An Improved Method of Real Estate Evaluation Based on Hedonic Price Model

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Abstract — **As real estate is a heterogenous good, there are distinctive differences on the characteristics composing the using value of real estate. Evaluating the value of real estate from the implicit price of the characteristics can improve three traditional evaluation methods: market comparative method, income capitalization method, and replacement cost method. Based on the introduction to foreign experience, the paper takes the housing market of Hangzhou city as a case and establishes a housing hedonic price model. From the model, we get the implicit prices of 18 housing characteristics and the evaluation model of housing value.**

Keywords—**hedonic price model, housing characteristic, real estate evaluation**

I. INTRODUCTION

With the innovation and perfection of the housing institution, the real estate market in China will become more and more prosperous, and real estate evaluation will play a more and more important role in the real estate market. Currently in practice, market comparative method, income capitalization method and replacement cost method are adopted in China, and in addition other methods are generally derived from these three methods. These evaluation methods have their applied areas respectively, and are always restricted by some situation in practice. As real estate is a good with heterogeneity, there are many apparent differences on housing characteristics composing the using value of real estate, so hedonic price model is often used as the evaluation method in many foreign countries. Hedonic price method, evaluating the value of real estate from the implicit price of the characteristics, can improve market comparative method, income capitalization method, and replacement cost method. Based on the introduction to hedonic price analysis of real estate, this paper takes the housing market of HangZhou city as an example, establishes a housing hedonic price model, gets implicit price of 18 housing characteristics, and sets the evaluation model of the housing value as a result.

II. LIMITATIONS OF THREE TRADITIONAL METHODS OF REAL ESTATE EVALUATION

A. Three Traditional Evaluation Methods and their Theoretical Foundation

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The definition of market comparative method is as follows: comparing the under-evaluated real estate with the similar real estate transacted recently in the same district, taking these transaction prices as the reference price, and then correcting it in the situation of normal market. This method is adopted widely in those mature markets like England, American, Japan, Taiwan, Hong Kong etc. Market comparative method is based theoretically on supply-demand theory. From the angle of the products of real estate itself, by the use of substitute principle and on the basis of the rule that prices of the products with the same kind, the same utility and the same quality will tend to be identical in the competitive market, this theory deems that the real estate price is equal to the balanced price when market is well-balanced.

Income capitalization method evaluates the real estate value by the way of forecasting the to-be net income of the under-evaluated real estate, choosing the proper interest rate and accumulating all the income with discount. This method is often used on the evaluation of the business real estate, like shops and restaurants etc. Income capitalization method is based on the expectation principle, that the real estate value is determined by the future factors, not the departed factors. In more detail, the real estate value is usually not based on the price, the cost or the market condition in the past, but based on the expectation of the income, or the pleasure the consumer can enjoy in the future. Mainly from the viewpoint of consumers, this method applies the expectation principle and the utility theory, capitalizes the future incomes, and confirms that real estate price is equal to the sum of all the discounts of the future incomes.

Replacement cost method analyses all the costs of the under-evaluated real estate, seeks the reconstructed price of the real estate in the evaluation time, deducts the depreciation, and then gets the reasonable real estate value. When certain housing property is being evaluated, based on the original value of the house, this method calculates with the depreciation by the average of years. When certain land value is being evaluated, this method calculates the cost of each unit according to all the fees of the exploitation of the land, then work out the land price, including the fee of land expropriation, the exploitation fee, the normal profits and the tax etc. The theoretical foundation of replacement cost method is production-cost theory. From the viewpoint of developer, this theory applies the investment principle that equal quantity investment obtains equal quantity income at least, confirms that the real estate price is equal to all the

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invested capital and profits.

B. Limitations of Three Traditional Methods

In practice, the evaluated results of these three methods may differ even on the evaluation of the same real estate. Usually, the result of replacement cost method is lower than that of income capitalization method, and the result of market comparative method is higher than that of the former but lower than that of the latter. The reason may be: replacement cost method is from the aspect of supplying, income capitalization method is from the aspect of demanding, market comparative method is from the aspect of the balance of supply and demand. Thus, the two sides of supply and demand's bargaining make the income of using the real estate more or at least equal to the cost of real estate, and the excess part will be shared by the two sides. Furthermore, there are some restricts and shortcomings in the process of the use of these three methods.

When market comparative method is being used, it is needed to have many transactions of similar real estate. It is hard to adopt this method to evaluate real estate in some areas where the real estate market is not mature enough. Even in the area where the market is highly-developed, it is also hard to apply this method in some situation; for example, there is not any real estate transaction in certain areas because of some reasons. Secondly, market comparative method needs to correct the difference of some factors, like the transaction situation, date and real estate characteristics. Some amendments are hard to adopt quantitive formulas, so evaluators sometimes judged it by their knowledge and experience, but it does influence the accuracy of the evaluation.

The basic principle of income capitalization method is concise and it is easy to be understood, but it is not easy to ascertain the proper interest rate and anticipates the net profit in the future. This method can't bring into effect when the real estate has no profit or the profit can't be calculated, and the estimate of the future profits will be influenced by the management ability of the firm. In practice, the man-made interest rate often greatly influences the results.

Theoretically, as long as the cost of real estate could be calculated, it could be adopted replacement cost method to evaluate it. But in real life, the real estate price depends on its utility, not just its' costs, and the addition of the cost does not always add its value. When the cost is low, it doesn't mean the value is not high. When this method is adopted, it is often consuming more time and energy. The hardest problem is calculating the depreciation, especially the old real estate; it often depends on the subjective judgment of evaluators, which influences the accuracy of the evaluation.

III. Hedonic Price Analysis of Real Estate

Since Ridker applied the hedonic price theory to analysis urban housing market in 1967, hedonic price model has become one of the most abroad-applied models in the real estate academe. The difference of real estate price reflects the difference of real estate characteristics' number; this opinion has been accepted largely. The hedonic price theory points out that real estate is a heterogenous good with a series of characteristics that are the sources of the utility, and the combination of different characteristics forms the bundles of characteristics which influence the total utility of the consumers. A real estate characteristic corresponds with an implicit price, every characteristic corresponds with one implicit market, and the total market is composed by several characteristics' implicit markets. Though the transaction prices of real estate are visible in the market, these implicit prices can't be observed. In the real market, the transaction price is the sum of its' implicit price or hedonic price of the characteristic which the real estate comprises, it will be different because of the difference of the internal characteristic and the quantity.

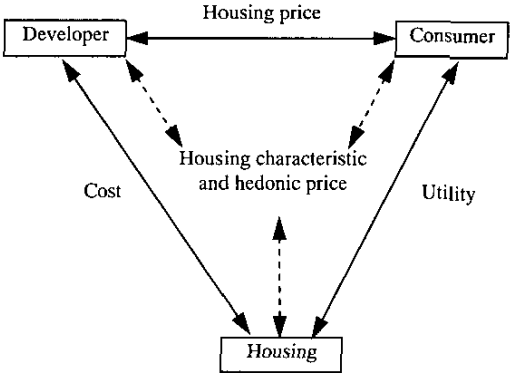

Fig. 1. Hedonic price analysis frame of real estate

Take housing as an example, the housing characteristics contact developer, consumer and housing tightly (see figure 1). Developers supply housing products with different characteristics by the design, building and maintaining housing and bear different costs because of different characteristics. To consumers, purchasing housing is to satisfy the needs of life and entertainment, the utility of housing depends on the combination and quantity of housing characteristics. Developers and consumers bargain by market, the transaction price of housing is the sum of the products' hedonic prices. The under-evaluated real estate is detailed to individual, the characteristics are apparent, and the data of characteristics is easy to get. Thereby, if hedonic price could be calculated by the datum of the market transaction, then it could be got the evaluation prices of the real estate by the quantity of characteristics.

IV. Housing Hedonic Price Model: An Empirical Case of Hangzhou City

Table I
MEANINGS AND MEASURE METHODS OF HOUSING CHARACTERISTIC VARIABLES

Characteristic s class	Variable	Variable meanings and measure methods
Structure characteristic	Floor acreage	Total floor acreage of one housing (square meter)
	Housing age	Housing age (Year, the age of housing built in 2003 is 1)
	Orientation	Dummy variables: south-north is scored 1, other is 0
	Decoration degree	Divided into 5 degrees: no decoration (scored 1), simply decoration (scored 2), medium decoration (scored 3), high-level decoration (scored 4), exquisite decoration (scored 5)
	Housing floor	The number of the floor
	Garage	Dummy variables: Having garage or parking location is scored 1, or is 0
	Attic	Dummy variables: having attic is scored 1, or else is 0
Neighborhood characteristic	Environment	The environment quality around the community is divided into 5 degrees: quiet bad (scored 1), bad (scored 2), common (scored 3), good (scored 4), very good (scored 5)
	Inner environment	The environment quality inside the community is divided into 5 degrees: quiet bad (scored 1), bad (scored 2), common (scored 3), good (scored 4), very good (scored 5)
	Community management	The service quality of the community management is divided into 5 degrees: quiet bad (scored 1), bad (scored 2), common (scored 3), good (scored 4), very good (scored 5)
	Nearby university	Dummy variables: college or university within 1000 meter is evaluated 1, or is 0
	Life establishment	Supermarket, terminal market, bank, post office, hospital within 1000 meters from the community, each item is scored 1, total is 5
	Education establishment	Kindergarten, elementary school and middle school within 1000 meters from the community, each item is scored 1, total is 3
	Entertainment and PE facility	Natatorium, body-healthy facility, basketball court, tennis court, agedness entertainment stage inside the community, each item is scored 1, total is 5
Location characteristic	Distance to CBD	The linear distance from the community to Wulin Square (kilo meter)
	Distance to West Lake	The linear distance from the community to West Lake (kilo meter)
	Traffic condition	The total numbers of the bus routines within 500 meters of the community
Other characteristic	Transaction time	Transaction time, expressed in month, from 1 to 7

This paper takes five old districts: Shangcheng District, Xiacheng District, Gongshu District, Jianggan District and Xihu District as the research districts, all are in the urban area of Hangzhou city, and chooses the multi-floor housing and litter-tall-floor housing as the research object. The total samples are 2473, the time span is from Jan. 1st 2003 to Jul. 31st 2003.

A. Choice and Measure of Characteristic Variables

It's very important to choose characteristic variables when hedonic price method is being used to evaluate real estate. Through the review of foreign literature, we found housing characteristics were divided into three types: structure characteristic, neighborhood characteristic and location characteristic. This paper follows the analyzing frame, and chooses 7 structure characteristics, 7 neighborhood characteristics and 3 location characteristics as the model independent variables. Transaction time is as the other variable to measure how housing price changes along with the time.

B. Model Result and Discussion

The function form of hedonic price model adopts liner form, namely:

$$P = \alpha_0 + \sum \alpha_i Z_i + \varepsilon \quad (i=1\text{-}18). \qquad (1)$$

Thereinto α_i is under-decided coefficient, Z_i is relevant housing characteristic variables, ε is random error.

We take the multi-factor regression with SPSS10.0 software, use the OLS method to estimate parameters and get the regression equation. R square of the model is 0.852, adjusted R^2 is 0.851, D-W value is 1.991, all indicate that the fitness of the model is high and possess good explaining capability. The F value is 787.431 and the Sig. value is 0.000, indicate that the fitness of samples datum with the model is meaningful in the statistics and the regression equation is effective.

Table II
MULTI-FACTOR REGRESSION COEFFICIENT ANALYSIS

	Un-standardization coefficient	Standardization coefficient
Constant	-15.082***	
Floor acreage	0.594***	0.833
Housing age	-3.324E-03	-0.006
Housing floor	0.269***	0.029
Garage	6.101***	0.048
Attic	5.528***	0.036
Orientation	-1.166	-0.008
Decoration degree	1.212***	0.046
Environment	1.758***	0.041
Inner environment	1.963***	0.067
Community management	0.924***	0.044
Nearby university	-1.328*	-0.016
Life establishment	-7.689E-02	-0.002
Education establishment	0.626	0.013
Entertainment and PE facility	1.613*	0.020
Distance to CBD	-1.122***	-0.059
Distance to West Lake	-3.624***	-0.154
Traffic condition	0.506***	0.056
Transaction time	0.520***	0.022

***: significance level is 1%; **: significance level is 5%; *: significance level is 10%

The regression results show in table II. Un-standardization coefficients correspond hedonic prices of housing characteristics, for example, the hedonic price of the floor acreage is 5940 Yuan per square meter, indicates that on the condition of unchanging other characteristics, when one square meter is added, housing price will add 5940 Yuan. Some meaningful results could be got easily according to the meaning of housing characteristics, for example, housing price will raise 12120 Yuan when the decoration degree raises one class, the average price of one housing will raise 5060 Yuan when one traffic routine is added in the influenced area, etc. According to table II, the evaluation model of housing price in Hangzhou city is:

$$P = -15.082 + 0.594Z_1 + -3.324E\text{-}03Z_2 + 0.269Z_3 + 6.101Z_4 + 5.528Z_5 - 1.166Z_6 + 1.212Z_7 + 1.758Z_8 + 1.963Z_9 + 0.924Z_{10} - 1.328Z_{11} - 7.689E\text{-}02Z_{12} + 0.626Z_{13} + 1.613Z_{14} - 1.122Z_{15} - 3.624Z_{16} + 0.506Z_{17} + 0.520Z_{18}. \qquad (2)$$

When a housing price is being evaluated, it only needs to substitute with the numerical value of housing characteristics; the evaluated price could be got by the equation.

V. CONCLUSION

By setting the evaluation model of housing market in Hangzhou city, it is found that comparing with three traditional evaluation methods, the new evaluation method, based on hedonic price, has three advantages:

1) Hedonic price method extends from market comparative method. Supply-demand theory is one of the theoretical foundations of hedonic price method, but setting hedonic price model needs to consider more variables, and adopted samples are also abundant. Using hedonic price model could get the implicit price of variables, and overcome the limitation of correcting the differences of real estate by experience in market comparative method.

2) Compared with income capitalization method, it needn't determine the interest rate and forecast the net income of the real estate in the future, so the evaluating

results are more reliable.

3) Compared with replacement cost method, the depreciation of real estate can adopt the age of the housing as one characteristic variable, and the hedonic price model can get its implicit price directly. Avoiding the calculation of the depreciation of real estate, the accurate evaluating results could be obtained easily.

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