Journal of Zhejiang University SCIENCE
ISSN 1009-3095
http://www.zju.edu.cn/jzus
E-mail: jzus@zju.edu.cn

Hedonic price analysis of urban housing: An empirical research on Hangzhou, China*

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Received Sept. 18, 2004; revision accepted Feb. 18, 2005

Abstract: The hedonic price model is widely applied to study the urban housing market because of the heterogeneity of housing products. Literature indicated that the hedonic price theory mainly includes two parts: Lancaster's partiality theory and Rosen's characteristic market equilibrium analysis. This paper chose 18 characteristics as independent variables and set up a linear hedonic price model for Hangzhou City. The model was tested with 2473 housing samples and field survey data of 290 housing communities. This research found that 14 out of 18 characteristics had significant influence on housing price. They were classified into 5 groups according to their impact degree.

Key words: Housing price, Housing characteristics, Hedonic price model
doi:10.1631/jzus.2005.A0907 **Document code:** A **CLC number:** F290; TU976

INTRODUCTION

Urban housing is a "unique product" with three peculiarities (Harsman and Quigley, 1991): (1) Complexity of housing. As a kind of complicated goods, housing can meet a great variety of a family's demands and be closely related to such activities as residents' life, work, amusement, etc.; (2) Fixity of housing. Housing directly relates to urban land in special location. The movement of housing is basically impossible under the present technological conditions, with residents' frequent migration being very expensive and inconvenient in China. This means choice of housing involves consideration of neighborhood relations, reachability of job site and corresponding public service facilities such as schools, shopping centers, etc.; (3) Durability of housing. This characteristic affects the new housing market and stock housing market as well. Different from other common commodity market, housing market has a corresponding stock market. Consumers can carry on replacement among new or old houses, choose building type, community environment, degree of accessibility and so on, to meet individual preferences and get the greatest utility. These characteristics indicate that influential factors of housing price are very complicated and closely related to housing characteristics. Investigating the influence factors of housing price inside the city from the viewpoint of housing characteristics is a rational approach. In fact, since housing is a kind of heterogeneous product, and there are obvious differences between housing characteristics, scholars abroad often establish hedonic price model to carry on researches.

As the setting-up of a hedonic price model of urban housing requires the collection of voluminous data and carrying out of comparatively extensive investigation, empirical researches on the urban housing market in the Chinese mainland have been very few (Ma and Li, 2003; Wen, 2004). To apply the hedonic price model to the actual situation in Chinese

* Project supported by the National Social Science Foundation of China (No. 05CJY017), the Philosophy and Social Science Foundation of Zhejiang Province, China (No. N04GL06), and Shuguang Project (2004) of Zhejiang University, China

cities, to study the relation between housing characteristics and housing price, to estimate the implicit prices of housing characteristics, and to analyze the supply and demand characteristics of the housing market, are the multiple tasks the author of this paper attempts to accomplish in this work.

ECONOMIC THEORY OF HEDONIC PRICE MODEL

A. T. Court, an analysis expert of the American automobile industry, established the first hedonic price model in 1939 (Goodman, 1998). He adopted the term "hedonic", regarded automobile price as a function of the automobile's different characteristics, and carried out hedonic price analysis of heterogeneous goods. His final purpose was to structure the price index for the automobile industry. After that, this method began to expand to other consumer goods, such as tractors, washing machines, etc. Colwell and Dilmore (1999) put forward different suggestions, and believed Haas was one of the first users of the hedonic price model. Haas (1922) used the concept of "hedonics", and set up a simple hedonic price model for farmland, taking the distance to the city center and the city size as two important characteristic variables. Wallace (1926) and Waugh (1928) also used hedonic price method for studying farmland price and vegetables price. Ridker (1967) was one of the earliest scholars to apply hedonic price theory to analyze the housing market. He used housing data to set up a hedonic price model, calculated the impact of improving environmental quality (such as the elimination of air pollution) on housing price.

The theoretical foundation of the hedonic price model was generally named as hedonic price theory; mainly including two contents:

American scholar Lancaster (1966) first put forward a new consumer theory. The theory was expanded from the consumer theory of classical economics, also known as Lancaster preference theory. From the product heterogeneity, Lancaster (1966) analyzed basic "element" spaces that formed the product, and argued that the demand for the product was not based on the product itself, but on its characteristics. Heterogeneous goods (especially such as housing) have a series of integrated characteristics, and the goods are sold as the gathering of inherent characteristics. Families purchased these goods, used them as a kind of "investment", and turned them into utilities. The level of utilities depended on the quantity of different characteristics. It is difficult to analyze such goods market with the traditional economic model, because it cannot be considered by a single total price. So we have to adopt a series of prices (hedonic price) to express corresponding product characteristics. Therefore, the product price is made up of hedonic prices, with each product characteristic having its own implied price, and all hedonic prices form a price structure.

Then, American economist Rosen (1976) put forward the equilibrium model of market supply and demand based on product characteristics. Under the condition of perfect competition market, with maximizing consumer's utility and producer's profit as the goal, Rosen (1976) analyzed theoretically the long term and short-term equilibrium of the heterogeneous product market. Rosen's work established the modeling foundation for the hedonic price theory, based on which, econometrics method can be used to estimate the hedonic price function, get implicit prices of product characteristics, and then analyze the demand of product characteristics.

HEDONIC PRICE MODEL FOR HANGZHOU'S HOUSING MARKET

According to the hedonic price theory, the relation between housing price and housing characteristics can be expressed as:

$$P=f(Z) \tag{1}$$

where, P is housing price, and Z is housing characteristic vector. By calculating the partial derivative of this equation with each housing characteristic variable, we can get the corresponding implicit price of housing characteristic. The hedonic price equation is:

$$P_{Z_i}=\frac{\partial P}{\partial Z_i} \tag{2}$$

Choices and measurements of characteristic variables

Review of related literature (Chang and Lee, 1999; Chau *et al*., 2001; Chin and Chau, 2003; Maand

Li, 2003; Palmquist, 1984; Wen, 2004), showed that housing characteristics can be generally divided into three types: structure characteristic, neighborhood characteristic and location characteristic. Especially, Chin and Chau (2003) provided a critical literature review on the application of the hedonic price model, and identified a list of housing characteristics used in the estimation of the hedonic price models and their effects on housing price. This list can serve as a useful basic checklist for the choice of characteristic variables of the hedonic price model in different markets (Table 1).

With consideration of Hangzhou's actual conditions, we followed the analyzing frame and chose 18 housing characteristics as model independent variables finally. Among them: 7 structure characteristics, 7 neighborhood characteristics and 3 location characteristics. Transaction time, another variable, was to measure how housing price changes along with time. Variables' measurements and signs of expectancy influence on housing price were showed in Table 2.

Function form and estimation method

There are 3 kinds of function forms frequently adopted in hedonic price model: linear, logarithm, logarithm-linear. After trying of model structuring, linear function was found to meet the requirements of this research, so was it selected to express the relation between the housing characteristic and housing price. That is:

$$P = \alpha_0 + \sum \alpha_i Z_i + \varepsilon \qquad (i = 1 \sim 18) \tag{3}$$

where α_i are under-decided coefficients, Z_i are relevant housing characteristic variables, ε is random error. Because independent variables and dependent variable are in the linear model, regression coefficients α_i in the corresponding hedonic prices are constants.

The model's estimation method was the ordinary least squares method (OLS), most frequently used. The multiple-regression was obtained by SPSS10.0 software, and the law of "Enter" was chosen as the analytical method, namely 18 independent variables were entered into the hedonic price model.

The index of *VIF* (variance inflation factor) was used to monitor the muticollinearity between independent variables.

RESULTS AND DISCUSSION

In this paper, the five old districts: Shangcheng District, Xiacheng District, Gongshu District, Jianggan District and Xihu District, all in the urban area of Hangzhou City, were taken as the research districts,

Table 1 List of key housing characteristics used in previous hedonic price model (Chin and Chau, 2003)

	Housing characteristic	Expected sign on housing price
Structure characteristic	Number of rooms, bedrooms, bathrooms	+
	Floor area	+
	Basement, garage, and patio	+
	Building services (e.g. lift, air conditional system etc)	+
	Floor level (multi-story buildings only)	+
	Structural quality (e.g. design, materials, fixtures)	+
	Facilities (e.g. swimming pool, gymnasium, tennis court)	+
	Age of the building	–
Neighborhood characteristic	Income of residents	+
	Proximity to good school	+
	Proximity to hospitals	?
	Proximity to places of worship (e.g. mosques, churches, temples)	+
	Crime rate	–
	Traffic/airport noise	–
	Proximity to shopping centers	?
	Proximity to forest	?
	Environmental quality (e.g. landscape, garden, playground)	+
Location characteristic	Distance from CBD	–
	View of the sea, lakes or rivers	+
	View of hills/valley/golf course	+
	Obstructed view	–
	Length of land lease	+

Table 2 Measure methods and signs of housing characteristic variables

Characteristics class	Variable	Variable meanings and measure methods	Sign
Structure characteristic	Floor area (Z_1)	Total floor area of one housing (square meter)	+
	Housing age (Z_2)	Housing age (Year, the age of housing built in 2003 is 1)	–
	Orientation (Z_3)	Dummy variables: south-north is scored 1, other is 0	+
	Decoration degree (Z_4)	Divided into 5 degrees: no decoration (scored 1), simple decoration (scored 2), medium decoration (scored 3), high-level decoration (scored 4), exquisite decoration (scored 5)	+
	Housing storeys (Z_5)	Number of the storey	?
	Garage (Z_6)	Dummy variables: Having garage or parking space is scored 1, or else is 0	+
	Attic (Z_7)	Dummy variables: having attic is scored 1, or else is 0	+
Neighborhood characteristic	Environment (Z_8)	The environmental quality around the community is divided into 5 degrees: quite bad (scored 1), bad (scored 2), common (scored 3), good (scored 4), very good (scored 5)	+
	Inner environment (Z_9)	The environmental quality inside the community is divided into 5 degrees: quite bad (scored 1), bad (scored 2), common (scored 3), good (scored 4), very good (scored 5)	+
	Community management (Z_{10})	The service quality of the community management is divided into 5 degrees: quite bad (scored 1), bad (scored 2), common (scored 3), good (scored 4), very good (scored 5)	+
	University nearby (Z_{11})	Dummy variables: college or university within 1000 meter is evaluated 1, or else is 0	+
	Life establishment (Z_{12})	Supermarket, terminal market, bank, post office, hospital within 1000 meters from the community, each item is scored 1, total is 5	+
	Education establishment (Z_{13})	Kindergarten, elementary school and middle school within 1000 meters from the community, each item is scored 1, total is 3	+
	Entertainment facility (Z_{14})	Natatorium, body-healthy facility, basketball court, tennis court, entertainment stage for the elderly residents inside the community, each item is scored 1, total is 5	+
Location characteristic	Distance to CBD (Z_{15})	The linear distance from the community to the Central Business District (CBD) of Hangzhou: Wulin Square (km)	–
	Distance to West Lake (Z_{16})	The linear distance from the community to West Lake (km)	–
	Traffic condition (Z_{17})	The total number of the bus routes within 500 meters of the community	+
Other characteristic	Transaction time (Z_{18})	Transaction time of the housing sample, expressed in month, from 1 to 7	+

and the multi-storey housing and litter-tall-storey housing (>7 storeys) were taken as the research objects. The number of total samples was up to 2473 and the time span was from Jan. 2003 to Jul. 31st, 2003.

Test of the housing hedonic price model

R square of the model was 0.852, adjusted R^2 was 0.851, the *D-W* (Durbin-Watson) value was 1.991, all which indicated the fitness of the model was high. The F value was 787.431 and the p-value was 0.000, which indicated that the fitness of samples data to the model was meaningful statistically and that the regression equation was effective (Table 3 and Table 4).

Table 5 shows that the significance level of t test of most coefficients was smaller than 10%, which indicated the corresponding coefficient had significance influence. Among *VIF* values of all variables, the minimum was 1.012 and the maximum was 4.304, both far smaller than 10, which indicated that the muticollinearity degree between the independent variables was not serious.

Table 3 Model summary

R	R^2	Adjusted R^2	Std. error of the estimate	*D-W*
0.923	0.852	0.851	13.1406	1.991

Table 4 ANOVA

	Sum of squares	*Df*	Mean square	F	p-value
Regression	2447476.750	18	135970.931	787.431	0.000
Residual	423748.289	2454	172.677		
Total	2871225.039	2472			

Table 5 Regression coefficients

	Unstandardized coefficients		Standardized coefficients	*T*-value	*VIF*
	B	Std. error	*Beta*		
Constant	–15.082	3.010		–5.011***	
Z_1	0.594	0.008	0.833	72.664***	2.186
Z_2	–3.324E-03	0.005	–0.006	–0.713	1.012
Z_3	0.269	0.080	0.029	3.379***	1.222
Z_4	6.101	1.060	0.048	5.758***	1.179
Z_5	5.528	1.293	0.036	4.275***	1.159
Z_6	–1.166	1.098	–0.008	–1.062	1.023
Z_7	1.212	0.214	0.046	5.656***	1.096
Z_8	1.758	0.381	0.041	4.611***	1.296
Z_9	1.963	0.426	0.067	4.612***	3.508
Z_{10}	0.924	0.339	0.044	2.728***	4.304
Z_{11}	–1.328	0.680	–0.016	–1.953*	1.094
Z_{12}	–7.689E-02	0.452	–0.002	–0.170	1.459
Z_{13}	0.626	0.478	0.013	1.310	1.654
Z_{14}	1.613	0.838	0.020	1.924*	1.794
Z_{15}	–1.122	0.289	–0.059	–3.877***	3.803
Z_{16}	–3.624	0.302	–0.154	–12.020***	2.747
Z_{17}	0.506	0.084	0.056	6.015***	1.420
Z_{18}	0.520	0.183	0.022	2.835***	1.014

* significant level was10%; ** significant level was 5%; *** significant level was 1%

Results and discussion

Values of coefficient and significance test results are given in Table 5.

1. Sign analysis of the housing hedonic price

At the significance level of 10%, 14 independent variables entered the model, and the significance levels of 12 variables among them were smaller than 1%. Four variables housing age, orientation state, life establishment and education establishment had significance level greater than 10%. Statistically, these four coefficients were not different from zero, namely these variables did not enter into this model. Except the variable university nearby, the signs of the other 13 variables were the same as those expected. According to their signs, we can qualitatively analyze the trend of housing characteristics impacts on housing price. Among them: floor area, decoration degree, housing storeys, garage, attic, environment, inner environment, community management, entertainment facility, traffic condition, transaction time had positive influence on housing price, while the distance to CBD and West Lake had negative influence on housing price. As to the variable of university nearby, the sign was negative and the significance level was 5.1%. It proved that universities had negative influence on the housing price of the surrounding communities in Hangzhou.

2. Hedonic price analysis of housing characteristic

The function form of the model was linear, so unstandardized coefficients were corresponding hedonic prices of housing characteristics. For example, the hedonic price of floor area was 0.5940 ten thousand Yuan/square meter, which means that any increase by one square meter the housing price would increase by 5940 Yuan when other characteristics keep constant. Fourteen housing hedonic prices are listed in Table 6.

In term of the description statistics, the mean values of 14 housing characteristic variables are given in Table 6. Housing, with numerical value of every characteristic equaling to the mean value of the whole market, is defined as the standard housing. For the standard housing, the contribution to the housing value of individual housing characteristic (named total characteristic value) is equal to the hedonic price of characteristic multiplied by the corresponding characteristic quantity, and then the contribution ratio equals to total characteristic value divided by the sum of the absolute value of all total characteristic values, just as Table 6 shows. For the standard housing, the contribution rate to the housing price of architecture characteristic was 60.0%, the contribution rate of neighborhood characteristic was 16.5%, the contribution rate of location characteristic was 19.8% and the contribution rate of other characteristic was 2.7%.

3. Influence degree analysis of housing characteristic

Because the units of hedonic price were different, the influence degree of each characteristic on housing price cannot be compared directly, but the standardized regression coefficient (*Beta*) obtained after all

Table 6 Hedonic price of housing characteristic

Characteristics class	Variable	Hedonic price	Standard housing		
			Mean value of variable	Total characteristic value	Contribution ratio
Structure characteristic	Floor area	0.594	93.86	55.753	55.4%
	Housing storeys	0.269	4.9634	1.335	1.3%
	Garage	6.101	7.97E-02	0.486	0.5%
	Attic	5.528	4.21E-02	0.232	0.2%
	Decoration degree	1.212	2.144	2.599	2.6%
	Total				60.0%
Neighborhood characteristic	Environment	1.758	3.6247	6.372	6.3%
	Inner environment	1.963	3.5677	7.003	7.0%
	Community management	0.924	2.7222	2.515	2.5%
	University nearby	–1.328	0.2087	–0.277	0.3%
	Entertainment facility	1.613	2.2321	0.374	0.4%
	Total				16.5%
Location characteristic	Distance to CBD	–1.122	3.8273	–4.294	4.3%
	Distance to West Lake	–3.624	3.6613	–13.269	13.2%
	Traffic condition	0.506	6.7744	3.428	3.4%
	Total				19.8%
Other characteristic	Transaction time	0.520	5.243	2.726	2.7%
	Total				2.7%
	Total				100%

variables were standardized (Z mark), can serve as index to make comparison and Beta's absolute value was used for sequencing the characteristic influence degree directly, and the order (before test) is shown in Table 7. There were possibly sample errors, so the comparison results of $|Beta|$ need statistical test.

Dependent variable P' and independent variables V_k (k=1~14) were first obtained after all variables were standardized by Z mark, then α_{ij} was set to be $|\alpha_i|-|\alpha_j|$ (i, j=1~14, and $i<j$), to examine by t-test if there was significant difference between α_{ij} and zero. Putting $|\alpha_i|=\alpha_{ij}+|\alpha_j|$ into $P'=\sum\alpha_k V_k$, yielded $P'=\pm\alpha_{ij}V_i+\alpha_j(\pm V_i+V_k)+\sum\alpha_k V_k$ (k=1~14, and $k\neq i$, j). The equation to be calculated is given in Table 8.

Table 7 Order and classification of influence degree on housing price

Variable no.	Variable	*Beta*	Order (before test)	Order (after test)	Class
V_1	Floor area	0.833	1	1	1
V_2	Distance to West Lake	–0.154	2	2	2
V_3	Inner environment	0.067	3	3	3
V_4	Distance to CBD	–0.059	4	4	3
V_5	Traffic condition	0.056	5	4	3
V_6	Garage	0.048	6	5	4
V_7	Decoration degree	0.046	7	5	4
V_8	Community management	0.044	8	6	4
V_9	Environment	0.041	9	6	4
V_{10}	Attic	0.036	10	7	4
V_{11}	Housing storeys	0.029	11	8	5
V_{12}	Transaction time	0.022	12	9	5
V_{13}	Entertainment facility	0.020	13	9	5
V_{14}	University nearby	–0.016	14	10	5

Table 8 Equation to be calculated

α_i	α_j	$\lvert\alpha_i\rvert-\lvert\alpha_j\rvert=\alpha_{ij}$	$P'=\pm\alpha_{ij}V_i+\alpha_j(\pm V_i+V_k)+\sum\alpha_k V_k$
>0	>0	$\alpha_i-\alpha_j=\alpha_{ij}$	$P'=\alpha_{ij}V_i+\alpha_j(V_i+V_k)+\sum\alpha_k V_k$
>0	<0	$\alpha_i+\alpha_j=\alpha_{ij}$	$P'=-\alpha_{ij}V_i+\alpha_j(-V_i+V_k)+\sum\alpha_k V_k$
<0	>0	$-\alpha_i+\alpha_j=\alpha_{ij}$	$P'=\alpha_{ij}V_i+\alpha_j(-V_i+V_k)+\sum\alpha_k V_k$
<0	<0	$-\alpha_i-\alpha_j=\alpha_{ij}$	$P'=-\alpha_{ij}V_i+\alpha_j(V_i+V_k)+\sum\alpha_k V_k$

Calculation with this equation yielded the value of α_{ij} and t-value (Table 9). At the significance level of 10%, the influence degree on housing price between V_6 and V_7 was not different from zero, and the results of their comparative with all other variables were just the same, so V_6 and V_7 were classified as of the same order. Adopting the same principle showed that V_4 and V_5, V_8 and V_9, V_{12} and V_{13} had the same ranks. The order (after test) is just as Table 7 shows.

The absolute value of *Beta* was used for cluster analysis (Squared Euclidean Distance used) with SPSS 10.0, giving Vertical icicle picture shown in Fig.1. Comparison reveled it was suitable to classify the housing characteristics into five types; the results are just as Table 7 shows.

CONCLUSION

The theoretical foundation of the hedonic price model is mainly made up of two parts: Lancaster preference theory and Rosen's characteristic supply-demand equilibrium model. This paper uses the characteristic analysis frame of structure-neighborhood-location, chooses 18 housing characteristics as the independent variables of the model, and adopts the linear function form to structure the hedonic price model for the housing market of Hangzhou. Through model estimation and coefficient analysis, as far as the whole housing market of Hangzhou is concerned, 14 housing characteristics with different influence degrees on housing price, arranged sequentially from great to small: floor area, distance to West Lake, inner environment, distance to CBD, traffic condition, garage, attic, decoration degree, environment, community management, housing story, entertainment facility, transaction time, university nearby. Other four variables' (housing age, orientation state, life estab-

Table 9 Values of α_{ij} and results of *t*-test

V	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1														
2	0.679*** (39.873)													
3	0.766*** (39.469)	0.087*** (4.885)												
4	0.774*** (40.436)	0.096*** (3.674)	0.008 (0.392)											
5	0.777*** (51.583)	0.099*** (6.625)	0.011 (0.680)	0.003 (0.152)										
6	0.785*** (52.853)	0.106*** (6.817)	0.019 (1.091)	0.010 (0.582)	0.007 (0.574)									
7	0.787*** (58.466)	0.109*** (6.919)	0.021 (1.276)	0.013 (0.738)	0.010 (0.796)	0.003 (0.201)								
8	0.789*** (35.393)	0.111*** (5.052)	0.023 (0.822)	0.015 (0.705)	0.012 (0.625)	0.005 (0.250)	0.002 (0.114)							
9	0.792*** (53.688)	0.114*** (8.467)	0.026 (1.502)	0.018 (0.904)	0.015 (1.318)	0.008 (0.630)	0.005 (0.432)	0.003 (0.167)						
10	0.797*** (52.662)	0.119*** (7.693)	0.031* (1.903)	0.023 (1.388)	0.020 (1.589)	0.013 (0.970)	0.010 (0.869)	0.008 (0.453)	0.005 (0.417)					
11	0.804*** (51.940)	0.126*** (8.576)	0.038** (2.285)	0.030* (1.866)	0.027** (2.198)	0.020 (1.622)	0.017 (1.427)	0.015 (0.772)	0.012 (1.017)	0.007 (0.571)				
12	0.811*** (58.082)	0.132*** (8.857)	0.045*** (2.684)	0.037** (2.124)	0.033*** (2.742)	0.026** (2.291)	0.024** (2.084)	0.022 (1.234)	0.019 (1.562)	0.014 (1.157)	0.007 (.582)			
13	0.813*** (49.221)	0.135*** (7.292)	0.047*** (2.609)	0.039*** (2.657)	0.036** (2.418)	0.028** (2.128)	0.026* (1.921)	0.024 (1.173)	0.021 (1.448)	0.016 (1.171)	0.009 (0.703)	0.002 (0.168)		
14	0.817*** (57.196)	0.139*** (8.533)	0.051*** (3.091)	0.043*** (2.617)	0.040*** (3.083)	0.033*** (2.800)	0.030*** (2.584)	0.028* (1.728)	0.025** (2.004)	0.020* (1.666)	0.013 (1.147)	0.006 (0.557)	0.004 (0.320)	

* significant level was10%; ** significant level was 5%; *** significant level was 1%; *t*-value in the bracket

Number of clusters	Case																									
	14		13		12		11		10		9		8		7		6		5		4		3		2		1
1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		X
4	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		X
5	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X		X	X	X	X	X		X		X
6	X	X	X	X	X		X		X	X	X	X	X	X	X	X	X		X	X	X	X	X		X		X
7	X	X	X	X	X		X		X	X	X	X	X	X	X	X	X		X	X	X		X		X		X
8	X	X	X	X	X		X		X	X	X		X	X	X	X	X		X	X	X		X		X		X
9	X		X	X	X		X		X	X	X		X	X	X	X	X		X	X	X		X		X		X
10	X		X	X	X		X		X		X		X	X	X	X	X		X	X	X		X		X		X
11	X		X	X	X		X		X		X		X	X	X		X		X	X	X		X		X		X
12	X		X	X	X		X		X		X		X	X	X		X		X		X		X		X		X
13	X		X	X	X		X		X		X		X		X		X		X		X		X		X		X

Fig.1 Vertical icicle

lishment and education establishment) coefficients were not statistically different from zero. In standard housing, the contribution rate to housing price of architecture characteristic, neighborhood characteristic, location characteristic and other characteristic were respectively 60.0%, 16.5%, 19.8%, 2.7%.

The improved place and the deficiency of this research are as follows:

1. The subdividing of housing market has not been considered. In the realistic housing market, there may be some submarkets. Because the purpose of this paper was to study the influence degree of housing characteristics to housing price from the scope of the whole urban area, the impact of market segment on the hedonic price model has not been investigated in detail, and needs further study.

2. The function form needs further optimization. The paper adopted the linear function form and obtained the hedonic price from the model coefficients directly. Though this kind of function form has been used most extensively in the hedonic price model, it can only obtain the average hedonic price of the

housing characteristic on the whole. Further study on quantification methods of some characteristic variables and the improvement of the functional relation of some housing characteristics and housing prices may make the result more convincing.

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