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Brand Value of Property in Bangkok Metropolitan Region (BMR), Thailand

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This paper aims to evaluate the brand value of property in subdivision developments in the Bangkok Metropolitan Region (BMR), Thailand. The result has been determined by the application of a hedonic price model. The development of the model is developed based on a sample of 1,755 property sales during the period of 1992-2010 in eight zones of the BMR. The results indicate that the use of a semi-logarithmic model has stronger explanatory power and is more reliable. Property price increases 12.90% from the branding. Meanwhile, the price annually increases 2.96%; lot size and dwelling area have positive impacts on the price. In contrast, duplexes and townhouses have a negative impact on the price compared to single detached houses. Moreover, the price of properties which are located outside the Bangkok inner city area is reduced by 21.26% to 43.19%. These

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findings also contribute towards a new understanding of the positive impact of branding on the property price in the BMR. The result is useful for setting selling prices for branded and unbranded properties, and the model could provide a reference for setting property prices in subdivision developments in the BMR.

Keywords

Property price model; Hedonic pricing approach; Subdivision development; Bangkok metropolitan region; Brand value

1. Introduction

Property, defined as land and dwelling, is a high-value asset which is important for the living needs of humans. For buyers, the purchase of property is a substantial issue that should be given careful consideration. Property price is one of the most important criteria for buyers in making their property purchase decision (Jim and Chen, 2009, Eves, 2009). Therefore, an understanding of property price models is also greatly needed, especially for developers. Several studies have indicated that property price usually comprises property characteristics, such as physical characteristics, location, the environment, and branding (Roulac, 2007, Guttery, 2002, Sirmans et al., 2005). It is clearly understood that physical characteristics, location and the environment have a strong relationship with property price (Jim and Chen, 2006, Din et al., 2001, Song and Knaap, 2004). On the other hand, a number of studies have also indicated that branding influences property price.

Roulac (2007) has indicated that branding is one of the important components of property price. Brand development has thus become a prioritising strategy of developers. This finding is supported in a study by Fah and Cheok (2008) who have confirmed that branded developers gain benefits from their brand. The prices of branded properties are normally higher than other properties in the same conditions. In addition, Pfrang (2010) has also indicated that that price of branded properties is about 7.5% - 15.1% higher than that of unbranded property. In conclusion, these indicate that branding is an important influence on property price. Meanwhile, this study defines brand variable as a property developed by well-known listed companies in the Stock Exchange of Thailand (SET) (SET, 2010). Therefore, the studying of the effect of brand value on property price will be necessary to further understand the subdivision development industry.

There are a number of studies on property price modelling in the BMR. For example, Calhoun (2002) has developed a property price model by using the logarithm-linear form. Dependent variable data are collected from the

Government Housing Bank. The independent variables are mostly focused on the structure characteristics and their location. In addition, Buranathanung et al. (2004) have illustrated property price indices by using a hedonic pricing approach. The property price data are also collected from the Government Housing Bank. There are 7 independent variables which include year of valuation, type of dwelling, dwelling area, floor level, and building systems. The models have been developed with traditional property characteristic variables: physical characteristics and location. Meanwhile, the branding variable is neglected in property price modelling in the BMR.

This study focuses on the brand value impact of property in subdivision developments in the BMR. The brand value will be evaluated by a hedonic property price modelling approach. The hedonic price model will be selected by an empirical method analysis. Sets of dependent and independent variables are also collected from both primary and reliable secondary sources. The dependent variable is actual property selling price. Meanwhile, the dependent variables include objective and control variables. The objective variable is branding, while the control variables are sale year (SY), lot size (LS), dwelling area (DA), and location. The results should provide an understanding of the brand value of property in subdivision developments in the BMR. Moreover, the property price model should be a guideline for developers on setting appropriate prices for property in subdivision developments in the BMR.

The structure of this paper is as follows. The coming sections provide information on the studied area, a literature review on the hedonic price model, the research methodology, and the results and interpretation of both empirical models. Finally, a general conclusion and discussion will be offered in the last section.

2. Subdivision Development in the BMR

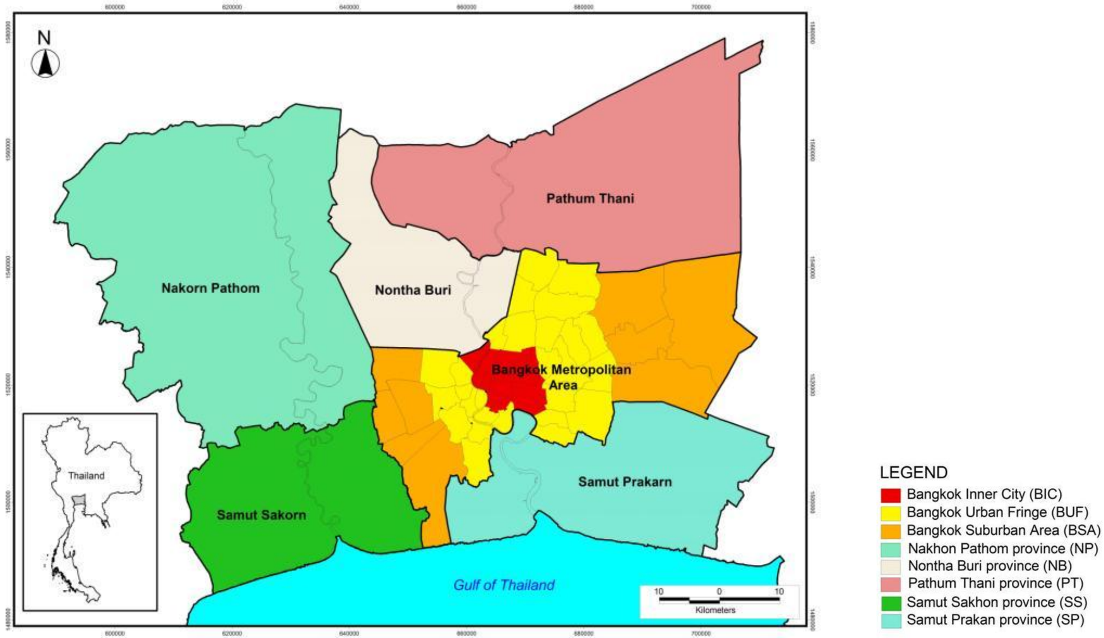
This section outlines the characteristics of the BMR, including the geography, demography and residency. The BMR is an area that consists of the Bangkok Metropolitan Area (BMA), the capital city of Thailand, and its five adjacent provinces: Nontha Buri (NB), Pathum Thani (PT), Samut Prakan (SP), Nakhon Pathom (NP), and Samut Sakhon (SS). The BMR is the centre for various major activities in Thailand, including political, commercial, agricultural, and industrial activities. Consequently, the BMR is the most densely populated area in Thailand. Moreover, the BMR must integrate infrastructures, such as mass transportation systems, telecommunication networks, and electricity distribution systems (REIC, 2009a, Sheng, 2002). The BMR can be divided into eight zones which include three zones of the BMA and its five adjacent provinces. Descriptions of the three zones of the

BMA (Bangkok Data Centre, 2009, Jeewasuwan, 2010, pp. 8-9), and its five zones are as follows.

First, the Bangkok inner city (BIC) contains the government buildings, old cultural area, education institutes and central business district (CBD). The population density is greater than 10,000 people per km^2. Next, the Bangkok urban fringe (BUF) connects the BIC and the suburban zone. This zone has experienced continuous economic growth, and high growth in population density and subdivision development. This zone is located in a 10 – 20 km radius from the BIC with urban sprawl development patterns. The third zone is the Bangkok suburban area (BSA) which is a mix of urban and rural. Most of the land is used for agricultural activities and there is a large amount of natural resources. The BSA is located more than a 20 km radius from the BIC. Then, the NB province is directly located northwest of the BMA. Most of this province is as urbanized as the capital, and the boundary between the BMA and NB can hardly be distinguished. Next, there is the PT province which is directly located north of the BMA. Some parts of the boundary between the BMA and PT are not noticeable, as both sides of the boundary are being equally urbanized. The sixth zone is the SP province, directly located south of the BMA. Many parts of the boundary between the BMA and SP are not very clear. The Suvarnabhumi Airport or New Bangkok International Airport is located in the SP. The seventh zone, the NP province, is located 56 km west of the BMA in the alluvial plain of central Thailand. Lastly, the SS province is the smallest province among those in the BMR, located southwest of the BMA and connected to the Gulf of Thailand. A map of the BMR is given in Figure 1.

As the population in the BMR is the highest in Thailand, the number of houses is also the greatest. According to the information from the Department of Provincial Administration, Ministry of Interior, the actual number of houses in the BMR was 4,188,353 units in 2008, and this represents a growth rate of 3.69 % during the period of 2005 – 2008. The house growth rate in the BMR is the highest compared to the other major provinces in Thailand and 1.3 times higher than the Thailand average. At the same time, a comparison between each province in the BMR shows that the NB has the highest growth rate of 5.55%; the PT follows at 5.05%, while the BMA has the lowest rate at 2.74% (Department of Provincial Administration, 2010). Meanwhile, a comparison between the population growth and houses in the BMR shows the same trend; the growth in housing is approximately 3 times the population growth. This implies that the demand for new houses each year is related to population growth. In addition, the high price of land in the BIC and the expanding mass transit network from the inner to the urban and suburban areas of the BMR are the driving factors that increase the trend for new subdivision developments in the suburban and adjacent provinces of the BMA.

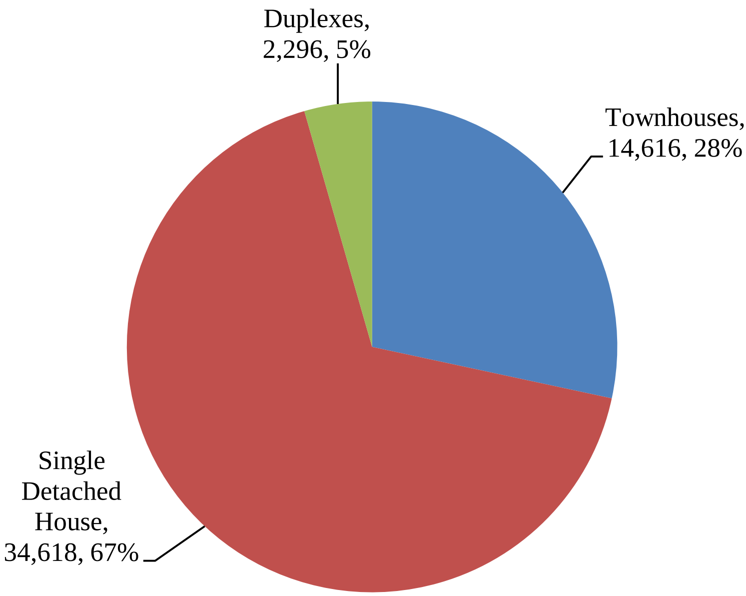
Figure 1 **Map of the Bangkok Metropolitan Region (BMR)**



Source: Department of Public Works and Town & Country Planning (DPT) (2012), modified by the author.

The Real Estate Information Centre (REIC) (2009b) presented the number of new houses in the BMR for 2008. However, this study focuses on single-family housing; the number of single-family houses and percentage of each type in 2008 are presented in Figure 2. According to Figure 2, the most popular house type is the single detached house (SDH) at 34,618 units (67%) compared to duplexes (DPs) and townhouses (THs) at 2,296 units (5%) and 14,616 units (28%) respectively.

Figure 2 House Types in 2008 in the BMR (REIC, 2009b)



3. Hedonic Price Model

Brand value can be evaluated by several techniques. However, one of the most common techniques for brand value evaluation is regression analysis (Roulac, 2007, Park and Srinivasan, 1994, Chattopadhyay et al., 2008, Ailawadi et al., 2003). Therefore, this study will identify brand value by applying a regression analysis called hedonic price modelling. A brief review of hedonic price modelling and its applications are provided as follows.

Hedonic price modelling is the application of regression analysis, which is a powerful and appropriate research tool for assessing the implicit values of products (Jim and Chen, 2006, Sirmans et al., 2005). Regression analysis allows for modelling and analysing the relationship between a dependent variable and one or many independent variables. It facilitates the understanding of the marginal value of dependent variable changes when any one of the independent variables is changed, while the other independent variables are fixed. Regression analysis is widely used for prediction and exploration of the forms of these relationships (Prasitrathasin, 2005, Johnson and Bhattacharyya, 2006, Bryman and Hardy, 2004). Additionally, the hedonic regression function has been usually used to model property values (sell or rent) (Chongyosying, 2005, Baranzini and Schaerer, 2007). The modelling approach regresses property price on various characteristics, such as LS, DA, dwelling appearance and features, location, neighbourhood, accessibility, pollution and environmental conditions, view, land use proportion, and design quality (Cho et al., 2008, Jim and Chen, 2009, Gao and Asami, 2007).

A simple pricing model can be used in linear relationships between property price (dependent variable) and its characteristics (independent variables). There is no specific functional form of hedonic pricing models. The model can be used in many functional forms, such as simple linear, semi-logarithmic, double-logarithmic (log-log), and Box-Cox (Jim and Chen, 2006). The most suitable model is usually determined by empirical methods (Palmquist et al., 2005). Examples of studies on model form selection for hedonic pricing modelling are presented in Table 1 below.

According to the information in Table 1, the semi-logarithmic form is most frequently used for hedonic pricing modelling, followed by the linear form. In contrast, several previous studies concluded that the semi-logarithmic model is the most preferable function form, which is less complicated to apply and able to estimate the percentage change in predictor associated with their independent variables (Baranzini and Schaerer, 2007, Guttery, 2002, Din et al., 2001, Bowman et al., 2009). This study adopts an experimental method to collect the most suitable form of the hedonic price model in the BMR.

4. Research Methodology

This research was carried out based on a qualitative analysis on property price modelling with a field survey. Hedonic pricing modelling is the modelling approach utilized for this study. A quantitative field survey was adopted to collect all of the necessary data, such as actual property selling price, property physical characteristics, location, and branding. The mathematical function of the property price model, data collection, selection of model variables, and research limitations will be presented below.

Table 1 Examples of Model Form Selection for Hedonic Pricing Modelling Studies

No.	Source	Model form	Comments
1	Henry (1999)	double-logarithmic	There is no valid reason to select this model form. However, the model form might be selected from various experiments, but present only the most suitable one.
2	Song and Knaap (2003)	semi-logarithmic	There is no comparison between various model forms. However, this paper has indicated that semi-logarithmic is a common form of hedonic pricing modelling.
3	Limsombunchai et al. (2004)	semi-logarithmic	There is no comparison between various model forms. The paper merely presented the result in a semi-logarithmic form.
4	Rahmatian and Cockerill (2004)	linear, semi-logarithmic, and double-logarithmic	This paper presents 3 different model forms and concludes that the semi-logarithmic model is the most suitable with a high R^2 (equal to a double-logarithmic) and fewer insignificant variables.
5	Hui et al. (2007)	semi-logarithmic	There is no comparison between various model forms. However, the paper indicated that a suitable model is selected from the best fit model.
6	Kong et al. (2007)	linear and semi-logarithmic	The best fit is the semi-logarithmic form.
7	Din et al. (2001)	semi-logarithmic	There is no reason to select this model form.
8	Lee and Li (2009)	linear	There is no reason to select this model form.
9	Selim (2009)	semi-logarithmic	There is no reason to select this model form.
10	Kanemoto and Nakamura (1986)	Box-Cox	There is no reason to select this model form.

(Continued…)

(Table 1 Continued)

No.	Source	Model form	Comments
11	Wong et al. (2011)	linear	There is no reason to select this model form, but this paper has presented a list of examples of hedonic modelling studies. Most of them are in the linear form.
12	Lavin et al. (2011)	semi-logarithmic	A selective model is the best fit from their experimental process.
13	Bolitzer and Netusil (2000)	linear and semi-logarithmic	A comparison between 2 model forms found that the semi-logarithmic form is the most suitable.
14	Bowman et al. (2009)	semi-logarithmic	There is no reason to select this model form.
15	Jones et al. (2009)	semi-logarithmic	There is no reason to select this model form.
16	Espey and Lopez (2000)	linear, semi-logarithmic, double-logarithmic and Box-Cox	A comparison between 4 models found that the linear model is the most suitable. However, this study has indicated that there are slightly different results between the different model forms.
17	Blanco and Flindell (2011)	linear, semi-logarithmic, and double-logarithmic	This paper has presented 3 different model forms and concluded that the semi-logarithmic for is the most suitable with a high R^2 (equal to the double-logarithm) and fewer insignificant variables.

4.1 Property Price Model

This study carries out the experiment with a method that formulates two hedonic pricing models, which are simple linear and semi-log models, with an objective variable (branding) and three sets of control variables (SY, structural characteristics, and project location). The property price model of this study is estimated by using the ordinary least squares (OLS) estimation. The function form is presented in Equation 1.

$$Y = \beta_0 + \beta_B B + \beta_{SY} SY + \beta_S S + \beta_L L + \varepsilon \qquad (1)$$

where Y is the property price (P) for a simple linear function and the natural logarithm of property price ($ln(P)$) of the semi-log function, B corresponds to the branding variable, SY corresponds to the sale year variable, S corresponds to the structural characteristic vector of the property, L corresponds to the project location vector of the property, β_0 is a constant term of the model, β_B ,β_{SY}, β_S and β_L correspond to the regression coefficient vectors of each independent variable, and ε is an error term that reflects the unobservable.

Moreover, to solve the problems from the hedonic pricing modelling process, this study has mitigated the outliers, and analysed the multicollinearity and heteroskedasticity problems by using the extreme studentized deviate (ESD) (Piyapimonsit, 2004, Walfish, 2006, Hodge and Austin, 2004), variance inflation factor (VIF) (Mohamed, 2006, Poudyal et al., 2009), and Breusch-Pagan (BP) (Breusch and Pagan, 1979, Godfrey, 2008) methods, respectively.

4.2 Data Collection

This study selects data from both primary and secondary sources. The primary data was collected through a field survey of 50 private subdivisions in the BMR. The secondary data was obtained from the "Housing Yellow Pages in Bangkok Metropolitan Region, 2008" published by the Agency for Real Estate Affairs (AREA) (2009). The data from both sources were collected by the same methodology, and confirmed by comparing similar data between the primary and secondary sources.

The sample size followed the requirements of Yamane's formula, in which the minimum requirement is 400 sets at a 95% confidence interval (1973, p. 1089). The data were systematically and randomly collected according to the proportion of dwelling type. The total number of the initial sample was 1,770 property sales during the period of 1992-2010, which were spread out among the eight zones of the BMR. However, after eliminating the outlier problems with the ESD method, the final sample size comprised 1,755 property sales.

To manage and mitigate the problem of omitted variables between the design features (internal and external features) to the branding variable, an analysis of variance (ANOVA) of the design features between the branded and unbranded properties was used. The results are presented in Table 2 below.

Table 2 ANOVA Testing of Design Features Among Branded and Unbranded Properties

Design feature		Group		ANOVA test		
		Branded	Unbranded	F	p-value	Different
Internal	Dwelling area (m^2)	181.27	234.37	27.631	0.000	Yes
	Number of bedrooms (Room)	3.1	3.3	25.460	0.000	Yes
	Number of bathrooms (Room)	2.6	3.0	29.333	0.000	Yes
	Number of garages (Car/unit)	1.8	2.1	31.266	0.000	Yes
External	Density (Unit/1,000-m^2)	2.78	2.69	0.843	0.359	No
	Park area (m^2)	4,774.82	4,136.96	2.504	0.114	No
	Lake area (m^2)	475.04	713.47	2.238	0.135	No
	Infrastructure area (m^2)	23,671.98	24,374.41	0.121	0.728	No
	Street width (m)	9.13	9.34	1.865	0.173	No
	Walkway width (m)	1.72	1.76	3.129	0.077	No

Note: The F-critical for the 1,755 samples sizes is 3.847 at a 95% significance level

According to the information in Table 2, the ANOVA tests of all the internal features show that there are significant differences between the two groups. On the other hand, the results of the external features show that all of them are not significantly different between the two groups. These results conclude that branding does not affect the internal feature designs, only the external features. Therefore, to mitigate the omitted variable problem, external features will not be selected for the modelling.

However, to avoid multicollinearity between the internal features, this study has tested the correlation between each variable. The results are presented in Table 3 below.

Table 3 Correlation Testing between Each Internal Feature Variable

Internal feature	Dwelling area	No. of bedrooms	No. of bathrooms	No. of garages
Dwelling area	1			
Number of bedrooms	0.777	1		
Number of bathrooms	0.830	0.765	1	
Number of garages	0.881	0.655	0.734	1

Table 3 shows that the correlation between dwelling area and number of bedrooms, bathrooms, and garages is very high. All of them are greater than 0.75. Therefore, to avoid multicollinearity, the number of bedrooms, bathrooms, and garages will be dropped from the modelling.

4.3 Selection of Model Variables

The dependent variable is property-selling price, while independent variables are brand (B), SY, LS, DA, dwelling type and project location. The definition and summary of the dependent and the selected independent variables are described in Table 4.

Brand variable (B) is the objective variable of this study. It is a dummy variable used to consider the influence of the brand name of property development companies in Thailand. As branding is an abstractive object, there is no specific information to identify branded property in Thailand. Meanwhile, the REIC (2010) refers to branded property as property that is developed by listed companies in the SET. Therefore, the brand variable is recorded as 1 if the property is developed by well known listed companies in the SET (SET, 2010), and 0 for the rest.

The year of property sale compared to 2010 (SY) considers the time difference of the data of each sale. Property sold in 2010 is recorded as 0, 2009 is 1, and 2008 is 2. The procedures of recording are similar.

Table 4 Definitions and Summary of Variables in the Hedonic Pricing Modelling

	Variable	Definition	Minimum	Maximum	Mean
Independent variable					
	P	Total price	455,000.00	37,000,000.00	4,743,623.07
	ln(P)	Natural logarithm of total price	13.03	17.43	15.11
Objective variable					
	B	Branded property	0	1	0.26
Control variable					
	SY	Sale year up to 2010	0	18	1.69
Structural variable	*LS*	Land lot size (m^2)	64.00	2,328.00	234.19
	DA	Dwelling area (m^2)	40.00	775.00	176.84
	SDH	Single Detached House	0	1	0.65
	DP	Duplexes	0	1	0.09
	TH	Townhouses	0	1	0.25
Location variable	*BIC*	Property located in BIC	0	1	0.02
	BUF	Property located in BUF	0	1	0.26
	BSA	Property located in BSA	0	1	0.34
	NB	Property located in NB	0	1	0.15
	NP	Property located in NP	0	1	0.03
	PT	Property located in PT	0	1	0.12
	SP	Property located in SP	0	1	0.06
	SS	Property located in SS	0	1	0.03

The structural variables of this study include the size of the land, dwelling characteristics and dwelling types. The LS is the basic characteristic of property in subdivision developments. The minimum requirement of the LS for subdivision development in the BMR, is divided into three dwelling types, 64.0 m^2 for THs, 140.0 m^2 for DPs, and 240.0 m^2 for SDHs (Royal Thai Government, 2000). The minimum LS of this study is 64.0 m^2, while maximum is 2328.0 m^2.

The dwelling characteristics of this study are represented by DA. The DA represents customer requirement in relation to service area. The DA is normally stated in the property advertising or sale promotion documents (Jeewasuwan, 2010, Tangmatitham, 2010). The DA of this study ranges between 40.0 – 808.0 m^2.

Dwelling type is the dummy variable, which consists of three different types: SDH, DP and TH. SDH is the reference category for the regression analysis, while DP and TH are the alternative categories. To mitigate the bias problems of dwelling type, this study will parallel the number of dwelling type in the sample with dwelling proportion, see Figure 2.

The last variable set of this study is project location. Many previous studies have used several location variables, such as latitude, longitude, postal code, and distance from important amenities by applying geographic information systems (GISs) (Kong et al., 2007, Lee and Li, 2009, Geoghegan et al., 1997).

However, due to the lack of information to address the specific location of all secondary data, the location variable of this study is a dummy variable, which is represented by the zone of the project site. There are eight areas that represent the three zones in the BMR and five provinces in the vicinity of the BMA. The BIC is the reference category for the project location dummy variable, which is used as a comparative base for the significance of each project location dummy variable with property price, while the BUF, BSA, NB, NP, PT, SP, and SS are the alternative categories.

Moreover, to test the impact of branding on different dwelling types and project locations, ANOVA tests of the property price of different dwelling types and project locations between branded and unbranded properties were carried out. The results are presented in Table 5 below.

Table 5 ANOVA Tests of Property Price of Dwelling Type and Project Location between Branded and Unbranded Properties

Variable		Group		ANOVA test			
		Branded	Unbranded	F	p-value	F-critical	Different
Dwelling type	SDH	7,561,916	5,555,562	19.552	0.000	3.856	Yes
	DP	2,059,433	2,937,760	13.915	0.009	3.819	Yes
	TH	3,116,882	2,263,875	11.358	0.001	3.865	Yes
	Overall	6,222,828	3,941,071	56.278	0.000	3.849	Yes
Project location	BIC	17,863,533	6,450,000	5.178	0.037	4.494	Yes
	BUF	8,722,885	4,780,918	31.578	0.000	3.885	Yes
	BSA	4,869,972	4,867,963	0.000	0.997	3.862	No
	NB	5,330,792	3,178,442	32.191	0.000	3.885	Yes
	NP	1,777,000	2,598,590	1.839	0.182	4.073	No
	PT	2,940,250	2,816,385	0.053	0.818	3.919	No
	SP	5,531,714	2,204,947	19.166	0.000	3.951	Yes
	SS	3,361,000	1,874,450	5.949	0.024	4.351	Yes
	Overall	6,222,828	3,941,071	56.278	0.000	3.849	Yes

Table 5 find that the property price of all the dwelling types are significantly different between the different groups, and the property prices in the BIC, BUF, NB, SP and SS are also significantly different between the different groups, while the property prices in the BSA, NP, and PT are not significantly different between the groups. However, the test results of the overall property price are significantly different between the different groups. The results show that branding does not affect the different types of dwelling. In the meantime, branding affects some of the project locations, but the effect does not extend to the overall project location. The results conclude that there is a very small omitted problem in the different project locations, but it does not affect the overall results of this study.

In conclusion, the models have been developed under a recognized method. Variables and sample size have been selected with reference to supporting academic reviews. The limitation of the spatial geographic location variable will be addressed by an equivalent project zone dummy variable. The results of this study will be presented in the next section.

4.4 Research Limitations

This research aims to apply the hedonic pricing approach to develop a property price model due to its effectiveness. However, there are two major limitations in this research.

First, hedonic pricing modelling comes with many problems, such as outliers, multicollinearity, heteroskedasticity, and omitted variable bias (Bowman et al., 2009, Troy and Grove, 2008, Clark, 2006, McConnell and Walls, 2005).

This study has analysed and mitigated the problems of outliers, multicollinearity, and heteroskedasticity. However, the omitted variable bias problem is very difficult to resolve without additional information. If the other variables are uncorrelated with the omitted variables then the results are unbiased. Thus, if no predictor variables could be correlated to the omitted variables, then this may be able to reduce the bias problem. This is one reason that the model may not be applicable to additional variables. On the other hand, the omitted variable bias problem can be reduced by carefully selecting variables through a quality literature review (McConnell and Walls, 2005, Gibbons, 2009), mitigated by complex methods such as the Frontier models (Carriazo et al., 2011).

Nevertheless, this study has selected dependent predictor variables through resources that are sufficient in quality, and the variable numbers are not extremely large compared to the sample sizes. So, it could be expected that the omitted variable bias is not a serious problem in this study.

Secondly, due to the limitation of the data, this research assumes that the implicit property price will change from one year to the next. Meanwhile, this research also assumes that the implicit price of LS and DA is the same over the study area. The testing of these aspects has been omitted for the study.

5. Results

The correlation matrix of the variables is presented in Table 6, while the results of the estimation of both the linear and semi- logarithmic models are presented in Table 7.

In Table 6, none of the correlation coefficients among the independent variables are greater than 0.75 (Prasitrathasin, 2005), and the variance inflation factor (VIF) value of each variable in Table 7 is less than 10.0 (Franke, 2010, Tu et al., 2005); therefore, there is no serious multicollinearity problem.

Moreover, the values of the Breusch-Pagan chi-square (BP-χ^2) are 60.74 for the linear model, and 3.28 for the semi-logarithmic model. When the results are compared to the value of $\chi^2_{0.95,1}$ (3.84), it is found that there is heteroskedasticity in the linear model. On the other hand, no heteroskedasticity can be found in the semi-logarithmic model.

In Table 7, the results similarly show high explanatory power; R^2 = 0.794 for the linear model and R^2 = 0.836 for the semi-logarithmic model. A comparison between the two models shows that the R^2 of the semi-logarithmic model is greater than that of the simple linear model.

In the linear model, the DP dummy variable is the only variable that is statistically non-significant, while the other variables are significant at confidence levels that are less than 0.01. On the other hand, the result from the semi-logarithmic modelling shows that the signs of all the independent variables are significant at confidence levels less than 0.01. The coefficients show that the price of the branded property increases by 12.90% for similar structural and location characteristics, while the selling price rises about 2.98% annually.

In addition, property price increases about 0.08% and 0.40% for 1 m^2 of change in LS and DA, respectively. The results indicate significant differences based on dwelling type with DPs and THs showing a decrease in the selling price of 26.95% and 46.12%, respectively. Finally, the price of properties located outside of the BIC is reduced by 21.24% for the BUF, 28.96 % for the BSA, 26.15% for the NB, 43.78% for the NP, 41.69 % for the PT, 36.76 % for the SP, and 42.42% for the SS, compared to similar properties located in the BIC.

Table 6 Correlation Testing between Each Model Variable

Variables	Price	SY	B	LS	DA	DP	RH	BSA	BUF	NB	NP	PT	SP	SS
Price	1													
SY	0.03	1												
B	0.21	-0.18	1											
LS	0.76	0.09	0.14	1										
DA	0.82	0.16	0.06	0.72	1									
DP	-0.15	-0.03	0.03	-0.15	-0.17	1								
RH	-0.30	0.06	-0.16	-0.55	-0.25	-0.18	1							
BSA	0.07	-0.08	-0.01	0.05	0.08	0.00	-0.04	1						
BUF	0.08	0.04	0.14	0.04	0.08	-0.01	-0.05	-0.42	1					
NB	-0.07	0.14	-0.09	-0.10	-0.05	-0.02	0.07	-0.30	-0.25	1				
NP	-0.06	0.00	-0.05	-0.03	-0.03	0.01	0.00	-0.13	-0.10	-0.07	1			
PT	-0.15	-0.05	-0.12	0.01	-0.16	0.01	-0.06	-0.26	-0.22	-0.15	-0.07	1		
SP	-0.08	0.02	-0.06	-0.09	-0.07	0.03	0.14	-0.18	-0.15	-0.11	-0.04	-0.09	1	
SS	-0.07	-0.10	0.11	-0.03	-0.06	0.04	0.00	-0.12	-0.10	-0.07	-0.03	-0.06	-0.04	1

Table 7 Regression Modelling for Property Price

Variable	Linear model		Semi- logarithmic model			Collinearity	
	Coefficient	p-Value	Coefficient	p-Value	Marginal (%)	Tolerance	VIF
(Constant)	4,277,077.245	0.000	14.050	0.000			
Objective variable							
B	923,287.553	0.000	0.121	0.000	12.90	0.86	1.16
Control variable							
SY	-230,488.980	0.000	-0.030	0.000	-2.98	0.90	1.11
LS	9,241.150	0.000	0.001	0.000	0.08	0.31	3.24
DA	30,343.516	0.000	0.004	0.000	0.40	0.42	2.40
DP	201,950.710	0.257	-0.314	0.000	-26.95	0.86	1.16
TH	796,105.909	0.000	-0.618	0.000	-46.12	0.56	1.80
BSA	-5,167,657.249	0.000	-0.239	0.000	-21.24	0.12	8.34
BUF	-5,360,323.333	0.000	-0.342	0.000	-28.96	0.14	7.08
NB	-5,268,094.349	0.000	-0.303	0.000	-26.15	0.12	8.40
NP	-6,029,091.380	0.000	-0.576	0.000	-43.78	0.33	2.99
PT	-6,272,214.909	0.000	-0.539	0.000	-41.69	0.12	8.19
SP	-5,704,934.496	0.000	-0.458	0.000	-36.76	0.22	4.64
SS	-6,701,949.494	0.000	-0.552	0.000	-42.42	0.36	2.80
R^2	0.794		0.836				
Adjusted R^2	0.792		0.834				
F	477.908		631.563				
Significant F	0.000		0.000				
BP-χ^2	60.74		3.28				

6. Discussion

As the adjusted R^2 value of the semi-logarithmic model is greater in comparison to the adjusted R^2 value of the linear model, this study concludes that a semi-logarithmic hedonic pricing model provides more accurate property price estimators than the linear model. The independent variables consist of one objective variable and three control variables.

Objective Variable: Branding

Branding is the objective variable in this study. It is the dummy variable of the brand value in the property price. There are few previous studies that refer to the brand value of property price. Roulac (2007) has indicated that the value of property includes the components of brand, beauty and utility. In addition, Fah and Cheok (2008) and Pfrang (2010), have all indicated the importance of brand development for property development firms. However, there is no study on implicit brand value by using a hedonic pricing model of property in subdivision developments in the BMR. Thus, the result of this study provides a new focus on property brand value. The model confirms that the price of branded properties increase by 12.90% compared to unbranded properties with a similar SY, structure condition, and location characteristics. In conclusion, brand value in this study can be used as a guideline for setting the selling price on properties in subdivision developments in the BMR. However, this is only the average value of branded companies. Specific studies on brand value should be applied to identify the individual brand value, if required.

Control Variables

The results from the semi-log regression analysis show that selling price increases about 2.98% per year. This can explain the value of money changing over time, by annual inflation or discounted rates per the financial situation in Thailand (Buranathanung et al., 2004, BOT, 2011). This number is necessary to adjust property prices for further modelling studies and also essential for developers to set the property asking price due to different SYs.

Furthermore, increases in LS and DA will increase the property price. The results confirm the common sense utilized by customers with respect to the size and design of a product. The by-product of property is land and/or its dwelling, so increasing the size might have a positive effect on the price. In the same way, significant differences in dwelling types among the SDH, DP, and TH show that price is decreased for the latter two, relative to similar property characteristics. This is because customers perceive SDHs as being more luxurious than DPs and THs. In the BMR, the subdivision design for SDH-based projects will normally provide high quality neighbourhood amenities, such as low density, larger community parks and recreation areas, and complete community facilities and management of the units (Askew, 2002, Savasdisara et al., 1987, Kuanchom, 2006). The development cost of the neighbourhood designs will also be added onto the property price (Henry, 1999, Guthrie, 2010); however, additional studies are required to explain the effectiveness of neighbourhood amenities on property price for subdivision development in the BMR.

The last variable is in the dummy set of independent variables, which is location. The BMR is divided into 8 zones. The results show that the prices of properties located in zones outside of the BIC are lower than those inside the BIC. This is because the initial land prices in the BIC are higher than the others (Calhoun, 2002, Buranathanung et al., 2004). On the other hand, the BIC has the highest concentration of work places in the BMR; it contains many of the government buildings, education institutes, and business and commercial buildings. Moreover, the results indicate that the BUF has the second highest property prices, while the prices in the NB are higher than those in the BSA and 4 other nearby provinces in the vicinity, while the lowest property prices are located in the NP. There is no doubt about the BUF, but why are the prices in the NB higher than the others, even in the BSA? There are 2 primary reasons: the BUF and NB are not very far away from the BIC, and there are many current and upcoming mass transit projects that expand from the city into these areas. At the same time, the NP is quite a distance away from the BIC and there are no existing and incoming plans for mass transit projects into this area. The results of this variable strongly confirm that the initial land price, distance to work place, and urban facilities and infrastructures are significant for the property price.

7. Conclusion

This study aims to evaluate the brand value of property in subdivision developments in the BMR. This study has successfully evaluated the brand value by applying a hedonic price modelling approach in the BMR. The experiment shows that a semi-logarithmic model is more suitable compared to a simple linear model for this specific studied area. The results present new knowledge on the brand value of property, which is also useful for property development practices in the BMR. This study also shows the impact of differences in SY, which is consistent with the average inflation rate of Thailand. Moreover, this study strongly confirms the significance of traditional hedonic variables of both structural and location characteristics of property. Finally, the model can provide a guideline for developers on setting appropriate property prices for subdivision projects.

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References

Ailawadi, K. L., Neslin, S. A. and Lehmann, D. R. (2003). Revenue premium as an outcome measure of brand equity. *Journal of Marketing*, 67, 1-17.

AREA (2009). *Housing yellow pages in Bangkok Metropolitan Region*, 2008 (in Thai), Bangkok, Thailand, Agency for Real Estate Affairs (AREA).

Askew, M. (2002). A place in the suburbs: making a neighborhood in the middle-class housing estate. *Bangkok: place, practice and representation.* London ; New York: Routledge.

Bangkok Data Centre. (2009). Location and geography of Bangkok (in Thai) [Online]. Bangkok, Thailand. Available at: <http://203.155.220.230/nowbma/frame.asp>.

Baranzini, A. and Schaerer, C. (2007). A sight for sore eyes: Assessing the value of view and landscape use on the housing market. *Cahier de Recherche.* Geneve: Center de Recheche Appliquee en Gestion.

Blanco, J. C. and Flindell, I. (2011). Property prices in urban areas affected by road traffic noise. *Applied Acoustics*, 72, 133-141.

Bolitzer, B. and Netusil, N. R. (2000). The impact of open spaces on property values in Portland, Oregon. *Journal of Environmental Management,* 59, 185-193.

BOT (2011). *Inflation report (in Thai).* Bangkok, Thailand: Bank of Thailand (BOT).

Bowman, T., Thompson, J. and Colletti, J. (2009). Valuation of open space and conservation features in residential subdivisions. *Journal of Environmental Management*, 90, 321-330.

Breusch, T. S. and Pagan, A. R. (1979). A simple test for Heteroscedasticity and Random Coefficient Variation. *Econometrica*, 47, 1287-1294.

Bryman, A. and Hardy, M. A. (2004). *Handbook of data analysis,* London, SAGE.

Buranathanung, N., Ahuja, A., Karnchanasai, C., Preecha, R. and Sodsrichai, T. (2004). Housing price index: The Thai experience (in Thai). Bangkok: Bank of Thailand.

Calhoun, C. A. (2002). Property valuation models and house price indexes for the provinces of Thailand: 1992-2000. *Housing Finance International,* 31-41.

Carriazo, F., Ready, R. and Shortle, J. S. (2011). Using Frontier Models to Mitigate Omitted Variable Bias in Hedonic Pricing Models: A Case Study for Air Quality in Bogotá, Colombia. *Documento* CEDE No. 2011-11.

Chattopadhyay, T., Shivani, S. and Krishnan, M. (2008). Approaches to measurement of brand equity. 2008. *Oxford Business & Economics Conference Program*, Oxford.

Cho, S. H., Poudyal, N. C. and Roberts, R. K. (2008). Spatial analysis of the amenity value of green open space. *Ecological Economics*, 66, 403-416.

Chongyosying, C. (2005). *Application of a hedonic pricing model for real estate valuation in Bangkok Metropolis*. Doctor of Philosophy (Business Administration), Ramkhamhaeng University.

Clark, D. E. (2006). Externality effects on residential property values: The example of noise disamenities. *Growth and Change*, 37, 460-488.

Department of Provincial Administration. (2010). *Numbers of populations and houses* (in Thai) [Online]. Bangkok, Thailand. Available at: <http://www.dopa.go.th/xstat/popyear.html>.

Din, A., Hoesli, M. and Bender, A. (2001). Environmental variables and real estate prices. *Urban Studies*, 38, 1989-2000.

DPT (2012). *DPT GIS Web Location*. Bangkok, Thailand: Department of Public Works and Town & Country Planning (DPT).

Espey, M. and Lopez, H. (2000). The impact of airport noise and proximity on residential property values. *Growth and Change*, 31, 408-419.

Eves, C. (2009). Assessing the impact of streetscape on residential property in lower to middle socio-economic areas. *16th Annual European Real Estate Society Conference*, 24-27 June 2009 Royal Institute of Technology, Stockholm.

Fah, C. F. and Cheok, J. (2008). Importance of branding for property developers in Malaysia. *Sunway Academic Journal*, 5, 65-81.

Franke, G. R. (2010). Multicollinearity. *Wiley International Encyclopedia of Marketing*. John Wiley & Sons.

Gao, X. and Asami, Y. (2007). Effect of urban landscapes on land prices in two Japanese cities. *Landscape and Urban Planning*, 81, 155-166.

Geoghegan, J., Wainger, L. A. and Bockstael, N. E. (1997). Spatial landscape indices in a hedonic framework: an ecological economics analysis using GIS. *Ecological Economics*, 23, 251-264.

Gibbons, C. (2009). *Omitted variables bias.* University of California, Berkeley.

Godfrey, L. G. (2008). Testing for Heteroskedasticity and predictive failure in Linear Regression Models. *Oxford Bulletin of Economics and Statistics,* 70, 415-429.

Guthrie, G. (2010). House prices, development costs, and the value of waiting. Journal of Urban, *Economics*, 68, 56-71.

Guttery, R. S. (2002). The effects of subdivision design on housing values: The case of alleyways. *Journal of Real Estate Research*, 23, 265-274.

Henry, M. S. (1999). Landscape quality and the price of single family houses: further evidence from home sales in Greenville, South Carolina. *Journal of Environmental Horticulture*, 17, 25-30.

Hodge, V. and Austin, J. (2004). A Survey of Outlier Detection Methodologies. *Artificial Intelligence Review*, 22, 85-126.

Hui, E. C. M., Chau, C. K., Pun, L. and Law, M. Y. (2007). Measuring the neighboring and environmental effects on residential property value: Using spatial weighting matrix. *Building and Environment*, 42, 2333-2343.

Jeewasuwan, E. (2010). *Business plan for real estate development on small-size land in urbanized area of Bangkok (in Thai)*. Master of Science (Innovative Real Estate Development), Thammasat University.

Jim, C. Y. and Chen, W. Y. (2006). Impacts of urban environmental elements on residential housing prices in Guangzhou (China). *Landscape and Urban Planning*, 78, 422-434.

Jim, C. Y. and Chen, W. Y. (2009). Value of scenic views: Hedonic assessment of private housing in Hong Kong. *Landscape and Urban Planning*, 91, 226-234.

Johnson, R. A. and Bhattacharyya, G. K. (2006). *Statistics : principles and methods*, Hoboken, NJ, John Wiley & Sons.

Jones, C., Leishman, C. and MacDonald, C. (2009). Sustainable urban form and residential development viability. *Environment and Planning A*, 41, 1667–1690.

Kanemoto, Y. and Nakamura, R. (1986). A new approach to the estimation of structural equations in hedonic models. *Journal of Urban Economics*, 19, 218-233.

Kong, F., Yin, H. and Nakagoshi, N. (2007). Using GIS and landscape metrics in the hedonic price modeling of the amenity value of urban green space: A case study in Jinan City, China. *Landscape and Urban Planning,* 79, 240-252.

Kuanchom, P. (2006). *Customers' satisfaction with housing project of Land and Houses Public Company Limited in Bangkok Metropolitan Area and neighbouring provinces (in Thai)*. Master of Business Administration in General Management, Dhonburi Rajabhat University.

Lavin, F. V., Dresdner, J. and Aguilar, R. (2011). The value of air quality and crime in Chile: a hedonic wage approach. *Environment and Development Economics*, FirstView, 1-27.

Lee, J. S. and Li, M.-H. (2009). The impact of detention basin design on residential property value: Case studies using GIS in the hedonic price modeling. *Landscape and Urban Planning*, 89, 7-16.

Limsombunchai, V., Gan, C. and Lee, M. (2004). House price prediction: Hedonic Price Model vs. Artificial Neural Network. *American Journal of Applied Sciences*, 1, 193-201.

McConnell, V. and Walls, M. (2005). The value of open space: Evidence from studies of nonmarket benefits. *Resources for the future.* Washington, DC: Resources for the Future

Mohamed, R. (2006). The economics of conservation subdivisions: Price premiums, improvement costs, and absorption rates. *Urban Affairs Review,* 41, 376-399.

Palmquist, R. B., Karl-Göran, M. and Jeffrey, R. V. (2005). Chapter 16 Property value models. *Handbook of Environmental Economics.* Elsevier.

Park, C. S. and Srinivasan, V. (1994). A survey-based method for measuring and understanding brand equity and its extendibility. *Journal of Marketing Research (JMR),* 31, 271-288.

Pfrang, D. C. (2010). Property brands - Development of a strategic brand management model for the real estate industry. *17th European Real Estate Society (ERES) Annual Conference.* Bocconi University Campus, Milan, Italy.

Piyapimonsit, C. (2004). Outlier. *HCU Journal*, 8, 106 -110.

Poudyal, N. C., Hodges, D. G., Tonn, B. and Cho, S.-H. (2009). Valuing diversity and spatial pattern of open space plots in urban neighborhoods. *Forest Policy and Economics,* 11, 194-201.

Prasitrathasin, S. (2005). *Multivariate analysis technics for social and behaviour research (in Thai)*, Bangkok, Thailand.

Rahmatian, M. and Cockerill, L. (2004). Airport noise and residential housing valuation in southern California: A hedonic pricing approach. *International Journal,* 1, 17-25.

REIC (2009a). *The glossary of real estate terms in Thailand (in Thai).* Bangkok, Thailand: Real Estate Information Centre (REIC).

REIC (2009b). *Newly completed and registered housing units in Bangkok and vicinities.* Bangkok, Thailand: Real Estate Information Centre (REIC).

REIC (2010). *Annual report 2009 (in Thai).* Bangkok, Thailand: Real Estate Information Center (REIC).

Roulac, S. E. (2007). Brand + beauty + utility = property value. *Property Management,* 25, 428-446.

Royal Thai Government (2000). Land Subdivision Act, B.E. 2543 (in Thai). *Royal Thai Government Gazette,* 117, 1-22.

Savasdisara, T., Tips, W. E. J. and Suwannodom, S. (1987). Residential satisfaction, mobility and estate management in private lower-cost housing estates in Thailand. Pathum Thani, Thailand: Asian Institute of Technology.

Selim, H. (2009). Determinants of house prices in Turkey: Hedonic regression versus artificial neural network. *Expert Systems with Applications*, 36, 2843-2852.

SET. (2010). List of property development companies, [Online]. Bangkok, Thailand. Available at: <http://marketdata.set.or.th/mkt/sectorquotation.do?sector=25&industry=5&sectorName=A_5_25_0_S&market=A> [Accessed 6th June 2010].

Sheng, Y. K. (2002). Housing, the state and the market in Thailand: Enabling and enriching the private sector. *Journal of Housing and the Built Environment,* 17, 33–47.

Sirmans, S. G., Macpherson, D. A. and Zietz, E. N. (2005). The composition of hedonic pricing models. *Journal of Real Estate Literature,* 13, 1-44.

Song, Y. and Knaap, G.-J. (2003). New urbanism and housing values: A disaggregate assessment. *Journal of Urban Economics,* 54, 218-238.

Song, Y. and Knaap, G.-J. (2004). Measuring the effects of mixed land uses on housing values. *Regional Science and Urban Economics,* 34, 663-680.

Tangmatitham, P. (2010). How to make the "better" houses, but "cheaper"? (in Thai). *Non-secreat tips, Supalai + Real estate.* Bangkok, Thailand: Nai-in Book.

Troy, A. and Grove, J. M. (2008). Property values, parks, and crime: A hedonic analysis in Baltimore, MD. *Landscape and Urban Planning*, 87, 233-245.

Tu, Y. K., Kellett, M., Clerehugh, V. and Gilthorpe, M. S. (2005). Problems of correlations between explanatory variables in multiple regression analyses in the dental literature. *British Dental Journal*, 199, 457-461.

Walfish, S. (2006). A review of statistical outlier methods. *Pharmaceutical Technology,* 30, 82.

Wong, S., Chau, K., Yau, Y. and Cheung, A. (2011). Property price gradients: the vertical dimension. *Journal of Housing and the Built Environment,* 26, 33-45.

Yamane, T. (1973). *Statistics: An introductory analysis*, New York, Harper & Row.