Hedonic Price Model of Secondhand Condominium Units in Bangkok

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Abstract

In this research, the objective was to explore prices of secondhand condominium units in Bangkok, as well as to generate a hedonic price model. The data from 200 samples of secondhand condominiums posted on six well-known secondhand real estate websites in Thailand were gathered and analyzed by Multiple Regression Analysis. A hedonic price model with a logarithmic form with an adjusted R^2 of 72.7 percent was proposed. There are a total of 11 determinants regarding customer satisfaction, in which six variables have negative effects while the remaining determinants have positive effects. From the paired sample t-test, the means of the observed selling prices and the predicted selling prices are not significantly different, at a 95 percent confidence level.

Disciplinary: Architecture and Real Estate Development.

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Cite This Article:

Tochaiwat, K., Uruhamanon, P., Pultawee, P., and Naksuksakul, S. (2021). Hedonic Price Model of Secondhand Condominium Units in Bangkok. *International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies, 12*(1), 12A1A, 1-9. http://TUENGR.COM/V12/12A1A.pdf DOI: 10.14456/ITJEMAST.2021.1

1 Introduction

In 2010, the number of condominiums in Bangkok presented at 34,381 units, but as the high growth of condominium supplies, there were about 566,583 units in the first half of 2019. At the same time, the demands decreased which directly affected the sale rate because of the weak economy, loan-to-value limitation measure, and strong Thai baht against the U.S. dollar and Chinese Yuan. Therefore, this totally changed the estate developers' action plans as they

postponed their condominium projects to clear their stocks, and launched other projects, such as single-detached houses, semi-detached houses, and townhouses instead (Knight Frank, 2019).

Various factors encourage buyers' preference to buy secondhand condominiums rather than buying a new condominium. The first factor is the price because the price of a secondhand condominium is cheaper than the price of a new condominium even if the projects are close by (Pitchon, 2019). On the other hand, secondhand condominiums would normally be offered at the more usable areas than new ones at the same price. Because everyone desires to live in a good location and nearby facilities, i.e. business area, land or underground mass transit station, suitable price, and location are the factors of decision making. For the investors, buying a secondhand condominium at a low price and a good location could bring them greater returns (Frank, 2019).

The hedonic price model could help buyers find the most suitable price, reduce risk, and increase profitability (Virsnieks, 2001; Ross, 2008; Rosen, 1974; Rinchumphu, Kridakorn Na Ayutthaya & Yunus, 2020; Khumpaisal, Weeraprajack & Dechphun, 2016). In this research, the acquired hedonic price model will answer what are the determinants of the selling prices of secondhand condominiums and will predict the selling prices of the secondhand condominiums in Bangkok.

2　Review of Literature

Typically, the price of a condominium depends on many factors, as shown in Table 1. It mainly relies on the location, i.e. mass transit station, main road, convenience, and shopping mall. Other determinants consist of floor level, age of condominium, room size, and area location.

Table 1: Determinants of Secondhand Condominium Unit Price.

No.	Determinant	Mok et al. (1995)	Choy, et al. (2007)	Banthaokul (2007)	Kulkolkarn & Laophairoj (2012)	Chutamat (2015)	Kulkosa (2017)	Wipoomitsitsakul (2019)	Suwanphorung (2018)	Sawadmool (2018)
1.	Project Developers				✓	✓		✓	✓	
2.	Age of Condominium Building	✓	✓	✓				✓		✓
3.	Room Unit Size			✓	✓			✓	✓	✓
4.	Area Location of the Condominium				✓	✓	✓		✓	
5.	Types of Building							✓		
6.	Floor Level	✓	✓	✓	✓	✓				✓
7.	Number of Bedrooms				✓	✓			✓	
8.	Number of Bathrooms								✓	
9.	Furnishing				✓	✓				
10.	Electrical Appliances								✓	
11.	Distance to Mass Transit Stations		✓	✓	✓	✓	✓	✓	✓	✓
12.	Distance to Main Roads			✓				✓		
13.	Distance to Convenience Stores								✓	
14.	Distance to Shopping Malls								✓	✓

3 Research Methodology

The research started by studying the related theories and research works regarding the secondhand condominiums in Bangkok and the hedonic price model, then design the research methodology. This is a quantitative study, which all data were collected from the condominium units posted for sale on estate websites from February-April 2020. The required data were recorded by the research checklist and used in analyzing the hedonic price model of condominium units in Bangkok by Multiple Regression Analysis.

Table 2: Determinants of Secondhand Condominium Unit Price.

No.	Determinant	Details	Variable Type	Unit
1	Room size	Room area posted on the websites	Ratio	Square meters
2	Number of bedrooms	The total number of bedrooms posted on the website. The studio room is equal to zero bedrooms.	Ratio	Room
3	Number of bathrooms	Total number of bathrooms posted on the website	Ratio	Room
4	Floor level	The floor number that the unit located	Ratio	Level
5	The unit is fully furnished	1 if the unit is a fully furnished room, 0 if not	Dummy	No unit
6	The unit is fully fitted	1 if the unit is fully fitted room, 0 if not	Dummy	No unit
7	The room has air conditioner.	1 if the unit has an air conditioner, 0 if not	Dummy	No unit
8	The room has refrigerator.	1 if the unit has a refrigerator, 0 if not	Dummy	No unit
9	The room has washing machine.	1 if the unit has a washing machine, 0 if not	Dummy	No unit
10	The room has water heater.	1 if the unit has a water heater, 0 if not	Dummy	No unit
11	The room has microwave.	1 if the unit has a microwave, 0 if not	Dummy	No unit
12	The room has cooker hob and hood.	1 if the unit has cooker hob and hood, 0 if not	Dummy	No unit
13	The room has dishwasher.	1 if the unit has a dishwasher, 0 if not	Dummy	No unit
14	Age of building	Age counted from the completed construction year until the year 2020	Ratio	Years
15	High-rise building	1 if the unit is in a high-rise building (more than 8 stories), 0 if not	Dummy	No unit
16	Developed by the listed company	1 if the unit was developed by the listed company in the Stock Exchange of Thailand, 0 if not	Dummy	No unit
17	Percentage of parking lot	The ratio of parking lots and the number of units in a condominium	Ratio	Percent
18	The condominium has lift.	1 if the condominium has a lift, 0 if not	Dummy	No unit
19	The condominium has fitness room	1 if the condominium has a fitness room, 0 if not	Dummy	No unit
20	The condominium has swimming pool	1 if the condominium has a swimming pool, 0 if not	Dummy	No unit
21	The condominium has sauna room	1 if the condominium has a sauna room, 0 if not	Dummy	No unit
22	The condominium has wi-fi	1 if the condominium has Wi-Fi, 0 if not	Dummy	No unit
23	The condominium has playground	1 if the condominium has a playground, 0 if not	Dummy	No unit
24	The condominium has cctv	1 if the condominium has CCTV, 0 if not	Dummy	No unit
25	The condominium has 24 hours security guard	1 if the condominium has 24 hours security guard, 0 if not	Dummy	No unit
26	The condominium has key card access.	1 if the condominium has key card access, 0 if not	Dummy	No unit
27	The condominium has lift-access control.	1 if the condominium has lift-access control, 0 if not	Dummy	No unit
28	The unit has digital door lock	1 if the unit has a digital door lock, 0 if not	Dummy	No unit
29	The condominium is located in Inner Bangkok.	1 if the condominium is located in Inner Bangkok, 0 if not	Dummy	No unit
30	The condominium is located in middle Bangkok.	1 if the condominium is located in the Middle Bangkok, 0 if not	Dummy	No unit
31	Distance to mass transit station	Distance from condominium to the nearest mass transit station	Ratio	Kilometers
32	Distance to main road	Distance from condominium to the nearest main road	Ratio	Kilometers
33	Distance to convenience stores	Distance from condominium to the nearest convenience store	Ratio	Kilometers
34	Distance to shopping malls	Distance from condominium to the nearest shopping mall	Ratio	Kilometers

The researchers define the model variables from related literature as shown in Table 1 and the real estate websites. The acquired variables consisted of 34 determinants (independent variables) and 1 dependent variable. The dependent variable of this research was the "selling price" of the secondhand condominium unit posted on estate websites, in baht per square meter. The acquired 34 determinants of the price of a secondhand condominium unit are shown in Table 2.

The samples used in this research were 200 secondhand condominium units, with the selling prices below 200,000 baht per square meter, posted on 5 estate websites, as mentioned above, with the suggestion that the sample size must not be less than 5 samples per determinant proposed by Bartlett, Kotrlik, & Higgins (2011). It should be noted that the data were collected from 3 zones of Bangkok: 21 districts of inner Bangkok, 18 districts of middle Bangkok, and 18 districts of outer Bangkok.

Then, the researchers analyzed the data by a statistical computer program to find the sample correlation coefficient and statistical results of Multiple Regression Analysis. There were three groups of attributes included in the checklist: (1) the attributes of secondhand condominium units directly appeared in real estate websites: selling price, room size, number of bedrooms and bathrooms, floor-to-floor level, furnishing, and electrical appliances included; (2) the attributes of condominium buildings - Some websites, e.g. homenayoo.com and thinkofliving.com, contained the data of the condominium buildings; and, (3) the data of distance from the condominium buildings to interested facilities or infrastructures such as mass transit stations, shopping malls, and main roads – The distance can be measure from a navigation website.

The data analysis of this research consists of 3 techniques: (1) Item-Objective Congruence Index (IOC) was applied for determinant screening, where the determinants with IOC equal or greater than 0.50 shall be put into the prediction model; (2) Sample Correlation Coefficient shows the measurement between two linear variables. The equation is defined as follows:

The coefficient ranges from -1 to +1. If the value closes to -1, it indicates a strong negative relationship between two linear variables and vice versa. Finally, (3) Multiple Regression Analysis - A data analysis technique that has an assumption that the dependent variable (Y) is a function of independent variables ($X_1, X_2, ..., X_p$) and an error term or a random variable (ε). The coefficient β_0, β_1, β_2,..., β_p are the regression parameters. The multiple regression model is as the following equation (Anderson et al., 2001).

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_p X_p + \varepsilon \qquad (1)$$

The statistics ($b_0, b_1, b_2, ..., b_p$) are used to estimate the parameter value. So, the Multiple Regression Analysis equation is as follows (Anderson et al., 2001).

$$\hat{y} = b_0 + b_1 x_1 + b_2 x_2 + \cdots + b_p x_p \qquad (2)$$

Where $\hat{y}$ is the estimated value of the dependent variable

To test the model accuracy, the Paired Sample t-Test resulted in paired observations to find out the difference of means between two sets of data. There will be statistical procedures applied in this section.

4 Results and Discussion

Among four alternatives, the best model was the ln–ln model because of its compliance with all conditions and the highest Adjust R^2. The details of four alternative models are summarized in Table 3.

Table 3: Statistical Test Results of Alternative Models.

Statistical Test	Linear-Linear Model	Linear-ln Model	ln-Linear Model	ln-ln Model
Adjusted R^2	0.689	0.721	0.702	0.727
VIF of all significant independent variables are less than 10	Satisfied	Satisfied	Satisfied	Satisfied
Durbin-Watson	1.448	1.455	1.595	1.532
Residual Analysis				
(1) Residuals are normally distributed	0.016 Not Satisfied	0.200 Satisfied	0.200 Satisfied	0.200 Satisfied
(2) Residuals' mean is equal to zero	0.000 Satisfied	0.000 Satisfied	0.000 Satisfied	0.000 Satisfied
(3)There is no relationship between each residual	1.448 Not Satisfied	1.455 Not Satisfied	1.595 Not Satisfied	1.532 Satisfied
(4) There is no heteroscedasticity problem	Satisfied	Satisfied	Satisfied	Satisfied
Number of independent variables	10	8	10	11

The ln-ln model of selling price of secondhand condominium, shown as the following equation, has the VIF's of all determinants and the scatter plot of the standardized residuals and the predicted values as shown in Table 4 and Figure 1, respectively. It consists of 11 variables, of which 6 variables are dummy variables and 5 variables are ratio variables.

Table 4: Regression Results of ln-ln Model

X	Determinant	B	t	Sig.	Statistics VIF
	Constant	11.976	129.744	0.000	-
x_1	The Condominium Is in Inner Bangkok	-0.558	-5.113	0.000	1.416
x_2	The Condominium Is High-rise Building	0.966	2.994	0.003	1.599
x_3	The Unit Has Digital Door lock	-0.131	-2.644	0.009	1.356
x_4	Distance to Mass Transit Stations	-0.062	-3.288	0.001	1.572
x_5	The Unit Has Cooker Hob and Hood	-0.169	-2.946	0.004	1.307
x_6	The Unit has Refrigerator	0.400	3.356	0.001	1.248
x_7	Age of Building	-0.175	-4.797	0.000	1.300
x_8	Distance to Shopping Mall	-0.108	-3.627	0.000	1.380
x_9	Distance to Convenience Stores	0.011	2.258	0.026	1.222
x_{10}	The Unit Is Fully Furnished	0.090	2.550	0.012	1.246
x_{11}	The proportion of the number of Parking Lots to the Number of Units	0.191	2.244	0.027	1.557
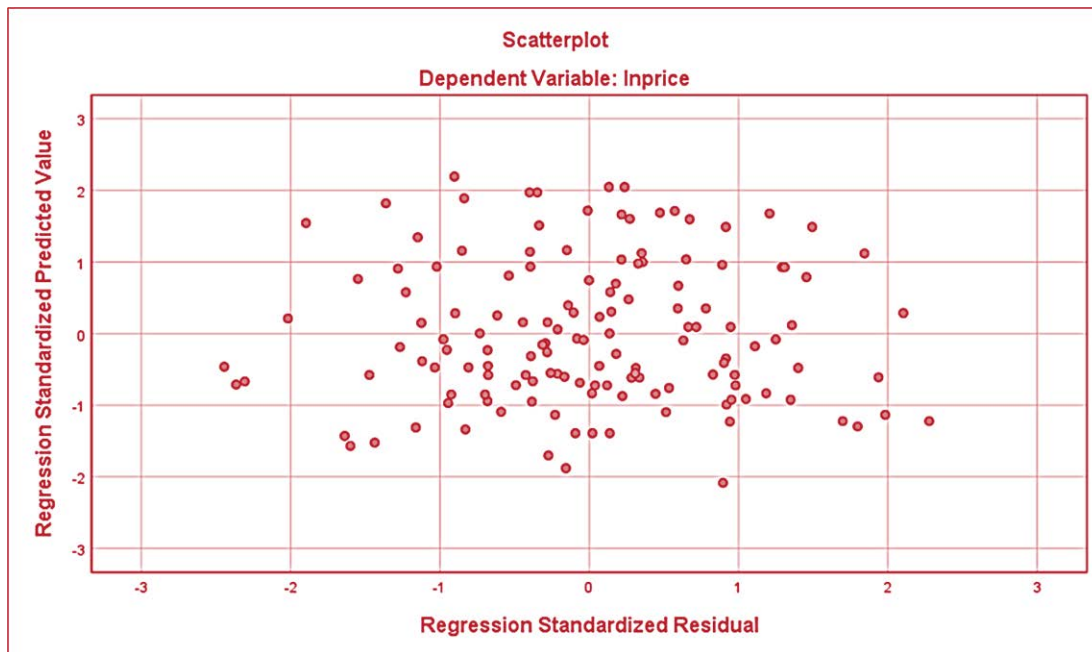
Figure 3 Scatter Plot of Standardized Residuals and Predicted Values of ln-ln Model
Hence, the best equation among the alternative equations was as follows:

Therefore, the acquired hedonic price model of the secondhand condominium units in Bangkok is

$$\ln y = 11.976 - 0.558 \ln x_1 + 0.966 \ln x_2 - 0.131 \ln x_3 - 0.062 \ln x_4 \tag{3},$$
$$- 0.169 \ln x_5 + 0.400 \ln x_6 - 0.175 \ln x_7 - 0.108 \ln x_8 + 0.011 \ln x_9$$
$$+ 0.090 \ln x_{10} + 0.191 \ln x_{11}$$

where

y = Estimated Selling Price of a Secondhand Condominium Unit

$x_1, x_2, x_3, ..., x_{11}$ = Determinants of the Selling Price of a Secondhand Condominium Unit, as described in Table 5

Table 5: Determinants of the Proposed Model

X	Determinant	Type of Variable	Unit	Z-score (in case of dammy variable)	
				Yes	No
x_1	The Condominium Is in Inner Bangkok	Dummy	No unit	1.220	-0.814
x_2	The Condominium Is High-rise Building	Dummy	No unit	0.928	-1.070
x_3	The Unit Has Digital Door Lock	Dummy	No unit	1.604	-0.619
x_4	Distance to Mass Transit Station	Ratio	Kilometers	N/A	N/A
x_5	The Unit Has Cooker Hob and Hood	Dummy	No unit	1.472	-0.675
x_6	The Unit Has Refrigerator	Dummy	No unit	0.838	-1.185
x_7	Age of the Building	Ratio	Years	N/A	N/A
x_8	Distance to Shopping Mall	Ratio	Kilometers	N/A	N/A
x_9	Distance to Convenience Store	Ratio	Kilometers	N/A	N/A
x_{10}	The Unit Is Fully Furnished	Dummy	No unit	0.476	-2.086
x_{11}	The proportion of the Number of Parking Lots to the Number of Units	Ratio	Percent	N/A	N/A

A paired sample t-test was applied to test the accuracy of the proposed model. The test hypotheses can be written as follows.

H_0: *The mean of observed prices and the mean of predicted prices are not different.*
H_1: *The mean of observed prices and the mean of predicted prices are different.*

Table 6 shows the results of a 2-tailed Paired Sample t-Test. As the p-value is greater than 0.05, the null hypothesis (H_0) is not rejected. Hence, the mean of observed prices and the mean of predicted prices are not significantly different and the model has acceptable accuracy.

Table 6: Results of Paired Sample t-Test of ln-ln Model

Model	Mean Difference	S.D.	T	Sig. 2-tailed of Paired Sample t-Test
ln-ln	- 1,396.511	24,308.849	- 0.445	0.658

5 Conclusion

The results of the research showed that one can use the acquired hedonic price model to predict the reasonable selling price of secondhand condominium units with the selling prices below 200,000 baht per square meter. From 140 samples used in developing the model, exploring 4 alternatives of the models, e.g. linear-linear, linear-ln, ln-linear, and ln-ln by screening 34 initial variables by experts and entering the remaining 23 variables by stepwise multiple regression analysis procedures, the result shows that ln-ln model is the best fitting model with 0.727 Adjusted R^2. Eleven variables are revealed to affect selling prices of secondhand condominium units in Bangkok, 6 variables have negative effects and 5 variables have positive effects, according to Table 4. The Paired Sample t-Test showed the insignificant difference between the mean of observation values and the mean prediction values of the selling prices of secondhand condominium units in Bangkok that confirm the accuracy of the model.

The limitation of this research is that some attributes such as the information on sale conditions such as an agreement on transfer fees or property tax were not considered in the analysis because of the unavailability of information on the websites. However, this limitation can be a trade-off with convenience in finding the input data of the model, which makes the acquired model practical to be used.

Finally, the researchers have the recommendation that in future research, one can apply a similar approach to the other specific area or price-range of condominiums so that the data may not be heterogeneous, which can impact the accuracy of the research. Additionally, one can add some new determinants from other sources of data to explore their impacts on the selling price of secondhand condominium units such as the sale condition, quantity of electrical appliances, and ratio of a number of lifts to the number of units.

6 Availability of Data and Material

Information can be made available by contacting the corresponding author.

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