At the same time, all industries expanded continuously. Although subprime crisis has moved forward gradually to the end, expansion of domestic demand would still be the focal point of future economic development in China, in which real estate played an important part. Property investment (4044.18 billion) accounted for large share (23.4%) of total fixed asset investment in 2008. (Yearly Book, 2009) As a pillar industry of national economy, it promotes the boom of related industries, such as cement, steel and building materials. In addition, this industry accelerates urbanization, improving the construction of urban infrastructure. What's more, the revenue and employment have been increased during the course.

As a result of RMB appreciation, so much foreign hot money swarmed into China. Owing to the irreplaceable role of high return, large amount of it pours in housing market. In line with Qin. S and He. L (2010), this makes imbalance of real estate supply and demand. Hot money belongs to venture capital, which focuses on luxury residential buildings and villas, because of high margin. On the contrary, affordable housing or low and medium residential are out of favor for developers. Due to the main source of fiscal revenue and high added value, government encouraged its growth. Rapid rate led to housing price beyond of people's affordability. Overheating situation aroused people's thinking. China's economy over-dependend on real estate in the past years, which pushed our economy into the abnormal situation. Instable factors come out, such as widening the gap between the poverty and rich, distortion of the distribution of social wealth.

People expected for healthy and stable real estate market. These years, regulations experienced the stages from inhibition of expansion for market demand, prevention prices rising fast to encouragement of rational demand and change of investment-driven economic growth.

In order to make a sustainable investment, many scholars took part in study actively recently. Here, the real estate investment can be defined as the action that all kinds of real estate companies develop the housing residencies, plants, warehouses, restaurants, hotels, holiday villages, office buildings, as well as public facilities and land development. (Yearly Book, 2009) Research fields referred to wide-ranging, such as macroeconomic policy, the relationship between housing price or GDP and investment, risk. However, there are seldom references regarding on how the warning system of macro economy prosperity affected the investment, which consists of a series of economic indicators to monitor the trend of macro economy and predict its development. The warning system of macro economy prosperity will be used for this paper, including leading, coincide and lagging indicator. Leading indicator refers to the data that change before the overall increase or decrease of national economic cycle. The second one can reflect the characteristics of fluctuation, and its turning point synchronizes with the transformation of economy. The last one shows the effect after the rise and down. (Xie. J. B, Wang. B. H, 2007)

## **1.2 Purpose**

This paper will try to illustrate the relationship between macro economy prosperity and real estate investment based on the reality. Within this context, the study of this issue is of great significance. Investigation before real estate investment is in the initial stage in China, especially based on the warning system of monitoring macro economy prosperity. Through this analysis, policy makers could make effective adjustment on policies more immediately and it would be beneficial for consumers to invest more rationally. Additionally, the firms' governors can master the overall situation and make a sensible

decision, which can promote the healthy development of real estate in China.

### **1.3 Outline**

The remainder of the paper is divided into four parts. In section two, we will provide literature review from home and abroad references. One area—warning system of macro economy prosperity, which should have an effect on property investment, has been neglected by most of the people. Methodologies will be presented in section three, including the introduction of unit root, co-integration and error correction, VAR model, Granger causality, impulse response function. The description for data will be illustrated in Section four. Section five will focus on analysis and results according to the previous study. Section six presents the summary. Suggestions will be given in the section seven. In the last section, the scope and limitation of the this research will be discussed.

## 2. Literature Review

Looking at the world, real estate investment has increasingly affected the overall economy. The development of global real estate investment benefits from the liberalization and internationalization of financial market. The evaluation of market fundamentals and institutions of recipient localities are the key factors to consider. (Zhu.J.M, Sim.L.L, Zhang.X.Q, 2006) For the global investment, cost of international real estate diversification should also be taken into account. The cost can be reduced by invest in public property companies, who pays much attention to their local and domestic market. (Eichholtz.P, Koedijk. K, Schweitzer.M, 2001)

For different countries, the study key points of housing investment are like chalk and cheese. For example, in UK, The monetary policy has larger impact on residential investment than fiscal policy. However, the power of money has disappeared in 1980s of post deregulation. So the causality between residential investment and macroeconomic variables had been changed during that time. (Hasan.M.S, Taghavi.M, 2002) In France, Arrondel.L (2001) compares the differences between housing investment and consumption, which can influence the purchase decision as an occupier-owner or landlord. However, the researches of real estate investment in Australia are focused on cost and return of small investment companies and individual investors, who account for majority of real estate investment market. (Eves, C. & Wills, P., 2003)

In China, real estate investment is a totally different activity, upstream concerning for government monopoly, while downstream related to common people. There is a game between selling land at a high price and creating harmonious society for the government. For the common people, stable and affordable housing market can increase the happiness index. So the macroeconomic control for the real estate investment becomes so important. Chen.B.G (2010) said the macroeconomic control in China went through

five years. The central government regulated the real estate market due to the high growth of housing price in 2005~2006. The measures were mainly contraction fiscal and monetary policy, including tightening of the mortgage, increasing the percentage of down payment. Then the housing price calm down, and the property market recessed. Nevertheless, due to the adjustment in 2007, the market boomed. One year later, contraction policy was again brought it to the downturn. It was not until to 2009, Chinese government realized that the role of real estate as pillar industry, which would have an effect on expansion of domestic demand and economic growth in the prosperity of global financial crisis. On the contrary, too far away from balance, abnormal speed of development turned up.

No matter how many stages of real estate investment experienced, it is closely related to macro economy at the time. Many scholars paid much attention to research the relationship of these two aspects. Zhang.X.J and Sun.T (2006) analyzed the real estate cycle and financial stabilization, including the growth, policy and macro aspect, by using quarterly data of 1992~2004. Either the real estate industry or the housing price would go up. It was reflected on credit risk and government guarantee risk that how the real estate cycle affects stable finance. Wu.S (2010) studied the interaction between the real estate investment and economic growth of the past 15 years, which showed that the two variables had long term dynamic equilibrium. The increase of production factors supply and productivities led to economic growth, consisting of the improvement of industrial structure, scale economy, technology innovation, capital and labor. All of these played a significant role in real estate investment and development. Sheng.C.M & Fang.Z.D (1999) pointed that the change of national economy in China will lead to the change of real estate investment. According to Duan.Y.Y and Tian.H (2009), real estate investment and housing price were positively correlated by analysis of real estate investment and GDP growth, housing price and people's disposable income. Both of the growth rate of property investment and housing price were much faster than national economy. In the long run, the industry of real estate should keep pace with national economy, people's disposable income. When national economy growth rate increased

1%, the real estate investment went up 12.7%, vice versa. The larger the investment range fluctuates, the slower the development for this industry. So the target of macroeconomic control was to reduce the swing, making the growth sustainable. (Wang.M, Tang.X.F, 2000)

Searching the previous study of real estate investment in China, most people focused on economic growth or housing price. Although they were some of the most significant factors, warning system of monitoring macro economy prosperity has been neglected, which may affect the confidence of investors and their behaviors. In the following of the paper, we will discuss the relationship between these two aspects.

### 3 Methodology

When choosing methodology to analyze, several methodologies occur to us. They are theoretical analysis, fundamental analysis and VAR models analysis. However, theoretical analysis is too abstract for such a practical problem and could not reflect direct information for government or investors to take measures accordingly. Considering fundamental analysis, since fundamentals in real estate investment are hard to measure and quantified and we have no access of data of fundamentals in real estate investment, it's also not the main focus of this study. Meanwhile, in recent researches, VAR models have been proven to be one of the most effective and easiest methods in studying the relationship of variables in the housing market as well as forecasting variables. For example, Zhou, Z. (1997) examined demand in the existing single-family housing market and concentrated on relationship between sales volume and median sales price and furthermore forecasting sales and prices of single-family housing in the United States using VAR models. However, the limitation of VAR models is that they require a large number of data in models. Therefore, we collect a long-term period monthly data of 20 years for variables respectively.

In this part, the methodology employed in the thesis will be introduced. Unit root test is to examine whether the time series data are stationary, which is essential for establishing VAR models since non-stationary data are not supposed to be used in regression models to avoid spurious regression. There are three kinds of unit root tests test for different properties of data and we could choose one according to the plot of time series. If they are non-stationary, difference the data to make them stationary and then we perform co-integration test to examine whether they share similar stochastic trends. If they are not co-integrated, any regression relationship between time series is fake. VAR models are used to describe the interrelationship between two stationary variables, which is also an effective tool to forecast economic variables. (Hill R. C, Griffiths, E. W & Lim, C. G, 2008)

### 3.1 Unit root

In the autoregressive model,

$$y_t = c + \beta y_{t-1} + \varepsilon_t \quad (1)$$

Where  $c$  is a constant,  $\beta$  is coefficient,  $\varepsilon_t$  is the sequence of error items of zero mean, and  $t=1, 2, 3 \dots T$ . If the absolute value of  $\beta$  equals to one, leading to non-stationary time series, the process of (1) is called random walk, which means that  $y$  at time  $t$  depends on the previous value of  $y_{t-1}$ . Random walk is a special example of unit root process, in which the coefficient of  $y_{t-1}$  is one at the first order of autoregressive model. According to Wooldridge (2005), unit root test has become increasingly important in the modern time series econometrics. If the unit root exists, the normal approximations are no longer valid even in the large sample sizes. Although there is many a method for this kind of test, here Dickey-Fuller test will be chosen, since it is the most popular and easiest one.

Subtracting  $y_{t-1}$  from both sides of equation (1), and defining  $\theta = \beta - 1$ , the Dickey-Fuller could be:

$$\Delta y_t = c + \theta y_{t-1} + \varepsilon_t \quad (2)$$

Where  $\Delta y_t$  is the first order difference of sequence  $y_t$ . Wooldridge (2005) points that if we assume the null hypothesis of  $H_0: \theta = 0$ , the alternatives  $H_1: \theta < 1$ . Given that there is a unit root for (2), then  $\Delta y_t = c + \varepsilon_t$ , mean linear exists in the change of  $y_t$ . So the appropriate hypothesis should be  $H_0: \theta = 0$ . For this test,  $t$  statistic will be used, which is defined as:

$$t = \frac{\theta - 0}{se(\theta)} \quad (3)$$

Where  $se(\theta)$  is the standard error of  $\theta$ . The Dickey-Fuller test will be performed for real estate investment and leading indicator. And the result will be presented in the next section.

## 3.2 Co-integration and error correction

Once the Dickey-Fuller test done, if the two series of  $y_t$  and  $x_t$  experience unit root process, it can be said to be integrated at order one or  $I(1)$ . Generally speaking, the linear combination of them is still  $I(1)$ . Nevertheless, it could be the weakly dependent process or  $I(0)$ . If it is in this case, the two series are co-integrated at order one, which implies they have constant mean, constant variance.

In order to check the co-integration, we define a new formula first,

$$y_t = \alpha + \beta x_t + u_t \quad (4)$$

Then we have to check if the residuals of  $u_t = y_t - \alpha - \beta x_t$  is stationary. If we refuse the null hypothesis of unit root in  $\{u_t\}$ ,  $y_t$  and  $x_t$  are co-integrated. Otherwise, the two sequences are not co-integrated. The spread between them could be very large, and no tendency for them to come back together. If we go as it is, we will run a spurious regression, making no sense for the long-run relationship.

There are a number of methods can be used for testing co-integration. For instance, we can use Dickey-Fuller (DF) or Augmented Dickey-Fuller (ADF). Gujarati (2004) elaborates that  $u_t$  is based on regressed coefficient  $\beta$ , so the DF or ADF critical significant value may not suitable. Under these circumstances, Engel-Granger (EG) or Augmented Engel-Granger (AEG) test can be the better choice. When we performed a unit root test on the residual from Equation (4), we will get the below relationship:

$$\Delta u_t = \gamma u_{t-1} + c. \quad (5)$$

In this study, we will test co-integration between real estate investment and leading indicator. If  $y_t$  and  $x_t$  are not co-integrated, we might consider a dynamic model in first differences, i.e:

$$\Delta y_t = c + \alpha t + \theta \Delta y_{t-1} + \gamma_0 \Delta x_t + \gamma_1 \Delta x_{t-1} + u_t \quad (6)$$

Where  $u_t$  has zero mean. From the above, we can find long-run propensity as well as lags distribution. If  $y_t$  and  $x_t$  are co-integrated, the error correction term should be added to (5), such as  $\delta(y_{t-1} - \beta x_{t-1})$ , and the model could be error correction model.

For simplicity, the model can be written as: (Wooldridge, 2005)

$$\Delta y_t = c + \gamma_0 \Delta x_t + \delta(y_{t-1} - \beta x_{t-1}) + u_t \quad (7)$$

According to Gujarati (2004),  $\Delta y_t$  depends not only on  $\Delta x_t$  but also on  $(y_{t-1} - \beta x_{t-1})$

### 3.3 VAR Model

Wooldridge (2005) points out that if the series of y and x follow

$$y_t = \delta_1 + \alpha_1 y_{t-1} + \gamma_1 x_{t-1} + \alpha_2 y_{t-2} + \gamma_2 x_{t-2} + \dots \quad (8)$$

and

$$x_t = \delta_2 + \alpha_1 y_{t-1} + \gamma_1 x_{t-1} + \alpha_2 y_{t-2} + \gamma_2 x_{t-2} + \dots \quad (9)$$

which is the vector autoregressive (VAR) model. Each equation has a zero expected error.

There are types of criteria. Here, we discuss between in-sample and out-of-sample. In regression, in-sample is better, using R-square.

$$R^2 = \frac{SSE}{SST} = 1 - \frac{SSR}{SST} \quad (10)$$

SST means the total sum of squares, SSE equals to explained sum of squares, and SSR denotes to the sum of squared residuals.

As a penalty for imposing independent variable to increase  $R^2$ , adjusted R-squared has been developed.

$$\bar{R}^2 = 1 - \frac{SSR / (n-k-1)}{SST / (n-1)} \quad (11)$$

Here k means the number of independent variables.

It may be better for us to choose the second criteria, since forecasting is not an in-sample issue. If there are e+f observed values, the first e values can be used in the regression model, while the later f ones can be applied for forecasting. Besides those,

we also have to consider Akaike information criterion (AIC), Schwarz Information criterion (SIC), forecast  $\chi^2$  (chi-square), Final prediction error (FPE) and Hannan-Quinn Information Criterion (HQIC).

Gujarati (2004) elaborates another penalty for adding independent variables is to use Akaike information criterion (AIC), in which the definition is:

$$AIC = e^{2k/n} \frac{\sum \hat{\delta}_i^2}{n} = e^{2k/n} \frac{SSR}{n} \quad (12)$$

Conveniently, the above can be written as:

$$\ln AIC = \left(\frac{2k}{n}\right) + \ln\left(\frac{SSR}{n}\right) \quad (13)$$

Where  $\ln AIC$  is the log of AIC and  $2k/n$  means the penalty factor. The lower AIC the model has when comparing, the better it is. What's more, this criterion fits not only the in-sample but also the out-of-sample. Similar to AIC, SIC can be defined as:

$$SIC n^{k/n} \frac{\sum \hat{u}_i^2}{n} = n^{k/n} \frac{SSR}{n} \quad (14)$$

Or

$$\ln SIC = \frac{k}{n} \ln n + \ln\left(\frac{SSR}{n}\right) \quad (15)$$

Here  $\frac{k}{n} \ln n$  is the penalty factor. Likewise, the model with the lowest SIC is preferred.

Given  $n$  observations in the regression sample, we want to use them to forecast the model for the added  $t$  observations. So the forecast chi-square ( $\chi^2$ ) can solve the problem, which can be defined as:

$$\chi^2 = \frac{\sum_{n+1}^{n+t} \hat{u}_i^2}{\hat{\delta}^2} \quad (16)$$

Where  $\hat{u}_i$  is the forecast error for time  $i$  ( $i=n+1, n+2 \dots n+t$ ) based on the fitted model and the post sample period, and  $\hat{\delta}$  is the error from ordinary least square of the fitted regression.

Final prediction error (FPE) is another information criterion. According to Akaike (1970),

$$FPE = \left(\frac{n+p}{n-p}\right) \left(\frac{SSR(m)}{n}\right) \quad (17)$$

Where  $n$  is the sample size,  $m$  is the lags,  $p=m+1$  if series of  $y_t$  and  $x_t$  are not co-integrated, while  $p=m+2$  if they are.

In 1979, Hannan and Quinn found alternative information criterion to AIC and SIC, which can be written as:

$$HQIC = n \ln \left(\frac{SSR}{n}\right) + 2k \ln(\ln n) \quad (18)$$

Here  $k$  is the number of parameters.

### 3.4 Granger causality

According to Granger (1969), the causality is defined as if it is better to forecast  $y_t$  based on all obtainable data than if the data is apart from  $x_t$ , we say  $x_t$  is causing  $y_t$ .

Wooldridge (2005) tells us that  $x$  Granger causes  $y$  when  $E(y_t | I_{t-1}) \neq E(y_t | J_{t-1})$ , where the information of past  $y$  and  $x$  is included in  $I_{t-1}$ , while only information of  $y$  is included in  $J_{t-1}$ . Provided the linear model and the lags of  $y$  have been chosen, it is easy to test the null hypothesis in which  $x$  does not Granger  $y$ . At first, the autoregressive model of  $y$  has to be estimated, as well as  $t$  and  $F$  tests are used to determine how many lags of  $y$ . The lags of quarterly and monthly data are more than that of yearly data. We can take a simple example, given  $E(u_t | y_{t-1}, y_{t-2}, y_{t-3}, \dots) = 0$

$$y_t = \delta_0 + \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + \alpha_3 y_{t-3} + u_t \quad (19)$$

As long as the autoregressive model of  $y$  has been decided, the lags of  $x$  can be determined, which is less significant since  $x$  does not Granger  $y$ . If one lags of  $x$  is added to the above formula,  $t$  test can be used to examine the significance. While if two or more lags of  $x$  are added,  $F$  test can be used for the joint significance, such as

$$y_t = \delta_0 + \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + \alpha_3 y_{t-3} + \gamma_1 x_{t-1} + \gamma_2 x_{t-2} + u_t \quad (20)$$

### 3.5 Multiple-Step-Ahead Forecast

Given that we want to forecast  $y_{t+1}$  at time  $t$  and  $s$  ( $s < t$ ), the  $\text{VAR}[y_{t+1} - E(y_{t+1} | I_t)] \leq \text{VAR}[y_{t+1} - E(y_{t+1} | I_s)]$ , which is to say the more information the less error variances. Assuming  $\{y_t\}$  abides by autoregressive progress of order one, or  $[\text{AR}(1)]$ , such as

$$y_t = c + \beta y_{t-1} + u_t$$

$$E(u_t | I_{t-1}) = 0, I_{t-1} = \{y_{t-1}, y_{t-2}, y_{t-3}, \dots\},$$

where the variance  $\sigma^2$  of  $\{u_t\}$  is constant. As a result, the one-step-ahead forecast has the variance of  $\sigma^2$ . In the multiple-step-ahead forecast, through repeated substitution, we get

$$y_{t+h} = (1 + \beta + \dots + \beta^{h-1})c + \beta^h y_{t-1} + \beta^{h-1} u_{t+1} + \beta^{h-2} u_{t+2} + \dots + u_{t+h} \quad (21)$$

We expect all the  $u_{t+j}$  to be zero, for  $j \geq 1$ , at time  $t$ . Therefore,

$$E(y_{t+h} | I_t) = (1 + \beta + \dots + \beta^{h-1})c + \beta^h y_{t-1} \quad (22)$$

Where the forecast error is  $e_{t,h} = \beta^{h-1} u_{t+1} + \beta^{h-2} u_{t+2} + \dots + u_{t+h}$ . So the  $\text{Var}(e_{t,h}) = \sigma^2 (1 + \beta^2 + \dots + \beta^{2(h-1)})$ . When  $\beta^2 < 1$ ,  $\text{Var}(e_{t,h}) = \sigma^2 / (1 - \beta^2)$ . If  $\beta^2 = 1$ ,  $f_{t,h} = ch + y_t$ , and  $\text{Var}(e_{t,h}) = \sigma^2 h$ .

Likewise, it is also applied to VAR model. Supposing

$$y_t = \delta_0 + \alpha_1 y_{t-1} + \gamma_1 x_{t-1} + u_t \quad (23)$$

and

$$x_t = \theta_0 + \alpha_1 y_{t-1} + \gamma_1 x_{t-1} + v_t \quad (24)$$

If we wish to forecast  $y_{t+h}$  at time  $t$ , we can get

$$E(y_{t+h} | I_t) = \delta_0 + \alpha_1 E(y_{t+h-1} | I_t) + \gamma_1 E(z_{t+h-1} | I_t). \quad (25)$$

As a result of  $E(u_{t+h} | I_t) = 0$ , the above can be written generally down as:

$$\hat{f}_{t,h} = \hat{\delta}_0 + \hat{\alpha}_1 \hat{f}_{t,h-1} + \hat{\gamma}_1 \hat{g}_{t,h-1} \quad (26)$$

So as to know how precise we forecast  $y$  for this out-of-sample, the root mean squared error (RMSE) and the mean absolute error (MAE) can be used, including:

$$\text{RMSE} = (m^{-1} \sum_{h=0}^{m-1} \hat{e}_{n+h+1}^2)^{1/2} \quad (27)$$

and

$$\text{MAE} = m^{-1} \sum_{h=0}^{m-1} | \hat{e}_{n+h+1} | \quad (28)$$

Here  $\hat{e}_{n+h+1} = y_{t+h+1} - \hat{f}_{t+h}$ . We prefer the smallest RMSE and MAE in order to minimizing the largest absolute values of the forecast errors. (Wooldridge, 2005)

### 3.6 Impulse response function

Gujarati (2004) sets forth that the coefficients of VAR model are difficult to interpret, so we introduce impulse response function (IRF). The IRF illustrates how a shock of one standard deviation of error term ( $\delta_1$  or  $\delta_2$ ) influences endogenous variables. Take Equation (7) and (8) for example. Suppose  $\delta_1$  increase through a shock of one standard deviation in  $y$  regression. Such a change will influence  $y$  at present as well as in the future. Since  $y$  appears in  $x$  regression, the shock of  $\delta_1$  will have an effect on  $x$ . Analogously, such a shock in  $\delta_2$  of  $x$  regression will lead  $y$  to change.

## 4 Data

The leading index will be chosen to represent the warning system of monitoring macro economy prosperity in according to Table 1, since the property construction depends on steel production, iron ore production, steel stocks, cement stock, infrastructure loan, number of projects started, also people's affordability reflects on wages of individuals, all of which are comprised in leading index. Moreover, econometric method to forecast real estate investment is seldom used in China. The data used in this thesis are leading index of macro economy prosperity and real estate investment index which are monthly data from January 1990 to September 2010 obtained from National Bureau of Statistics of China.

Leading index of macro economy prosperity, denoted as  $ldind$ , changes in advance compared to fluctuation of macro economy cycles. For instance, if some indicators achieve peaks or troughs earlier than macro economy cycles for several months, they are called leading indicator, which could predict the economic situation to some extent in following years. (Xie Jiabin & Wang Binhui, 2007)

**Table 1 The prosperity index system of China**

	Leading index	Coincide index	Lagging index
Output of light industry	Steel production	Gross output value of industrial	National investment in fixed
Total production of primary energy	Iron ore production	Sales revenue of industrial enterprises in the budget	Commercial loans
Output of 10 kinds of non-ferros	Steel stocks	Retail sales of social commodity	Revenue and expenditure
Net purchases of industrial products	Cement stock	Net purchases of goods	Retail price index
Export turnover of the ministry of foreign trade	Infrastructure loan	Net sales of goods	CPI
Wages and other expenses for	Number of projects started	Customs imports	Fair trade price indices
Purchases of agricultural products	Customs export	Money in circulation	
Sales of goods	narrow money M1	Broad money M2	
Cash Expenditure	industrial loan	Cash income of bank	

Source: Xie, J. B., Wang, B. H. (2007), The Warning System of Monitoring Macro Economy Prosperity in China

Real estate investment index, denoted as rlestinv, contains the capital of real estate investment, land development, construction area, land development area, completion of construction area, and property price during the reporting period. The rlestinv, which is based on the same time of the last year, reflects the current level of real estate compared with a year earlier.

According to Appendix 1, we summarize below table, which shows the observations for each are 237 and 235 individually, and the means are 101.78 for ldind and 104.89 for rlestinv. The minimum of rlestinv is less than ldind while the maximum is larger.

Table 2 Summarizing statistics for time series

<b>Variable</b>	<b>Obs</b>	<b>Mean</b>	<b>Std. Dev</b>	<b>Min</b>	<b>Max</b>
<b>Ldind</b>	237	101.7831	2.73206	96.83	112.29
<b>Rlestinv</b>	235	104.8909	10.30838	83.79	138.06

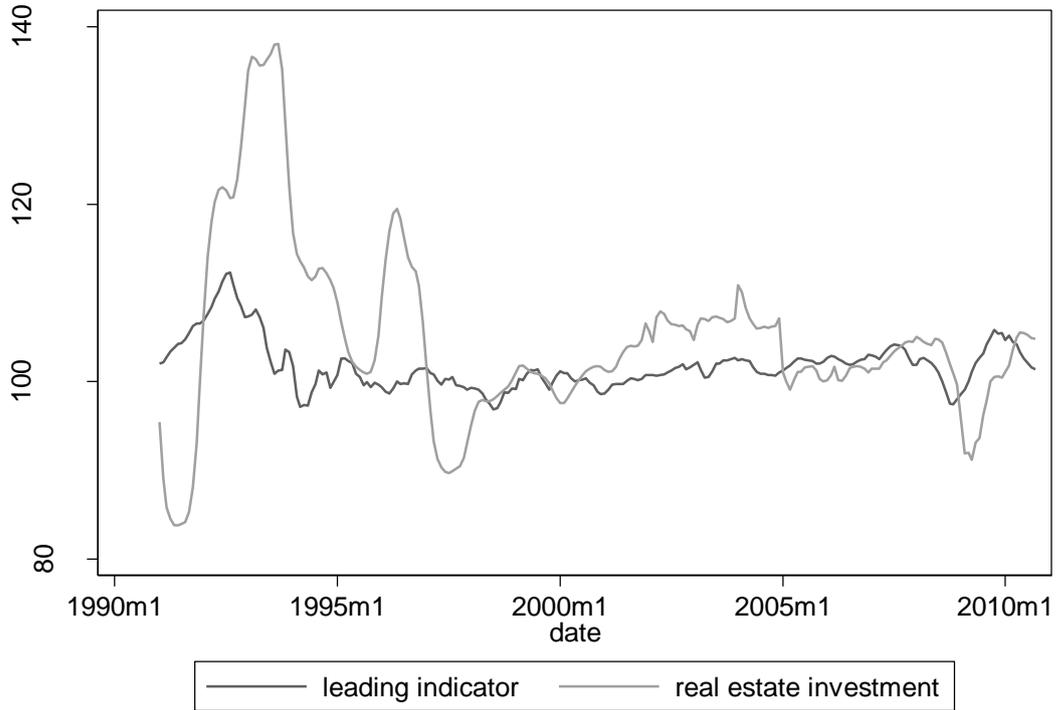
# 5 Empirical Result

## 5.1 Result of Unit root tests

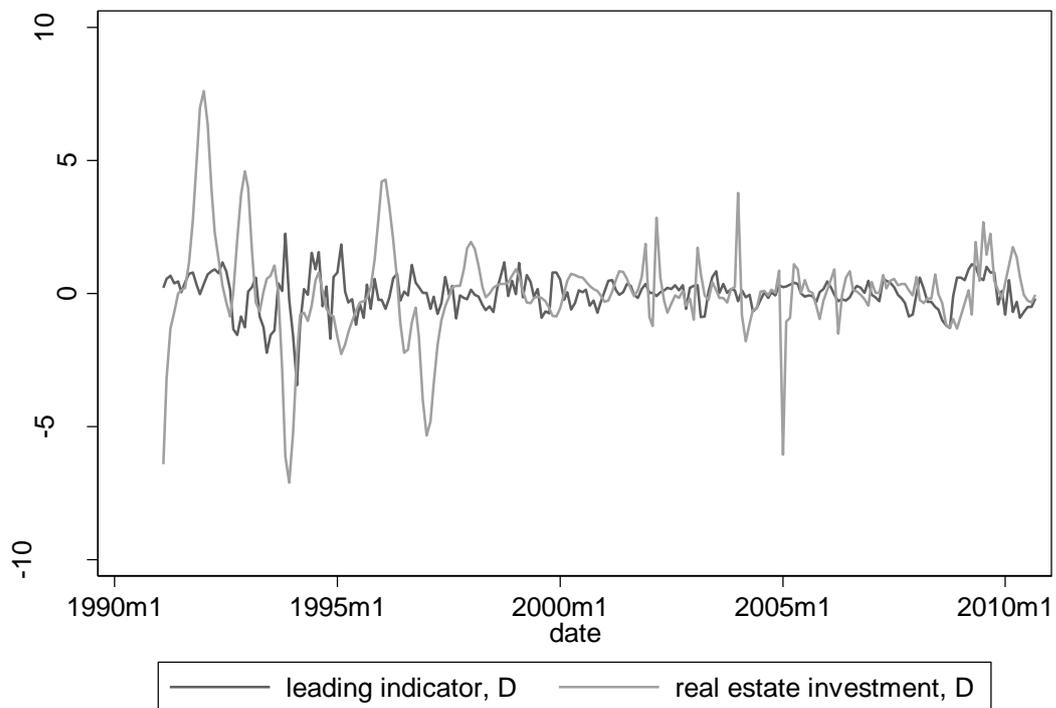
From Figure 1, we can see that these two series are nonstationary which follow in different patterns. But leading indicator leads the development of real estate investment to some extent. However, the fluctuation of real estate investment is much larger than that of leading indicator. In several months of 1993, the *rlestin* climbed nearly to 140, meaning the volume of real estate investment is as 1.4 times as the same time of 1992, since the hot money swarmed into property, and economy excessively relied on real estate. Later on, when the government issued a package of policies to control the inflation, the investment became cool. Especially when it came across Asian Financial Crisis, the development level decreased. In the following years, the event experienced several peaks and bottoms. In January 2004, the investment went to 110.89, referring as 1.1089 times as the level of the same time of 2003. We can see the *rlestin* went lower than 100 in 2009 compared to 2008, due to the subprime crisis. The overall economy has been affected, including property industry. Although the curve strived to climb up since 2010, the government issued many a regulation to control the real estate. As a result, the margin is not large.

While in Figure 2, the plots of first-order difference ( $\Delta y_t = y_t - y_{t-1}$ ), whereas, seem stationary. But this kind of judgment, to some extent, is relatively subjective. For the sake of objective conclusion, the augmented Dick-fuller has been used to test the unit root.

**Figure 1 Plots of time series of leading indicator and real estate investment**



**Figure 2 Plots of time series of leading indicator and real estate investment with first-order difference**



Using Stata 10.0, we do the unit root test for *ldind* and *rlestin*, including constant but no time trend. Since they are monthly data, 12 lags have been chosen. According to Table 3, test statistics for these two are -2.429 and -2.045 respectively, both of which are larger than the critical value. As a result, we cannot reject the null hypothesis that they are nonstationary. So we assume they are at  $I(1)$ .

**Table 3 Augmented Dickey-Fuller test for unit root**

Variables	ADF	Critical Value	P-value
<i>ldind</i>	-2.429	-2.882	0.1336
<i>rlestin</i>	-2.045	-2.883	0.2673

## 5.2 Result of Co-integration tests

Earlier, we found there exit unit root in the above two series. Now, we have to know if they are co-integrated in order to avoid spurious regression. Let us first estimate *rlestin* on *ldind* and obtain following regression:

$$rlestin = 1.256961ldind - 23.04795$$

Since *rlestin* and *ldind* are respectively nonstationary, it is possible that this regression is spurious. But when we performed a unit root test on its residuals, we conclude the following results:

$$\Delta u_t = -0.0624216u_{t-12} + 0.0992208$$

$$t = (-5.19) \quad (0.83)$$

$$R^2 = 0.1095$$

The p-value for  $u_{t-1}$  is 0.000, which is to say the two series are  $I(0)$ . In other words, the regression residuals are stationary, so that leading indicator and real estate investment are co-integrated in the long run, implying they are moving together in the long run. Thus, 1.256961 represents the long-run marginal propensity to real estate investment.

### 5.3 Result of Error correction

We just showed that  $rlestin_v$  and  $ldind$  are co-integrated. However, there may be disequilibrium in the short period. Therefore, we have to add the error term to identify the short term behavior.

$$D. rlestin_v = 0.0423247D. ldind - 0.0656059L12. ehat + 0.0674634$$

$$t = \quad (0.27) \quad \quad \quad (-6.14) \quad \quad \quad (0.64)$$

$$R^2 = 0.1482$$

Accordingly, the error term is zero, meaning that  $rlestin_v$  adjusts to changes in  $ldind$  in the same time period. Short-run shift in  $ldind$  have a positive impact on short-term changes in  $rlestin_v$ . We can interpret 0.0423247 as the short-run marginal propensity to real estate investment.

### 5.4 Establishing VAR model

Based on the variables of leading indicators and real estate investment, the vector autoregressive model has been established. In order to determine the lags, the information criterion will used to choose (see Table 4).

**Table 4 The information criterion for VAR lags**

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1361.52				701.436	12.2289	12.2412	12.2594
1	-651.711	1419.6	4	0.000	1.24982	5.89875	5.93576	5.99042
2	-503.318	296.79	4	0.000	.342326	4.60375	4.66543	4.75654
3	-499.846	6.9442	4	0.139	.34396	4.60848	4.69483	4.82239
4	-476.174	47.344*	4	0.000	.28834*	4.43205*	4.54307*	4.70707*

In the practical application, the lag period is the problem we have to think about. The larger the lags, the more it can reflect the dynamic characteristics. On the contrary, the larger the lags, the more unknown variables, and the less the degree of freedom. So there is a trade-off between lags and degree of freedom. As the above shown, lag 4 is

the best choice according to the five criterion. Then VAR (2) would be set up. The formula is ( see Table 5)

$$\begin{pmatrix} r_{\text{lestin}} \\ l_{\text{dind}} \end{pmatrix} = \begin{pmatrix} -6.783 \\ 3.776 \end{pmatrix} + \begin{pmatrix} 1.724 & -0.220 \\ 0.027 & 1.401 \end{pmatrix} \begin{pmatrix} r_{\text{lestinL } 1} \\ l_{\text{dindL } 1} \end{pmatrix} + \begin{pmatrix} -0.685 & 0.285 \\ -0.0008 & -0.184 \end{pmatrix} \begin{pmatrix} r_{\text{lestinL } 2} \\ l_{\text{dindL } 2} \end{pmatrix} + \\ \begin{pmatrix} 0.095 & -0.220 \\ -0.012 & -0.669 \end{pmatrix} \begin{pmatrix} r_{\text{lestinL } 3} \\ l_{\text{dindL } 3} \end{pmatrix} + \begin{pmatrix} 0.123 & -0.054 \\ -0.022 & 0.423 \end{pmatrix} \begin{pmatrix} r_{\text{lestinL } 4} \\ l_{\text{dindL } 4} \end{pmatrix} + \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \end{pmatrix}$$

**Table 5 VAR model**

Sample: 1991m5 - 2010m9, but with gaps	No. of obs	=	223
Log likelihood = -476.1736	AIC	=	4.43205
FPE = .2883396	HQIC	=	4.543073
Det(Sigma_ml) = .245333	SBIC	=	4.707068

Equation	Parms	RMSE	R-sq	chi2	P>chi2
rlestinv	9	1.02755	0.9902	22480.98	0.0000
ldind	9	.504335	0.9680	6744.329	0.0000

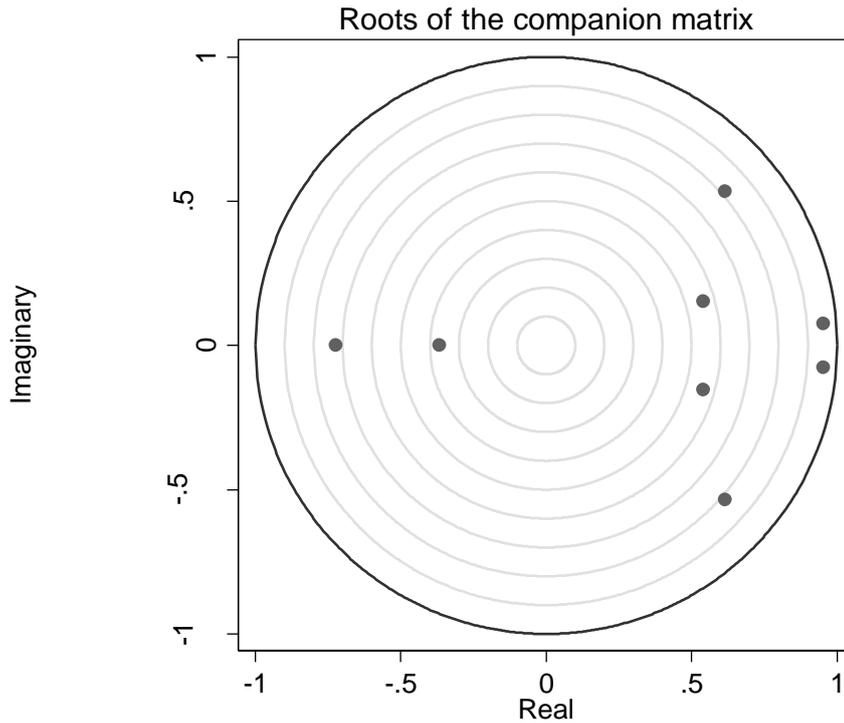
  

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
rlestinv					
rlestinv					
L1.	1.723995	.065794	26.20	0.000	1.595042 1.852949
L2.	-.6848364	.1309009	-5.23	0.000	-.9413976 -.4282753
L3.	-.2001627	.1288311	-1.55	0.120	-.452667 .0523416
L4.	.1232692	.0626078	1.97	0.049	.0005601 .2459782
ldind					
L1.	-.2197616	.1230583	-1.79	0.074	-.4609515 .0214282
L2.	.2845382	.2078789	1.37	0.171	-.122897 .6919734
L3.	.0951706	.2097708	0.45	0.650	-.3159727 .5063138
L4.	-.0541205	.1242968	-0.44	0.663	-.2977377 .1894967
_cons	-6.783649	2.87417	-2.36	0.018	-12.41692 -1.150378
ldind					
rlestinv					
L1.	.0268239	.0322926	0.83	0.406	-.0364684 .0901161
L2.	-.0007659	.064248	-0.01	0.990	-.1266895 .1251578
L3.	-.0117713	.063232	-0.19	0.852	-.1357038 .1121612
L4.	-.0219959	.0307288	-0.72	0.474	-.0822231 .0382314
ldind					
L1.	1.401059	.0603987	23.20	0.000	1.282679 1.519438
L2.	-.1842628	.1020298	-1.81	0.071	-.3842375 .0157119
L3.	-.6687648	.1029583	-6.50	0.000	-.8705594 -.4669702
L4.	.4226625	.0610065	6.93	0.000	.3030919 .5422331
_cons	3.776213	1.410682	2.68	0.007	1.011328 6.541098

rlestinv means real estate investment index, ldind means leading indicator. L1, L2, L3, L4 mean the first, second, third and forth lag from period t respectively.

The first and fourth lag of real estate investment and the second and third lag of leading indicator positively affect the real estate investment. The result shows the goodness-of-fit is 99.02% and 96.8% individually. Also, all the unit roots in the unit circle (Figure 3), so the structure of the model is stable.

**Figure 3 Stabilization for the Model**

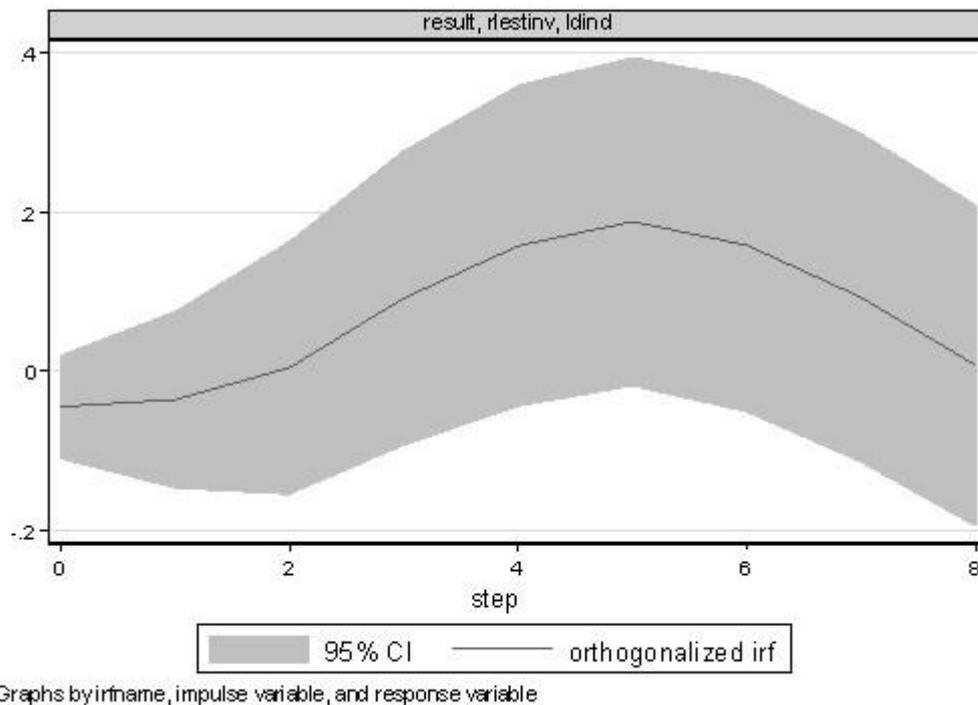


## 5.5 Results of Impulse and Response Function

In practical application, the coefficients of VAR model are difficult to understand. So we don't always analyze how one variable affect another. Instead, we can find how a shock of one standard deviation of error term ( $\delta_1$  or  $\delta_2$ ) influences endogenous variables. Given a positive impact of leading indicator and real estate investment, the graph of impulse response function will be got, in which the lateral axis stands for the lags of impact (unit: month), the vertical axis represents the property investment, and the dark line shows the impulse response function, the dashed area means the twice of plus or minus standard deviation (Figure 5, 6).

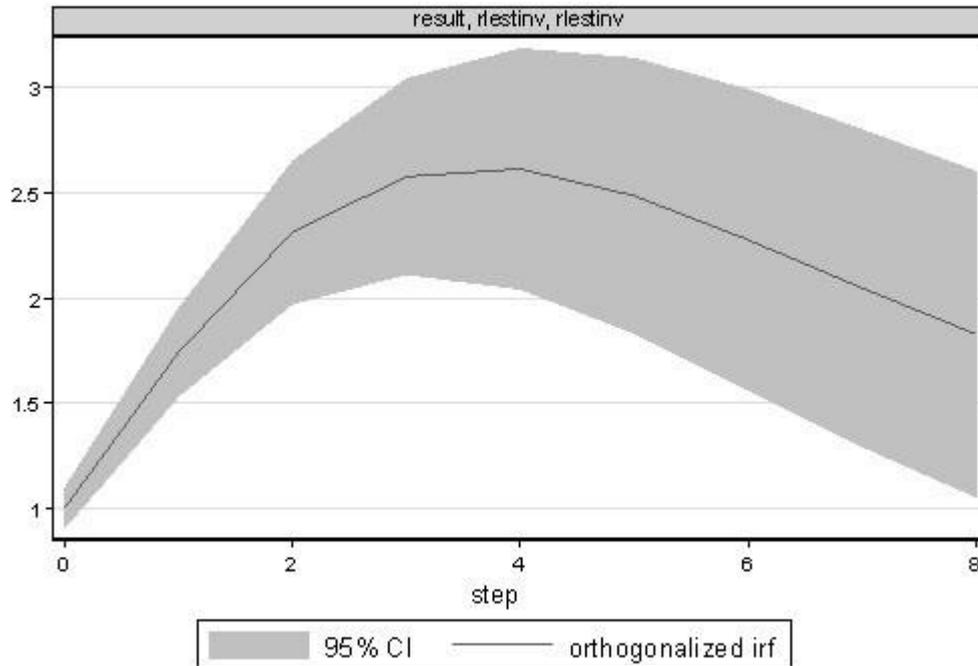
As shown in Figure 5, given a positive shock of leading indicator in current period, the line starts below zero, then a slow increase and maximizes in the fifth period. Although the strength of influence falls slightly, it may lasts for a while, showing the impact of leading indicator for property investment drops off, and goes down to around zero. That is to say, the leading indicator and real estate investment almost change in the same direction. We can conclude that the increase of factors in the leading indicator may promote the real estate investment. The shape change of the below graph may also be interpreted as: the development of related factors listed in leading indicator, such as cement, steel, infrastructure loan and so on, bring along the real estate.

**Figure 5 The Impact of Leading Indicator to Real Estate Investment**



The graph, presented in Figure 6, shows that given a positive shock of real estate investment itself in current period, the curve will soon climb to 2.6 at Period 4, which is larger and earlier than the previous situation. Then the impact declines to about 1.8. Figure 6 & 7 have almost the same trend, but influence of real estate investment itself is more powerful. The reasons for the stronger shock are that policies change.

**Figure 6 The impact of Real Estate Investment its own**



Graphs by irfname, impulse variable, and response variable

## 5.6 Results of Granger causality test

In order to know the relationship between variables, Granger causality test should be applied as described earlier.

**Table 6 Granger causality Wald tests**

Equation	Excluded	chi2	df	Prob > chi2
rlestinv	ldind	20.777	4	0.000
rlestinv	ALL	20.777	4	0.000
ldind	rlestinv	20.621	4	0.000
ldind	ALL	20.621	4	0.000

From Table 6, the result implies that leading indicator Granger causes the real estate investment, also the latter Granger causes the former, since the p-values are sufficiently low so that we can reject the null hypothesis. The fact warrants the conclusion.

### **5.6.1 In the Period of 1990~1996**

Since early 1990's, China's experienced fast development of economic transition. By establishing the goal of socialist market economy in 1992, the expansion came to the climax. The government wanted to devote major effort to develop post and telecommunications, chemical industry, infrastructure, energy resources in advance, which stimulated the means of production, such as steel and cement. The situation excessively relying on the investment came into being. The real estate craze acted according to the circumstances, especially in Hainan province. The price was about RMB 1000 per square meter at first, while went up to RMB 3000, even 10,000 yuan between the year 1991 and 1993. (Niu. R. B and He. B, 2002)

In order to eliminate the side effect of overheating economy, contracted monetary policy was adopted. At the same time, the State Council issued "The Suggestions on Present Economic Situation and Strengthening the Macro-control". The effect first reflected on the production of raw material, infrastructure loan, which reflected on the declining trend of leading indicator. As a result of the warning signal for future economy, entrepreneurs' confidences are greatly dampened, further affecting their decision. Due to the hysteretic nature, the decrease in property investment exhibited later. With the decreasing of leading indicator in the middle of 1990's, the overall trend of fix asset investment declined, although there was a little fluctuation.

Generally speaking, the developers made investment decisions in the booming cue. When the warning system illustrated depression, capital flows to other fields. Unlike other industries, real estate itself referred to lags. Sometimes, the leading indicator had gone down during the process of construction while it was too late to adjust for developers. Once the projects completed, the entire environment changed. Since the high price wasn't in people's affordability, the demand for the housing went down. Real estate companies had difficulty in taking a step of financing as a result of the policy. Seldom new projects are started, but more space available on the market.

Some projects cannot be completed. A lot of property firms went to bankrupt due to lack of loans when the old ones expired.

In addition, real estate itself is a dog-eat-dog industry so that some state-owned firms could not adapt to the fast changing market for the sake of the rigid system. On the other hand, overheated property investment is the engine for economy. The peak of real estate attracted the authorities' attention. They were aware that if the growth relied mainly on real estate, how would the vacant properties go and how would the inflation turn down. Soft-landed economic policy came out accordingly. The fiscal expenditure decreased, while the interest rate went into the other direction. Through these measures, currency circulation reduced. (Liu. W, 2005) As a result of depression, output of raw material, primary energy and light industries would decrease. So did the infrastructure loans and started projects. That is to say, real estate investment turned down the economy, reflected on leading indicator.

### **5.6.2 In the Period of 1997~2004**

Unfortunately, Asian financial crises broke out in 1997, which influenced China's foreign trade deeply, only with the degree of contribution of 0.2 in economic growth. Decreasing export led to less foreign investment, as well as higher unemployment. Finally, national economy was inevitably affected. (Cao. J. F, L. L, 2008) Most kinds of industries, listed in the leading indicators, showed a tendency of decrease, which influenced real estate investment.

In order to pull through, the Chinese government took the measures of slack fiscal and monetary policy to expand the domestic demand. On one hand, the proactive fiscal policy opened up a market for the weak domestic demand, such as the long-term construction bond. From 1998 to 2002, we had issued this kind of bond for 660 billion RMB. A package of polices were adopted like increasing tax refunds to exporters,

cutting regulation tax on fixed asset investment orientation by half at first then the all between 1998 and 2000. On the other hand, the prudent monetary policy was benefit to stabilize the prices. The reserve ratio was lowered from 13% to 8% in 1998, while the interest rate was reduced in four successively running. (Yuan. Z. X, 2010) This regulation stimulated the steel price slightly increase of RMB 500 to RMB 2630 per ton. Higher price made the suppliers interest in this industries. So did the other products not just related construction materials as a result of the low reserve ratio and interest rate. “The Management for Personal Housing Loan” was published by People’s Bank of China in 1998, allowing for all commercial bank to offer loans to individuals who wanted to buy a house. It seemed surprising but made sense.

In spite of a bit fall, the leading indicator and real estate investment kept the overall upward trend until 2004. The iron, steel and cement were produced 110, 109 and 335 billion ton respectively in January 2001. Later, all of these went to 188, 218 and 755 billion ton individually at the same time of 2004. (Yearly Book, 2009) Meanwhile, the export, energy and metals boomed which promoted the leading indicator. The index, because, implied good future economy, the property firms found business opportunities.

The real estate investment got golden age. Different from the previous cycle, it progressed smoothly. The government and developers tended to pursue the rational mode. Consequently, this round, which showed the expansion period, advanced wave upon wave. (Zhou. X. Y, 2009)

### **5.6.3 Ever Since 2005**

The latest phase lasted from 2005. With the dramatic increase of national economy, all professions and trades appeared a scene of prosperity. The production related construction material continued to rise. By perfecting the laws and regulations of

foreign trade, exports further contributed to the economy. In the mean time, M1 was on the rise. The high growth needed large number of workers, thus rural population swarmed into the cities, enlarging the urbanization. (Chen. R. L, 2009) A new round of real estate investment boom began.

In this period, the lag effect performed most significantly. The leading indicator preceded property investment a few months, both of which got another peaks in 2007. Yet unpredictable American sub-prime crises shocked us a lot. Foreign export decreased sharply, occurring economic weakness. For example, steel 482 billion ton, cement 1208 billion ton in August 2007, while both had 3 billion ton decrease over the same period of 2008. (Yearly Book, 2009) The investment went to the bottom in the early 2009. According to Yuan. Z. X (2010), this time is different from the last one. This time created double burden. For the outside, decreasing foreign customers affected our export market. For the inside, inflation, over capacity, unbalanced structure made the economy downturn objectively. By effective and efficient fiscal and monetary policy, the factors of leading indicator gradually got warm again, showing the prosperity for future environment. The decision-makers were greatly encouraged, then property investment was back on stage.

However, in the recent one year, irrational demand and development led to the housing price seriously exceed people's affordability. In order to control the investment overheating, central government published a package of laws and regulations, such as increasing the down payment of the second apartment and interest rate, imposing property tax and so on. Psychological warfare among developers, consumers, government and banks quietly began. Since possessing cost increased, the buyers and the renters were in a wait state for a long time. They couldn't decide to buy or not to buy, hoping the price to decrease to a psychological level. But for developers, the situation was another matter. The confidence and construction were influenced seriously in deed. Obtaining land and financing have been affected significantly. On the contrary, some new properties were set abnormally high price to

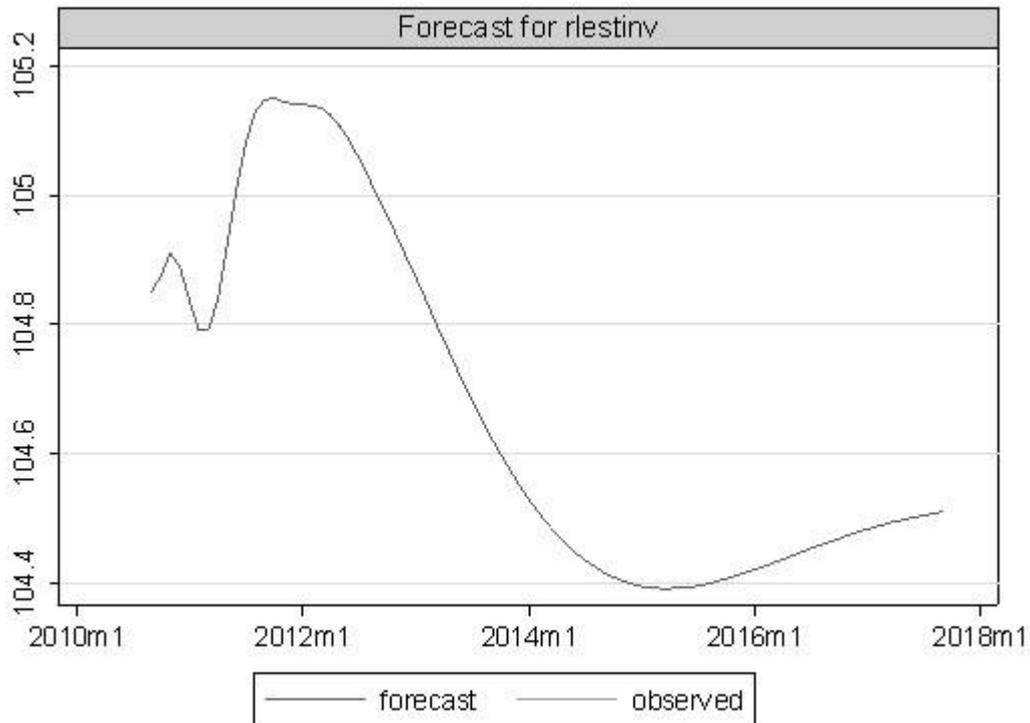
stop sale. Once the action lasted for a while, the capital chain might face tremendous pressure. The developers trapped in the dilemma of decreasing the price or not, investing or not. In regard to regional governments, the revenue would decrease since it relied on land transfer fee. What's more, all of city and town land use tax, housing property tax, farm land occupation tax turned over to local governments. The above might account for 50%-70% fiscal revenue. (Lin. Y. Q, 2010) By implementing the new policy, this part would be impaired a lot. As a result, the construction processes for affordable housing would be affected. Control or not puzzled the officials. Another aspect could not be ignored——banks. Interest rate increase would lead to fewer loans, which seriously affected banks' earnings. Increasing or not interrupted bank executives.

For the uncertainty of future market, the market became ambiguous. Although development was still carried out, as well as increasingly housing price, the growth rate slowdown. The fluctuation and increase of this cycle alternatively performed. At the same time, when over investment, contracted fiscal and monetary policy would inhibit industrial production, such as factors listed in leading indicator. In other words, property investment also influenced leading indicator.

## **5.7 Forecast of the Real Estate Investment in the Following 7 Years**

From previous analysis, we can see that real estate cycle in our country was 6~7 years, so the following 7 years will be predicted. After considering the information in Figure 7, the investment is coming down in early 2011. However, the line is modest increasing in around of 2012. But the figure of climax at this time is much lower than before. As indicated in the graph, the index reveals a trend of steady decrease for the next five years.

**Figure 7 Forecast for Real Estate Investment**



The forecast of next phase almost is keeping with the development of China’s real estate. But we have to explore the deep-seated reasons for future move.

“Technological innovation, energy saving” is the idea of industry in the next five years for China. China is a large country for steel production and consumption. Due to the fast development, over-capacity is a big problem should be relived. (Deng.Q.L, 2010) The total quantity is estimated to be controlled. So did in the cement industry. (Li. X, Song. L. Y, 2009) Allowing for cement running high investment in fixed asset in the past years, and the implementation for low carbon economy, the production in the future will be expected to slow down. At the same time, the output of non ferrous metal will be controlled. Light industry, which is in the period of optimizing and upgrading structure, will face opportunities and challenges. All these are the important component of leading indicator, which indicate a slow growth in economy.

Supply exceeds demand much. Take 2008 for example. The sale area for commercial residential building was 660 million square meters, while the completed area was 665

million square meters and the floor space under construction was 2832 million square meters. (Yearly Book, 2009) Plus previous vacant area, the accumulation will further increase. Different from other commodities, real estate has the characteristics of long-term, high input. For the most ordinary Chinese families, buying a house may cost their life savings. Once they buy, the houses may play an effect for several decades. Even though the commercial real estate, these features also perform significantly. As a result, digestion for the vacant areas will be a long time.

CPI increased 4.9% compared with the same period last year. Price stabilization is the key duty this year. In Feb 9<sup>th</sup> 2011, central bank of China increased the interest rate by 0.25% in order to bring the monetary policy back to normal state. This is the third time for interest rate hike since October last year. The act cannot be ignored in real estate. The hike changed investors' expectation. That is to say, realizing the shift domestic monetary policy and speculated financing conditions, the investors will adjust the speed of development, since the chance of utilizing the bank leverage reduces and the financing cost raises. What's more, hike is a cumulative process. Once the loans cost out of consumers' affordability, the demand will go down sharply. In the light of expectation for the future slow growth, the confidence of entrepreneurs' will go down which will affect their decision. Then supply will react accordingly.

In the newly issued real estate regulation, we can feel the strict the control policy. For the family who buy the second apartment, the down payment should be higher than 60% of the full price, and the loan interest would be 1.1 times higher than the basic interest. It is said that the land supply of affordable housing, shantytown renovation, small and medium size apartment should be more than 70% of the overall quantity. Neither the market level nor the policy supports the situation of continued rise. The interest rate will be added in the first half of this year. Evidences show that real estate investment will steadily decrease although there will be a little peak.

## 6 Summary

As a pillar industry, real estate plays an essential part in our country's development. It promotes economic growth, since it involves dozens of the related industries.

Furthermore, China is in the middle stage of urbanization and industrialization, property supplies people with residential place and employment. However, facing increasingly high housing price and scarce land resources, development comes across bottleneck. Additionally, two large-scale financial crises in the past decades, the banking sector was implicated. Then financing became sufficiently difficult, which may hinder its development. If we can find some clues through the warning system of monitoring macro economy prosperity, real estate investment will follow the healthy direction. So the analysis of these two aspects may be beneficial for mastering their relationships, leading to the property investment flourish and laying down policies.

By using the time-series data of leading indicator and real estate investment between 1991m1 and 2010m9 (Appendix 1), this paper establishes the VAR model showing the dynamic relationship of variables. Through Granger causality test and impulse response function, we research the long-term dynamic equilibrium of the model.

Based on the above VAR discussion, the conclusions are as follows:

Firstly, both of leading indicator and real estate investment are non-stationary time series. But we can find that co-integration exists between them. That is to say, they are in the state of long-term dynamic equilibrium. By investigating the error correction model, we can see how they fluctuate in short term.

Secondly, leading indicator Granger causes real estate investment, which is more obvious since leading indicator is supposed to predict the economic trend including the real estate investment. At the same time, the more interesting point found in this thesis is that real estate investment Granger causes leading indicator. History has

proved that through the wavy development of these two series, they interacted with each other.

Thirdly, the paper forecasts the investment in the following years. According to the previous analysis, the cycle of China last for 6~7 years. Based on our models, in next 7 years, the investment will get to another climax in around 2012. It is estimated that it will go down due to the decreasing leading indicator as well as macro economy control policy. However, the economic development in China depends heavily on government policies which could not be predicted by our models. Therefore, the forecast result could differ a lot with reality if there are big changes of policies of real estate regulation and control.

Last but not least, impulse response function further confirms that leading indicator plays an irreplaceable part in real estate investment. Meanwhile, real estate investment influences itself, which could be explained by bandwagon effect: people's preference for investing properties increases when the number of people investing properties increases.

In the end, we proposed some suggestions based on our analysis to improve the real estate investment conditions from three aspects of government, investment companies and individual investors. Government could control the land supply by changing the style of land provision to monitor real estate investment at root. Investment companies need to react in time according to leading index of warning system and increase the investment risk consciousness at the same time. For individual investors, we should take more responsibility for our investment behaviors and be more rational to invest in real estate.

## 7 Suggestions

In consideration of the key position, real estate investment concerning for people's livelihood and rational decision-making is the inevitable trend in the long run. While in the short run how to guide investment according to the warning system is the practical problem that needs us pay much effort to explore.

First of all, the regional governments have to set up the concept of sustainable development. Economic growth relies on the land transfer excessively. The officials regard the transfer fee as the prime revenue. Land is non-renewable resource. The areas of agricultural acreage were 130.0 million (2001) and 121.7 (2008) respectively. (Yearly Book, 2009) The decreasing rate was 0.9% per year. If we let it go, foodstuff may be a big problem for Chinese people. So the governments should control the land supply. Also, the provision style has to be changed. Auction is the main way at present. However, the highest bidder gets the land which forces the houses' price up. Once it goes out of people's affordability, there will be no market price. As a result, the developers may face the vacant situation. Consequently, we suggest the land should not belong to the highest bidder. When making decision, the governments have to take measures of comprehensive evaluation, the factors of which include development qualification, amount over the past years, quality of the buildings and so on. Effective and efficient control will restrain the hot investment.

In addition, the developers need to react in time according to warning system, and increase the investment risk consciousness. The warning system of macro economy prosperity provides us with signal of overall condition, especially the leading indicator that illustrates the future economy behavior. Real estate investment index explains the current property development. It is better for the developers to make full use of these so that they can avoid risk. Moreover, the entrepreneurs have to adjust the investment plan according the interval of market (super cooling, normal, super hot).

When it is super cooling, selling old buildings and delaying construction are the good chooses. These measures are increasing the cash holdings to prevent trouble before it happens. Super hot as it is, keeping their head is essential for developers. Generally speaking, over-prosperity breeds bubbles. Control policies must be paid attention to so that the strategies can be changed to reduce the risk. Only in this way, the firms may avoid bubble burst leading to capital tied up.

What is more, feasibility analysis of new buildings is essential. Real estate development refers to land, tax, project, marketing, finance as well as unpredictable fees. The financial fees include cost and return, mainly on dynamic analysis, accompanied by statistic study. Researching on the cash flow, internal rate of return and payback period, senior executives can know the appropriate input amount, also the best ratio for shops, residential and office.

The current situation of investing residential property in China is that the majority of residential property investment market is occupied by individual investors, which means a large number of families hold more than one residential property. People buy as many as possible properties to resist high inflation rate and the more significant factor is that prices of residential properties are expected to increase a lot. The behavior disturbs the normal real estate market in terms of two aspects: the housing price is pushed up and vacancy rate increases further. Hence, guiding real estate investment behavior of individual investor is of great important. As individual investors, we also need to have concept of sustainable investment. In order to establish more healthy real estate investment environment, more rationality is required.

## **8 Scope and Limitation of the study**

Insufficient data on public shelters illustrates some shortfalls in this study, which reflects on two aspects. Since China is a large country, the regional disparities of property investment perform significantly, the declining trend from east to west. Also, the proportions for every investment kind are unable to find out. Due to lack of regional and type data, this paper only focuses on overall analysis of China. At the same time, only the period of two decades examined because of the accessibility of the time-series data. Actually, both of data of real estate investment and leading index of macro economy prosperity are available for no more than twenty years in China.

Therefore, the suggestion of the prospective research is to expand the time horizon of data so that more business cycles could be examined to obtain more complete and accurate results and pay much attention to the regional investment to do analysis according to different province. Also, the importance of investment for different property kinds should be attached. Another potential research could focus on comparing the relationship between consumer sentiment and the housing price with quantitative method across different countries.

Appendix 1 The data of leading indicator and real estate investment

Date	Leading Indicator	Real Estate Investment	Date	Leading Indicator	Real Estate Investment
1991m1	101.99	95.42	1994m5	97.26	111.85
1991m2	102.20	88.99	1994m6	98.79	111.40
1991m3	102.74	85.80	1994m7	99.70	111.90
1991m4	103.42	84.48	1994m8	101.25	112.70
1991m5	103.81	83.79	1994m9	100.77	112.77
1991m6	104.26	83.79	1994m10	101.03	112.20
1991m7	104.30	83.92	1994m11	99.32	111.42
1991m8	104.72	84.14	1994m12	99.94	110.55
1991m9	105.45	85.32	1995m1	100.72	108.93
1991m10	106.23	88.09	1995m2	102.57	106.66
1991m11	106.55	93.13	1995m3	102.63	104.74
1991m12	106.52	100.11	1995m4	102.29	103.29
1992m1	106.88	107.72	1995m5	102.08	102.27
1992m2	107.60	114.10	1995m6	100.90	101.63
1992m3	108.44	118.01	1995m7	100.52	101.30
1992m4	109.36	120.30	1995m8	99.60	101.02
1992m5	110.13	121.60	1995m9	99.93	100.85
1992m6	111.31	121.90	1995m10	99.35	101.10
1992m7	112.14	121.57	1995m11	99.89	102.37
1992m8	112.29	120.70	1995m12	99.64	105.19
1992m9	110.95	120.76	1996m1	99.40	109.40
1992m10	109.39	122.78	1996m2	98.83	113.69
1992m11	108.52	126.49	1996m3	98.68	116.95
1992m12	107.24	131.08	1996m4	99.25	118.95
1993m1	107.31	135.06	1996m5	99.99	119.48
1993m2	107.56	136.67	1996m6	99.73	118.38
1993m3	108.16	136.33	1996m7	99.81	116.15
1993m4	107.30	135.67	1996m8	99.73	114.05
1993m5	106.03	135.74	1996m9	100.81	112.96
1993m6	103.80	136.28	1996m10	101.21	112.44
1993m7	102.24	136.95	1996m11	101.45	110.79
1993m8	100.85	138.01	1996m12	101.47	106.78
1993m9	101.24	138.06	1997m1	101.50	101.43
1993m10	101.33	135.21	1997m2	100.93	96.62
1993m11	103.58	129.09	1997m3	100.81	93.23
1993m12	103.33	121.98	1997m4	100.05	91.28
1994m1	101.74	116.74	1997m5	99.68	90.28
1994m2	98.30	114.41	1997m6	100.30	89.79
1994m3	97.16	113.61	1997m7	100.25	89.67
1994m4	97.32	112.88	1997m8	100.53	89.91

Date	Leading Indicator	Real Estate Investment	Date	Leading Indicator	Real Estate Investment
1997m9	99.59	90.20	2000m12	98.56	101.64
1997m10	99.51	90.48	2001m1	98.63	101.34
1997m11	99.33	91.39	2001m2	99.11	101.07
1997m12	99.11	93.08	2001m3	99.62	101.13
1998m1	99.26	95.01	2001m4	99.74	101.66
1998m2	99.20	96.68	2001m5	99.69	102.51
1998m3	99.07	97.71	2001m6	99.73	103.32
1998m4	98.64	97.96	2001m7	100.10	103.88
1998m5	98.01	97.81	2001m8	100.38	104.04
1998m6	97.53	97.81	2001m9	100.32	103.94
1998m7	96.83	98.02	2001m10	100.16	104.06
1998m8	97.01	98.34	2001m11	100.33	104.68
1998m9	97.64	98.70	2001m12	100.70	106.54
1998m10	98.81	99.05	2002m1	100.73	105.65
1998m11	98.72	99.45	2002m2	100.76	104.43
1998m12	99.20	100.13	2002m3	100.67	107.29
1999m1	99.18	101.05	2002m4	100.71	107.89
1999m2	100.33	101.73	2002m5	100.82	107.60
1999m3	100.19	101.80	2002m6	101.03	106.88
1999m4	100.89	101.46	2002m7	101.20	106.50
1999m5	101.31	101.11	2002m8	101.52	106.42
1999m6	101.20	100.95	2002m9	101.65	106.24
1999m7	101.36	100.84	2002m10	101.95	106.33
1999m8	100.46	100.67	2002m11	101.37	105.87
1999m9	99.80	100.38	2002m12	101.58	105.68
1999m10	99.06	99.83	2003m1	101.87	104.69
1999m11	99.85	99.00	2003m2	102.19	106.42
1999m12	100.63	98.13	2003m3	101.31	107.15
2000m1	101.16	97.58	2003m4	100.45	107.07
2000m2	100.93	97.58	2003m5	100.53	106.83
2000m3	100.98	98.06	2003m6	101.16	107.26
2000m4	100.39	98.80	2003m7	101.99	107.37
2000m5	100.03	99.50	2003m8	102.02	107.21
2000m6	100.16	100.13	2003m9	102.37	107.03
2000m7	100.20	100.72	2003m10	102.39	106.70
2000m8	100.34	101.18	2003m11	102.56	106.87
2000m9	99.88	101.46	2003m12	102.68	107.11
2000m10	99.61	101.63	2004m1	102.39	110.89
2000m11	98.89	101.72	2004m2	102.52	110.07

Date	Leading Indicator	Real Estate Investment	Date	Leading Indicator	Real Estate Investment
2004m3	102.37	108.28	2007m7	104.18	103.41
2004m4	102.32	107.15	2007m8	104.14	103.72
2004m5	101.64	106.53	2007m9	103.94	104.07
2004m6	101.08	105.98	2007m10	103.57	104.42
2004m7	100.84	106.06	2007m11	102.70	104.53
2004m8	100.88	106.16	2007m12	101.90	104.46
2004m9	100.71	106.08	2008m1	101.90	105.07
2004m10	100.76	106.22	2008m2	102.50	104.83
2004m11	100.68	106.24	2008m3	102.70	104.48
2004m12	100.99	107.10	2008m4	102.40	104.28
2005m1	101.22	101.05	2008m5	102.10	104.08
2005m2	101.49	100.00	2008m6	101.60	104.79
2005m3	101.83	99.08	2008m7	101.00	104.77
2005m4	102.24	100.17	2008m8	100.00	104.40
2005m5	102.60	101.09	2008m9	98.80	103.22
2005m6	102.59	101.11	2008m10	97.50	101.94
2005m7	102.47	101.60	2008m11	97.40	100.98
2005m8	102.40	101.69	2008m12	98.00	99.66
2005m9	102.30	101.72	2009m1	98.60	
2005m10	102.00	101.24	2009m2	99.10	91.88
2005m11	102.05	100.29	2009m3	100.00	92.00
2005m12	102.21	100.03	2009m4	101.10	91.20
2006m1	102.66	100.18	2009m5	102.10	93.13
2006m2	102.87	100.72	2009m6	102.70	93.60
2006m3	102.82	101.63	2009m7	103.20	96.28
2006m4	102.53	100.13	2009m8	104.20	97.75
2006m5	102.31	100.09	2009m9	105.00	100.01
2006m6	102.04	100.68	2009m10	105.80	100.49
2006m7	101.89	101.52	2009m11	105.40	100.60
2006m8	101.98	101.66	2009m12	105.50	100.42
2006m9	102.27	101.72	2010m1	104.70	
2006m10	102.49	101.68	2010m2	105.20	101.83
2006m11	102.52	101.46	2010m3	104.50	103.58
2006m12	103.00	101.00	2010m4	104.20	104.94
2007m1	102.96	101.42	2010m5	103.30	105.56
2007m2	102.81	101.44	2010m6	102.60	105.50
2007m3	102.53	101.47	2010m7	102.10	105.23
2007m4	103.07	102.17	2010m8	101.60	104.89
2007m5	103.54	102.37	2010m9	101.40	104.85
2007m6	103.94	102.85			

Source: Leading indicator from [http://www.stats.gov.cn/was40/gjtjj\\_outline.jsp](http://www.stats.gov.cn/was40/gjtjj_outline.jsp)

Real estate investment from <http://mac.hexun.com/Default.shtml?id=B405>

## References:

- Arrondel.L (2001) Consumption and Investment Motives in Housing Wealth Accumulation: A French Study, *Journal of Urban Economics*, 50, 112-137
- Cao. J. F, L. L, (2008) The Comparative Analysis of Asian Financial Crises and American Subprime Crises for China's Economy, *Journal of Yunnan Finance and Economics University*, 23 (5), pp. 39-41
- China Statistic Bureau (2009), Yearly Book, *China Statistic Press*
- Chen.B.G (2010), The Contradictions and Coordination for the Real Estate Market and Macroeconomic Control, *E-House Analysis*, 10
- Chen. R. L, (2009) Macro-Control Policy and its Impact on Real Estate in China, *Journal of Changjiang Engineering Vocational College*, 26 (3), pp. 54-56
- Deng.Q.L, ( 2010) Enhancing the Core Competitiveness of the Steel Industry, *Qiushi*, 21, pp. 44-46
- Eichholtz.P, Koedijk. K, Schweitzer.M, (2001) Global Property Investment and the Costs of International Diversification, *Journal of International Money and Finance*, 20, 349-366
- Eves, C. and Wills, P. (2003). The true cost and performance of individual residential property investment and the implication on real estate agency practice. *In: Pacific Rim Real Estate Society 9th Annual Conference*, 19-22 January 2003, Brisbane, Australia. (Unpublished)
- Feng.L, Gong.Y.L, (2002) The Several Index for China's Real Estate, *China Real*

*Estate*, 4, 25-27

Granger. C. W. J (1969), Investigating Causal Relations by Econometric Models and Cross-spectral Methods, *Econometrica*, Vol. 37, No. 3, pp. 424-438

Gujarati (2004), Basic Econometrics 4th Economy Edition, *Tata McGraw Hill*

Hannan, E. J., and B. G. Quinn (1979), The Determination of the Order of an Autoregression, *Journal of the Royal Statistical Society*, B, 41, 190-195.

Hasan.M.S, Taghavi.M, (2002) Residential Investment, Macroeconomic Activity and Financial Deregulation in the UK: an Empirical Investigation, *Journal of Economics and Business*, 54, 447–462

Hill, R. C, Griffiths, E. W & Lim, G. C (2008), Principles of Econometrics, *Third Edition*

Hirotsugu Akaike (1970). Statistical Predictor Identification, *Ann. Inst. Statist. Math.*, 22:203–217. ISSN 0020-3157.

Hwee.W.T.Y, Addae-Dapaah.K, (2009) The Unsung Impact of Currency Risk on the Performance of International Real Property Investment, *Review of Financial Economics*, 18, 56–65

Li. X, Song. L. Y, (2009) Excess Capacity of Cement Cannot be Ignored, *China Building Materials*, 9, pp. 30-32

Lin. Y. Q (2010), Unruled Housing Price and Government Control, *Macro Economy Analysis*, 5, 27-35

- Liu. W (2005), The Problem on China's Economic Growth and Micro-Control, *Finance and Economy*, 8, 3-7
- Niu. R. B and He. B (2002), The Reason and Suggestion of Real Estate Bubble, *Journal of Jinan University*, 12 (5), 64-66
- Qin. S and He. L (2010), The Impact of Foreign Hot Money on Real Estate Market of China, *Economy and Management*, 24 (1), 89-91
- Sheng.C.M, Fang.Z.D (1999) Property Investment in China during the Changing Economic System, *Property Management*, 17(3), 1999, 262-270
- Wang.M, Tang.X.F, (2000) The Relationship between Real Estate Investment Fluctuation and Economic Cycle, *Journal of Sichuan University*, 3, 40-43
- Wu.S (2010) China's Real Estate investment and Economic growth in of the quantitative analysis, *Technology Economy and Management Study*, 1, 22-25
- Wooldridge.J.M, (2005) Econometric introduction, third edition, *South-Western College Pub*
- Xie. J. B, Wang. B. H (2007), The Warning System of Monitoring Macro Economy Prosperity in China, *Statistics and Decision-Making*, No. 4, pp. 122-124
- Yuan. Z. X, (2010) The Coordination between China's Fiscal Policy and Monetary Policy during the Latest Two Financial Crises, *South Financial*, 6, pp. 31-34
- Zhang.X.J and Sun.T (2006) China's Property Cycles and Financial Stability, *Economic Analysis*, 1, 23-33

Zhou. X. Y, (2009) The Positive Analysis for China's Real Estate Cycle, *Study and Explore*, 3, pp.134-136

Zhou. Z., (1997) Forecasting Sales and Price for Existing Single-Family Homes: A VAR Model with Error Correction, *Journal of Real Estate Research*, 14, 155-167.

Zhu.J.M, Sim.L.L, Zhang.X.Q, (2006) Global Real Estate Investments and Local Cultural Capital in the Making of Shanghai's New Office Locations, *Habitat International*, 30, 462-481