

Impacts of Housing Features on Home Prices in Chengdu: Logarithmic Linear Regressions

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Abstract - This paper aims to analyse the effects of several housing features on home prices in Chengdu, China. These features include larger floor space and green coverage rate. There are 1006 samples. Sampling is focused on existing ordinary homes. Data were collected from metropolitan Chengdu. Utilizing log-linear hedonic techniques, the study suggests a nonlinear marginal effect of housing age on house prices. Green converge has a positive impact on prices. We suggest higher property tax rates applicable to units with larger floor space, higher green coverage rate and lower volume fraction.

Index Terms – Home space, green coverage, housing feature, log-linear, marginal effect.

1. Introduction

Chengdu has since 2008 conducted large-scale development activities on underground railways. The dual effects of urban transit track on real estate prices are suggested [1-3]. Elasticity of private house price relative to walking distance is -0.02 [4]. Railway stations [5], light rails [6], underground stations [7] increased either land or house values. However, negative externalities such as noise and congestion reduced house prices [8][2].

Chengdu metropolis displays a spatially concentric pattern. House prices vary inversely with distance or travel time to the CBD, holding other amenities constant. The CBD in Chengdu is situated in Yan Shi Kou nexus. Starting from CBD outwards are four ring broad ways, i.e., Ring Road No. 1, Ring Road No. 2, Ring Road No. 3 and Around-the-city Expressway. Renmin Nan Lu Road and Shu Du Da Dao Avenue are two main radial avenues starting from CBD outwards. Thus, nonlinear and concave urban property prices may exist in Chengdu metropolitan area [9][7]. House prices have a tendency to change marginally with various features such as the distance and age [10].

This paper mainly aims to examine the nonlinear effects of several selected housing features on house prices in metropolitan Chengdu. We introduced a hedonic technique and thus estimated implicit house prices. We expect that the paper would contribute to the house price gradient from the CBD, property valuation, and property tax policy.

2. Methods

Housing properties comprise various features [11][8]. Hedonic methods could discover the prices of these housing features [12]. Hedonic prices are often called implicit prices because they are not explicitly 'viewed' or listed on the board. It has been suggested that there are the alternative functional

forms of hedonic models [13]. Past studies on real estate markets widely use hedonic techniques [14-20][8][21-24].

One commonly used hedonic technique is the log-linear equation [25-27]. Right inferences could be reached using the log-linear form [28]. It is formulated as

$$\log \text{PRICE} = \alpha + \sum_{i=1}^m \beta_i \log X_i + \sum_{j=1}^n c_j D_j + \varepsilon \quad (1)$$

Where PRICE is the house price. X_i represents the i^{th} feature of m housing characteristics. D_j represents the j^{th} element of n house features. D stands for the dummy variable, e.g. CBD location and lake view. Log denotes the natural logarithm. ε is an error term. β_i is a constant elasticity given the continuous variable X_i , or implicit price $P_i = X_i^{\beta_i}$ given integer variable X_i . Existence of D_j implies that price change is $(e^{c_j} - 1) \times 100\%$ [29]. Marginal house price changes could be suggested using estimates of the coefficients [10].

3. Data

We selected 1006 existing ordinary-type units in Chengdu metropolitan area. Sampling area is restricted within Around-the-city Expressway. Suppose that various housing features impact house prices (PRICE). We selected ten housing attributes defined in Table 1. Sampling spans the period from mid-January to mid-April.

Home price is the asking price listed on websites [30][31]. The price is a supply-side price. Floor space is restricted to a range of 50 to 200 square meters. Distance to CBD is that to Yan Shi Kou (city center). The city government has planned that Yan Shi Kou is CBD, where business buildings and activities become highly concentrated.

There are two underground railway lines recently available in Chengdu. Walking distance to nearest underground railway station is divided into five ranges and corresponding dummy variables. A range of up to 400 meters (below five minutes) is assigned 1. A range of 401 to 800 meters (five to ten minutes) is assigned 2. A range of 801 to 1200 meters (ten to fifteen minutes) is assigned 3. A range of 1201 to 1600 meters (fifteen to twenty minutes) is assigned 4. A range of above 1600 meters (above twenty minutes) is assigned 5.

Table I Variable and Definition

Variable	Definition
PRICE	Asking price on the market (RMB/square meter)
Housing features:	
AREA	Floor space (square meters)
YEAR	Home age (years)
BEDROOM	Number of bedrooms
HALL	Number of halls
FLOOR	First, second, ..., <i>n</i> th floor
DECORATION	High quality assigned 1, medium 2, general 3, and not decorated 4
GREENCOVERAGE	Green coverage rate (%)
VOLUMEFRACTION	Neighborhoods volume fraction
DIST_CBD	Distance to CBD (meters)
DIST_STATION	Walking distance to nearest underground railway station (meters)

4. Regressions

We took a stepwise regression strategy. Preliminary regression (Table 2) suggested that two out of ten variables were statistically insignificant. Removing HALL and FLOOR from the initial regression, we obtained the estimated results in Table 3. All the coefficients in Table 3 are significant.

Table II Results of Initial Regression

Variable	Estimates	<i>t</i>	<i>P</i>
LOG (AREA)	1.07	30.2	0.00
LOG (YEAR)	-0.13	-8.33	0.00
LOG (BEDROOM)	0.12	2.93	0.00
LOG (HALL)	-0.02	-0.56	0.57
LOG (FLOOR)	-0.01	-1.28	0.20
LOG (DECORATION)	0.07	4.90	0.00
LOG (GREENCOVERAGE)	0.09	3.13	0.00
LOG (VOLUMEFRACTION)	-0.04	-2.12	0.03
LOG (DIST_CBD)	-0.15	-6.94	0.00
LOG (DIST_STATION)	0.02	1.98	0.05
Constant	-0.51	-2.67	0.01
R-squared:	0.82		
Adjusted R-squared:	0.82		
F-statistic	444		

Hence, given other features constant, the growth of 1% in distance from the CBD implies that the price reduces by about 0.15%. However, a 1% increase in floor area suggests that the house price grows by 1.07%. An increase of 10% in green coverage rate may provoke a rise of nearly 1% in price. An increase of 10% in volume fraction will decrease the price by 0.5%.

Given other features constant, underground railway services have little effect on home prices. The estimate for DIST_STATION is subtle and contains a positive sign.

Given other features constant, for an average one-year 'new' unit, the implicit price is $1^{(-0.17)} = 1$ RMB/square meter

(sqm). For an average 5-year unit, the implicit price is $5^{(-0.12)} = 0.82$ RMB/sqm. For an average 10-year unit, the implicit price is $10^{(-0.12)} = 0.76$ RMB/sqm, and so on. Hence, house prices decrease marginally with house ages.

Table III Results of Final Regressions

Variable	Estimate	<i>t</i>	<i>P</i>
LOG (AREA)	1.07	30.4	0.00
LOG (YEAR)	-0.12	-8.22	0.00
LOG (BEDROOM)	0.11	2.91	0.00
LOG (DECORATION)	0.07	4.92	0.00
LOG (GREENCOVERAGE)	0.09	3.09	0.00
LOG (VOLUMEFRACTION)	-0.05	-2.60	0.01
LOG (DIST_CBD)	-0.15	-6.91	0.00
LOG (DIST_STATION)	0.02	2.10	0.04
Constant	-0.55	-2.91	0.00
R-squared:	0.82		
Adjusted R-squared:	0.82		
F-statistic:	555		

5. Concluding Remarks

It has been argued that various structural and environmental features impact housing prices. Few studies analyzed the implicit prices in Chengdu. The Chengdu metropolis is characterized by a monocentric pattern and has rapidly expanded in terms of economy, population and built area over the past decade. We selected existing ordinary housing units within the Around-the-city Expressway.

The paper employed a hedonic technique and conducted regressions using log-linear equations. We find that larger floor space, higher ages, good decoration, higher green coverage rate and lower volume fraction help to increase house prices.

We suggest that the government could impose higher property tax rates on units with a larger floor space and lower volume fraction.

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