Conceptual Housing and Housing Prices: An Empirical Study Based on Micro-big Data of Hangzhou Newly-built Housing Market

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Abstract. With the fierce competition in the market and the improvement of residents’ consumption concepts, a multitude of new concept products have emerged in the real estate market, including green housing, education housing, subway housing, and park housing. However, the existing research does not fully explain how these housing concept labels affect the housing price. This study takes Hangzhou as an example, collects a total of 36,907 transaction data of new housing districts in 2016, and constructs a hedonic price model to analyze the influence of four housing concept labels, namely green housing, education housing, subway housing, and park housing, on housing prices. The empirical results show that the impact of diverse types of concept labels on housing prices is heterogeneous. In addition to education housing, the impact of green housing, subway housing, and park housing on housing prices is significant and positive, which can bring an 8.2%, 3.0%, and 4.1% price increase.

1. Introduction
The rapid growth of the real estate industry, while increasing the scale of the real estate, has also made the homogenization of newly-built housing more apparent. Facing the increasingly fierce market competition, developers and sellers try to improve the positioning of real estate in various ways, so that the housings developed by them can stand out from many homogeneous properties and win the favour of buyers. As a result, the housing marketing becomes very essential. Likos et al. [1] pointed out that if real estate developers want to gain competitive advantage, they must develop and design housing products based on consumer demand, strengthen customers’ willingness to pay by improving the quality of products and services. In the marketing activities, developers often use the concept marketing to convey the advantages and characteristics of housing products to the buyers, strengthen their cognition of the concept of housing products. As a common product concept in the housing market, green housing, education housing, subway housing, and park housing attract more and more buyers.

This study collects the price and characteristic data on newly-built housing in Hangzhou in 2016, identifies green housing, education housing, subway housing, and park housing according to the information in the developer’s building book, and further analyzes the impact of these marketing labels on housing prices through the hedonic price model. Compared with the existing literature, this study has distinguished conceptual housing from ordinary houses based on the product positioning transmitted by real estate developers, focusing on the capitalization effect of the product concept and the premium capacity of conceptual housing, which has certain theoretical research value.
2. Literature review
In marketing, the concept is regarded as a comprehensive summary of the particularities of products, services, marketing concepts, etc., and the concept of housing is to summarize the advantages of housing products in terms of quality, function, and price in concise terms [2]. Real estate projects need the support of concepts, which are intangible elements in real estate development and marketing and endow the housing theme and soul. Conceptual marketing has been active in the market as a new marketing model. As a concept housing that appeared earlier in the housing market, green housing, education housing, subway housing, and park housing have received relatively extensive attention in previous literature.

(1) Green housing
As a type of conceptual housing that was early active in the market, green housing uses new technologies and rationally allocates resources to achieve the purpose of natural environmental protection. It aims to provide residents with a healthy, comfortable and ecologically balanced living environment in an efficient and energy-saving manner. [3]. The relevant empirical results also show that the willingness to pay for green housing has become stronger. For example, Ye et al. [4] used the newly-built housing transaction information of 26 green and non-green housing projects in Shanghai from 2009 to 2012 to carry out stepwise multiple regression, and the result has shown that the premium rate of green housing in Shanghai is 8.1%.

(2) Education housing
At present, the construction of educational real estate is mainly realized through two modes, namely self-construction mode and nearby mode [5]. Under the self-construction mode, real estate developers build new kindergartens, primary schools, and other educational facilities near the community, or invite schools with better teaching quality to cooperate in running schools. However, in the nearby mode, real estate developers tend to build their housings near famous schools when choosing lots, thereby occupying the scarce geographical advantage of being adjacent to famous schools. In empirical research, although a large number of studies have shown that educational facilities have a significant capitalization effect, few literatures study how the education-related marketing concepts impact on housing prices directly.

(3) Subway housing
Due to the improvement of accessibility, rail transit usually helps to increase the value of surrounding housing [6]. The subway housing, which developed based on the advantage of subway accessibility, has become a new concept in the era of urban rail transit. In the study on the influence of a new subway line on house prices in Daegu, South Korea, Im and Hong [7] pointed out that the houses along the subway line are often used as appreciation selling points, and their research results show that the house premium within 500m of the new subway line station is 96.3 USD / m².

(4) Park housing
The improvement of social material level and residents' income has dramatically improved the homebuyers' attention degree and willingness to pay for the quality of the living environment. The definitions made by Liu and Luo [8] on the real estate of the park refer to the real estate properties around the park or green space, allowing residents to enjoy the leisure and comfort brought by the park at close range. In related aspects, scholars have also conducted a lot of empirical studies. For example, Maruani and Cohen [9] analyzed the marketing advertisements of Israeli residential projects and then found that the characteristics and information of the park landscape in the advertisements are natural to attract buyers and can bring an apparent premium.

3. Data and model
3.1. Data and variable description
Housing data includes the transaction data of 283 newly-built housing districts in eight districts of Hangzhou (Shangcheng District, Xiacheng District, Gongshu District, West Lake District, Jianggan District, Binjiang District, Xiaoshan District, Yuhang District) in 2016. Excluding the samples with
incomplete information, 36907 sets of housing transaction sample valid data were finally obtained. Housing data includes transaction prices and housing characteristics.

The housing transaction data comes from the Hangzhou government housing net. This study selects ordinary housings as the research object, excluding the relevant data of high-price housings such as villas and townhouses, so that the housing prices are comparable. Characteristic data of housing districts are collected through SouFun (http://www.soufun.com). As a leading real estate information website in China, many scholars use relevant information and data on the website to study the real estate market [10]. The concept characteristic information of housing comes from the building book issued by the developer.

In terms of the selection of characteristic variables, it generally starts from three aspects: structure characteristic variables (area, floor, etc.), neighbourhood characteristic variables (educational facilities, surrounding living facilities, etc.), and location characteristic variables (CBD distance, etc.). Based on the existing research results at home and abroad, this study considers the key factors that affect the housing price substantially. Besides, in terms of housing concept, this study mainly chooses "green housing", "education housing", "subway housing" and "park housing", which are four common concepts in marketing or advertising. The quantification of specific housing characteristic variables and their expected impact is shown in Table 1.

| Characteristic type       | Variables       | Variable definition                                           | Expected sign |
|--------------------------|-----------------|---------------------------------------------------------------|---------------|
| Dependent variable       | Price           | Unit price of a housing (CNY/m²)                              | /             |
| Structure characteristic  | Area            | Housing sales area (m²)                                       | +             |
|                          | Floor           | The floor of the housing                                     | +             |
|                          | Decoration      | 1 if the decoration status is hardcover, and 0 otherwise     | +             |
|                          | Well-known      | 1 if the developer is in the "2017 China Top 100 Real Estate Enterprises List", and 0 otherwise | +             |
| Neighborhood characteristic| Property fee    | Housing district property management service level (CNY / m² · month) | +             |
|                          | Volume rate     | The volume ratio value stated in the developer's publicity   | -             |
|                          | Living facilities| Banks, hospitals, food markets and supermarkets; each item is scored 1, and 4 points in total | +             |
|                          | Educational facilities| Kindergartens, primary schools, junior high schools and senior middle schools; each item is scored 1, and 4 points in total | +             |
| Location characteristic   | West Lake       | Straight-line distance from the community center to the coast of West Lake (km) | -             |
|                          | Distance        | Straight-line distance from the community center to the new CBD of Qianjiang New Center (km) | -             |
| Conceptual characteristic | Green housing  | 1 if the project characteristic label is related to green, and 0 otherwise | +             |
|                          | Education housing | 1 if the project characteristic label is related to education, and 0 otherwise | +             |
|                          | Subway housing  | 1 if the project characteristic label is related to rail transit, and 0 otherwise | +             |
|                          | Park housing    | 1 if the project characteristic label is related to park, and 0 otherwise | +             |
3.2. Model specification

The hedonic price model has been widely used in the valuation of heterogeneous commodities. Under its theoretical framework, commodities and services can be regarded as a collection of characteristics. Therefore, buyers are paying prices for a large number of housing characteristics. The sale price of the housing is a hedonic price function that can be expressed as market and non-market characteristics.

Three functional forms of the model are frequently used, namely linear form, logarithmic form, and log-linear form. After continuous trial and comparison, and referring to the existing research results of other scholars, the model is established based on the logarithmic form, taking the logarithmic form of housing price as the dependent variable, the positive and continuous independent variables (such as area, floor, distance) are in the logarithmic form, the dummy variables are in the linear form, and the basic functional form is as follows:

\[ \ln P = \beta_0 + \sum \beta_i \ln X_i + \sum \alpha_j Z_j + \varepsilon \]  

In the formula, \( P \) is the total transaction price of a single house; \( X_i \) takes a positive and continuous variable, such as housing area, floor, West Lake distance; \( Z_j \) is a dummy variable; \( \beta_0, \beta_i, \) and \( \alpha_j \) are parameters with estimates; \( \varepsilon \) is the error term.

4. Results and discussion

In this study, the OLS method is used to perform regression analysis on the characteristic variables and housing prices by the Stata 15.0. The regression results of the model are shown in Table 2. It can be seen from the table that the F value of the analysis of variance is 20150.000, and it is significant at the level of 1%, indicating that the fitting of the model to the sample data is statistically meaningful. The logarithmic function that sets between the housing price and the selected housing characteristics is valid. The adjusted R² value of the model is 0.884, which indicates that the model can explain about 88.4% of the difference of dependent variables. Therefore, the model has a good fit and good explanatory ability. In the collinearity test, the VIF value of all feature variables is between 1.04 and 2.85, which is far less than 5, so it can be considered that there is no large collinearity problem between the independent variables.

Table 2 Hedonic price model regression results.

| In Price                  | Coef  | St. Err | t-value | Sig     | VIF  |
|--------------------------|-------|---------|---------|---------|------|
| In Area                  | 1.132*** | 0.005   | 222.12  | 0.000   | 1.04 |
| In Floor                 | 0.012*** | 0.001   | 9.51    | 0.000   | 1.15 |
| Well-known developers    | 0.041*** | 0.002   | 17.33   | 0.000   | 1.36 |
| Decoration               | 0.185*** | 0.003   | 58.30   | 0.000   | 1.70 |
| Property fee             | 0.028*** | 0.002   | 15.56   | 0.000   | 1.89 |
| Volume rate              | -0.020*** | 0.002   | -8.25   | 0.000   | 1.40 |
| Living facilities        | 0.038*** | 0.001   | 32.03   | 0.000   | 1.57 |
| Educational facilities   | 0.024*** | 0.001   | 16.98   | 0.000   | 1.34 |
| In West Lake Distance    | -0.742*** | 0.004   | -197.03 | 0.000   | 2.71 |
| In Qianjiang New Center  | -0.152*** | 0.003   | -47.80  | 0.000   | 2.85 |
| Green housing            | 0.079*** | 0.003   | 29.15   | 0.000   | 1.43 |
| Education housing        | -0.002   | 0.003   | -0.61   | 0.544   | 1.04 |
| Subway housing           | 0.030*** | 0.003   | 9.40    | 0.000   | 1.17 |
4.1. Impact analysis of traditional characteristics

In the model, the significance level of 10 variables of traditional housing characteristics is less than 0.01, and the symbols of each variable are consistent with the expected symbols. The increase of volume rate, West Lake distance, and Qianjiang New Center distance will restrain the rise of housing prices, while the other characteristic variables, including area, floor, living facilities, etc., have a positive impact on housing prices.

Besides, in the logarithmic model, the regression coefficient of continuous variable corresponds to the price elasticity of housing characteristics, while the semi-elasticity coefficient is derived from the opposition number of the regression coefficient of discontinuous variable. According to the result of data processing, the accurate value of each variable to housing prices can be obtained. For example, for every 1% increase in the housing area, the total price of the house increases by 1.132%, while the price of the house developed by a well-known developer can increase by 4.2%. Other variables can be analyzed similarly.

4.2. Impact analysis of conceptual characteristics

The developers advertise the advantage resources of the real estate through the conceptual way, which helps to increase the buyers' understanding of the housing products and their willingness to pay, so that the conceptual characteristics can be capitalized in the housing price. According to the regression results after processing, the following conclusions can be obtained: The concept of "green housing" has a higher value-added rate to the housing price than the other three concept characteristics, and can bring 8.2% value-added rate to the housing, which means that the liveable ecology and energy-saving efficiency of green housing are increasingly favoured by home buyers with the increase of people's demand for high living standard and the enhancement of environmental protection awareness. What is more, the 4.1% premium generated by "park housing" is also higher than the 3.0% price increase that the "subway housing" can bring, which shows that the preference of buyers for housing environmental attributes and liveability is more evident among the neighbourhood characteristics. As the most important open space in the city, the park has many functions, such as sports, recreation, sightseeing, and space purification. It is also the most convenient ecological landscape for residents to use. In recent years, with the improvement of people's requirements for the living environment, their priority has become higher and higher in consideration of housing purchases.

However, it can be found from Table 2 that the significance level of education housing is greater than 0.1, which shows that there is no significant difference between the regression coefficient of this characteristic variable and zero in the statistical sense. The reason may be that the concept of "education housing" only conveys the information that there are educational resources near the housing districts, while the parents are mainly concerned about the primary and junior middle school education with the school district system. Therefore, the category limitations of educational resources, the uncertainty of new educational resources quality, and the inferior quality of the existing educational resources near the housing, all may lead to the low willingness of buyers to purchase the education housing. Moreover, most of the high-quality school district housings in Hangzhou are second-hand housings. Compared with newly-built education housing, parents may prefer to buy high-quality second-hand school district housings.

5. Conclusions

This study takes 283 newly built housing districts in eight urban districts of Hangzhou as samples, collects housing transaction data and housing characteristic data, and uses it to empirically analyze the impact of the conceptual characteristics passed by developers on housing prices. By constructing a
hedonic price model for regression analysis, this study finds that the three conceptual characteristics of "green housing," "subway housing" and "park housing" all affect the housing price positively, which can bring the price increase of 8.2%, 3.0%, and 4.1%. It confirms that the price difference exists between the concept housing and the ordinary housing, and the premium rate varies with the type of conceptual housing.

The conclusions of this study can provide excellent references and suggestions for real estate developers and buyers. On the one hand, developers must focus on the core value of housing products from the perspective of consumer demand. In the design and development process, the concept of products should be concentrated, and effective marketing measures should be taken to convey the real and reliable information of housing products to buyers, help buyers understand the conceptual housing, and promote the development of the housing market. On the other hand, in the face of diversified housing characteristic information, buyers need to strengthen this information's screening ability to make the right decision.

Acknowledgments
This study is supported by the Natural Science Foundation of China (No: 71974169).

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