

# APPLICATION OF HEDONIC PRICING MODEL INTO DEFINING INFLUENTIAL FACTORS IN HCMC-BASED REALTY MARKET

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*In pricing a real estate or researching a housing market, the Hedonic pricing method is often employed to investigate influential factors in realty price. Through 160 observed samples collated in the HCMC realty market, the paper tailors some crucial factors affecting real estate pricing, that is, realty location, lot area, housing area, distance to city center, and distance to main streets.*

*Keywords: Hedonic model, realty price, HCMC main street.*

## 1. Introduction

To most households, their house means not only accommodation but also a fortune, and the most crucial asset in their investment. In fact, real estate is still the biggest item in assets owned by affluent households in developed countries. Thus, the value of their houses has a great impact on their spending and savings as well as the supply and demand mechanism. As Ustaoilu E. (2003) put it, house price is a matter of concern to real estate developers, banks, policy-makers, actual or potential homeowners and the public in general.

The realty market may be profoundly affected by macroeconomic variables, and difference in terms of space, community structure, and realty features. Real estate pricing is extremely needed in order to measure quantitatively benefits and legal responsibilities concerning real estate ownership. Normally, such pricing is often undertaken by real estate agencies, appraisers, inspectors, mortgagees, brokers, realty developers, investors, asset management

companies, lenders, market researchers, analysts, consultants and other experts.

## 2. Hedonic pricing model and empirical researches

The Hedonic pricing method (HPM), one of the oldest evaluating techniques developed by Lancaster (1966), Ridker (1967), Griliches (1971), Rosen (1974) and others, is primarily employed to determine the economic value of a property. It was first employed to examine the relationship between air pollution and asset values, and played an important part in the second half of the 1970s and during the 1980s. In this period, the Hedonic pricing method became a useful tool in both theoretical and empirical researches to assess the value of a property in connection with effects of environmental attributes and lot location.

Ridker (1967) developed the first basic Hedonic pricing model as follows:

With  $P_i = f(S_{1i} \dots S_{ki}, N_{1i} \dots N_{mi}, Z_{1i} \dots Z_{ni})$

Where,

$P_i$ : House price

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S: Structural characteristics (1..k) such as size of house, number of rooms, construction quality, etc.

N: Neighborhood attributes (1..m) such as distance to the workplace, schools' quality, local crime rates, etc.

Z: Environmental characteristics (1..n) such as quality of air and water, noise, etc.

We have:

$$P_i = \alpha_0 + \alpha_1 S_{1i} + \alpha_{2i} S_{2i} + \dots + \alpha_{ki} S_{ki} + \beta_1 N_{1i} + \beta_2 N_{2i} + \dots + \beta_m N_{mi} + \gamma_a Z_{ai}$$

Recently, several empirical researches have also utilized HPM for real estate pricing. Sérgio A.B. et al. (2002) did employ HPM to assess adverse effects of stale odor from a sewage treatment plant in Brasilia of Brazil on the price of surrounding properties. They tailored twenty variables and developed four models to analyze them. The results showed that the air quality sharply impacts on the price of apartments. The closer the apartment to the sewage treatment plant, the lower its price.

Examining internal characteristics of a house in Turkey, Selim S. (2008) worked out a Hedonic regression model expressed as  $\ln P = bx + u$ . His model figured out that house area, number of rooms, type of house, water system, swimming pool, house location and design sharply impinged on house price. In 2009, this model was further developed by Selim H. By the Hedonic regression model and the artificial neural networks (ANN), variables including water system, swimming pool, house type, number of rooms, house size, location, and design were proven to have influence on house price. It is observed that the house price in urban areas is 26.26% higher than that in rural areas. By comparing the prediction performance between the hedonic regression and ANN model, this study demonstrates that ANN can be a better alternative for prediction of the house prices in Turkey.

Gabriel K.B. (2011) used Hedonic regression model to point out that externalities such as distance to churches and workplaces, security and parking lots influence the real estate price.

His model is as follows:  $P = \beta_0 + \beta_j X_j + \beta_a X_a + u$ .

The regression results show that the impact of neighboring churches on house prices is adverse. The farther from churches the real estate is, the higher its price is.

There have been several Hedonic-pricing-model-based researches on real estate price in Vietnam. Hoàng Hữu Phê and Patrick Wakely (2000) who have recently developed a theory on status and quality, have introduced some guidelines on pricing real estate in the market economy. Their study figures out that the real estate price depends on its quality (CL) and status (VT) [ $Y = f(CL, VT)$ ]; and regression results show that lot area profoundly impacts on the property price which is then affected by the distance to city centers, number of floors, and location. In addition, effects of legal factors on house prices in Hà Nội and HCMC are also taken into account by Kim (2007) who developed a model with some representative legal variables such as green and red title deeds, and relevant legitimate rights.

### 3. Description of variables and regression model

The study surveys 160 samples (i.e. dwelling houses) which are located along main streets in the HCMC downtown area such as Nguyễn Trãi, Điện Biên Phủ, Hai Bà Trưng, Võ Thị Sáu, Nam Kỳ Khởi Nghĩa, and Trần Hưng Đạo. The Hedonic regression model and the adjusted theory on status and quality are employed.

Samples are randomly chosen in six busy main streets in HCMC and have been evaluated by the Asia Commercial Bank. There are sufficient legal papers concerning these properties such as title deeds, cadastral maps, registration duty papers, etc.

Due to the fact that the real estate market has been sharply affected by macroeconomic factors such as fluctuations in interest rate, exchange rate, and flows of capital, etc., the study is limited to a short period from June 1, 2010 to

Dec. 31, 2010 in the hope of minimizing such influences.

The regression model is written as  $\ln P = \beta x + u$ ; where,  $P$  denotes the house price,  $\beta$  is the regression coefficient,  $x$  represents explanatory variables, and  $u$  is the error term. The model comprises 10 explanatory variables and five out of which are variables of status, that is, property location, distance to the city center (i.e. Bến Thành market), distance to nearest main street, alley width, and the property utilization purpose (i.e. for living or working). The remainder fall to the property quality, that is, lot area, housing area, number of floors, roof terrace, and design.

$$\ln PRICE = \beta_0 + \beta_1 AREA + \beta_2 H\_AREA + \beta_3 CBD + \beta_4 DIS\_STREET + \beta_5 LC + \beta_6 SF + \beta_7 SH + \beta_8 ST + \beta_9 TR + \beta_{10} USE + \varepsilon_i$$

**Table 1: Definition of variables**

Variable	Description	Expected sign
LnPRICE	Napierian logarithm of the real estate price	
AREA	Lot area (m <sup>2</sup> )	+
H_AREA	Housing area (m <sup>2</sup> )	+
CBD	Distance to the city center (km)	-
DIS_STREET	Distance to the nearest main street (m)	-
SF	Frontal alley width (m)	+
SH	Realty design: dummy variable (equaling 1 if the rear lot line is wider than the front one, and 0 otherwise.)	+
ST	Number of floors: dummy variable (equaling 1 if it is less than or equal to 4 floors, and 0 otherwise)	-
TR	Roof terrace: dummy variable (equaling 1 if with a roof terrace, and 0 otherwise)	+
LC	Location: dummy variable (equaling 1 in	+

	case of having a main street frontage, and 0 otherwise)	
USE	Utilization purpose: dummy variable (equaling 1 if for business and living, and 0 if for dwelling only)	+

The real estate price is based on the market price. When at least two-meter width of a property's street frontage faces a named street and the occupancy is legalized, it can be called as a main-street-fronted house. Such kind of property is more advantageous than those without due to potential business operations and can enjoy an extra of 5 to 30 percents besides its market price. Meanwhile, the value of alley-fronted houses is often deduced by 20 to 70 percent as compared to the main-street-fronted ones. The width of six surveyed streets is as follows: Hai Bà Trưng (10 – 13m), Võ Thị Sáu (12 – 18m), Nguyễn Trãi (11 – 12m), Trần Hưng Đạo (14 – 18m), Nam Kỳ Khởi Nghĩa (10 – 30m), and Điện Biên Phủ (13 – 60m).

#### 4. Results

In Model 1, there occurs the multicollinearity among variables and the autocorrelation between USE and LC (i.e. correlation coefficient equals 0.8). Additionally, USE is not statistically significant and thus are eliminated.

In Model 2, although the autocorrelation is removed, the multicollinearity still exists because  $R_i^2$  is quite high. Hence, the variable TR, which has a low statistical significance and bears an unexpected sign, is eliminated. Similarly, the variables ST, SH, SF are respectively removed from models 3, 4, and 5 due to its lack of statistical significance and bearing unexpected signs. However, the multicollinearity has not been corrected in Model 5 due to a large  $R_i^2$  has generated a large VIF. Hence, Model 6 is the best one.

Regarding Model 6, all variables are statistically significant and bear expected signs. The analysis shows that the price of main-street-fronted properties, on average, is 84.6% higher

**Table 2: Variables descriptive statistics**

Variables	Mean	Maximum	Minimum	Std. Dev.
LNPRICE	9.26	11.61	7.30	0.91
AREA	61.78	314.82	21.50	33.56
CBD	2.93	6.81	0.33	1.22
DIS_STREET	46.09	300.00	0.00	56.70
H_AREA	165.10	841.22	30.06	122.77
LC	0.36	1.00	0.00	0.48
SH	0.26	1.00	0.00	0.44
SF	8.09	60.00	1.20	8.78
ST	0.91	1.00	0.00	0.29
TR	0.27	1.00	0.00	0.44
USE	0.47	1.00	0.00	0.50

**Table 3: Regression results of six models**

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
AREA	0.0133*** (9.262)	0.0133*** (9.284)	0.0134*** (9.680)	0.0131*** (10.017)	0.0130*** (9.939)	0.0127*** (9.712)
H_AREA	0.0007 (1.521)	0.0007 (1.540)	0.0007 (1.473)	0.0008** (2.401)	0.0010*** (2.691)	0.0010*** (2.806)
CBD	-0.053* (-1.866)	-0.055* (-1.932)	-0.0551* (-1.942)	-0.0590** (-2.113)	-0.0666** (-2.426)	-0.0730*** (-2.660)
DIS_STREET	-0.0015* (-1.814)	-0.0015** (-1.978)	-0.0015** (-1.973)	-0.0015** (-1.954)	-0.0015* (-1.909)	-0.0014* (-1.806)
LC	0.8962*** (6.792)	0.9291*** (8.789)	0.9368*** (8.993)	0.9424*** (9.073)	0.9424*** (9.052)	0.8467*** (9.286)
SF	-0.0095* (-1.865)	-0.0093* (-1.835)	-0.0097* (-1.956)	-0.0098* (-1.971)	-0.0092* (-1.856)	
SH	0.1083 (1.335)	0.1075 (1.328)	0.1087 (1.348)	0.1056 (1.312)		
ST	-0.1093 (-0.742)	-0.1118 (-0.762)	-0.1222 (-0.845)			
TR	-0.0328 (-0.393)	-0.0383 (-0.466)				
USE	0.0503 (0.420)					
R <sup>2</sup>	0.7921	0.7919	0.7916	0.7906	0.7882	0.7835
Adjusted R <sup>2</sup>	0.7782	0.7794	0.7806	0.7809	0.7799	0.7764
F-statistic	56.790***	63.429***	71.703***	81.999***	94.929***	111.456***

Note: \*, \*\*, \*\*\* respectively signify the reliability level of 90%, 95% and 99%.

than that of alley-fronted ones. Each meter far from the main street can make the property value decrease roughly 0.14%; and each kilometer far from the city center can reduce the property value by 7.3%. If the lot area increases by one square meter, the gross value will edge up by 1.3%. Although the average area of surveyed properties (just around 61.78m<sup>2</sup>) is not as enormous as that surveyed by HCMC Association of Real Estate (105.04 m<sup>2</sup>), any rise in the total area can push the gross value of property up. The results also show that the housing area has little effect on the property price. If the housing area rises by 1m<sup>2</sup>, the property price just goes up around 0.1%.

The analysis model is:

$$\text{LNPRICE} = 8.274344 + 0.012711\text{AREA} + 0.001006\text{H\_AREA} - 0.073008\text{CBD} - 0.001388\text{DIS\_STREET} + 0.846731\text{LC}$$

The following two basic cases will be taken into account.

**(1) For main-street-fronted properties:**

If it is a main-street-fronted property, we have: LC = 1, DIS\_ROAD = 0, AREA = 61.78 m<sup>2</sup>, H\_AREA = 165.10 m<sup>2</sup>, and CBD = 2.9km.

Accordingly, LNPRICE = 9.86051918 and PRICE = 19.159 (equaling VND19.159 billion).

In sum, a main-street-fronted property located in the downtown area and around 2.9km far from Bến Thành Market, having the land area of 67.78m<sup>2</sup> and housing area of 165.1m<sup>2</sup> (equaling three stories), can be sold at VND19.159bn; and the land alone can be sold at VND16.228bn, equaling VND262.7 million per square meter.

**(2) For alley-fronted properties:**

If it is an alley-fronted property, we have: LC = 0, DIS\_ROAD = 46.09 m, AREA = 61.78 m<sup>2</sup>, H\_AREA = 165.10m<sup>2</sup>, CBD = 2.9km.

Accordingly, LNPRICE = 8.94972308 and PRICE = 7.706

An alley-fronted property located 46m far from the main street, despite satisfying aforementioned features of a main-street-fronted one, can only be sold at VND7.706bn. Apparently, the value of such type of property falls dramatically as compared to that of a main-

street-fronted property. And in this case, the land value is just VND6.526 billion (equaling VND105.6 million per square meter).

## 5. Conclusion

In the study, the Hedonic regression model and the theory on status and quality have been employed to determine the value of HCMC-based properties. Findings have shown that property location, distance to the nearest main street, distance to the city center, lot area, and housing area sharply affect the real estate price.

Some people hold a superstitious belief that if the rear lot line of a property is wider than its front lot line, homeowners can enjoy an affluent life. Yet in fact, there have not been any empirical research on the effects of property shape on the prosperity level of homeowners. In HCMC, over 50% of properties are trapezoid-shaped due to the fact that zoning and planning were not done scientifically and congruently. According to the regression results, the property shape does not affect its price.

The regression results also show that the utilization purpose is not clear-cut. For main-street-fronted properties, the ground floor is often for business, and the remaining area will be for family dwelling. Therefore, it is difficult to differentiate utilization purposes■

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