The Review on Non-linear Analysis and Forecasting

Methods of the Real Estate Market in China

Chongjun Fan (Corresponding author)

Business School, University of Shanghai for Science and Technology, Shanghai 200093, China

E-mail: cjfan@sh163.net

Hui Xu

Business School, University of Shanghai for Science and Technology, Shanghai 200093, China

E-mail: xuyuqinxuhui@163.com

Abstract

The real estate market is a complex system .The scientific analysis and forecast are the premise of making correct decision .This paper gives a review of the research and application on the non-linear quantitative analysis and the forecast methods of the real estate market. Especially, its development during the recent years in China is discussed. It is in hopes of providing references to the researchers on this aspect.

Keywords: Real Estate, Nonlinear economics, Data analysis, Economic forecasting

1. Introduction

The real estate industry is an important industry for the development of the national economy, whose healthy development plays an important role on stimulating the economic growth, adjusting the industrial structure, and improving the peoples' living standards. In recent years, the trend of the real estate price receives attention from every walks of life.

The scientific analysis and forecast are the premise of making correct decision. The real estate market is a complex system, which is not only influenced by macroscopic environment such as politics, economy and so on, but also is related to many factors such as person's behavior, psychology, policy-making and so on .

The analysis and predict of the real estate market data is virtually to establish suitable mathematical model and to use it. The real estate system is an unstable stochastic process. When we analyze and the forecast the real estate market, many data show the remarkable nonlinear characteristic. It is very difficult to establish the simple linear mathematics relationship for this kind of time series data, which has brought lots of difficulties for the real estate price's analysis and the forecast. Therefore, when we analyze and forecast the real estate market data, we need to establish the nonlinear model which can well fit the data characteristic. It is an urgent demand for the current real estate industry development to research and apply the method of the analysis and forecast the real estate market. Thus, this paper introduces some methods which are used in the real estate market analysis and forecast recently that is in hopes of providing references to the researchers on this aspect.

2. Real estate market quantitative analysis and forecast method

Presently, there are some research and the application on nonlinear complex system's analysis and forecast methods in China and other countries. These methods are the nonlinear regression, the neural network, the grey theory, the wavelet arithmetic, the Bayesian method, the misalignment time series and the stochastic process, the misalignment dynamic model and so on. They had the preliminary application, and had made certain progress.

Now narrate them below according to the method classification.

2.1 Neural network model

It had been several dozens years since the proposal of the neural network. Its research experienced a devious process from the prosperous development to fall into the trough and grows strong again. At present the neural network method is already accepted and applied by the numerous research workers .It becomes one of the important ways to solve

complex problem.

Many scholars use the neural network model to analyze the real estate market. Lan Guoliang (2003) used the artificial neural networks model to forecast the housing sales rate. A.Quang Do and Grudnitski and Gary (1992) has made the analysis to the housing property situation by using the neural network, and pointed out that to this kind of nonlinear unstable system's analysis such as the housing property, the neural network model is one kind of better choice.

Hu Zhangming (2006) has forecast and researched on the real estate price index by using the BP neural network and the RBP neural network, and has explained the RBF neural network and the BP neural network can approach any nonlinear function by the random precision. Owing to difference of using the excitation function and the training arithmetic, their capability of approaching the performance are also different. The BP neural network uses the Sigmoid function. It has the overall characteristic. Each node has the influence the export value in very wide range of the input value, and excitation function mutual influence in very wide range of input value. Therefore, the BP neural network's training consumes more time; moreover, it is very easy to fall into the local minimum trap.

What the RBF neural network uses is the partial excitation function, which has overcome some BP network's flaws to a great extent. It is not that each node has the non-zero value to each input value, but often only very few several nodes have the non-zero stimulant value. In this way, it only needs to change the weight of very few partial nodes, which makes the network training speed quickly and adapts to the new data more easily, and its astringency also easily guarantee comparing the BP neural network.

Based on the application of neural network, the researchers also had use all kinds of arithmetics which combined with neural network to analyze real estate and made good effect. Wang Jing and Tian Peng (2005) used the wavelet neural network to analyze and forecast the real estate price index. This kind of wavelet neural network integrated the merit of the wavelet analysis and the tradition neural network and has the time-frequency localization analysis and the capability of self-learning to the data, thus it has displayed the superior adaptiveness in the processing nonlinear data fitting and the forecast aspect.

They also has   compared the forecasting result with smoothing method and the RBF neural network forecast .They explained that the wavelet neural network convergence rate is quick, the approaches in the fitting precision and the forecast precision aspect has the good effect by using MATLAB to simulation the fitting and forecasting process. The result indicated that in the big sampled data situation, using the wavelet neural network to forecast the real estate index is able to obtain the good effect.

2.2 Grey theory and method

The grey theory possesses the characteristic that only needs a few data which can make the system analysis, build the model, forecast the future, make decision to the behavior and control process. It had solved some economic problems such as unable research or studies with difficulty because of fewer data and information indefinite. At present, it has been applied widespread in many domains in the social economy.

In the area of real estate , Ma Haitao, Chen Lin and Lu Zhengnan (2007) discussed the gray forecast method—GM(1,1) model structure and the model examination question basing on the grey theory. They used Chinese real estate price index from 1999 to 2004 to establish the Chinese real estate price index forecast model and carried on the analysis to the real estate price index. The forecasting result of this model is good which can really reflect the change tendency of the Chinese house price. OuYang Jiantao (2005) used the nonlinear gray forecast model, and carried on the forecast to the 2004 and 2005's data by using some commercial housing's average price statistical data from 1996 to 2003 .They compare them with the actual data, and it has also made the good effect.

In recent years, there is not many literatureto analyze the real estate price by using the grey theory and the neural network.. Some scholars used the model which combines the grey theory and the neural network to analyze some economic problems. Xia Jingming, (2004), Xiao Dongrong and so on proposed the combination grey neural network forecast model on the basis of the gray GM(1,1) forecast model. They used the grey model to forecast first, then revise its forecast residual with the neural network model, and analyze the actual economic problem. Finally the result indicated that this method increased the forecast precision and had better application prospect. In view of the fact that the real estate's price complexity and the misalignment characteristic, Cai Xiao, Ren Peiyu (2007) used Chengdu real estate price data and established Chengdu real estate price single item forecast model separately, and carried on the comparative analysis to the good and bad points of the single item forecast model by using the improvement   gray forecast model and the RBF neural network model. Then they used the standard deviation method to carry on the weighted distribution, combined two models, and established Chengdu real estate price combination forecast model. This model has been used to forecast the real estate price of Chengdu in the future 5 year.

2.3 Bayesian method

Bayesian method is the system modeling method which developed in the recent several dozens years .Its basic idea is

that combine people's experience and knowledge which are regarded as the apriori information with the actual model, namely using the model information, the data message and the apriori information to carry on the forecast.

Due to practical significance, the research has a quick development in this area, especially in the social economy domain's application. It is said strictly the Bayesian method cannot belong to the nonlinear method. But in view of the fact that its technology to agilely choice a priori distribution and its unique superiority to deal with the complex economic problem, this article also gives the narration on it.

Bayesian method is an analysis forecasting technology based on statistics. Its research has increased day after day in recent years in China. But its development isn't still consummation and mature compared with overseas. Chiong Longguo (1997) used the Bayesian method to establish the house price exchange index model and carry on the comparative analysis to the former model data. He explained the different model might obtain the different error which can instruct scholars to establish the model when analyzing the real estate. Dnalelle Lewis and Thomas M.Springer (2003) used the Bayesian stochastic edge model to carry on the analysis to the investment in real estates cost efficiency. Wen Haizhen, Jia Shenghua and Yang Zhiwei (2006) used the Bayesian method to carry on the analysis to the comparison and choice of the real estate project .They calculated expected revenue of the project under four kinds of external environment and Bayesian income value of 16 decision function. The Bayesian method can effectively choose the real estate project and can be propitious to reduce preliminary risk of the project development through the research analysis.

2.4 Regression, time series, stochastic process and fuzzy

The traditional statistics and mathematical model such as Regress, time series, stochastic process, fuzzy and so on has the widespread application in any economic analysis and the forecast domain. The real estate market is not an exception. Usually we may select the different model according to the different analytic purpose.

Ou Tinghao (2007) used the ARMA model and carried on the demonstrative analysis on the quarter data from the first quarter's real estate price index in 1998 to the ones of the third quarter in 2006.. Then they used the established model to make the forecast to the real estate price index of the fourth quarter in 2006 and the first quarter in 2007 and gave the precision magnitude of error which had received the good effect. Substantively, what he used was still a linear method.

W. Miles (2008) proves that the GAM model surpasses ARMA and the GARCH model in the forecast aspect when analyzing house price which is nonlinear system through experiment. Particularly, its application has better effect in the high price tradition housing market which is in existence of soaks the desert.

Zhang Suodi and Li Bin (2007) has researched that it is possible by using nonlinear dual stochastic process model (AR(1)-MA(0) the model) to explore the law of development and the future condition of the real estate price. They obtained the real estate price predicted value in certain range. Based on this, they carried on demonstrative study on Taiyuan commodity house price housing price from 2001 to 2005 and made forecast appraisal of it. This model has fitted the historical data well. The appraisal result confirmed that this method had the well feasibility and precision.

Wang Laifu and Guo Feng (2007) pointed out that the influence of the monetary policy on the real estate price will be a long-term dynamic process and the change and impact of the money supply and the interest rate level will have the long-term influence to the real estate price. Through establishing the VAR model, they used the pulse response function and the variance decomposed method to study that money supply and the interest rate change attacks bring dynamic effect to the Chinese real estate price. The analysis result indicated that the money supply change will have long-term continues positive influence to the real estate price. The increasing of money supply will cause the real estate price rise. The interest rate change has the negative influence to the real estate price, but its dynamic effect weakens gradually in the long-term and returns to the origin finally. The contribution rate of the money supply change is bigger than the interest rate change to the real estate price change and the former assumes ascensive trend, but the latter gradually reduces. Based on this they has given the related policy suggestion.

Wu Honghua (2005) proposed a method of the real estate price stochastic-fuzzy regress evaluation using the fuzzy mathematics and random theory. This method has the scientific and the accuracy nature. It is simple and practical. At the same time it has the broad application prospect. Finally he used an example to explain practicability of this method.

2.5 Other idea and method

Billie Ann Brotman (1990) has made the predictive analysison four important housing characteristics by using the nonlinear model. The result indicated that the nonlinear model is in surpassing of the linear model in the real estate analysis. John Okunev, Patrick J Wilson (1997) have made the synthetic evaluation on the relevance between the housing market and Stock market by using the nonlinear method which has good effect.

In the 1990s, about researching the complex nonlinear system, Ott from Maryland University in the USA and 3 scholars firstly proposed the chaos control thought to realize the analysis to the nonlinear system.

Ma Junhai and Mou Lingling (2005) carried on the analysis to the house price by using the nonlinear gambling model

and pointed out that when the land price adjustment parameter changed, the government and the real estate businessmen's gross revenue and the marginal revenue had the possibility to enter the chaotic state.

Through joining the external control signal in the model, they could control the state variable value, which may make the land price and the house price converge quickly and effectively to the Nash equilibrium point from the starting value. The government and the real estate businessmen's gross revenue may also enter the chaotic state from the stable state separately. Comparing government accumulation income uncontrolled with the one controlled, they found that after the control, government accumulation income grew 25.2% and gave out the corresponding numerical simulation result.This method has the good application value in the housing market regulation aspect.

There are other methods in the real estate market nonlinear quantitative analysis aspect. Yao HongXing and Wang Guodong (2008) introduced the limited rational dynamic Gunuo model into the real estates investment based on our country real estate market which has not been mature. Considering the complexity of the investment in real estates, they has established the investment model under a nonlinear cost function which made this model conform to the actual utilization nonlinear theory well. They analyzed the stability of the model singular point and theoretically analyze the influence of various parameters on the stability of investment process Through theoretical analysis and numerical simulation, they discovered when the certain parameter of the model varied to certain extent, the Nash equilibrium point would become unstablewhich caused the system become unstable. They has given this system's stability region, analyzed the influence of the parameter to the stablity of the invest process, and gave the economic explanation to each kind of situation the system appeared.They attempted to provide theory reference to the investment behavior.

Sun Yun and Nie Qibo (2001) proposed to construct the real estate price hierarchical structure system by using the AHP method, constructed the fuzzy relationship the comparison matrix by using 1-9 scales which compared with each other, and reckoned the similar degree between the estimating real estate and the similar real estate. Then they estimated the real estate market price through the price and the similarity fitting function. and pointed out that using the AHP method's estimate model to compile the computer program. They developed "the real estate estimate information management system". It not only could balance the estate price quickly but also realize the standardization evaluation mode, which provided the effective tool for the real estate price appraisal in our country by using consistent and scientific program and criterion.

Conclusions

There are lots of achievements at present about the analysis, the research and the application of the nonlinear economic system and it is still consummating and developing. In analyzing the housing market, we may select and establish suitable model according to the different purpose and the different data characteristic. We should notice that when analyzing to the housing market in reality, any model is only reflecting or describing the phenomenon and the characteristic from a certain aspect. Inevitably, it exists in the limitation. Therefore, we should examine the model promptly according to the change of the influence factor to the real estate market, revise analysis and the forecasting result and unceasingly improve and   consummate the model and the method which is in order to reducing the model's limitation, enhancing the analysis, the appraisal and the forecast effect, providing the correct policy-making basis for the real estate market related department and instructing our country real estate market to develop well.

Acknowledgements

References

A Quang Do, Grudnitski, Gary. (1992). A neural network approach to residential property appraisal, *Real Estate Appraiser*, 58(3).

Billie Ann Brotman. (1990). Linear and Nonlinear Appraisal Models, *The Appraisal Journal*, 58(2).

Cai Xiao, Ren Peiyu. (2007). The Application of Combination Forecasting Model in Chengdu Real Estate Price, *Pioneering with Science & Technology Monthly*, 2007(12).

Chiong-Long Guo. (1997). A Bayesian Approach t the Construction and Comparison f Alternative House Price Indices, *Journal of Real Estate Finance and Economics*, 1997(14): 113-132.

Dnalelle Lewis, Thomas M. Springer. (2000). Residential Real Estate Brokerage Efficiency from a Cost and Profit Perspective, *Journal of Real Estate Finance and Economics*, 20(3): 295-310.

Hu Zhangming. (2006). Research on Forecasting Real Estate Price Index Based on Neural Networks, *Journal of the Graduates Sun Yat-Sen University*, 27(2).

John Okunev, Patrick J Wilson. (1997) Using nonlinear tests to examine integration between real estate and stock market, *Real Estate Economics*, 25(3).

Lan Guoliang. (2003). The Application of the Artificial Neural Networks on Forcast of Sale Rate of Dwelling, *Geological Technoeconomic Management*, 25(4).

Ma Haitao, Chen Lin, Lu Zhengnan. (2007). Forecasting Real Estate Price Index Based on Grey theory, *Statistics and Decision*, 2007(19).

Ma Junhai; Mu Lingling, (2007). Control and Analysis on Nonlinear House Price Game Model, *Complex Systems and Complexity Science*, 2(4).

Ou Haoting. (2007). Real Estate Price Index Based on ARMA Model, *Statistics and Decision*, 2007(7).

Ouyang Jiantao. (2005). Application of Nonlinear Gray Forecast Model on Investment in Real Estates Price, *Industrial Technology & Economy*, 24(5).

Sun Yun, Nie Qibo. (2001).On the Application of AHP in the Real Estate Evaluation, *Journal of Nanjing Architectural and Civil Engineering Institute*, 59(4): 84-89.

Wang Laifu, Guo Feng. (2007). Dynamic Effect Research of Monetary Policy on the real estate price, *Research on Financial and Economic Issues*, 2007(11): 16-19.

Wang Jing, Tian Peng. (2005). Real Estate Price Indices Forcast by Using Wavelet Neural Network, *Computer Simulation*, 22(7).

Wen Haizhen, Jia Shenghua, Yang Zhiwei. (2006). Application of the Bayesian method on the selection of real estate projects, *China Civil Engineering Journal*, 39(9).

W. Miles. (2008). Boom–Bust Cycles and the Forecasting Performance of Linear and Non-Linear Models of House Prices, *Journal of Housing and the Built Environment*, 2008(36): 249-264.

Wu Honghua. (2005). Random-Fuzzy Regressive Method of Real Estate Price Evaluation, *Journal of Wenzhou University*, 18(5): 27-31.

Xia Jingming, Xiao Dngrong, Xia Jinghong, Jia Jia. (2004). Research on Short-term Forecasting Negotiable securities Based on Grey Networks Model, *Industrial Technology & Economy*, 23(6).

Yao Hongxing, Wang Guodong. (2008). Analysis Complex of a kind of Investment in Real Estates Model. *Statistics and Decision*, 2008(1): 55-57.

Zhang Suodi & Li Bin. (2007). Real Estate Price Index Based on AR(1) MA(O) Model, *Pioneering with Science & Technology Monthly*, 2007(2).