



An Empirical Analysis of the Impact of Urban Land Reserve System on Housing Prices Based on Network Open Big Data With Wuhan City Taken as an Example

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Abstract. In this paper, with the open network big data taken as a research basis and Wuhan City as a subject for empirical research, the authors select a variety of influencing factors including regional GDP, total population of the region, the per capita disposable income of residents, the per capita consumption expenditure of residents, the sales area of commercial housing and the total investment of real estate development, adopt BP artificial neural network method to forecast the real estate economy and try to demonstrate the impact of urban land reserve system on housing prices.

Keywords: Urban Land Reserve System · Housing Prices · Open Network Big Data · Wuhan City

1 Introduction

Richard P. Fishman (1975) of the United States held the belief that land reserve is a system where the government obtained land for future development and control the development scale and direction of the city. The government manages to avoid premature development by acquiring or leasing in the process of urban development. Harold B. Dunkerley (1983) of the United Kingdom believed that land reserve refers to a series of control measures where the government acquires a considerable area of land in advance before it is needed and finally releases for development consistent with the plan to ensure the effective implementation of the plan and guide the rational development [1].

Sylvan Kamm (1975) of the United States argued that land reserve was a large-scale land acquisition, management and supply plan, which had a substantial impact on urban development patterns and land prices.

1.1 Research Progress at Home and Abroad

At present, a lot of researches on land reserve at home and abroad are conducted mainly about the significance and functions of land reserve system and most scholars believe that land reserve has various functions such as promoting the orderly development of

cities, reducing housing prices, stabilizing land prices, restraining land speculation and improving the quality of urban ecological environment (Chris, Stewart and Martin 1998). In addition to related theoretical studies that are mentioned above, some scholars have also conducted researches on the scale of land reserves and decision-making models [2]. In China, there is also researches focusing on risks of land reserve. On the issue of risks of land reserve, there are not many scholars who have done researches on land reserve risks although foreign researches on land reserves started earlier than China [3]. The reasons are listed as follows. First, laws in foreign countries are more complete than those in China. As a developing country, China has still been in the stage of exploration on many issues and many policies are frequently changed, while policy risks are much smaller in foreign countries, because there have long been land reserve laws and regulations in European and American countries; Second, funds of land reserve are basically undertaken by the government, and related work is basically completed by the government, with less private participation [5]; Third, since the land reserve has been basically completed by the government in foreign countries, the land reserve is relatively stable and therefore the correlation between land reserve risks and other industry risks is low [3].

China's land reserve system was established later than that in western developed countries, which is far from mature in terms of theories, and there is a lack of unified laws and regulations for guidance, so China lacks experience in risk control of land reserves. Therefore, researchers conducted by Chinese scholars on land reserve risks mainly focus on two aspects, risk identification and risk control [4].

2 Research Progress at Home and Abroad

2.1 Real Estate Bubbles and Land Reserve Risks

Real estate bubble is a kind of economic bubbles. In economics, bubbles refer to a phenomenon in which people inflate the value of a commodity or company to maddening levels, until people feel panic and rush to sell, causing a collapse in prices. However, the land reserve agency has both the characteristics of enterprises and the functions of government agency. On the one hand, it tries to monopolize the primary market of urban land, thus exercising the macro-control function of the local government in the land market and preventing the real estate market from overheating and recession (of course, functions such as helping state-owned enterprises out and sharing the worries of the government); on the other hand, the land reserve is responsible for one's own profit and loss in actual operation, and most profits from the two lines of fiscal revenue and expenditure are obtained by local finance. However, once a possible financial risk arise, local finance does not have enough capacity and incentives to fund the land reserve center. Therefore, the land reserve center is facing greater financial risks in terms of capital operation.

2.2 Real Estate Economy and Macro-economy

According to researches of many scholars, cyclical fluctuations do exist in real estate, which means that it will periodically show four links from prosperity, recession, depression, and recovery. Such cyclical fluctuations usually have a strong correlation with the

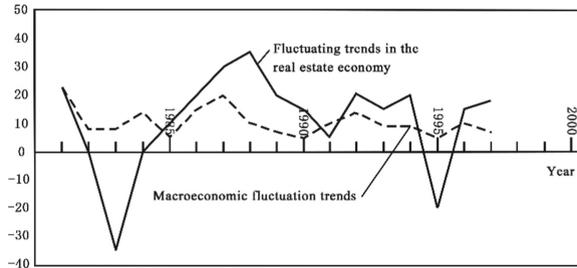


Fig. 1. Real estate economy and macroeconomic fluctuations in Hong Kong. Photo credit: Original

macro economy. Taking Hong Kong as an example, since the end of World War II, the real estate industry in Hong Kong has experienced 8 cyclical fluctuations, with obvious fluctuations, of which the shortest one is 6 to 7 years, the longest one is 9 to 10 years and the real estate cycle experiences fluctuation once every 8 to 9 years on average. In addition, each cycle shows an increase in the first 4 to 5 years and a decrease in the last 3 to 4 years. By comparing the real estate cycle with the macroeconomic cycle, it can be seen that the real estate cycle and the macroeconomic cycle basically tend to be synchronized in time. Sometimes the real estate cycle is slightly ahead of the macroeconomic cycle, but the volatility of real estate is significantly larger than that of the macro economy (Fig. 1).

It can be seen from this example that there is a strong correlation between the real estate economy and macroeconomic index. Therefore, by analyzing and forecasting the macroeconomic index, it is possible to forecast and analyze the real estate economy to a certain extent in order to provide a reference basis for land reserve decisions and reduce land reserve risks.

3 Real Estate Forecasting Model Based on Macroeconomic Index

Forecast refers to making statistical analysis based on the observable historical data, generating a model on this basis, describing the law and characteristics of data changes, connecting the past and present characteristics of the research target through the model and eventually extrapolating the observable historical data.

In this study, the BP artificial neural network method is planned to be adopted to forecast the real estate economy, which is a kind of black box model. The black-box model comes with a clear functional relationship and therefore is more in line with the operating laws of the real estate market. The irregularity and non-linearity of the real estate market make the black-box model a more suitable option. However, the disadvantages of this method is that it is difficult to control the design of the hidden layer, which usually needs to be determined after many attempts, with large difficulty in the debugging. Common black-box models include fuzzy judgment models, neural network models and so on. Artificial Neural Networks (ANNs for short) is a kind of neural network imitating the behavioral characteristics of biological brains, which has strong self-learning ability, can grasp the potential laws between data through a batch

of input and corresponding output provided to the network in advance and predict the output result through the new input according to these rules. Such an analysis process is called training. For a trained neural network, when only one new input information is given, the network can recognize and calculate the new information according to the existing knowledge, and give the learning result.

4 Selection of Model Index Factor and Experimental Process

The selection of experimental data has a great impact on the results of forecast by the network model, so the sample data selected should reflect the changing rules of housing prices as truly and objectively as possible. The factors affecting house prices selected should not only be reasonable, but also representative. In this study in which Wuhan City is taken as an example, six affecting factors of housing prices that are easy to quantify are selected, including regional GDP, total regional population, per capita disposable income of residents, per capita consumption expenditure of residents, sales area of commercial housing and total investment in real estate development (Table 1).

According to the forecast models of real estate prices in many papers, the time delay for the action of factors affecting house prices is set to two years, that is to say when designing the input and output of the network model, the data of affecting factor of previous two years should be used as the input data, while the year after these 2 years, that is, the house price data of the 3rd year, should be used as output data.

The number of neurons at the input layer of the BP neural network model is set to 12, while the number of neurons at the output layer is 1. Then, input the affecting factor data of 2003 and 2004 to forecast the house price in 2005, and similarly input the affecting

Table 1. The housing price data is comprehensively taken from a number of papers, and the rest of data comes from the “Wuhan Statistical Yearbook” (Data source) photo credit: Original

Year	permanent population/Million	per capita disposable income of urban residents/Yuan	GDP/ten thousand yuan	Residential sales area/10,000 square meters	real estate development investment/billion	Resident per capita consumption expenditure/yuan	Average price of commercial housing (yuan/square meter)
2003	812	8524.52	1622.18	512.13	169.5	7251.36	2020
2004	825	9564.05	1882.24	562.18	233.3	7792.63	2460
2005	838	10849.72	2261.17	613.91	297.99	8234.48	2986
2006	850	12360	2679.33	908.92	366.15	9182.04	3851
2007	858	14357.64	3209.47	1069.89	459.75	10600	4412
2008	897	16712.44	4115.51	683.24	570.36	11432.97	5405
2009	910	18385.02	4620.86	1041.39	778.59	12710.29	5256
2010	979	20806.32	5565.93	1091.49	1017.4	14490.07	6213
2011	1002	23738	6762.2	1323.51	1274.17	17140.96	6411
2012	1012	27061	8003.82	1576.11	1574.86	18813.14	6366
2013	1022	29821	9051.27	1750.43	1905.6	20157.32	6848
2014	1033.8	33270	10069.48	1978.96	2353.63	22002.22	7396
2015	1060.7	36436	10905.6	2413.77	2581.79	23943.05	8579

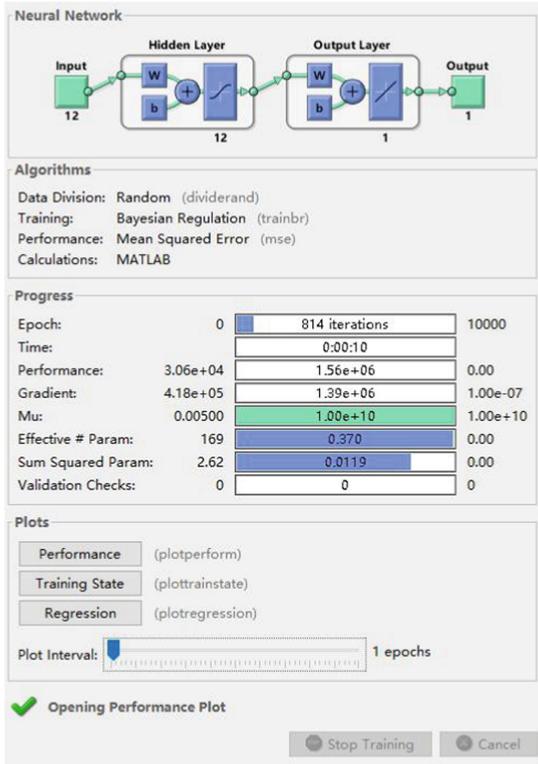


Fig. 2. Screenshots of the experimental process. Photo credit: Original

Sigmoid tangent function tansig is put to use as the transfer function of the hidden layer, while the transfer function of the output layer is a purelin function (Fig. 2).

The nodes of hidden layer of the BP neural network are usually determined by trial and error. To be specific, it is possible to first train the network by setting fewer hidden layer nodes, then gradually increase the number of nodes of the hidden layer, use the same sample set for training and finally select the corresponding hidden layer nodes in time of the smallest network error. In experiments, a rough estimated value is often obtained as the initial value according to the empirical formula and then the optimal nodes is determined by trial and error. According to tests, under the premise of the smallest average error, the number of hidden nodes finally adopted is 12.

The resulting forecast values are shown in the chart below. It can be seen that the error gradually becomes larger with the change of years, so this method can be adopted to forecast housing prices through macroeconomic data in recent years (Figs. 3, 4 and Table 3).

Table 3. Experimental table (photo credit: Original)

	Actual Value	Forecast Value	absolute error	relative error
2013	6848	6847.999985	-0.000	0.00%
2014	7396	7269.453591	-126.546	-1.71%
2015	8579	7595.846959	-983.153	-11.46%

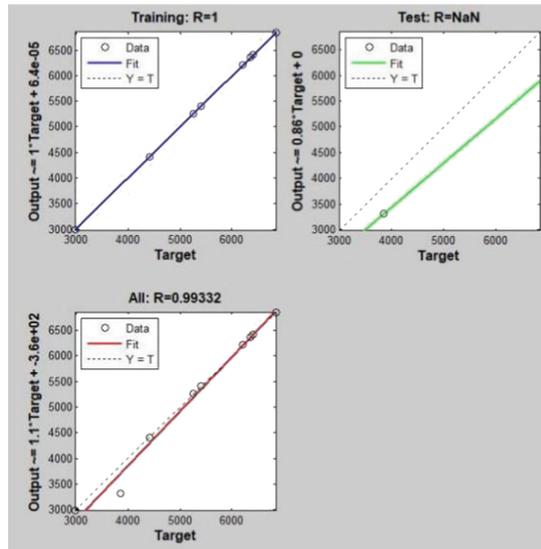


Fig. 3. Screenshots of the experimental process. Photo credit: Original

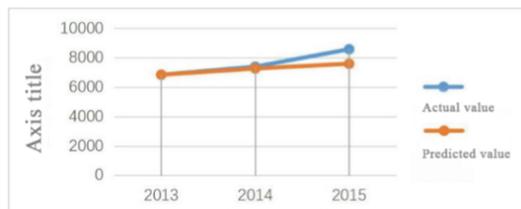


Fig. 4. Comparison between predicted value and actual value of model house price. Photo credit: Original

5 Conclusions

Similar to the macro economy, the real estate industry also has fluctuations, which is related not only to the macroeconomic environment, but also many factors such as human behaviors, expectations, and decision-making. Most of these factors are random and thus leads to the nonlinear fluctuation characteristics in the development of real

estate industry. In addition, China's real estate market is still at the immature stage with certain incomplete data, which is mainly because of the backwardness of statistics in the current real estate industry and the imperfect indicator system. Since statistical data cannot fully and truly reflect the real development of the real estate market, it cannot provide long-term, effective raw data for real estate forecasting [5].

From the above researches, it can be known that it is possible to forecast the trend of housing prices in the coming year to a certain extent based on macroeconomic indicators, but it can only be used for forecast recent years [6]. The error will gradually increase as time goes on. In addition, since the source of the data source cannot be guaranteed, even official statistics may be inconsistent due to different statistical calibers, it is possible to make a general macro judgment, without accurate forecast of skyrocketing and slumping of housing prices caused by unexpected factors.

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