A HEDONIC PRICING ANALYSIS: EVALUATING PRICES OF BANGKOK'S NEW CONDOMINIUMS ALONG BTS SKYTRAIN

BY

MISS TISSANA KULKOSA

AN INDEPENDENT STUDY SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE PROGRAM IN FINANCE (INTERNATIONAL PROGRAM)

FACULTY OF COMMERCE AND ACCOUNTANCY
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ABSTRACT

Increasing numbers of condominium are seen in the center of Bangkok Metropolitan Area since BTS SkyTrain began operating in 1999. Areas along BTS are popular spots to capture benefits and convenience this rapid transit offers. This study investigates the willingness to pay for a new condominium located along BTS SkyTrain within one kilometer walking distance from the stations. Hedonic approach is applied to study the effects of location, structural, and neighborhood attributes have on condominium price. Geographically weighted regression (GWR) is conducted to test for spatial variation that may exist in the data. The results reveal no spatial dependence problem among the observations. OLS regression is performed to estimate the relationship condominium attributes have on price. The results reveal six significant attributes, which are land price, proximity to original BTS stations, location along BTS Sukhumvit Line, number of storey, car parking, and common fee. It also shows that the attributes affecting the willingness to pay for condominium vary in different locations.

Keywords: Hedonic pricing analysis, Condominium price, GWR

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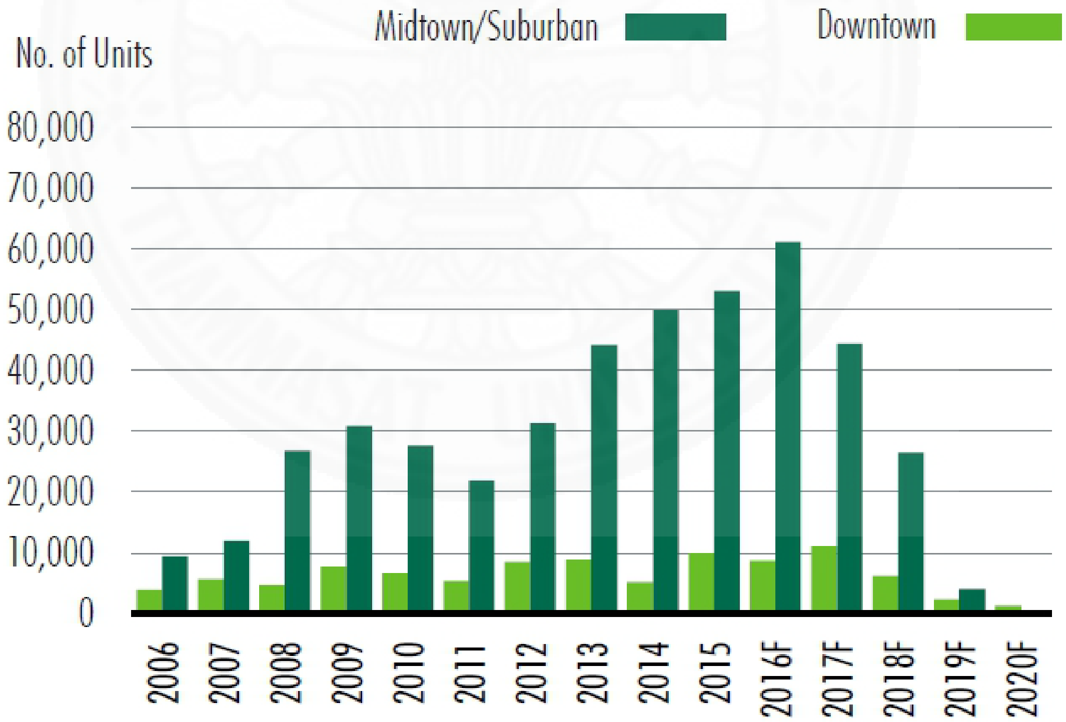
CHAPTER 1
INTRODUCTION

Bangkok's condominium market has expanded tremendously over the past five years. Demand for living closer to central Bangkok along BTS SkyTrain and MRT Subway lines increases as people want to save commuting time and costs. Figure 1.1 shows that the number of newly completed condominium units in midtown and suburban area has risen steeply since 2012. A large number of middle class condominium projects have been launched along the extension of BTS and MRT in the city fringe of Bangkok. The number of downtown condominium has not moved much due to very limited room to expand in the city center and land price is extremely expensive.

Figure 1.1: Newly completed condominiums in Bangkok

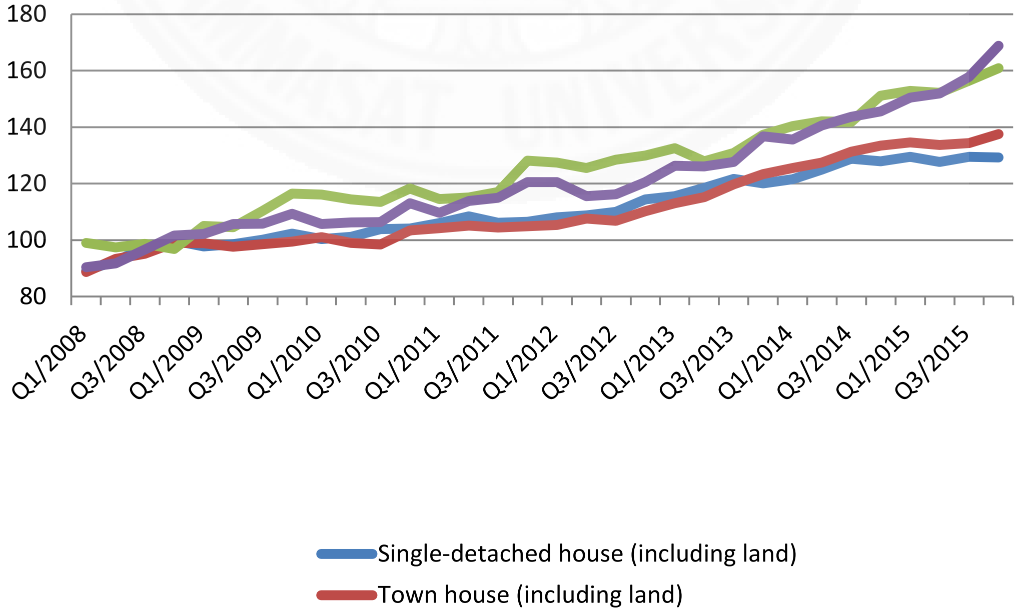


Source: CBRE Research, Q1 2016

Thanyalakpark (2011) explained that economic conditions and public transit systems are the two main factors affecting a soar in demand for condominium and changes in consumer behavior. Bangkok sees a huge change in development after the operation of BTS SkyTrain and MRT Subway began in 1999 and 2004 respectively. The developers see the convenience of commuting on these rapid transit systems and launch the projects in close proximity to the stations in response to consumer's demand. Although the prices of new condominium located in these prime areas are extremely high mainly due to expensive land price but many projects were sold-out instantly during their pre-sale period. This shows that consumers are willing to pay high price to gain the benefits of living in the city. O'Sullivan (2011) outlined the advantages of living in the city include reducing transportation time and costs, and accessibility to wide range of products and services.

Agency for Real Estate Affairs (AREA) surveyed condominium market at the end of 2015; there are 1,760 residential projects in Bangkok Metropolitan Region offering 490,649 units. The percentage of condominiums sold to the total supply is 72 percent compared with 58 percent and 60 percent of single-detached houses and townhouses respectively. This evidently confirms the increasing popularity trend of purchasing a condominium in Bangkok. Bank of Thailand publishes House Price Index (HPI) with an index point of 100 in January 2009 as shown in Figure 1.2. House prices in Thailand show an increasing trend and condominium price has increased significantly compared with single-detached house and town house prices.

Figure 1.2: Thailand's House Price Index



Source: Bank of Thailand

Purchasing decision of condominium is influenced by many factors and varies depending on individual's prioritized criteria. Condominium stocks available in the market are also varied in characteristics, which are reflected on their prices (O'Sullivan, 2011). Generally, characteristics that affect residential house prices are categorized into location, structural, and neighborhood characteristics (Freeman, 1979). This study will examine the willingness to pay for condominiums based on attributes that are influential to prices of new condominiums in Bangkok located along BTS SkyTrain. Hedonic approach will be applied to measure the implicit prices of these attributes. Hedonic model is based on the idea that a product is a bundle of attributes and the price reflects implicit prices of these attributes.

Hedonic pricing analyses on willingness to pay for condominiums in Bangkok are conducted using geographically weighted regression (GWR) and ordinary least squares (OLS). A number of literatures commented that condominium data contains spatial dependence problem and OLS will not be efficient and the estimated standard errors are not consistent, which leads to incorrect test statistics. The study will use geographically weighted regression (GWR) to account for spatial dependence problem as introduced by Brunsdon et al. (1996). OLS will also be used and compare the results with GWR.

This study will examine new condominium data between 2012 and 2015, providing an update to condominium price evaluation and reflects current market conditions. It has at least two contributions. First, it uses GWR on condominium prices in Bangkok, which has never been conducted before. Second, it studies willingness to pay for condominiums located along BTS SkyTrain, which is an appealing location for condominium and will be useful for consumers who are looking to buy condominiums in Bangkok to determine appropriate price of a condominium along BTS SkyTrain. Developers can also use this study to set a competitive price as compared to other firms, as well as for strategic planning and marketing purposes in response to consumer's needs.

The paper is organized in the following orders: reviews of literatures on relevant studies, explanation of theoretical framework, research methodology, empirical results, and conclusion.

CHAPTER 2
REVIEW OF LITERATURE

This chapter provides reviews of previous literatures related to condominium prices and hedonic pricing models used for valuation of house prices.

Rosen (1974) explained that the underlying hypothesis of hedonic is that the value of differentiated products depends on their utility-bearing attributes or characteristics. Hedonic prices are the implicit prices of these attributes, depending on specific amounts of their characteristics, are shown in the observed prices of products. His paper illustrates that when goods are considered as tied bundles of characteristics then observed market prices can be comparable and the hedonic price-characteristics equation is identified by the interaction of demand and supply.

Hill (2013) commented that housing provides an extreme example of differentiated products as every house is different. Hedonic methods define house prices as a function of a vector of characteristics and can be applied to construct quality-adjusted residential property price indexes.

In Thailand, Calhoun (2003) showed the first attempt of using hedonic method to analyze housing values and to develop House Price Index. Bank of Thailand uses hedonic price method to estimate Thailand's HPI, which presents in three categories: Single-detached house, town house, and condominium (Augsorntung and Sittikul, 2016). Benyasut and Dispadung (2012) supported the use of hedonic HPI as they claimed that it can better represent economic cycles for calculation of CPI.

Apart from computation of HPI, a few researchers in Thailand used hedonic price model to determine various factors that affect the price of property. Previous papers mostly concerned the impact of rapid transit systems (RTS) on land and property value in Bangkok. Vichiensan (2009) and Malaitham (2013) focused on the impact of RTS development on land and property prices. It empirically shows that proximity to urban rail stations attracts condominium residential choice and largely influences land and property values. Kulkolkarn and Laophairoj (2012) showed various factors that determine condominium prices including project location, proximity to BTS and MRT, unit location, unit size, furniture, number of units in a project, land size, construction waiting time, developer reputation, parking space, common fee, and unit type.

Thamrongsrisook (2011) agreed that distance to RTS affects condominium price, however, the most influential characteristics on prices are distance to main streets and public facilities. Samaksamarn (2015) conducted surveyed questionnaires on the willingness to pay for condominium nearby proposed MRT project in Changwattana Road. The results reveal main factors influencing the willingness to pay are high-rise building, main road location, reputation of a developer, occupation, and income.

Varinpramote (2014) applied hedonic price model to evaluate an impact of Bangkok's urban rail system on land value. The study found that land value near operating urban rail transit stations reveals 10.2% premium on average, whereas, station announcement and construction have no or small influence on land value. Keetasin (2015) carried out field survey and concluded that proposed extensions of rapid transit systems into suburban areas will generate commercial projects and increase land value. More condominium projects are expected to emerge responding to higher costs of land price.

Regarding the specification of hedonic model, Butler (1982) explained that the theory provided no specific functional form. All estimates of hedonic relationship are more or less misspecified but the impact is somewhat small. Linneman (1980) suggested that Box-Cox transformation technique can be used to identify appropriate functional form to estimate the price of urban housing market. Most studies conducted on Thai data executed hedonic price model using OLS, except for Kulkolkarn and Laophairoj (2012) who included Box-Cox transformation technique and found that it the most suitable method compared to other models. Huh and Kwak (1997) studied the functional form of housing market in Seoul, and the results show Box-Cox functional form is the best hedonic price model in Seoul. The hedonic model structure is different from those studied in the US, Japan, and Hong Kong, confirming that there is no universal functional form.

In searching for suitable functional forms, Du and Mulley (2012) explained that hedonic models such as those for housing market have problems of spatial autocorrelation or spatial heterogeneity (spatial dependence) as parts of unexplained variance caused by interdependence between observations as a results of their relative location in space – spatial dependence. If these effects are not accounted for, it will give biased estimations of coefficients and spatial error dependence.

Hill (2013) further emphasized on the importance to consider spatial dependence problem in the estimation of hedonic models for housing market. Widlak et al. (2015) studied spatial and hedonic analysis of house price in Warsaw and confirmed that Geographically Weighted Regression (GWR) improves the results as compared to OLS. Geographically Weighted Regression was introduced by Brunsdon et al. (1996) to account for spatial dependence problem by adding a point coordinate to each observation and compute weight matrix based on location in geographical space. The idea is that observations within the same area have tendency to influence one another more than observations farther away.

In Thailand, there is only one study by Vichiensan (2009) that implemented GWR model. He conducted hedonic study of land use and transport interaction in Bangkok using OLS and GWR, which confirmed that GWR approach outperforms OLS. A hedonic study of condominium prices using GWR that accounts for spatial dependence has not been implemented, thus this study provides the first attempt of using GWR to evaluate prices of condominiums in Bangkok.

CHAPTER 3
THEORETICAL FRAMEWORK

This study will analyze the willingness to pay of consumers for purchasing a condominium in Bangkok based on hedonic model proposed by Rosen (1974). He explained that the implicit prices of the products can be estimated by regression analysis. The fundamental assumption of hedonic models is that there is large number of differentiated products available – spectrum of products – among which choices can be made. The product is described by n objectively measured characteristics. Thus, $\boldsymbol{z} = (z_1, z_2, \ldots, z_n)$ represents the vector of coordinates with z_i measuring the amount of the *i*th characteristic contained in each good. Then $p(\boldsymbol{z}) = p(z_1, z_2, \ldots, z_n)$ is a hedonic price function that is under the assumption of tied sales of the product, allowing the comparison between observed market prices of the products as price differences are recognized as equalizing differences for different attributes they contain. The implicit price of characteristic i or $p_i \equiv \frac{\partial p}{\partial z_i}$ can be estimated by the parameter of z_i from regression analysis. Generally, there is no reason for $p(\boldsymbol{z})$ to be linear as Rosen (1974) explained that the differentiated products are sold in separate markets that are highly interrelated.

The model shows that the implicit prices of underlying characteristics are derived from both demand and supply. Suppose that consumers maximize their utility subject to the nonlinear budget constraint. We get

$$Max\ U = U(x, z_1, z_2, \ldots, z_n) \text{ subject to } y = p(\boldsymbol{z}) + x \quad (1)$$

where U is the utility function from purchasing the product, x represents other product consumed, and y represents income. The consumers are required to choose x and $(z_1, \ldots, z_n)$ to satisfy the budget and the first order conditions

$$\frac{\partial p}{\partial z_1} = p_i = \frac{U_{z_i}}{U_x} \text{ for } i = 1, \ldots, n \quad (2)$$

where $\frac{U_{z_i}}{U_x}$ is the implicit marginal value a consumer is willing to pay to obtain an additional one unit of z_i, given the same utility and income level.

Rosen's hedonic model introduces bid function to tackle spatial equilibrium issue arisen when conceptualizing the problem of the product with a few underlying characteristics instead of a large number of closely related generic goods. The amount a consumer is willing to pay for alternative values of $(z_1, \dots, z_n)$ at a given utility index and income is represented by $\theta(z_i\,; u, y, \alpha)$ where α is a parameter that differs from person to person. Thus,

$$u = U(y - \theta, z_i, \alpha) \tag{3}$$

when y and u remain constant, the first order condition becomes

$$-U_x \theta_{z_i} + U_{z_i} = 0 \tag{4}$$

$$\theta_{z_i} = \frac{U_{z_i}}{U_x}\,. \tag{5}$$

Hence, θ_{z_i} is the marginal rate of substitution between z_i and money.

From equation (2) and (5), we see that $\theta_{z_i} = p_i$ is where the utility is maximized. Figure 3.1 illustrates consumer equilibrium, showing two different consumers; one with value function θ^1 obtaining maximum utility at point A, and the other with θ^2, while maximizes his utility at point B. The figure shows different consumption choice, where the second consumer purchases a product with more quantity of attribute z_1.

It is also important to look at the production decision to account for equilibrium of buyers and sellers' locational decisions. Under constant returns to scale, the producer maximizes profit

$$\pi = p(\boldsymbol{z}) - C(\boldsymbol{z}; \beta) \tag{6}$$

where $C(\boldsymbol{z}; \beta)$ is the cost per unit and β reflects underlying variable in the cost minimization problem or factor prices and production function parameters. First order condition gives

$$p_i = C_{z_i} \tag{7}$$

where $p_i$is the marginal revenue and C_{z_i} is the marginal cost of production to produce additional one unit of z_i, given the same profit level. At optimum, marginal revenue from selling additional attributes equals to their marginal cost of production per unit sold.

Offer function is incorporated into the model, symmetrically with the bid function from demand side. $\emptyset(z_i; \pi, \beta)$ represents unit prices (per model) that the firm is willing to take from attribute z_1, given a constant profit. Thus,

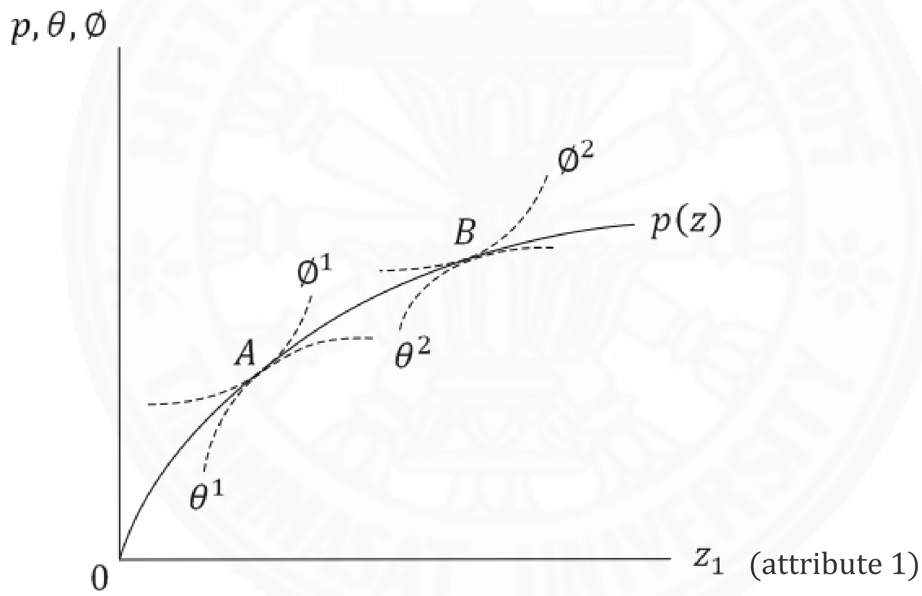
$$\pi = \emptyset(z_i; \pi, \beta) - C_{z_i} \quad (8)$$

and when π is constant, the first order condition gives

$$\emptyset_{z_i} = C_{z_i} \quad (9)$$

From equation (7) and (9), we obtain $\emptyset_{z_i} = p_i$, where producer's profit is maximized. As illustrated in Figure 3.1, two plants have different optimum points. The plant with $\emptyset^1$ has production and cost conditions that is suitable to produce lesser amounts of attribute z_1 (point A), while the plant with $\emptyset^2$ has a comparative advantage at producing more units of attribute z_1 (point B). Therefore, this evidently shows that the two firms have distinct value of the parameter β.

Figure 3.1: Choice of product attributes explained by bid and offer functions.



The curve $p(\boldsymbol{z})$ represents hedonic price schedule. It reveals prices of the product where demand equals supply and the market clears. As shown in the above figure, bid curves kiss offer curves at points A and B. Consumers choose a product containing the set of attributes where the willingness to pay is tangent to the minimum price they must pay. Similarly, firms choose to produce goods with the set of attributes where the willingness to accept is tangent to the maximum price obtainable for that model in the market.

CHAPTER 4
RESEARCH METHODOLOGY

1.1 Empirical model

Housing is considered as differentiated product i.e. houses differ in type, size, age, style, interior features, utility, and location (O'Sullivan, 2011). Different houses contain different set of characteristics and have different prices. Hedonic model framework as proposed by Rosen (1974) and described in the previous chapter, is one of the methods used to determine the equilibrium price of a house. It is based on the idea that a house is a bundle of attributes and the price reflects implicit prices of these attributes. As outlined in literature reviews, hedonic pricing model is proved to provide good approximations of house prices.

Freeman (1979) examined the application of hedonic approach in estimating property value. Characteristics of a dwelling can be divided into three categories namely location, structural, and neighborhood. Location attributes (L)describe the area where the property is situated, proximity to transportation, scenic views etc. Structural attributes (S) regard the physical characteristic of the property such as size, number of room, parking space etc. Neighborhood attributes (N) concern socioeconomic and physical aspects around the neighborhood. Public amenities, traffic congestion, air pollution etc. can also be included.

The hedonic price model for residential property can be stated as $p = f(L, S, N)$. It is important to note that there is no specific model for every case, so various functional forms can be applied (Butler, 1982). As mentioned in reviews of literature, spatial dependence problem tends to exist in property price data. This study will apply geographically weighted regression (GWR) to check for spatial dependence problem, and then OLS regression model will be conducted.

1.1.1 Geographically Weighted Regression (GWR)

Widlak et al. (2015) explained that using OLS for a city or a region can result in spatial dependence problem. Geographically weighted regression should be used with spatially heterogeneous data set in order to analyze the spatial variability of the coefficients. Brunsdon et al. (1996) introduced the GWR approach that accounts for spatial dependence, which refers to variations in relationships over space and is too complex to be represented by a simple linear or quadratic trend. They showed an example of the value added for an additional bedroom, which may be greater in an area populated by families with children than in an area populated by singles or elderly couples.

GWR extends the traditional regression framework by allowing coefficient β to vary spatially. The process weighs every observation by the matrix W_i and use OLS to estimate the local values of the parameters. The function is described as

$$y_i = \beta_{i0} + \beta_{i1}x_{1i} + \beta_{i2}x_{2i} + \cdots + \beta_{in}x_{ni} + \varepsilon_i \ . \tag{10}$$

Now β, the estimated parameter, varies in terms of location i and can be estimated by

$$\hat{\beta}_i = (X^T W_i X)^{-1} X^T W_i Y \tag{11}$$

where W_i represents a matrix of weights specific to location i, while X is the matrix of attributes and X^T is its transpose. Weighted least squares applies a weighting factor W_i to each squared difference before minimizing, whereas OLS minimizes the sum of the squared differences by the coefficient estimates. The essential idea is that for every location i there presents a “bump of influence” around i in which sampled observations close to i have more influence in the estimation of i’s parameters than sampled observations farther away. Hence, weighting an observation according to the proximity of i allows β parameters to be estimated that coincides with the claim for spatial variability of the coefficients when dealing with geographical data (Brunsdon et al., 1996).

1.1.2 Ordinary Least Squares (OLS)

Regression analysis provides an estimation of the relationship between dependent and multiple independent variables, predicting unknown quantities from existing data. Linear regression methods assume that the dependent variable is a linear function of the independent variables. Least squares method minimizes the sum of squared differences between the actual data and the predicted values. The linear function is

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n + \varepsilon \tag{12}$$

where dependent variable y denotes condominium price and independent variable x denotes attributes. Parameter β can be obtained by

$$\hat{\beta} = (X^T X)^{-1} X^T y \qquad (13)$$

where X is the matrix of attributes and X^T is its transpose.

1.2 Data

This study will focus on new condominium launched between 2012 and 2015, located in Bangkok along BTS Sukhumvit Line and BTS Silom Line within one kilometer walking distance, which is a distance transit planners can expect people to walk for rapid-transit service (Walker, 2011). During this peroid, the number of new condominium units launched has increased significantly. Year 2013 saw the highest number of new residential launches in which new condominium supply reached 84,250 units, almost double the number of horizontal housing types combined (Bank of Thailand, 2016). Thanyalakpark (2011) explained that economic conditions and public transit systems are the two main factors that affect soaring demand for condominium and changes in consumer behavior.

CBRE Global Research (2015) has surveyed the number of existing condominium supply in inner city of Bangkok. A large percentage of condominiums are located in Sukhumvit area where important offices and shopping centers are located. Sukhumvit is the most established residential area, supported by the core BTS Sukhumvit Line, with 31 percent of condominium supply in downtown area. The supply in Silom/Sathorn area, which is supported by BTS Silom Line, accounts for 19 percent. This shows that the most popular condominium locations are along BTS SkyTrain network.

The dependent variable investigated in this study is represented by $\boldsymbol{rpsqm}$, which is the minimum real price per square meter announced by the developer, not taking into account any sales campaign or promotion. Independent variables representing 11 attributes that affect the willingness to pay for condominiums are included in this study divided into three categories: location, structural, and neighborhood.

1.2.1 Location attributes

The selected area of study is considered as Bangkok's prime location with high density of residential and commercial zones. The total of four location attributes is included in the study.

$\boldsymbol{landpsqm}$ represents land price of the area where a condominium is located in and is measured in million Baht per square meter. Land price appraisal of districts in Bangkok during the period of 2012-2015 can be obtained from the Treasury Department. This variable is included as land price is the major cost for developing a condominium project. Scarcity of land for development in inner city of Bangkok results in very high land price. This variable helps to determine condominium price based on different proximity to Bangkok's inner city as the selected area of study covers inner city and city fringe.

$\boldsymbol{btsin}$ is a dummy variable taking 1 if a condominium is located within 400 meter walking distance to original 23 stations at the time of BTS opening in 1999, and 0 otherwise. BTS SkyTrain is Thailand's first elevated urban rail system. The network consists of Sukhumvit line or the dark green line, which runs to the north and the east from central Bangkok, and Silom line or light green line running to the west and the south. BTS SkyTrain carries, on average, 637,087 passengers daily (BTS Annual Report 2015/16). It is the most popular mass transit service as it runs along the main commercial and residential areas. This variable selects the location within the walking distance of 400 meters to transit as it is the most commonly cited standard used by transit planners (Walker, 2011).

$\boldsymbol{btssuk}$ is a dummy variable taking 1 if a condominium is located along BTS Sukhumvit line, and 0 otherwise. Sukhumvit is the most established residential area in Bangkok where large portion of condominiums is located (CBRE Global Research, 2015). The area is supported by the core BTS Sukhumvit line.

$\boldsymbol{mrt}$ is a dummy variable taking 1 if a condominium is located within one kilometer from MRT Subway station, and 0 otherwise. MRT Subway runs from Bang Sue to Hua Lamphong and connects to BTS at Chatuchak Park, Sukhumvit and Silom stations. MRT provides connection from inner city center to city center fringe along Ratchadapisek Rd where increasing number of office buildings are built. This also connects to populated residential areas in the northeastern suburbs of Bangkok.

1.2.2 Structural attributes

Structural attributes include six variables representing physical characteristics of a condominium.

$density$ represents the density of a condominium, measured by total number of unit/total land size in m^2. Higher density means more people will be sharing facilities and services.

$storey$ represents the number of storey of a condominium. Generally, there are two types of condominium: high-rise (more than eight stories) and low-rise (eight or less stories). Some people may prefer low-rise condominium as it tends to be quieter with less density.

$devage$ represent the age of a developer, measured in month since the establishment of a company to the time of condominium launch. Reputation of developer is one of the attributes consumers consider when purchasing a property. Consumers tend to put more confidence in reputable and experienced developers for the quality of condominium built and trust in project completion. Rinchumphu et al. (2016) studied brand value of property in Bangkok and confirmed that branding has an influential impact on property price.

car represents the ratio of total number of car parking space to total number of unit. For instance, if the project has 100 units and 70 parking spaces, this variable will equal to 0.7. Thailand Building Control Act B.E. 2544 states that there must be one parking space for condominium unit of 60 m^2 or larger or one parking space for every 120 m^2 floor area in the project, whichever is higher. The higher the number should have a positive impact on the willingness to pay for a condominium.

bed is a dummy variable taking 0 if a condominium unit is a studio type, 1 if it is a bedroom type. The price of a bedroom type condominium is higher than studio type as people are willing to pay more for function of a room (Li and Brown, 1980).

fur is a dummy variable taking 1 if a condominium is fully furnished, and 0 otherwise. Generally, fully furnished condominium should be more expensive. However, most high class condominiums are unfurnished as high income buyers want to choose the interior design of a room according to their tastes.

1.2.3 Neighborhood attribute

Neighborhood attribute consider physical and social aspects around the neighborhood.

fee represents common fee of a condominium in Baht per square meter. Common fee is paid by every co-owners to pay for expense such as hiring juristic person, house keepers, security guards, maintenance of common areas, electricity and water used in common areas, building insurance, and common facilities like swimming pool and fitness. The fee is higher if there are more facilities available and thus the price of a condominium also tends to be higher.

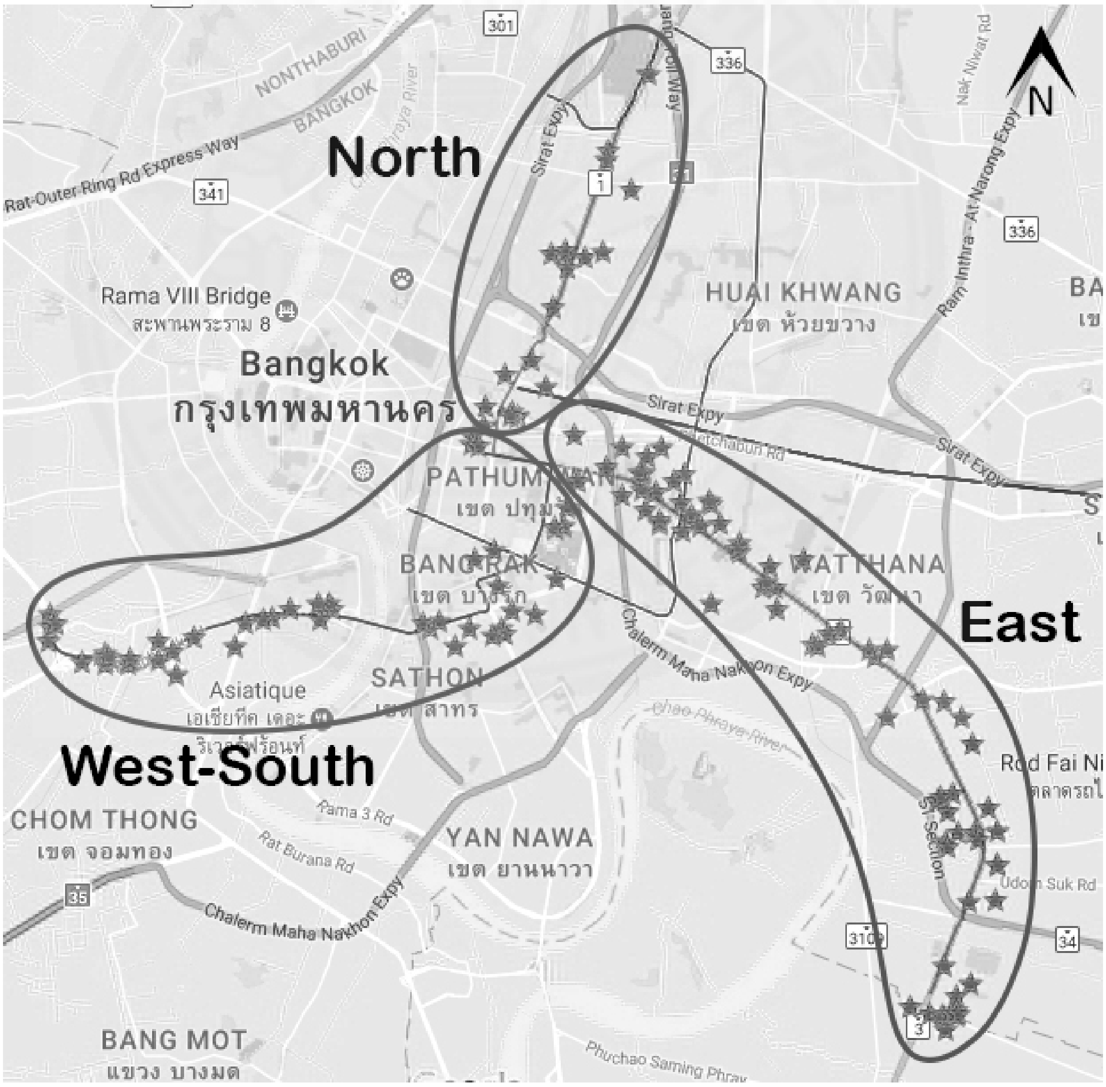
Summary of all variables and expected relationship with condominium price are outlined in table 4.1.

Table 4.1: List of variables and expected sign

Attribute	Definition	Variable	Expected sign
Dependent variable	Real price of condominium per m^2 (mn Baht)	$rpsqm$	
Location	Land price (mn Baht per m^2)	$landpsqm$	+
	Location within 400m walking distance to original 23 BTS stations (dummy)	$btsin$	+
	Location along BTS Sukhumvit Line (dummy)	$btssuk$	+
	Connection to MRT (dummy)	mrt	+
Structural	Density (number of unit/land size in m^2)	$density$	-
	Number of storey of the building	$storey$	- , +
	Developer's age (month)	$devage$	+
	Ratio of parking space to total no. of unit	car	+
	Bedroom type (dummy)	bed	+
	Furniture included in the room (dummy)	fur	- , +
Neighborhood	Common fee per m^2/month (Baht)	fee	+

This study gathers data information from various housing websites as well as Google Maps service. First, the list of newly launched condominiums during each year between 2012 and 2015 is obtained from www.kobkid.com. Afterwards, information of each condominium is gathered from www.thinkofliving.com, www.homenayoo.com, and www.hipflat.co.th. Then, the location of each condominium is saved on Google Maps and GPS north and east coordinates are obtained. The information of condominium are published at the time of its first openings, hence, it is important to adjust condominium price to real price taking year 2012 as base year. This study contains the total number of 125 observations and will perform four models based on area of BTS SkyTrain stations, i.e. whole area and three subareas: North, East, and West-South as shown in Figure 4.1.

Figure 4.1: Locations of condominiums and subareas



Source: Google Maps

According to descriptive statistics of whole area model, the average condominium price per m^2 is 113,900 Baht, in which the lowest price is 31,300 Baht and highest price is 273,300 Baht. Land price per m^2 ranges from 6,250 Baht to 125,000 Baht with an average of 42,900 Baht. The percentage of condominiums that are located within 400 meter walking distance to original BTS stations at the time of opening and is 41.6 percent. Condominiums that are located along the core Sukhumvit Line comprises 71.2 percent, while 13.6 percent have connection to MRT within one kilometer walking distance. The average density in a condominium project is 0.091 unit/m^2, with a minimum density of 0.032 unit/m^2 and a maximum density of 0.409 unit/m^2. The age of developer ranges from 3 to 387 months, which averages at 184.3 months. The ratio of car parking space to total unit is averaged at 0.596, with a minimum of 0.3 and a maximum of 2.36. Most condominiums in the study are a bedroom type at 74.4 percent of all observations. Fully-furnished condominiums make up of 36.8 percent. Common fee per m^2 ranges from 24 to 90 Baht, with an average of 53 Baht.

Data are also grouped into three sub-areas: North, East, and West-South, number of observation included are 18, 71, and 36 respectively. The average condominium prices of North and East subareas are higher than whole area average (136,900 and 115,300 Baht/m^2), while the average price of West-South subarea is lower (99,500 Baht/m^2). The average land prices of North and West-South subareas are higher than overall average (49,900 and 44,600 Baht/m2) whereas East subarea is lower (40,200 Baht/m^2). The percentage of condominiums that are located within 400 meter walking distance to original BTS are 72.22 percent for North subarea, 28.17 percent for East subarea, and 52.78 percent for West-South subarea. All observations in North and East subareas are located along the core BTS Sukhumvit line and West-South subarea includes the observations located along Silom line. East subarea contains the most number of condominiums with MRT connection and made up of 15.49 percent of observation, while North and West-South subareas contain 16.67 percent and 8.33 percent respectively. In terms of density, East subarea has the lowest density (0.081 unit/m^2) and below overall average but North and West-South subareas are higher (0.096 and 0.109 unit/m^2). Likewise for number of storey and developer age, East subarea shows lower averaged number than North and West-South subareas

($storey$: 18.15, 24.17, 24.78 and $devage$ (months): 165.37, 201.67, 213 respectively). The ratio of total number of car parking space to total number of unit is higher for East subarea than North and West-South subareas (0.625, 0.597, 0.537). Bedroom type condominium comprises of 88.89 percent for North subarea, 76.06 percent for East subarea, and 63.89 percent for West-South subarea. Fully furnished units are higher in East subarea, North subarea, and West-South subarea in descending order (40.85, 33.33, and 30.56 percent). North and East subareas have higher than overall average common fee (57.17 and 53.56 Baht/month), while West-South subarea has lower average (49.81 Baht/month).

Summary of descriptive statistics are shown in tables 4.2 and 4.3.

Table 4.2: Descriptive statistics

		Whole area (n=125)				**North subarea** (n=18)				**East subarea** (n=71)				**West-South subarea** (n=36)			
Variable	**Unit**	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**
$rpsqm$	mn Baht/m^2	0.1139	0.0516	0.0313	0.2733	0.1369	0.0435	0.0889	0.2405	0.1153	0.0571	0.0313	0.2733	0.0995	0.0388	0.0444	0.197
$landpsqm$	mn Baht/m^2	0.0429	0.0270	0.00625	0.125	0.0499	0.0103	0.03	0.0625	0.0402	0.0297	0.00625	0.125	0.0446	0.0271	0.018	0.125
$density$	unit/land area(m^2)	0.091	0.0411	0.032	0.409	0.096	0.0294	0.040	0.143	0.081	0.0264	0.032	0.173	0.109	0.0603	0.038	0.409
$storey$	number of storey	20.93	13.63	5	56	24.17	13.22	8	45	18.15	13.44	5	55	24.78	13.26	5	56
$devage$	month	184.31	124.98	3	387	201.67	125.6	5	374	165.37	122.95	4	378	213	125.38	3	387
car	total space/total unit	0.596	0.267	0.3	2.36	0.597	0.194	0.4	1.02	0.625	0.308	0.3	2.36	0.537	0.201	0.35	1.2
fee	Baht/m^2	53	15.13	24	90	57.17	11.69	40	90	53.56	16.34	24	90	49.81	13.80	30	85

Table 4.3: Descriptive statistics for dummy variables

		Whole area (n=125)		**North subarea** (n=18)		**East subarea** (n=71)		**West-South subarea** (n=36)	
Variable		**Frequency**	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
$btsin$	0	73	58.40	5	27.78	51	71.83	17	47.22
	1	52	41.60	13	72.22	20	28.17	19	52.78
$btssuk$	0	36	28.80	0	0	0	0	36	100
	1	89	71.20	18	100	71	100	0	0
mrt	0	108	86.40	15	83.33	60	84.51	33	91.67
	1	17	13.60	3	16.67	11	15.49	3	8.33
bed	0	32	25.60	2	11.11	17	23.94	13	36.11
	1	93	74.40	16	88.89	54	76.06	23	63.89
fur	0	79	63.20	12	66.67	42	59.15	25	69.44
	1	46	36.80	6	33.33	29	40.85	11	30.56

CHAPTER 5
EMPIRICAL RESULTS

Geographically weighted regression (GWR) is performed on STATA under two hypotheses. Firstly, does the GWR model describe the data significantly better than OLS? Secondly, does the set of parameter estimates exhibit significant spatial variation? The first hypothesis is tested by Monte Carlo simulation and the result suggests that GWR model is not significantly better for the dataset than OLS (see Appendix A). The second hypothesis is tested by comparing standard error of parameter estimates from observed data with those from each run of Monte Carlo simulation and the results reveal that there is no spatial dependence problem in this dataset (see Appendix B). These results are different from Vichiensan (2009), which studied land use and transport interaction in Bangkok and showed that GWR model describes the data better than OLS. The reason for this difference could arise from the area where condominium observations are located. The data in Vichiensan's study is more disperse, while the data in this study is clustered along BTS SkyTrain stations and may not contain much data variation spatially. Therefore, this study will focus on results estimated by OLS as shown in table 5.1.

Table 5.1: OLS regression results

Variable	**Coefficient**							
	Whole area		**North subarea**		**East subarea**		**West-South subarea**	
$landpsqm$	0.600	***	0.409		0.542	***	0.835	***
	(0.125)		(1.581)		(0.140)		(0.214)	
$btsin$	0.0123	**	0.0302		0.0203	***	-0.000331	
	(0.005)		(0.0417)		(0.00652)		(0.00728)	
$btssuk$	0.0174	***						
	(0.005)							
mrt	0.00316		-0.0214		-0.0122		0.0348	**
	(0.007)		(0.0439)		(0.00772)		(0.0134)	
$density$	0.0142		0.0521		-0.0233		0.0525	
	(0.0704)		(1.059)		(0.142)		(0.0644)	

Table 5.1: OLS regression results (continued)

$storey$	0.000288		-0.000656		0.000661	*	-0.00041	
	(0.0002)		(0.0022)		(0.00034)		(0.00035)	
$devage$	0.0000214		0.000177		-0.0000211		0.0000245	
	(0.00002)		(0.00013)		(0.00003)		(0.00003)	
car	0.0286	**	0.0509		0.0165		0.0547	**
	(0.0113)		(0.114)		(0.0138)		(0.0219)	
bed	0.00254		-0.00208		0.00344		-0.00953	
	(0.0052)		(0.0382)		(0.00616)		(0.00727)	
fur	-0.00362		0.0102		-0.00635		0.000721	
	(0.0046)		(0.0385)		(0.00527)		(0.00687)	
fee	0.00140	***	0.000897		0.00171	***	0.00056	
	(0.0002)		(0.00115)		(0.00025)		(0.00033)	
$(constant)$	-0.0331	**	-0.00959		-0.0189		0.0733	
	(0.0132)		(0.131)		(0.0192)		(0.0201)	
n	125		18		71		36	
Adjusted R^2	0.800		0.128		0.872		0.823	

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Whole area model

OLS results for whole area model shows significant overall F-test, which means that all coefficients are not equal to zero, and the adjusted R-squared is 80 percent. The results reveal five significant variables, which include three location attributes, one structural attribute, and one neighborhood attribute. This study investigates multicollinearity problem by performing variance inflation factor (VIF). Multicollinearity problem can increase the variance of estimated coefficients. VIF can be used to measure the increase of the variance as compared to when the variables are uncorrelated. VIF equals to one means they are not correlated. For example, a VIF of 1.8 means the variance of a coefficient is 80 percent larger. If VIF ranges between one and five, the variables are moderately correlated and still considered as acceptable range. VIF results are all lower than three, indicating that multicollinearity is low (see Appendix C).

Based on the results, three significant location attributes are land price, proximity to original BTS stations, and location along BTS Sukhumvit Line. This supports the results of previous studies (Vichiensan, 2009; Thamrongsrisook, 2011;

Kulkolkarn et al., 2012; Malaitham, 2013). Land price and location along BTS Sukhumvit Line are statistically different from zero at 99 percent confidence level. The results imply that one Baht increase in land price per m^2 will increase condominium price by approximately 0.6 Baht per m^2. Condominiums located in a popular residential area along BTS Sukhumvit Line enjoy a premium of 17,400 Baht per m^2. Proximity to original BTS stations is statistically different from zero at 95 percent confidence level. It shows that the price per m^2 of condominium located within 400 meters from original BTS stations at its opening is 12,300 Baht higher than those further away. Connection to MRT shows no relationship with condominium price. This could result from the observation area that limits to one kilometer from BTS stations and the sample size of MRT contained in this study is small.

The results show one structural attribute, which is the ratio of total car parking space to total number of condominium unit. It is statistically different from zero at 95 percent confidence level and implies that an increase of one of the ratio of parking space to total unit will increase the price by 28,600 Baht per m^2. The sign of coefficient for car parking space is different from previous study of Kulkolkarn et al. (2012) that reveal a negative relationship; however, the paper predicted a positive relationship. The significant positive relationship provides an interesting implication that although condominiums are located in a proximity to BTS, car usage still has an impact on willingness to pay for a condominium.

Common fee represents neighborhood attribute of a condominium. The results show that it is statistically different from zero at 99 percent confidence level. One Baht increase in common fee per m^2 will increase the price of a condominium by approximately 1,400 Baht per m^2. This supports the results from previous studies of Thamrongsrisook (2011) and Kulkolkarn et al. (2012).

Previous study conducted by Kulkolkarn et al. (2012) revealed a number of structural attributes that have significant effect on condominium price. This study indicates that only car park shows significant effect, whereas other attributes including density, number of storey, developer age, room type, and furniture do not affect the price. The estimated signs of coefficient of all variables follow prior prediction, except for density. The predicted sign of coefficient is negative but the results show otherwise. The reason may be that more people want to live in the city center to get benefits from infrastructures and services, as well as to save transportation costs and time.

North subarea model

The overall F-test of North model is not significant, which means that we fail to reject the null hypothesis that all coefficients are equal to zero. The adjusted R-squared is 12.8 percent. The results show no significant variables. Hence, OLS cannot be used to explain this model. The reason for this could be that there are only 18 observations included in this model. VIF shows that variables are highly correlated (see Appendix D).

East subarea model

The results of East subarea show significant overall F-test, which means that all coefficients are not equal to zero, and the adjusted R-squared is 87.2 percent. VIF values are lower than four for all variables (see Appendix E). The results reveal four significant variables. Land price, proximity to original BTS stations, and common fee are statistically different from zero at 99 percent confidence level, while number of storey is significant at 90 percent confidence level. An increase of land price by one Baht per m^2 will result in 0.54 Baht per m^2 increase in condominium price. The condominium is located within 400 meter walking distance from original BTS stations is 20,300 Baht per m^2 higher. If the common fee increases by one Baht per month, the price will increase by 1,710 Baht per m^2. Number of storey affects the price of condominium located along BTS East stations. Additional storey will increase the price by 661 Baht per m^2.

West-South subarea model

The overall F-test of West-South subarea is significant, which means that all coefficients are not equal to zero, and the adjusted R-squared is 82.3 percent. VIF values of all variable are lower than five (see Appendix F). There are three significant variables in this model. Land price is statistically different from zero at 99 percent confidence level. Connection with MRT and car parking are statistically different from zero at 95 percent confidence level. The results imply that one Baht per m^2

increase in land price will increase condominium price by 0.835 Baht per m^2. An increase of one of the ratio of parking space to total unit will increase the price by 54,700 Baht per m^2.

CHAPTER 6
CONCLUSION

This independent study applies hedonic approach to explore factors that affect the willingness to pay for condominium located near BTS SkyTrain stations. The price and characteristics of new condominiums launched between 2012 and 2015 are collected and categorized into three set of attributes, namely location, structural, and neighborhood. This study explores four models based on the location of observation, which are whole area model, North subarea, East subarea, and West-South subarea. Geographically weighted regression (GWR) is performed and reveals no spatial dependence problem among the studied condominium prices. Hence, OLS regression can be used to estimate the relationship that different attributes have on condominium price.

For whole area model, land price, proximity to original BTS stations, location along BTS Sukhumvit line, car parking, and common fee show significant relationship on price. North subarea contains small sample size, which results in high standard errors. This causes t-test to be unreliable, hence OLS estimations become biased. The price of condominiums located along BTS East stations are affected by land price, proximity to original BTS stations, number of storey, and common fee. West-South subarea condominium price is influenced by land price, connection to MRT, and car parking.

According to the results, location attributes are the most influential factors on condominium price. Land price shows significant relationship with price in whole area model, East and West-South subareas. The willingness to pay is higher for condominium located along the core BTS Sukhumvit line, especially for condominiums located within 400 meter walking distance to original BTS Sukhumvit East stations. Connection to MRT only impacts the price of condominiums located near West-South subarea or Silom line. For structural attributes, car parking shows significant relationship in whole area model. However, the results of subarea models show that it only affects the price of condominium on Silom line. Number of storey affects the price of condominium located along BTS Sukhumvit East stations.

Similarly, common fee representing neighborhood attribute only impacts the willingness to pay for condominium located near BTS Sukhumvit East stations.

The limitation of this study is that condominium prices included in this study are collected from the lowest price of condominium projects and not taking into account any sales promotions that may attract the buyers. Therefore condominium price that reflects the willingness to pay in this study does not include other incentives that may affect consumer's buying decision. Further researches can expand the study area of condominiums as well as include additional factors; for instance, financial transaction data such as required down payment amount and marketing campaigns such as discount or gift package that may affect the buying decision and the willingness to pay for condominiums.

REFERENCES

1. Agency for Real Estate Affairs (2016). This Year's Houses and Condominiums Outlook: Prosperous or poor. *AREA Press Release No. 35/2559*. accessed 7 August 2016, <http://www.area.co.th/thai/area_announce/area_press.php?strquey=press_announcement1271.htm> (written in Thai)

2. Augsorntung, C. & Sittikul, K. (2016). *The Developing of Thailand Residential Property Price Index*. Bank of Thailand Statistics and Information Systems Department. (written in Thai)

3. Bank of Thailand (2016). *Financial Stability Report 2015*. accessed 7 August 2016, <https://www.bot.or.th/English/FinancialInstitutions/Publications/FSR_Doc/FSR2015e.pdf>

4. Benyasut, P. & Dispadung, C. (2012). *Residential Property Price: An alternative approach for house rent in Consumer Price Index of Thailand*. Bureau of Trade and Economic Indices, The Ministry of Commerce, Thailand.

5. BTS Group Holdings PCL (2016). *Annual Report 2015/16*. accessed 17 August 2016, <http://ir.listedcompany.com/tracker.pl?type=5&id=79845&m=6437b8edc5d3f70a3f3a973f4f4daaaf7283c3de277007ffe8710d0eca012783&redirect=http%3A%2F%2Fbts.listedcompany.com%2Fmisc%2Far%2F20160621-bts-ar201516-en-02.pdf>

6. Brunsdon, C., Fotheringham, A. S. & Charlton, M. E. (1996) Geographically Weighted Regression: A Method for Exploring Spatial Nonstationarity. *Geographical Analysis*, 28(4), 281-375.

7. Butler, R. V. (1982) . The specification of hedonic indexes for urban housing. *Land Economics*, 58(1), 94-108.

8. Calhoun, C. A. (2003). Property Valuation Models and House Price Indexes for the Provinces of Thailand: 1992-2000. *Housing Finance International*, 31-43.

9. CBRE Global Research (2015). *Will Prices Rise in Bangkok's Old Condominium Building?*. CBRE Thailand Research Team. accessed on 17 August 1016, <http://www.cbre.co.th/en/ResearchCentre/Research/Will-Prices-Rise-in-Bangkoks-Old-Condominium-Buildings>

10. Choiejit, R. & Teungfung, R. (2005). The Influence of Employment Density on Commuting Patterns in Bangkok: A Case Study of Non-motorized Modes. *"Everyday*

Walking Culture", the 6th International Conference on Walking in the 21st Century, 31-42.

11. Du, H. and Mulley, C. (2012). Understanding spatial variations in the impact of accessibility on land value using geographically weighted regression. *The Journal of Transport and Land Use*, 5(2), 46-59.

12. Freeman, A. M. (1979). Hedonic Prices, Property Values and Measuring Environmental Benefits: A Survey of the Issues. *Journal of Economics*, 81(2), 154-173.

13. Hara, Y., Hiramatsu, A., Honda, R., Sekiyama, M. & Matsuda, H. (2010). Mixed land-use planning on the periphery of large Asian cities: the case of Nonthaburi Province, Thailand. *Sustainability Science*, 5(2), 237-248.

14. Hill, J. (2013). *Hedonic Price Indexes for Residential Housing: A Survey, Evaluation and Taxonomy*. *Journal of Economic Surveys*, 27(5), 879-914.

15. Huh, S. & Kwak, S.J. (1997). The Choice of Functional Form and Variables in the Hedonic Price Model in Seoul. *Urban Studies*, 34(7), 989-998.

16. Keetasin, S. (2015). *An Analysis of Residential Development Projects Along Rapid Transit Systems*. Real Estate Information Center. (written in Thai)

17. Kulkolkarn, K. & Laophairoj, C. (2012). Attributes Determining Condominium Prices in Bangkok. *Applied Economics Journal*, 19(1), 24-45. (written in Thai)

18. Linneman, P. (1980). Some Empirical Results on the Nature of the Hedonic Price Function for the Urban Housing Market. *Journal of Urban Economics*, 8(1), 47-68.

19. Li, M. M. & Brown, H. J. (1980). Micro-neighborhood Externalities and Hedonic Housing Prices. *Land Economics*, 56(2), 125-141.

20. Liu, L. & Jakus, P.M. (2015). Hedonic Valuation in an Urban High-Rise Housing Market. *Canadian Journal of Agricultural Economics*, 63, 259-273.

21. Malaitham, S. (2013). *A Study of Urban Rail Transit Development Effects in Bangkok Metropolitan Region*. Graduate School of Engineering, Kyoto University.

22. O'Sullivan, A. (2011). *Urban Economics* (8th Ed.). New York, McGraw-Hill Education.

23. Rinchumphu, D., Eves, C. & Susilawati, C. (2016). Brand Value of Property in Bangkok Metropolitan Region (BMR), Thailand. *International Real Estate Review*, 16(3), 296-322.

24. Rosen, S. (1974). Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition. *Journal of Political Economy*, 82(1), 34-55.

25. Samaksamarn, K. (2015). Willingness to Pay for Condominium Nearby Mass Rapid Transit Project: Case Study Jangwattana Road. *Journal by Faculty of Commerce and Accountancy*, Thammasat University, 146, 25-51. (written in Thai)

26. Thamrongsrisook, C. (2011). *The Influence of Rapid Transit Systems on Condominium Prices in Bangkok: A Hedonic price model approach*. KTH Architecture and Built Environment, Thesis no. 105.

27. Thanyalakpark, K. (2011). *Ultimate lifestyle condominium, only steps from BTS station*. Government Housing Bank.

28. Vichiensan, V. (2009). *Empirical Study of Land Use / Transport Interaction in Bangkok.* Asian Transportation Research Society, Project No: A08/003.

29. Varinpramote, S. (2014). *Bangkok's Urban Rail System: An impact evaluation*. Erasmus School of Economics.

30. Walker, J. (2011). *Basics: walking distance to transit.* accessed on 20 October 2016, <http://humantransit.org/2011/04/basics-walking-distance-to-transit.html>

31. Widlak, M., Waszczuk, J. & Olszewski, K. (2015). Spatial and hedonic analysis of house price dynamics in Warsaw. *NBP Working Paper*, No. 197.

APPENDICES

APPENDIX A
SIGNIFICANCE TEST FOR BANDWIDTH USING MONTE CARLO SIMULATION

Observed	P-Value
0.1509	0.269

APPENDIX B

SIGNIFICANCE TESTS FOR SPATIAL DEPENDENCE

Variable	Si	P-Value
$landpsqm$	0.0191	0.503
$btsin$	0.0010	0.381
$btssuk$	0.0006	0.649
mrt	0.0011	0.440
$density$	0.0082	0.329
$storey$	0.0001	0.111
$devage$	0.0000	0.100
car	0.0006	0.894
bed	0.0003	0.824
fur	0.0002	0.911
fee	0.0000	0.580
$(constant)$	0.0004	0.942

APPENDIX C

TABLE OF VIF AND 1/VIF FOR WHOLE AREA MODEL

Variable	VIF	1/VIF
$landpsqm$	2.65	0.377578
$storey$	2.58	0.387524
fee	2.13	0.468426
car	2.12	0. 472414
$density$	1.95	0. 513359
$devage$	1.57	0. 638031
$btsin$	1.41	0. 706982
mrt	1.21	0. 828516
bed	1.20	0. 834366
$btssuk$	1.20	0. 836159
fur	1.17	0. 855806
Mean VIF	1.74	

APPENDIX D

TABLE OF VIF AND 1/VIF FOR NORTH MODEL

Variable	VIF	1/VIF
$density$	9.98	0.100240
$storey$	9.00	0.111147
car	5.01	0.199717
$btsin$	3.82	0.262105
fur	3.59	0.278371
mrt	2.92	0.342568
$devage$	2.83	0.353182
$landpsqm$	2.76	0.362617
fee	1.88	0.532642
bed	1.58	0.634639
Mean VIF	4.33	

APPENDIX E

TABLE OF VIF AND 1/VIF FOR EAST STATION MODEL

Variable	VIF	1/VIF
$storey$	3.55	0. 281514
car	3.01	0. 332078
$landpsqm$	2.90	0. 345174
fee	2.78	0. 359191
$density$	2.35	0. 425393
$devage$	1.70	0. 588074
$btsin$	1.46	0. 686214
mrt	1.33	0. 754702
bed	1.17	0. 854098
fur	1.14	0. 877690
Mean VIF	2.14	

APPENDIX F

TABLE OF VIF AND 1/VIF FOR WEST-SOUTH STATION MODEL

Variable	VIF	1/VIF
$landpsqm$	4.41	0. 226685
$storey$	2.76	0. 362478
fee	2.73	0. 365977
car	2.55	0. 392611
$density$	1.98	0. 503905
mrt	1.86	0. 537738
$btsin$	1.78	0. 560994
bed	1.65	0. 607881
$devage$	1.56	0. 639261
fur	1.35	0. 738452
Mean VIF	2.26	

BIOGRAPHY

Name	Miss Tissana Kulkosa
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	2008: Intern Architect
	HASSELL Melbourne