A Study On Influential Factors of Residential Rental Prices Based On Hedonic Price Model ——Evidence From Central Urban Districts Of Chengdu

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A Study On Influential Factors of Residential Rental Prices Based On Hedonic Price Model

——Evidence From Central Urban Districts Of Chengdu

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Abstract: With the government's efforts to regulate housing prices, the trend of excessive housing price increases has been suppressed to some extent. Meanwhile, the government introduced a policy of renting and selling have the same rights, stimulating the development of the housing leasing market, increasing the market demand for residential leasing, and having an important impact on the formation of housing rental prices. This paper analyzes the influential factors of the formation of housing rental prices in Chengdu, selects the key variables of the residential rental characteristic price index, and constructs the model of the influential factors of the characteristic price of housing rental in Chengdu. The empirical study using residential sample data from three central urban districts in Chengdu. The data analysis showed that the 12 variables of residential building characteristics, neighborhood characteristics, location characteristics, and regional characteristics affected the residential rental price to varying degrees. The conclusions of this paper provide a theoretical basis for the pricing and management of residential leasing in Chengdu.

Keywords: residential leasing, residential rent, hedonic price model, Chengdu

1. INTRODUCTION

In recent years, the government has strictly controlled housing prices, making the price increase gradually stabilize. However, owing to the high housing prices in the first-tier cities, the single housing supply structure, and real estate purchase restrictions, the purchase of houses is no longer the only way for people to solve their housing problems (Su et al., 2014) [1].The gradually mature residential leasing market is increasingly becoming the main way to solve the housing problems of the floating population and low-and middle-income people (Zhang et al, 2017) [2] .In 2017, a number of cities have successively introduced the policy of renting and selling have the same rights, so that tenants can enjoy the same rights as the residents in the basic public services, and accelerate the cultivation and development of the residential leasing market. At the same time, the formation of reasonable residential rental prices will also promote the leasing market mature. At present, there are few kinds of research on the characteristic price of residential leases at home and abroad and mainly focus on the residential characteristic prices of new and second-hand houses (Deng et al, 2018) [3], while the characteristic prices of rental houses are rarely studied by scholars. Therefore, the formation mechanism of the rental price and its influential factors are also urgently needed to be studied, which provides a theoretical basis for the pricing and management of residential leasing, and provides a reference for the healthy development of the residential industry.

This paper applies the hedonic price theory , integrates the urban location theory , and expands the hedonic price model. On the basis of the existing research, consolidate the relevant kinds of literature, relevant key

variables are selected, and the regional characteristics of the residential house are included in the hedonic price model. The factors affecting the residential rental price are further analyzed, and the model of the residential characteristic price influencing factors is established. The pricing and management of residential leasing provide a theoretical basis.

2.   RELATED   THEORY

2.1 Hedonic price theory

The hedonic price theory is that consumers buy products or services because they have different values or functions, and these values become characteristic prices (Chen et al, 2011) [4]. The hedonic price theory consists of the preference theory proposed by Lancaster (1966) [5] and the market supply and demand equilibrium theory proposed by Rosen (1974) [6]. Lancaster's preference theory analyzes the basic "element" space that constitutes a commodity, starting from the difference of commodities. It is believed that the consumer's demand for commodities is not based on the commodity itself, but on the characteristics of the commodity. In a perfectly competitive market, Rosen aims to maximize the consumer utility and maximize the profit of producers,and analyzes the short-term equilibrium and long-term equilibrium of the heterogeneous product market, which lays a theoretical foundation for the estimation of the hedonic price model.

The existing literature is mainly based on the hedonic price theory, and the factors affecting the residential rental price are studied by constructing the hedonic price model. Yang et al. (2012) [7] applied the residential leasing market in Harbin as an example to construct a hedonic price model for residential rents in Harbin; Wang et al. (2006) [8] used the hedonic price model to study the residential leasing market in Hangzhou. For the characteristics of residence, most of the literature also divides it into three aspects, namely the location, building and neighborhood characteristics of the residence (Wen et al, 2012)[9] . Zhang et al. (2014)[10] took the Guangzhou residential market as the research object, indicating that the neighborhood characteristics of the residence have a significant impact on the residential price. Atterhog and Lind (2004) conducted a study using the hedonic price model, which showed that the building characteristics of the residence had a greater impact on the rent, and the rent of the residence increased with the increase of residential area. Yang and Li (2012) [7] attributed the traffic factor to the location characteristics of the residence, which in turn explained that the location characteristics of the residence affected the rental price.

2.2 Urban location theory

Urban location theory can be divided into classical location theory and political behavior school. The classical location theory has four major analytical traditions, which respectively explain the factors and mechanisms that determine the location distribution from different perspectives. They lay the basic framework for location analysis (Wei et al, 2005) [11]. The urban location theory reveals that the location of the house is different and its price will be different. The difference in location is not only reflected in the difference in commuting costs, but also in the differences in factors such as the economy, population, income, and public service resources. Therefore, location factors will also have an impact on residential rental prices and are worthy of study.

The existing literature applies urban location theory to study residential rental prices. Tu et al. (2005) [12] studied the effect of per capita consumption expenditure on rent increase from an economic perspective. The regional characteristics of real estate in the city center area are the most significant, followed by the building characteristics of the real estate and the location characteristics of the real estate , and finally the neighborhood characteristics of the real estate (Liu et al, 2018) [13]. The high level of development of urban central areas will

change the location conditions of regional housing, increase the location advantage of housing, and thus increase the housing rental price (Chen et al, 2017) [14]; Xiao et al. (2011) [15] studied the impact of educational resource allocation on housing prices. It is found that housing prices and rent prices in areas with better education resources are generally high; Li et al. (2011) [15] show that when people's consumption level is low, even if the demand side has subjective desire to buy houses, it will be constrained by consumption levels. Without the ability to buy a house, people will rent a house to meet the housing demand, and the rental price will be affected.

Most of the existing literature has studied the formation of residential rental prices based on the hedonic price theory or the urban location theory. Based on the above analysis, this paper integrates the hedonic price theory and the urban location theory, and incorporates the regional characteristic variables into the research model. Through empirical research, the key factors affecting the price are clarified.

3.   RESEARCH MODEL

3.1 Research model

Based on the above analysis, it is found that the factors affecting the residential rental price include many aspects. This paper integrates the hedonic price theory and the urban location theory, and uses the four dimensions of residential building characteristics, location characteristics, neighborhood characteristics,and regional characteristics to establish a research model of the factors affecting the residential rental price, as shown in Fig.1. Using the specific data of the residential characteristic variables in the central urban districts of Chengdu, empirical analysis analyzes the characteristics of the residential rental prices in Chengdu and determines the degree of impact.
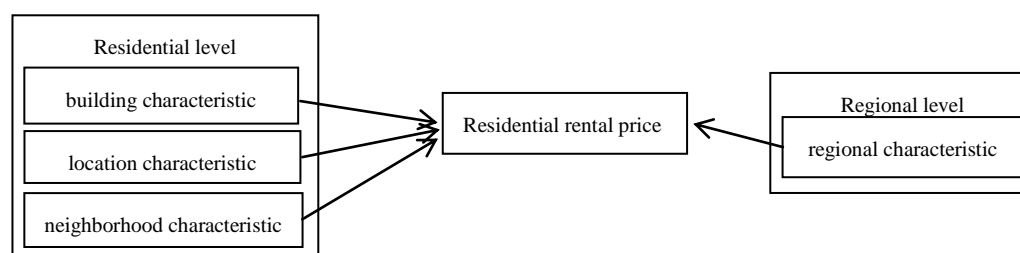

Figure 1.   Research model

3.2 Variable definition

Based on the above research model, the characteristic variables are extracted from the four characteristic dimensions of building, location, neighborhood, and region that affect the residential rental price. Firstly, according to the characteristics of residential construction, Su et al. (2014) [1] research on residential rents in Beijing shows that residential rents have a positive correlation with residential area and unit size. In addition, the floor and orientation of the building also have a significant impact on the rent level (Jia et al, 2014)[10]. Deng et al. (2018) [3] considered the residential characteristics of Wuhan City and considered that there was a significant negative correlation between rent and age. Therefore, this paper introduces research variables such as residential area, unit , and floor.

Secondly, with regard to housing location characteristics, Benjamin and Sirmans (1996)[16] studied residential buildings near the Washington subway station, noting that residential rents decreased as the distance from the subway station increased. Wang et al. (2014) [17] also studied the residential location of Yangzhou City and pointed out that the construction and renovation of transportation can improve the value of housing. In addition, the distance of the home from the center of the district will also affect the house price and rental price

(Wen et al, 2010)[9] .This paper intends to construct a research model using variables such as the number of subway stations and the distance from the center of the district.

Thirdly, from the characteristic dimension of the housing neighborhood, Feng et al. (2016) [18] pointed out that there is a quantitative relationship between the allocation of educational resources and the residential price in Hangzhou. Wu et al. (2012) [19] believe that people pursue a convenient life and hope to rent a community with perfect living facilities and commercial support. The cultural sites around the community are relatively complete, the surrounding greening environment will be better, and the rent will be affected (Zhou et al, 2017)[2] . This paper applies variables such as the number of parks, shopping malls, primary schools, and hospitals within a certain range around the community.

Finally, around the characteristics of the residential region, Xiao et al. (2011)[15] found that per capita disposable income reflects the development level of a region, and the area with higher development level will have higher rents for residence. Zhang et al. (2005)[12] studied the effect of per capita consumption expenditure on rent rise from an economic perspective. In addition, the regional public infrastructure is relatively complete, the population is dense, and residential rents are relatively high (Liu et al, 2018)[13]. This paper introduces a model for constructing variables such as per capita consumption expenditure and public infrastructure investment.

The specific rental residential characteristic variables are shown in Table 1.

Table 1.   Description of characteristic variables

Characteristic category	Characteristic variable	Description
Regional characteristics	Per capita disposable_Income	The average income of residents of a region available for discretion.
	Per capita consumption_Expenditure	The average expenditure for the residents of a region to meet the daily consumption.
	Public infrastructure_Investment	The direction in which the residence is located.
Building characteristics	Residence_Area	All available space area in the residence.
	Residence_Age	Days elapsed since the developer hand over the residence.
	Residence_Floor	The floor of the residence is classified into three types: low-level, middle-level, and high-level.
	Residence_Unit	The structure and shape of the residence.
	Residence_Orientation	The direction in which the residence is located.
Neighborhood characteristics	Park_Number	The number of parks within one kilometer of the residence.
	Square_Number	The number of squares within one kilometer of the residence.
	Shopping mall_Number	The number of shopping malls within one kilometer of the residence.
	Kindergarten_Number	The number of kindergartens within one kilometer of the residence.
	Primary school_Number	The number of primary schools within one kilometer of the residence.
	Secondary school_Number	The number of secondary schools within one kilometer of the residence.
	Supermarket_Number	The number of supermarkets within one kilometer of the residence.
	Hospital_Number	The number of hospitals within one kilometer of the residence.
Location characteristics	District center_Distance	The distance from the residence to the center of the district.
	Bus stop_Number	The number of bus stops within 500 meters of the residence.
	Subway station_Number	The number of subway stations within one kilometer of the residence.

4.   EMPIRICAL ANALYSIS

4.1 Data collection

The data in this paper is mainly collected in the following three ways: (1) Using the Python programming language, obtain the three central urban districts of Chengdu through the Lianjia. network, which are 91 communities in Jinjiang District, Chenghua District , and Jinniu District, with a total of 1760 residential houses sample. Through the Lianjia.network, the main listing information of the residence is collected, including the rent, unit, area, floor, orientation and age of the house. (2) Collecting the surrounding data of the community through Baidu map, which is mainly applied to reflect the neighborhood characteristics and location characteristics of the rental residences. (3) Search the national economic and social development statistical bulletin of Jinjiang District, Jinniu District and Chenghua District of Chengdu City through the official website of Chengdu Bureau of Statistics to collect the regional characteristics of the three districts of Chengdu.

4.2 Regression model construction

The residential rental price is used as the dependent variable, and the various characteristic attributes of the residence are used as the independent variables of the residence. A multiple linear regression model is constructed, and the least square method (OLS) is used to analyze the influence weight of various characteristic factors of the residence on the rent. Therefore, the general expression of the multiple linear regression model constructed in this paper is:

Residential rent_Price=α_0+α_1Residence_Area+α_2Residence_Age+α_3Residence_Floor+α_4Residence_Unit+α_5 Residence_Orientation+α_6Park_Number+α_7Square_Number+α_8Shoppingmall_Number+α_9Kindergarten_Number+α_{10}Primary school_Number+α_{11}Secondaryschool_Number+α_{12}Supermarket_Number+α_{13}Hospital_Number +α_{14}District center_Distance+α_{15}Bus stop_Number+α_{16}Subway station_Number+α_{17}Per capita disposable_Income+α_{18}Per capita consumption_Expenditure+α_{19}Public infrastructure_Investment + ε. In the model, Residential rent_Price is the rental price of the residence, α_0 is the constant term, α_i (i = 1, 2, 3...19) is the coefficient of the characteristic variable, and ε is the residual.

4. 3 Data processing

This paper has collected 1760 residential data in three central urban districts in Chengdu in October 2018, eliminating the incomplete data of variable information, and finally screening 1728 residential samples. The selected rental housing variables total 19, and different types of variables are quantified in different ways. The methods of quantification can be divided into three categories: (1) using raw data directly as variable values; (2) the floor uses dummy variables as application data, and the lower, middle and high floors are numbered 1, 2, and 3 respectively; (3) the units use categorical variables, and there are 16 different types of units, numbered with numbers 1-16; (4) the orientation of the residence uses dummy variables as application data. Because the orientation is more favored by people facing south, it will be marked as 1 by the north and 0 by the other. (5) In addition to the dummy variables, each variable data is substituted into SPSS 22.0 software, and the variable data is standardized. (6) Finally, the dummy variable data and the standardized score data were substituted into SPSS 22.0 software, and multiple linear regression analysis was performed. The model parameters were estimated by least squares (OLS).

4. 4 Model estimation and testing

In this paper, the linear functional form is used as the basic form of the model, and the least squares method is chosen as the method of model estimation. First, the sample data was analyzed. The relevant tests are as

follows:

(1) Significance test and analysis of variance. It is proved that the negative correlation coefficient R=0.82, which is very close to 1, indicating that the linear relationship between the independent variable and the dependent variable is very strong. The determination coefficient R^2=0.673 and the adjusted R^2=0.67, indicating that the model has a good degree of fitting and good interpretation ability, and the model can explain the percentage difference of the dependent variable is 67%.

It can be seen from Table 2 that the significance test of the regression equation variance analysis is 0.000, less than 0.001, indicating that the equation is highly significant, rejecting the null hypothesis that "all coefficients are zero." This indicates that the linear relationship between the residential rental characteristics entering the equation and the rent is established.

Table 2.   The result of ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	1161.635	18	64.535	195.253	.000
Residual	564.201	1707	.331		
Total	1725.835	1725			

(2) Collinearity diagnosis.The minimum value of VIF in the variable is 1.011 and the maximum value is 2.930, which is much smaller than 10, so that the collinearity problem between the independent variables is not serious, and the model is diagnosed by collinearity. Among them, the tolerance value of Per capita disposable_Income is .000, less than 0.1, indicating that there is serious collinearity between the variable Per capita disposable_Income and other independent variables, so the variables are eliminated. And the tolerance value of other variables are within reasonable ranges.

4.5 Model analysis

As can be seen from Table 3, 13 of the 19 independent variables entered the basic model. It can also be seen from table 3 that most of the variables have a significance level of less than 1%. The five variables of Residence_Floor, Residence_Orientation, Shopping mall_Number, Primary school_Number , and Secondary school_Number have a significant level of more than 10%. From a statistical point of view, there is no difference between the regression coefficient and zero, that is, these five variables cannot enter the model. And because the tolerance value of Per capita disposable _Income is .000, less than 0.1, it indicates that there is serious collinearity between Per capita disposable_ Income and other independent variables, so it is also excluded. Therefore, there are finally 13 variables added to the model. There are three building characteristics of the residence, namely Residence_Area, Residence_Unit , and Residence_Age; there are 5 neighborhood characteristics, namely Park_Number, Square_Number, Kindergarten_Number, Supermarket_Number, and Hospital_Number; there are 3 location characteristics, namely Subway station_Number, Bus stop_Number, and District center_Distance; there are two regional characteristics, namely Public infrastructure_Investment and Per capita consumption_Expenditure.

Table 3.   Analysis of regression coefficients

	B	Std. Error	Beta	t	Sig.
Constant	-7.223E-5	.014		-.005	.996
Residence_Area	.755	.018	.754	42.430	.000
Residence_Unit	-.123	.017	-.123	-7.206	.000
Residence_Orientation	-.014	.014	-.014	-.982	.326
Residence_Floor	-.012	.014	-.012	-.830	.407
Residence_Age	-.294	.017	-.294	-17.551	.000

	B	Std. Error	Beta	t	Sig.
Park_Number	.049	.016	.049	3.009	.003
Square_Number	.145	.019	.145	7.449	.000
Shopping mall_Number	.024	.019	.024	1.252	.211
Kindergarten_Number	-.165	.023	-.165	-7.020	.000
Primary school_Number	.025	.020	.025	1.249	.212
Secondary school_Number	.012	.017	.012	.709	.478
Supermarket_Number	.078	.017	-.078	-4.682	.000
Hospital_Number	.108	.018	.108	6.089	.000
Subway station_Number	.108	.019	.108	5.747	.000
Bus stop_Number	.029	.017	.029	1.715	.087
District center_Distance	-.152	.024	-.152	-6.426	.000
Public infrastructure_Investment	.043	.019	.043	2.217	.027
Per capita consumption_Expenditure	.069	.020	.069	3.437	.001

Among the 19 variables, 6 variables are Residence_Floor, Residence_Orientation, Shopping mall_Number, Primary school_Number, Secondary school_Number, and Per capita disposable_Income did not enter the model. For tenants, there is usually not much demand for the floor of the residence, because the high-rise houses are usually equipped with elevators, which have little effect on travel. When designing the structure of a residence, the developer usually considers the orientation of the residence. Usually, at least one room is oriented north facing, so the tenant does not excessively require all rooms to face south. In recent years, Chengdu's investment in the construction of primary and secondary schools has increased, not only in increasing the quality of primary and secondary schools but also constantly improving the faculty and teaching level of ordinary schools. Therefore, the number of factors affecting primary and secondary schools is not significant.

After screening the original independent variables, re-substitute the data, use SPSS 22.0 software to run the model, and repeat the above several test steps. After testing, it was found that the model after screening has good fitness and high interpretation ability. As shown in Table 4, the final regression coefficient can be resulted. Among them, the variable Bus stop_Number has a sig. value of 1.24 and a significance level greater than 10%, so it is excluded. The other 12 variables were significant and entered the final regression model. According to the above analysis, it can be concluded that the hedonic price model of Chengdu residential leasing is: Price=-0.061+0.754Residence_Area-0.295Residence_Age-0.126Residence_Unit+0.045Park_Number+0.147Square_Number-0.148Kindergarten_Number+0.73Supermarket_Number+0.116Hospital_Number-0.173District center_Distance+0.097Subway station_Number + 0.090Per capita consumption_Expenditure + 0.037Public infrastructure_Investment.

Table 4. Analysis of new regression coefficients

	B	Std. Error	Beta	t	Sig.
Constant	-.061	.042		-1.451	.147
Residence_Area	.754	.018	.754	42.698	.000
Residence_Unit	-.126	.017	-.126	-7.354	.000
Residence_Age	-.295	.017	-.295	-17.659	.000
Park_Number	.045	.016	.045	2.774	.006
Square_Number	.147	.019	.147	7.945	.000
Kindergarten_Number	-.148	.020	-.148	-7.417	.000
Supermarket_Number	.073	.016	-.073	-4.537	.000
Hospital_Number	.116	.017	.116	6.718	.000
Subway station_Number	.097	.018	.097	5.346	.000
Bus stop_Number	.008	.005	.025	1.537	.124
District center_Distance	-.173	.022	-.173	-7.861	.000
Public infrastructure_Investment	.037	.018	.037	2.025	.043
Per capita consumption_Expenditure	.090	.018	.090	4.921	.000

5.   CONCLUSION AND DISCUSSION

5.1 Research conclusions

This paper conducts exploratory research and analysis on the influencing factors of residential rental prices through empirical research. Studies have shown that the Residence_Area, Residence_Unit, Park_Number, Hospital_Number, District center_Distance, Public infrastructure_Investment and other variables all have a significant impact on the rental price of the residence to varying degrees.

In addition, this study also included the regional characteristics of the residence into the hedonic price model, and further explored the factors affecting the residential rental price. Studies have shown that per capita consumption expenditure and public infrastructure investment have a significant positive impact on the price of residential leasing, but per capita disposable income does not affect residential rental prices.

5.2 Research implications

Based on the hedonic price model adopted by previous scholars to study the influencing factors of residential rental price, this paper introduces the new characteristic variable of regional factor based on the original three characteristic variables, and quantifies it, and substitutes it into SPSS 22.0. Multiple regression analysis was performed in the software. Finally, it is concluded that the per capita consumption level of the region, the public infrastructure investment and the residential leasing price are positively correlated. Secondly, this study establishes the hedonic price model for residential rental in Chengdu. On the one hand, it can provide the reference for the pricing of all parties in the residential leasing market. On the other hand, it can also provide a basis for decision-making by relevant government departments.

5.3 Research limitations and prospects

It should be pointed out that there are some limitations to this study. First, the price of residential leasing will be affected by the season. Generally, there are off-season and peak seasons. In future research, The seasonal factor is included as an influencing factor of the residential rental price in the model for analysis. Secondly, in the hedonic price model, the selection of many characteristic factors needs further differentiation. Finally, in future research, the selection and measurement methods of characteristic factors can be developed and improved, and other functions such as logarithm function can be adopted.

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