Is There a Bubble in the Residential market?
Empirical Data from Tianjin

Peiyao Chen[1,a,*]

[1]School of Economics and Management, Beijing Jiaotong University, Beijing 100044, China

[a]chenpeiyao_17@163.com

*Corresponding author

Keywords: Real estate bubble, Principal component analysis, Comprehensive index system.

Abstract. In order to make a scientific judgement of the bubble level of residential property, the data from Tianjin is taken as an example to make a detailed analysis. From 2000 to 2015, nine indicators of residential property market in Tianjin were selected to analyze one by one, and a comprehensive evaluation system was established. Using the PCA-LINMAP coupling model, the principal component is extracted and the principal component synthesis index is formed. Then the weight of each index is determined by using the LINMAP model. Finally, the bubble measure is completed through weighted calculation. From the comprehensive index system, we can see that the bubble in Tianjin's housing market is unstable, which is greatly influenced by the level of investment and capital investment.

1. Introduction

In recent years, the real estate industry has developed rapidly, and the house price has been rising constantly. Because real estate is closely related to the scarce resource of land as the material base of national economic development, it lacks flexibility in supply, so it is easy for the real estate industry to produce bubbles that deviate from value. At the same time, as a pillar industry of national economic development, the real estate industry is closely related to the upstream and downstream industries and has a strong driving role. Therefore, when the real estate bubble expands to the extent that the national economy is unbearable, it will burst, causing severe economic turbulence or even collapse, seriously affecting social stability and national security. Therefore, it is very necessary to measure the degree of real estate bubble.

2. Measuring method of real estate bubble

2.1 The Basis of Method Selection

In this paper, we choose index method to build an index comprehensive analysis system, and describe the bubble level of Tianjin's housing market. According to the availability of indicators, nine dimensions of indicators are determined, and the critical value of indicators is determined. Using PCA-LINMAP coupling model, the principal component analysis of Tianjin residential market data over the years was carried out, and the composite index of principal component was obtained. Using the composite index to sort the data samples during the study period, we have ordinal pairs, and then use the LINMAP sub model to measure the weights, so as to complete the measurement of the bubble level of the housing market.

2.2 LINMAP sub-model

The normalized decision matrix is $(y_{ij})_{n*p}$, assuming that the sample of the decision maker's optimal preference is expressed as $(y_1^*, y_2^*, \ldots, y_p^*)$ in space, and the square of the Euclidean distance from any point in space to the optimal decision point is $S_i = \sum_{j=1}^{p} w_j (y_{ij} - y_j^*)^2, i = 1,2,\ldots,n$, where $w_j(j=1,2,3,\ldots,p)$ is the square of the weight of the index J, which is the result required for this model. According to the formula, the following constraint model can be obtained.

$$\min \sum_{(k,l)\in Q} \lambda_{kl} \begin{cases} \sum_{j=1}^{p} W_j\left(y_{lj}^2 - y_{kj}^2\right) - 2\sum_{j=1}^{p} V_J\left(y_{lj} - y_{kj}\right) + \lambda_{kl} \geq 0 \\ \sum_{j=1}^{p} W_j \sum_{(k,l)\in Q}\left(y_{lj}^2 - y_{kj}^2\right) - 2\sum_{j=1}^{p} V_J\left(y_{lj} - y_{kj}\right) = h \\ W_j > 0, \quad j = 1,2,\ldots,P \\ \lambda_{kl} \geq 0, \quad \text{for all } (k,l) \in Q \\ V_J \text{without non} - \text{negative restriction } \left(V_j = W_j y_j^*\right) \end{cases}$$

Among them, $\lambda_{kj}=\max\{0,(S_k-S_t)\}$ and Q are orderly sets of (k,l) samples, and Q={(k, l)|k samples are better than l samples}.

3. An empirical analysis of the bubble level of Tianjin's housing market

Because of the heterogeneity of the real estate market, it is more practical to choose a single city to measure the results. This paper analyzes the housing market in Tianjin and measures the bubble level in the market. Considering the comparability and availability of data, the research interval of data is selected from 2000 to 2015.

3.1 Indicator Selection and Description

The real estate bubble is a manifestation of the imbalance between supply and demand in the real estate market. Due to the lack of flexibility in the supply of real estate, the adjustment of supply is lagging behind, so it's easy to generate bubbles. Therefore, we can choose indicators from two aspects of supply and demand, and construct an index system.

3.1.1 Supply indicators

From the supply of the housing market, that is, the development process of the real estate market to monitor the indicators. This paper chooses investment in housing development/investment in social fixed assets (X_1), investment growth rate in housing development/GDP growth rate (X_2), investment in housing development/GDP (X_3), the growth rate of housing price/GDP (X_4) to measure the housing market from the perspective of supply.

The proportion of residential development investment in social fixed assets investment (X_1) reflects whether the structure of social fixed assets investment is reasonable, and reflects the stability and persistence of the real estate industry. When the ratio is too large, too much capital into real estate also occupies the funds for construction and development of other industries, which is not conducive to the long-term development of the national economy. When the index is 7%, it is more reasonable, and when more than 20%, there is a bubble. The index of Tianjin has exceeded 7% since 2000 and reached 14.57% in 2006. Thus, the investment in housing accounts for a large proportion in the national economy as a whole, but it still operates within the normal range.

The ratio of residential development investment to GDP (X_3) mainly reflects whether the investment is overheated or not, and reflects the expectation of future house prices and the rationality of investment structure in various industries. When the ratio of investment in real estate development to GDP is below 6.5%, which is larger than 10% in the market. Since 2000, the index of Tianjin has shown an overall upward trend, and in 2006 it exceeded 6.5% and in 2015 it exceeded 7.5%. In recent years, investment enthusiasm has gradually increased.

3.1.2 Demand indicators

Demand indicators monitor the real demand of the housing market from the perspective of demand in the market. This paper measures the housing market from the perspective of supply by choosing five indicators: house price-income ratio (X_5), residential sales/investment in residential development (X_6), growth rate of residential sales/growth rate of retail sales of social commodities (X_7), growth rate of residential prices/CPI (X_8), and growth rate of house prices (X_9).

Housing price income (X_5) reflects the ability of residents to pay for housing. The World Bank defines it as the ratio of the selling price of a single house to the average annual household income. The reasonable range of house price-income ratio is 3-6 times. From the data of Tianjin, it can be

seen that the ratio of the index has gradually increased, and it has exceeded six times by 2004. The ratio of housing price to income has not changed much in each year since 2009.

The housing growth rate (X_9) can reflect the change of housing prices in most years. When the price growth rate exceeds 10%, it is generally recognized as a bubble in the real estate market. The housing price in Tianjin has increased rapidly since 2003, and exceeded 10% in 2004. It has a certain degree of bubble and reached a high rate of 35% in 2005. Affected by the global economic crisis in 2008, the growth rate of housing prices has slowed down, but still maintained an upward trend. Housing prices rose further after a brief decline in 2012 and again exceeded 10% in 2015, with a further upward trend.

3.2 Comprehensive Analysis of Indicators

3.2.1 Principal factor analysis

According to the analysis of the index above, we set up an index system to measure the bubble level of Tianjin's housing market. SPSS22.0 was used for dimension reduction and principal component analysis, and three main components were extracted. The operation results were shown in Table 1. The initial factor load matrix is obtained, as shown in Table 2.

Table 1. Principal Component Extraction and Analysis Table

Component	Sum of squares		
	Total	Variance (%)	Accumulate (%)
Y_1	3.313	36.815	36.815
Y_2	2.249	24.993	61.808
Y_3	1.592	17.685	79.493

Table 2. Initial Factor Load Matrix

Index	Component			Index	Component		
	1	2	3		1	2	3
X_1	-0.003	0.513	0.776	X_6	0.782	0.189	-0.068
X_2	0.597	-0.707	-0.003	X_7	0.449	0.567	-0.399
X_3	0.223	-0.694	0.624	X_8	0.646	0.038	0.528
X_4	0.780	0.168	-0.034	X_9	0.792	0.520	0.054
X_5	0.664	-0.590	-0.391				

Using the initial factor load matrix, dividing the value of Table 2 by the arithmetic square root of the corresponding principal component eigenvalues, the coefficients between the indices and the corresponding principal components can be obtained. The weighted sum of three principal component eigenvalues is used to get the principal component analysis synthesis model.

$$Y = \frac{\lambda_1}{\lambda_1 + \lambda_2 + \lambda_3} Y_1 + \frac{\lambda_2}{\lambda_1 + \lambda_2 + \lambda_3} Y_2 + \frac{\lambda_3}{\lambda_1 + \lambda_2 + \lambda_3} Y_3$$

The principal component function expression is introduced into the principal component synthesis model, and the function expression of the synthesis model is obtained. $Y = 0.244X_1 + 0.003X_2 + 0.021X_3 + 0.228X_4 - 0.024X_5 + 0.227X_6 + 0.163X_7 + 0.265X_8 + 0.320X_9$

3.2.2 Multidimensional Preference Linear Programming

According to the function expression obtained by principal component analysis, the initial calendar year index measure values are brought into the function respectively, the principal component Y_i of each year is obtained, and the sum of Y is obtained, and the ranking is made according to the size of Y of each year. An ordered pair set Q is constructed as the constraint condition according to the ranking, and the initial nine measures are brought into the LINMAP model. According to the model, the weights are first planned and the average direction is $W_{1\sim j}$.

$$W_{1\sim j} = (0.1571, 0.0602, 1.3332, 1.3762, 7.8863, 2.1460, 8.1050, 23.4350, 0.3515)^T$$

After normalizing $W_{1\sim j}$, the weight of each index in the comprehensive index system is obtained. The initial index measurement value, critical value and weight are substituted into the formula to get the standard measure value and comprehensive measure value of the bubble index in the residential market. Compared with standard measured values, the foam trend of Tianjin residential market is shown in Fig. 1.
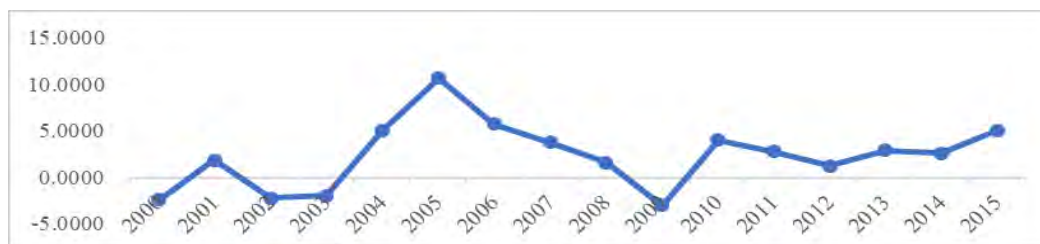
Fig. 1 The trend of the bubble degree in the residential market in Tianjin

4. Analysis and conclusion

After a comprehensive analysis of the bubble index of housing market, we can see that since the demand for housing for residents has been released after the real estate reform, a large amount of capital has entered the residential market in the 2003 place, which has continued to push up housing prices and made speculators enter the market. However, due to the unsound market system, the bubble in the residential market began to drastically expand, and the bubble began to decrease gradually in 2005. After the outbreak of the global financial crisis, the housing market bubble plummeted in 2009. At the same time, due to the introduction of a series of positive measures such as lowering down payment and letting go of the control of two suites, the price has been rising and maintaining stability. The bubble level has been kept at around 2. In 2015, the bubble rose to over 5, the market overheated and the bubble continued to expand.

From the above analysis, we can see that the change of real estate bubble is closely related to the investment direction and policy orientation of social capital. When the bubble continues to expand, it will play a negative role in economic and social development and stability. Combined with the trend of increasing bubble in Tianjin's housing market, we should be vigilant and monitor the change of bubble level and take corresponding policies and measures to control it.

References

[1] Tianyuan Ying. A new weighting method for systematic comprehensive evaluation -PC-LINMAP coupling model. *System Engineering Theory and Practice*. vol.2, pp.8-13, 1997.

[2] Yanxia Wu, Nan Wang. Research on the causes of real estate bubbles and the measurement of their speculative degree. *Forecast*. vol.2, pp.12-17, 2006.

[3] Yang Ge, Chong Chen. The relationship between supply structure and price bubbles in China's real estate marketl. *China's Economic Problems*, vol.2, pp.86-96, 2011.

[4] Ewald, W. The Burst of the Real Estate Bubble-More Than a Trigger for the Financial Market Crisis. *WIFO Journal Quarterly*, vol.1, pp.86-93, 2010.

[5] Craig, A. DIL, Harris H., Steve S. Flips, flops and foreclosures: anatomy of a real estate bubble. *Journal of Financial Economic Policy*, vol.3, pp.49-65, 2011.

[6] Bertrand, R. Real estate bubble and financial crisis in Dubai: Dynamics and policy responses. *American Real Estate Society*, vol.11, pp.51-77, 2012.

[7] Eleanor X., Tao C. The effect of monetary policy on real estate price growth in China. *Pacific-Basin Finance Journal*, vol.11, pp.62-77, 2012.

[8] Dai Fu, Measurement of real estate market bubble and construction of early warning index system. *Statistics and Decision-making*, vol.19, pp.65-67, 2015.