Analysis of the Factors of Real Estate Price Based on Hangzhou

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Abstract. The real estate industry plays an important role in the national economy and is an important industry to enhance the national economy and improve people's life. Due to the high correlation and strong driving force of the real estate industry, it has become an important industry of the national economy. This study adopted Hangzhou as an example, this paper studies the influencing factors of house prices. The results show that there may be many factors affecting house prices, resulting in poor prediction results. In addition, housing area, housing years and sales date are the most important factors. One of the important contents of a harmonious society is the people's livelihood, and the housing problem is an important people's livelihood problem, which is directly related to the improvement of people's living standards and quality of life. Therefore, accelerating urban housing construction and solving the problem of people's housing shortage is a major event related to the national economy and the people's livelihood, developing production and improving people's living standards. Promoting the healthy development of the real estate industry is the basic need to improve the housing level of residents, improve the living quality and meet the material and cultural needs of the people.

Keywords: Factors · Model Analysis · Real Estate Price

1 Introduction

1.1 Background

Since the beginning of the era of housing commercialization in 1998, the real estate industry has played an important role in China's economic development. The industry has experienced a rapid growth period of more than 20 years with population growth. After the start of a new round of regulation in 2016, the fundamentals of the real estate industry have changed differently from the past. Due to the high-frequency regulation of urban policies, cities and regions have formed their own cycles, and the overall cycle volatility of the industry has been leveled. Under the theme of "housing without speculation", the position of the real estate industry in the economy has changed from the original booster to stabilizer. Although the status has changed, real estate is still an important pillar industry of China's economy. In China's important cities, house prices have been at the price of tens of thousands of yuan. There are many factors affecting house prices, including policy, geographical location, school district housing and so on. Studying the influencing factors of house prices is of great significance for residents' investment.

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1.2 Related Research

Rosen sketches a model of product differentiation based on hypothesis of hedonic that goods have different value because of their utility discrepancy. It describes the theoretical framework of hedonic pricing model explaining that how much would the consumer pay depends on the enjoyment they get from the product [1]. Wen and Jia select several apartment basic data in Hangzhou to use the hedonic price model to show that when the housing developer and buyer are the rational person, the asking price function of housing, biding price function of housing and the hedonic function tangency, they all would have the best utility and the highest profit [2]. Markus analyses the link between the housing price and key macro variables such as prices, output and interest rate for ten countries. Finding that the monetary policy could lower the real house prices while the housing price react upon these key macroeconomic variables [3].

It shows that the idea behind HPM is that the housing are characterized by their constitute properties, so we can add up them to find out the price of housing. And the housing heterogeneous could be the evidence to estimate housing price by the HPM [4]. Cellmer use the geostatistical model to refine the traditional statistical model of property transaction prices. The combination model gives a process which is developing land value maps. With the maps it can predict the price of the undeveloped land to find the housing price on it [5].

It finds that the Investment theory dictates that capitalisation (cap) rates for freehold real estate should be determined by the risk-free nominal rate of return plus the risk premium (RP) less the expected growth rate, with an allowance for depreciation [6].

The article research the Orta neighborhood with hedonic pricing model find there is 4 variables which are floor area, age, distance to primary school and distance to city center hugely effecting to the sales price. And this article also use the semi-logarithmic model to study marginal effect [7]. Yeh and Hsu propose a new real estate valuation called quantitative comparative approach which could decrease the subjective decision of correction coefficients of traditional comparative approach. It assume the unit price is average price of the neighborhood multiplied by the product of several dimensionless adjustment coefficients of factors [8].

Yeh and Lien find that the housing price is influenced by the real estate price rate of change, present value of total real estate sales, duration, land value persistence factor, and present value of land with the help of the Binomial Option Pricing Model and Monte Carlo Simulation hybrid method [9]. Zhong use the hedonic pricing model utilizing thousands of apartment with multiply linear regression to research how the essential attribute such as the square, number of the function rooms, greening rate affect the housing price. After examining, it proves the logarithmic model has the best fitting degree [10].

1.3 Objective

This paper selects the housing price in Hangzhou as the research object, uses a variety of models to analyze, looks for important factors, and puts forward corresponding housing suggestions.

2 Method

2.1 Hedonic Pricing Model

The paper published in 1966 by Lancaster holds that when the consumer purchase a product, they are not only consider the use of the product itself but also the other characteristic of the product such as quantity, size, quality and etc. For the housing market, the price of the housing depends on the house's hidden feature. The hedonic pricing model points out the diverse commodity's price is determined by the combined the factor's influence. With the hedonic pricing model's help, the samples are easily to obtain and calculate, but the too many factors could be in multicollinearity.

2.2 Market Comparison Method

There is a principle in economics called substitution which could help to estimate the price of the commodity in the market. In the economics, the commodities with the same utility, price could be instead by each other. With the relationship of the supply and demand in the market, the same utility commodity will go to the same price which offers a way to match the price. But the market comparison method has limitation to use in housing market. First there have plenty of the sample in equity trade to provide the model. Second between the cases, they could be replaced by the same utility case which means the housing is in the same minimum domain. Third, the cases must be true and reliable, they must be under the equal and trade.

3 Commodity and Factors

3.1 Choosing Sample of Commodity

Hangzhou, a first tier city of the China, one of the highest and representative housing price city in China, has about 12 million of the inhabitant. As previous mentioned, the only the minimum domain could use the comparison method so that the influence of the district of the pricing become a huge factor. To avoid this, choosing the Shangcheng and Xiacheng district, which is the central area of Hangzhou become a reversible choice.

In China, housing built to live inhabitant could be classified in different category. The trade of categories could be free or limited. So to choose the commercial residential housing which could trade freely after holding by two years is meeting the limit of the substitution. And there is also a small difference between apartment and residence which representative the apartment could not hold the hukou to prevent your kids to go to the public school. This takes a large otherness than the residence so that the apartment should not be taken in the considerate.

3.2 Factors

This paper simply classified the factors which effect to the price of the housing. In China, there are several factors may do some effect to the price of housing in the same city.

3.2.1 The District Area

It called "qu" in Chinese, different district area may offer different school and the distance from the downtown and supermarket, which could hugely increase or decrease the price. In this site, choosing the housing from one or two similar district areas may be a good choice.

3.2.2 Transaction Attributes

In China, only the commodity housing could be sold and bought freely in the housing market, which is not allowed such as economically affordable housing, public housing and etc. It is mentioned that the commodity with same utility could be instead by each other, so choose the commodity housing as the object of study is reasonable.

3.2.3 Floor Area

IT does hugely effect of the price, so to use pprice which means price per square meter to take the place of the price could remove the linear correlation of the floor area and price of housing.

3.2.4 Central Heating

Central heating is important factor in the north of China, but in Hangzhou, no housing has central heating so that we could ignore it.

3.2.5 Usage of the House

It is fixed when the house were building, that could not be changed. Different usage may have different means of exchange, whether or not buyer's child could have chance to entrance public school. Under this circumstance, only using the normal resident as the object could be a well-founded choice.

3.2.6 Sell Date

Sell date could be a vital factor that we can find periodicity price fluctuated from the sell date and with the build time's help, we could calculate the using years which means the new or old for the housing.

3.2.7 Furnishing Style

Having a luxury furnish could have a higher price than the normal furnish and the no furnish housing in forecast.

3.2.8 Elevator

Housing with elevator could offer a convenience to the inhabitants which may have a higher price.

3.2.9 Floor and Total Floor

It's hard to say that how they effect to the price.

3.2.10 Rooms

The number of the rooms goes up, the housing could be lived in more people and separated to more areas which means hardly to bother each other but the room would goes smaller.

3.2.11 Oriented

The Chinese may prefer south oriented housing which means having more sunshine.

4 Different Model to the Regression of the Data

With the factors mentioned previously by, trying to fit a regression to estimate the price of the housing in Hangzhou, with using the square, decoration, elevator, total floor, floor, years, sell date and orientation as the factors.

4.1 Correlation Analysis

First doing some correlation analysis, since the data is not in a normal distribution, using spearsman correlation index could be a reasonable choice. It demonstrate only the roomindex and square is in a correlation that bigger square normally have more rooms and its roomindex would increase that could be explained. And the south with west and east is another pair of correlation, in China rooms with south oriented is easy to market circulation that every buyer prefer sunshine in their housing (Fig. 1).

4.2 Decision Tree Regression

With the machine learning helping and genetic algorithm's help, it can get the graph showing and proper index. It use 90% as training group and the other 10% as the test set. It could find that it can not do a good model to estimate the pricing cause there is only 0.232 of r^2 (Fig. 2 and Table 1).

4.3 Random Forest Regression

Then trying for another regression model, the factor's weight is similar to the Decision tree regression but its R2 is also too small to use this way. But has a little increase (Fig. 3 and Table 2).

4.4 Adaboost Regression

Adaboost regression is a method that it could change the weight of the training group to estimate properly to the test group. It performs perfectly on training group but does less on (Fig. 4 and Table 3).

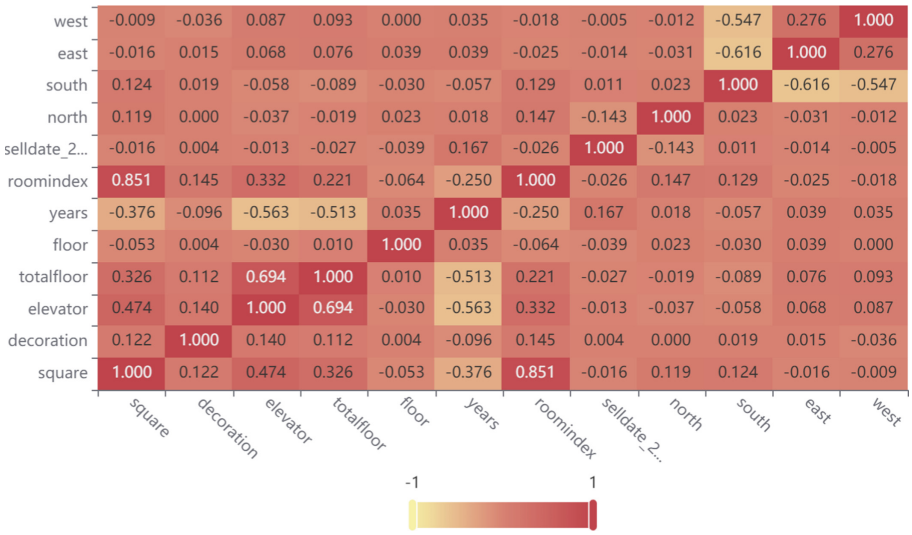

Fig. 1. Correlation of different factors

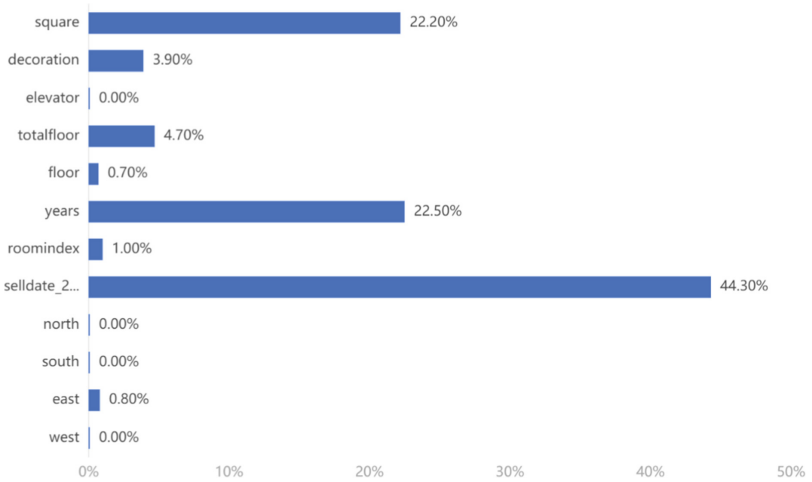

Fig. 2. The weights of different factors by Decision Tree

Table 1. Results of the Decision Tree model

	MSE	RMSE	MAE	MAPE	R^2
Training Group	0.611	0.781	0.586	13.847	0.426
Test Group	0.825	0.908	0.667	15.458	0.232

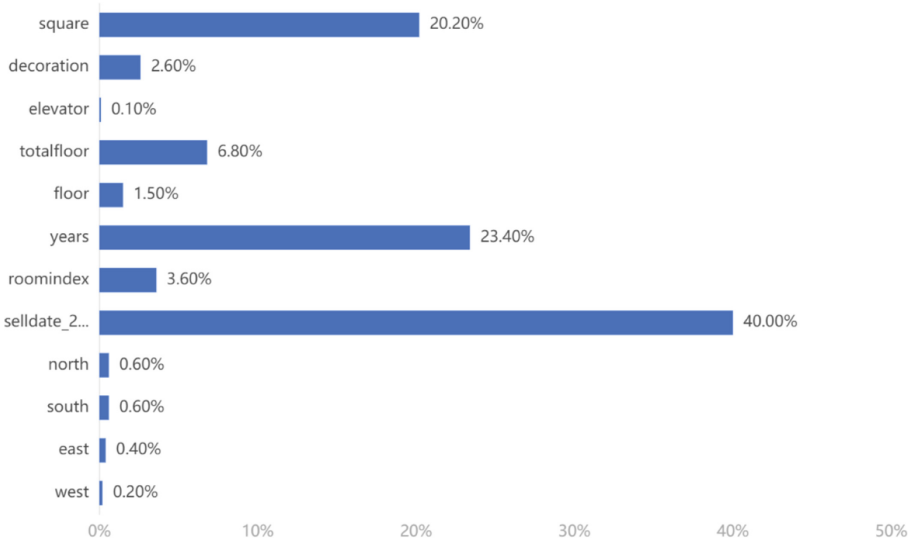

Fig. 3. The weights of different factors by Random forest

Table 2. Results of the Random forest model

	MSE	RMSE	MAE	MAPE	R^2
Training Group	0.56	0.748	0.571	13.431	0.476
Test Group	0.646	0.804	0.582	13.856	0.381

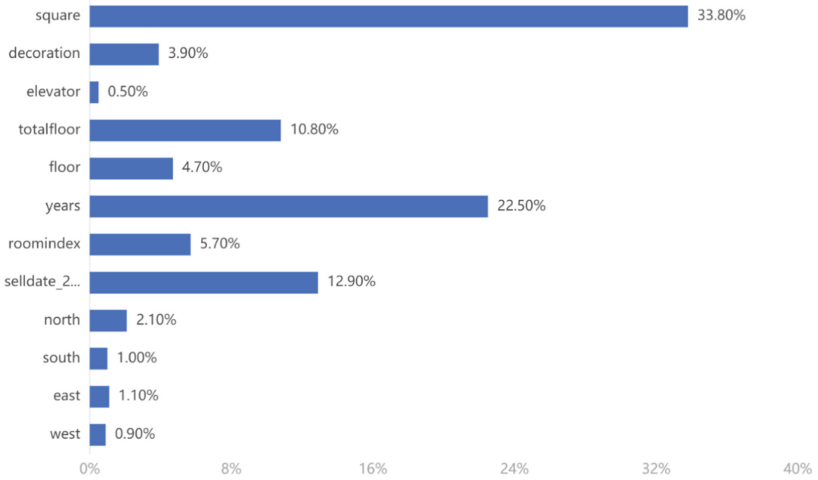

Fig. 4. The weights of different factors by Adaboost

Table 3. Results of the Adaboost model

	MSE	RMSE	MAE	MAPE	R^2
Training Group	0.002	0.05	0.014	0.414	0.998
Test Group	0.721	0.849	0.597	14.427	0.313

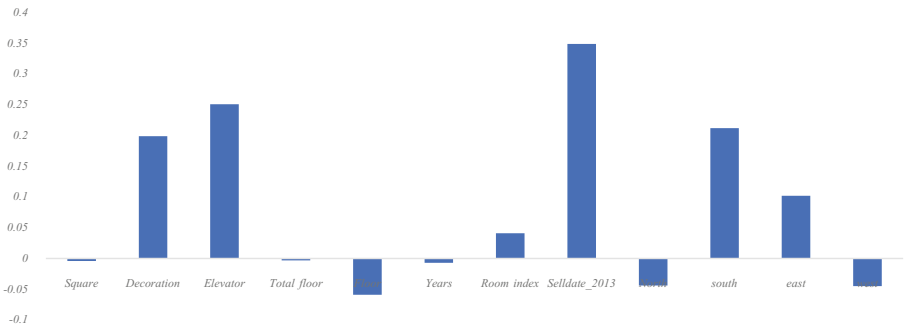

Fig. 5. The weights of different factors by Linear regression

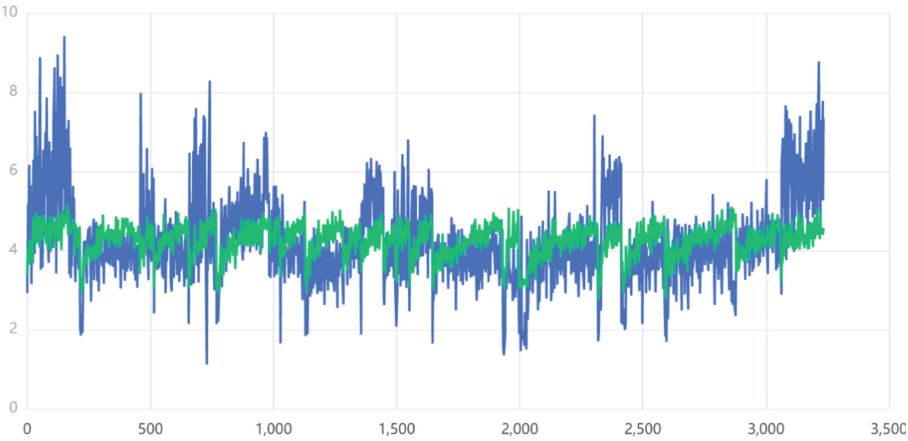

Fig. 6. The results of forecasting

4.5 Linear Regression

Linear regression is a simple and traditional way to find the relationship between the commodity and the factors. Figure 5 shows how weight does the factor effect the pricing.

It seems give a conclusion that how much every sector does contribution to the dependent variable but when seeing the fitting graph, the price of the housing is too fluctuated to predict. As shown in Fig. 6, the blueline is practical price, and the greenline is the regression price.

5 Conclusion

After using the several method to try estimate the district of Shangcheng and Xiacheng in Hangzhou, none of them could have a well fitting. The main reason of that is the unpredictable political sector which could not be estimated like the child-school-district and complicated limiting purchase policy. The policy changes first-hand price which definitely does effect on second hand market price. So that the price is not could be discovered from the basic sectors of housing. It better to try to estimate price with the same building but in that case the sample is too small to make substitution effect.

There is another reason that the investment means in mainland China are fewer than it should be, many buyer are speculators which give a abnormal and irrational price to hot the market up. Some rigid demander were in that period purchasing the housing so that even if the market is cold down, the price they want to sold isn't in a reasonable price. The model could be fitted in rational price but could not analyze the irrational price.

When it comes to the factor weight, it could find that the square, the housing years and the sell date give high weight whatever the regression method using. Even though using the price per square meter, it also does a significance affection. Big square could increase the price quickly and unaffordable, so that the square actually is a downtrend sector. And the sell date does a effection which proves what it mentioned previous, irrational purchasing sets difficulties of estimating the price. Housing year is the period from the construction time of the housing to the selling time, as more and more first-hand housing is limited to the whole buyers, the price of the first-hand housing is cheaper than the second-hand housing is a normal thing in China housing market which definitely not in foreign housing market.

References

1. S. Rosen, Hedonic prices and implicit markets: Product differentiation in pure competition, Journal of Political Economy, vol. 82, no.1, 1976, pp. 35–55.
2. H. Wen, S. Jia, Housing characteristics and hedonic price: Analysis based on hedonic price model, Journal of Zhejiang University, vol. 38, no. 10, 2004, pp. 101–105.
3. M. Demary, The Link between Output, Inflation, Monetary Policy and Housing Price Dynamics, Mpra Paper, 2009.
4. S. K. Herath, G. Maier, The hedonic price method in real estate and housing market research. A review of the literature, Institute for Regional Development and Environment, 2010, pp. 1–21.
5. C. Radoslaw, The possibilities and limitations f geostatistical methods in real estate market analyses, Real Estate Management and Valuation, vol. 22, no. 3, 2014, pp. 54–62.
6. N. Crosby, C. Jackson, A. Orr, Refining the real estate pricing model, Journal of Property Research, 2016.
7. A. Y. Ozalp, H. Akinci, The use of hedonic pricing method to determine the parameters affecting residential real estate prices, Arabian Journal of Geosciences, vol. 19, no. 24, 2017.
8. I. C. Yeh, T.K. Hsu, Building real estate valuation models with comparative approach through case-based reasoning. Applied Soft Computing, 2018.
9. I. Yeh, C. Lien, Evaluating real estate development project with Monte Carlo based binomial options pricing model, Applied Economics Letters, 2019, DOI: https://doi.org/10.1080/13504851.2019.161604

10. C. Zhong, Research on housing pricing of real estate project in Beicheng Era-based on hedonic price model, journal of University of electronic science and technology of China, 2020, DOI: https://doi.org/10.27005/d.cnki.gdzku.2020.004858.