The Effect of Mass Transit Systems on Price of Condominium in Bangkok

Undergraduate Honor Thesis
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Abstract

Since 1999, the BTS Skytrain and MRT Subway systems have helped ease the severe traffic problems in Bangkok, Thailand and increased the real estate properties' values especially condominiums near the mass transit route significantly as consumers are willing to pay more for the convenience. A hedonic price model is used to analyze the effect of mass transit systems on the price of condominiums in different areas of Bangkok. The regression results indicate that the valuation of condominiums near the mass transit system is sensitive to changes in distance from the mass transit stations as well as other housing traits.

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Introduction

Even though there are only few studies done on Bangkok real estate market, the Bangkok's land and housing markets, after the Asian Financial Crisis in 1997, have been performing well with strong supply and demand of high-quality and affordable housing projects. These properties' s prices have been rising rapidly, but traffic congestion is worsening because of the mushroom pattern of high-rise projects. Lacking any effective model to control city planning, Bangkok's urban development is market-driven integrating both commercial and residential land use in the centre of city. As the existing public transportations are insufficient and ineffective, there is a large number of cars coming to the city centre daily causing severe traffic problems. The Thai government had focused on building more road and expressway infrastructure in an attempt to ease heavy traffic congestion. However, this had led to undesirable result as the number of cars on the road increased dramatically. In 1999, the BTS Skytrain was first operated with route covering the central business district and inner city area. According to the Bangkok Metropolitan Administration, more than 500,000 single trips are made daily. The BTS Skytrain and MRT underground systems have been the alternatives that residents, living near these mass transit routes, use daily to commute to workplaces and avoid heavy road traffic. The BTS and MRT systems not only have helped combat the traffic congestion but also lifted the price of real estate properties, especially condominiums located near the BTS and MRT stations dramatically for the past years. Consumers are willing to pay more for properties which are closer to these stations because such decision can actually save commuting time and costs. Even though the BTS and MRT seem to be a solution to Bangkok's notorious traffic problems and also increase the capital values of real estate properties in Bangkok, the proposed expansion plans of the BTS and MRT route have been delayed for several years due to political problems. In examining the expansion plans, costs and benefits from implementing the BTS and MRT systems must also be addressed to help government authorities make informed decision.

This paper aims to pinpoint the impact of the BTS and MRT systems on residential properties. A total of 78 condominiums in Sukhumvit and Ratchada zones are studied to estimate the effect of mass transit on price of condominiums in high and lower density areas by using hedonic price analysis. In addition, the data were collected during July to August 2008 to minimize the effects of time-variant variables.

Brief Background of Bangkok

Bangkok is the capital and primary city of Thailand and has been the social and economic center for Southeast Asia. Bangkok is the world's 22nd largest city by population with approximately 8,160,522 registered residents. Bangkok is also home to the headquarters of large commercial banks and financial institutions. Until the late 1980s, much of the development in Bangkok was low density, with shop-houses and residential structures rarely exceeding five storeys in height (Dowall, 1991). Condominium development also began during this period after passing Condominium Act in 1979 (Foo, 1990). In addition, because of the unconstrained zoning, private developers have increased their projects' densities dramatically by building high-rise projects which also caused heavy traffic congestion in Bangkok especially in the downtown area. Traffic problems are likely to worsened due to two major reasons: 1) there are more development and 2) the rate of car-ownership increases at an estimate of 5.7 percent (Halcrox Fox Associates, 1990). In the area near central business district like Sukhumvit, traffic problems are more severe than those areas in the outer Bangkok areas.

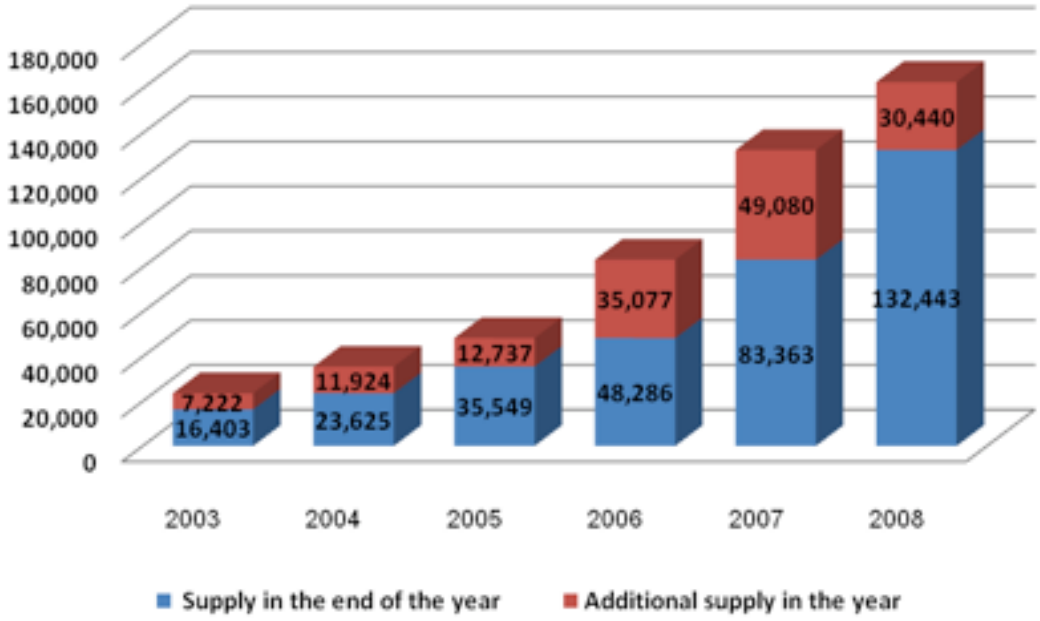
Transportation in Bangkok

* Source: Bangkok Metropolitan Administration (BMA)

There are several modes of public transportation in Bangkok including buses, river and canal network, and rail system. However, the elevated Skytrain(BTS) metro system and the MRT subway system are recently the most popular and fastest way to commute in Bangkok. The BTS Skytrain system consists of twenty-three stations along two lines: Sukhumvit line running northwards and eastwards and Silom line running from Silom to Saphan Taksin. The BTS system has a combined route of 55 kilometers. The MRT system runs from Bangsue to Hua Lamphong with a combined route of 21 kilometers. Over the past years, the BTS and MRT systems have eased traffic congestion especially in downtown area and reduced environmental problems such as air pollution. In addition, various expansion plans of BTS and MRT have been proposed that the system will have a combined route of 91 km covering all the major areas of Bangkok. Proximity to the BTS and MRT systems is now one of the major concerns when buying residential properties as people value their time and cost saving from commuting to their workplaces. Consequently, the BTS and MRT systems

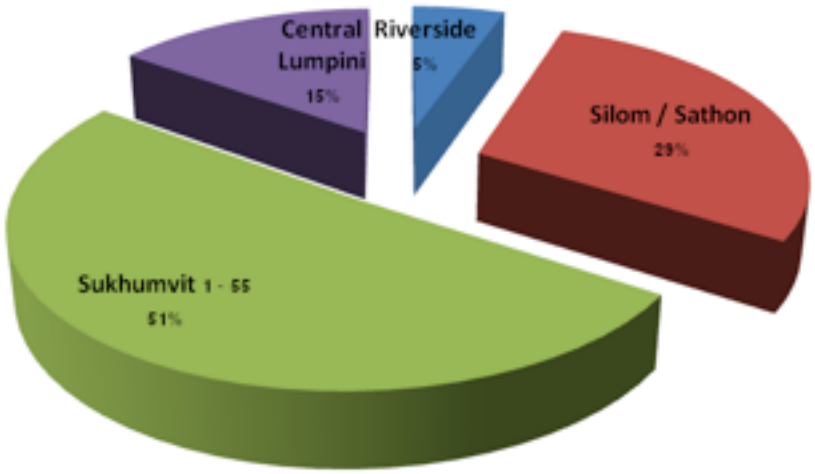
increased price of real estate properties such as condominiums and high-rise office buildings over the past years.

Condominium in Bangkok



*Source: Colliers International Thailand

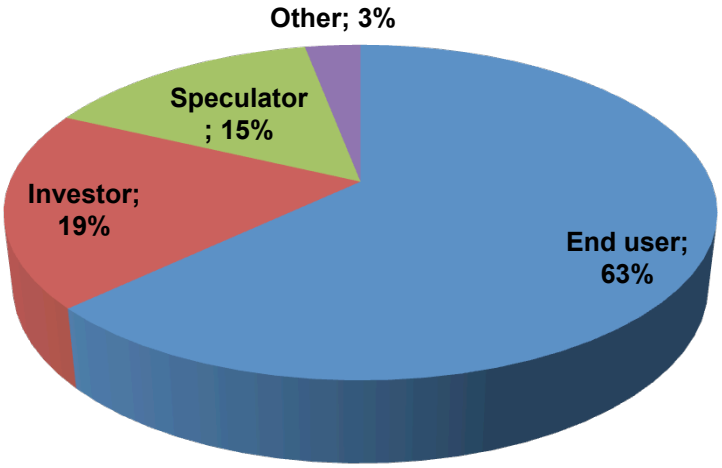
During the past five years between 2003 and 2008, there were over 120,000 condominium units completed. According to the diagram above, the supply of condominium in Bangkok increased steadily with an increasing rate of supply in the outer city area, while the scarcity of land in downtown area caused the slowdown of development projects. There were approximately 23,987 condominium units located in downtown Bangkok, with 12,183 units located between Sukhumvit Soi 1 and Soi 55, which is the Sukhumvit Zone in this study. In addition, majority of the condominiums in this area are located along the BTS line. In Bangkok downtown area, the upper-mid range grade of condominiums account for 30% while the high end and economy account for 11% and 34% respectively. On the other hand, as classified by their unit types, one, two, and three bedrooms account for 46%, 27%, and 16% respectively.



*Source: Colliers International Thailand

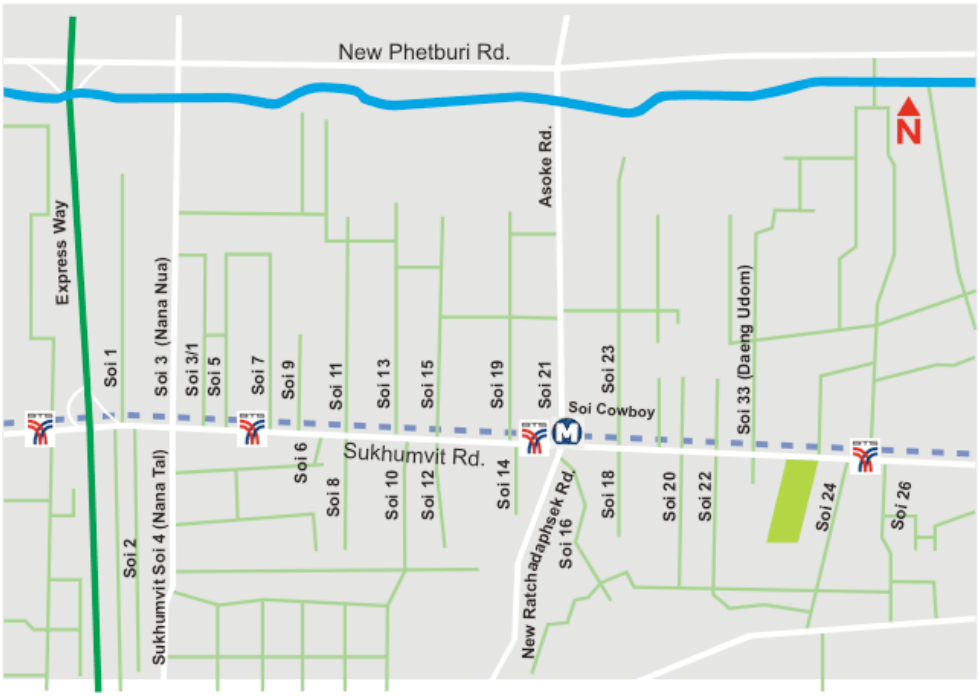
In addition, there were approximately 33,726 units located in Northern part of Bangkok, which are concentrated in Phahonyothin Road and Ratchadapisek Road (Ratchada Zone) along the mass transit in this area.

According to the study of middle-class condominium projects along mass transit route from Colliers International Thailand, they found that the purpose of buying condominium for real demand or for the purpose of their own staying is 63%, followed by the investment purpose and speculation purpose, represented 19% and 15% respectively.



*Source: Colliers International Thailand

Sukhumvit Zone



The Sukhumvit area of Bangkok serves as the main commercial street and is accessible via both the BTS and MRT. The traffic problems in this zone are severe because of high-density residential and commercial area. The pattern of circulation with only limited options for cross-town travel and the limited road width are incapable of handling travel demands (Dowall, 1991). The study area in this zone covers Sukhumvit soi (side street branching off a major street) 1 to soi 63. This area is a popular residential area for Western and Japanese expatriates.

Ratchada Zone

This area is located further from the central business districts but it is also accessible via both the BTS and MRT. Because of the location, the traffic problems are seemingly less severe. However, the MRT and BTS are still the main modes of transportation for people who commute to workplaces in the business district. This area also comprises of large shopping malls, parks, and schools. The main differences from Sukhumvit zone seem to be the lower density of commercial and high-rise residential buildings. In addition, there are less expatriates and more local residents living in this area.

The Model

Hedonic price model is used to analyze the relationship between price of the property and housing attributes. Marginal trait prices are the result of the equilibration of demand and supply for traits. The hedonic price function represent the locus of supply equal demand intersection for various levels of each trait (Rosen,1974). For many years, researchers also used hedonic price model to investigate the benefits from provision of local public goods in the housing markets (Harrison 1978, Nelson 1978, Edmonds 1983). In addition, a hedonic function should include only housing attributes that are costly to produce and yield utility to residents (Butler, 1982).

However, theory provides no strong restrictions on the functional forms of the hedonic functions. Freeman (1993) says that any form is plausible in the hedonic price function because the functional form could reflect the hedonic price structure of different housing. In addition, the Box and Cox (1964) developed a statistical model, which determines the functional form specification providing the best fit in terms of log likelihood. Following Freeman (1993) and Young (1980), the Box Cox technique is used to search for the best specification of hedonic equation when the functional form is ambiguous. Young (1980) suggested that the Box Cox parameters may indicate the degree of constraint in housing market, and a market in static equilibrium may have an approximate parameter value of 1 while a parameter value greater than 1 may suggest a loose market, but if less than 0 indicates a tight market (Megbolge, 1989). The functional form of the hedonic price model may vary in different cities reflecting the geographical attributes of each market. From the empirical studies, cities in US shows λ value between 0.2 and 0.4 (Linneman, 1980), $\lambda = 0$ in Tokyo (Edmonds, 1985).

This paper aims to use the hedonic price model and Box Cox technique in determining the best functional form specification to explore the effect of housing attributes on price of condominium. The housing attributes can be classified into locational traits (L) structural traits (S) and neighborhood traits (N) (Mok, 1995). Therefore, the market prices (P) of property can be expressed as $P = f(L,S,N)$.

The hedonic price model:

$$P = \beta_0 + \beta_1 L + \beta_2 S + \beta_3 N + \varepsilon \quad (1)$$

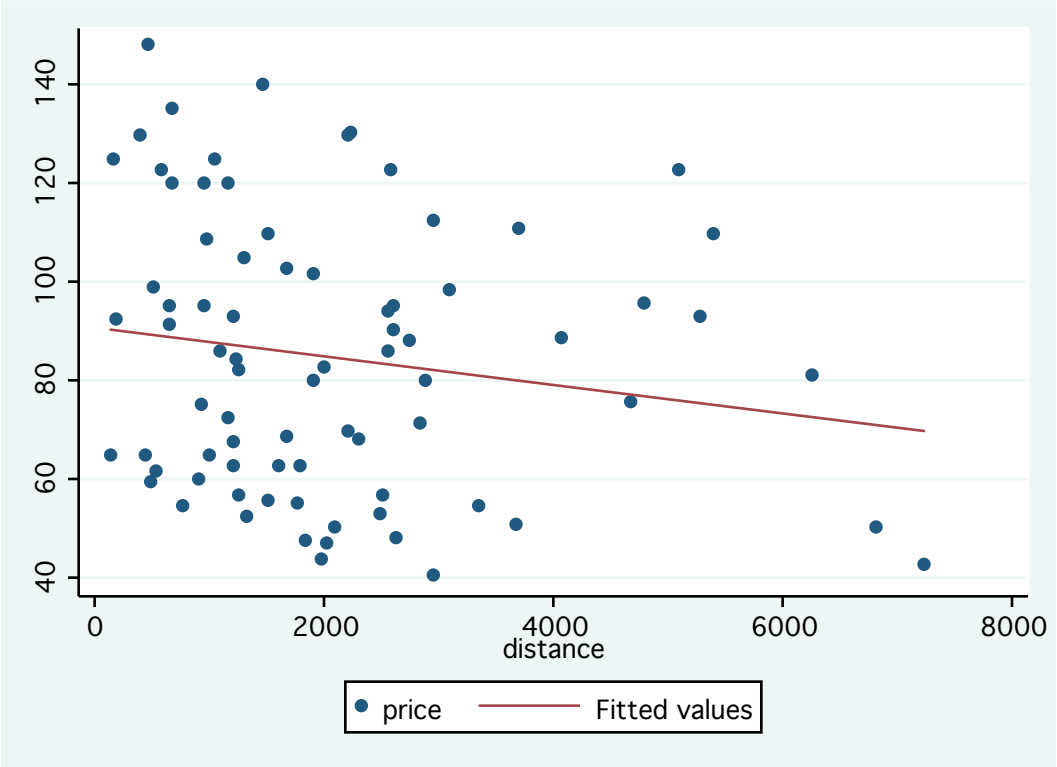
will be used in the first and second models to analyze condominiums in both zones: Sukhumvit and Ratchada separately as they differ in their attributes.

In determining the best specification of hedonic equation,

$$\frac{\left(P^{\lambda}-1\right)}{\lambda} = \beta_0 + \beta_1 L^{\lambda} + \beta_2 S^{\lambda} + \beta_3 N^{\lambda} + \varepsilon \quad (2)$$

equation(2) is used to perform a Box Cox power transformation on P and on the vectors of attributes L, S and N in the final model when both zones Sukhumvit and Ratchada are included. β is a variable coefficient and ε is the vector of errors in standard properties. When $\lambda = 1$, the hedonic equation is equivalent to linear specification and when $\lambda = 0$, the functional form approaches natural logarithmic.

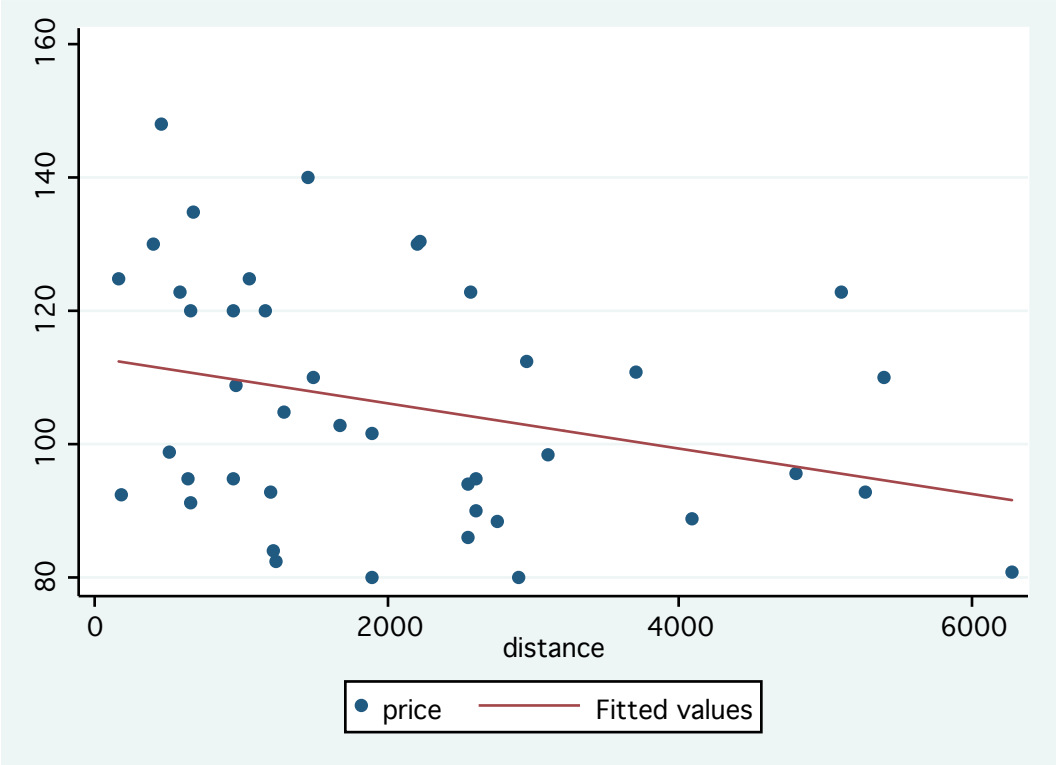
The Data



* Scatter plot of price (in thousands) and distance in both zones: Sukhumvit and Ratchada

Data of condominiums in Sukhumvit and Ratchada area in Bangkok were obtained from Colliers International Thailand (CIT). The Sukhumvit and Ratchada areas were chosen largely because of their differences in attributes whether to be the distance from the central business district, number of shopping malls and facilities, current condominium supply, demographics, and density. Also, the main purpose of choosing both areas is to study the impact of price of condominiums near mass transit route in areas differing in attributes.

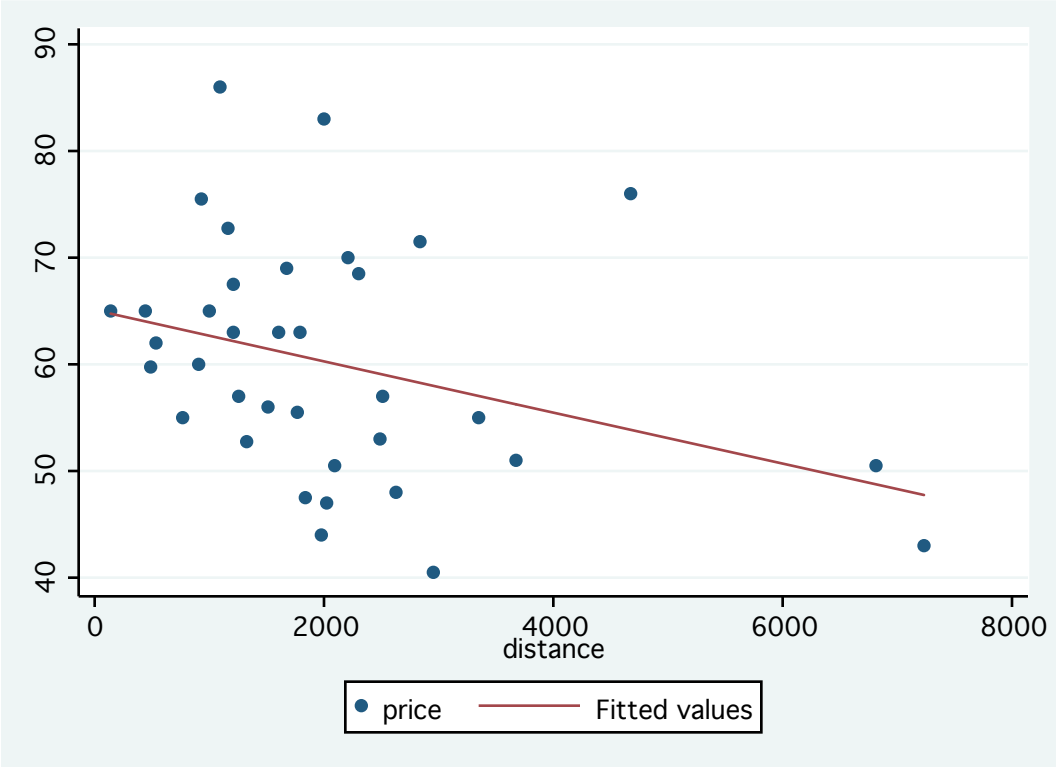
Sukhumvit Area



* Scatter plot of price (in thousands) and distance in Sukhumvit

According to the condominium database from CIT, there are total of 89 condominium projects launched between 2003 and 2008. The 89 condominiums in Sukhumvit accounts for a total of 14,235 units with an average price of 100,000 Baht per square meter. However, in this study only 42 condominiums of those are selected; and they are located between Sukhumvit soi 11 to 61 along the BTS sky train route, from Ploenchit to Ekamai station, with price ranging between 80,000 – 148,000 Baht per square meter as condominiums in this price range are classified as upper mid range to high end project. The selected condominiums are different in attributes such as distance from mass transit route, view, and size of the room, but they generally provide amenities and building specifications, which could be considered in the similar level of quality according to the price range. In addition, the selected condominium projects are located within 5000 feet from mass transit.

Ratchada Area



* Scatter plot of price (in thousands) and distance in Ratchada

There are a total of 84 condominium projects launched between 2003 and 2008 supplying 32,109 units. The average price of condominiums in this area is around 50,000 Baht per square meter. Thirty six condominium projects, located within 7300 feet from mass transit with price range between 41,000 to 86,000 Baht per square meter, are selected for this study. The average price of condominium projects in this area is relatively lower than the ones in Sukhumvit area for various reasons, for instance, demographics and distance from CBD. The price range of 41,000 to 86,000 Baht per square meter is also considered as upper mid range to high-end projects. Since many projects are developed by the same developers in Sukhumvit areas, the lower prices of these condominiums does not imply differences in term of building materials and qualities.

The Variable

As mentioned earlier, the variables in hedonic equation used in this model are classified in

	Variable	Definition	Expected Variable Sign
Dependent Variable	price	Price per square meter (Baht)	
Location Variable	distance	Distance from condominium project to closest mass transit station	(-)
Structural Variable	age	Age of bulding	(+),(-)
	size	Minimum size of room offered	(+)
	view	City view from condominiums which is higher than 10 floors	(+)
	garden	Garden in condominium	(+)
	developer	Developer's reputation	
Neighborhood Variable	neigbor	1) Quality of project location in the neighborhood 2) Distance from CBD	(+)

to three categories: locational trait variables, structural trait variables, and neighborhood trait variables.

Variable	Observation	Mean	Standard Deviation	Min	Max
price	78	84.96351	27.59638	40.5	148
distance	78	2067.154	1554.104	130	7230
garden	78	0.7435897	0.4394772	0	1
developer	78	0.4230769	0.4972452	0	1
view	78	0.6025641	0.492535	0	1
age	78	2.520727	1.529989	0.5833333	6.8
neigbor	78	0.5384615	0.5017452	0	1
size	78	60.82872	44.47514	25	319

* Descriptive Statistics of Variables in Two Zones

Location Variable

There are six BTS stations along Sukhumvit road. Most of condominium projects are also located near the train station. Therefore, tenants are able to save commuting time and costs to their workplaces during peak times. In Bangkok, heavy traffic may increase commuting times incredibly so it can take up to one to two hours for one to drive from Sukhumvit to central business district. Gauthier (1970) concluded that land values close to mass transit route is higher than areas farther away as resources and production may become more concentrated near mass transit. Increasing distance to the stations is associated with lower property values. Czamanski (1996) also found that accessibility to central business district is a prime determinant of land values. The locational variable is included in the model as it is costly for developers in term of land price and also yields utility to residents. The expected sign for this variable is positive as price of condominiums nearer to the mass transit is expected to be higher than condominiums farther away. The distance from condominiums to Mass transit route (BTS Sky Train) is measured in feet.

Neighborhood Variable

The area along Sukhumvit is also classified to two distinct areas: 1) Thonglor, Prompong, and Ekamai 2) Nana, Asoke, and Ploenchit. The quality of the two neighborhood areas is classified with consideration on traffic, distance to shopping mall, and demographics. The first area is located nearer to the shopping malls. There is also less traffic

because of wider roads and smaller number of offices located in this area. A large number of residents in this area are Western and Japanese expatriates. Traffic in the second area is heavy because there are relatively larger number of offices pubs, and bars in the area, narrower roads, Even though the second area is also located closer to the central business district but due to heavier traffic and longer distance from shopping malls, the average price of condominium in the first area is generally higher than in the second area. Condominiums in the first area were assigned value of 1 and condominiums in the second area were assigned value of 0. In Ratchada zone, the neighborhood variable is omitted, as it is difficult to distinguish areas in this zone. However, in the final model where the data of condominiums from the two zones are combined, the condominiums in Sukhumvit zone were assigned value of 1 while condominiums in Ratchada zone were assigned value of 0 as Sukhumvit zone is closer to central business district and many large shopping malls. Sukhumvit zone also has stronger demographics as residents in this area are mainly mixture between middle to high –income people and affluent expatriates. The average price of condominiums in Sukhumvit zone is generally higher than Ratchada zone.

Structural Variable

As most condominiums near mass transit route in both Sukhumvit and Ratchada zone provide amenities such as swimming pool and gym, all selected condominiums included in the model provide both swimming pool and gym facilities to control for these amenities variables. However, as shown from advertisement and brochures some condominiums in both zones do not provide open space like garden, which seems to be important factor in a busy metropolitan like Bangkok where open space is difficult to find. Garden in condominium would fulfill demand from residents who seek open space with nature as a place where they can enjoy from busy life. The expected variable sign for price and garden is positive.

The age of building was computed by the year in which the building sale was launched. Age ranges from half a year to four and a half year. The reason for choosing the launching year instead of the year when the building was completed is because some of condominium observations have not been completed. The expected variable sign is uncertain as during the first one to two years before the project is completed, the average price of condominium project is generally rising upon completion of project because buyers

bear less risk associated with construction or financing. However, for the condominiums older than two to three years, the price is expected to decline as age increases. Therefore, the effect of age on price of condominiums is ambiguous.

As people value the building that offers view of the city, the condominiums that are taller than 10 floors were assigned value of one while the condominiums lower than 10 floors were assigned value of 0. The expected variable sign for price and view is positive. In addition, the minimum size of room offered in condominium is also a main determinant of price. In general, as the size of room is larger, price per square meter is expected to be higher as well. The expected variable sign for price and size is positive. Developers' reputation is another important factor in making a decision as buyers make informed decision from past projects. Some developers failed to meet the building specification standard, and this would lower the future price of their projects. In the study of 150 developers by Foo, (1990), he found that almost all of the firms were private limited companies (90.9 percent) and more than half of which were family businesses. The condominiums built by top ten developers according to market shares in Bangkok were assigned value of one while others assigned zero. The criteria used in determining the top ten developers was considered from their market share of condominium in Bangkok from the year 2003 to 2008. The selected top developers have gained market share ranging between 5 to 10% of Bangkok condominium market as these developers has consistently built high-quality projects and customers are willing to pay higher because of their reputations. However, two foreign developers with strong reputation from abroad were also assigned value of one even though they are not one of the top ten developers according to the market share in Bangkok condominium market.

Results

In the hedonic price model(1), both zones Sukhumvit and Ratchada are analyzed separately.

Sukhumvit Zone

VARIABLES	(1) price	(2) price	(3) price	(4) price	(5) price	(6) price	(7) price
distance	-0.00313*	-0.00323*	-0.00313*	-0.00303*	-0.003	-0.00300*	-0.00298
	-0.0017	-0.00173	-0.00165	-0.00168	-0.00179	-0.0017	-0.00179
size	0.0985*	0.0896	0.0871*	0.0854	0.0857	0.0804	0.0749
	-0.0521	-0.0563	-0.0511	-0.0518	-0.0523	-0.0545	-0.0581
age		0.696					0.389
		-1.577					-1.636
developer			9.401*	8.813	9.534*	9.156*	8.534
			-5.306	-5.515	-5.419	-5.405	-5.695
view				2.604			2.583
				-5.713			-5.864
neigbor					-1.078		
					-5.64		
garden						-2.199	-1.864
						-5.755	-6.114
Constant	104.6***	103.4***	101.9***	100.3***	102.3***	103.6***	101.1***
	-6.348	-6.923	-6.36	-7.306	-6.699	-7.798	-9.462
Observations	42	42	42	42	42	42	42
R-squared	0.165	0.169	0.229	0.233	0.23	0.232	0.237

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

As shown in the table, distance is statistically significant at 10 percent level for five out of seven models, followed by developer and size in three and two models. According to the adjusted R squared, the model (3) seems to be the best model with the adjusted R squared of 16.7%. In model (2) where age is included in the model, size is no longer

statistically significant at 10 percent level. From the F-statistic test of age and size (F(2,38) =1.85), the coefficient of age and size is significant at 18 percent. From the pairwise correlation analysis, age and size are found to have a strong correlation. However, size is more strongly correlated with price and age is dropped from the model. When view, location, and garden are added in the model (4), (5), (6), and (7), the adjusted R squared dropped gradually to 10.7%. Thus, the model (3) would be the choice of final model for interpretation. According to the adjusted R squared in model (3), distance, size and developer variables explains 16.7% of variation in prices of condominiums.

$$P = \beta_0 + \beta_1(distance) + \beta_2(size) + \beta_3(developer) + \varepsilon$$

From regression results: Price= 101.9 –(0.00313)(distance)+ (0.0871)(size)+ (9.401)(developer)

The sign of coefficient in the regression is as expected with negative sign for distance and positive sign for size and developer. The negative sign of distance coefficient implies that as distance from mass transit station is further, price per square meter will decline as it takes more time and increases commuting costs for residents. A 1 percent increase in distance means an expected decrease of 0.003 percent for price on average. The magnitude of coefficient is very small but distance is statistically significant across models. The positive coefficient of size implies that as size of room increases, price per square meter is increased as well. A 1 percent increase in size means an expected increase of 0.09 percent for price on average. In addition, the positive coefficient of developer implies that residents would prefer condominium built by well-known developer. Price is expected to be higher by 9.4 percent on average for condominium developed by top ten developers.

Ratchada Zone

VARIABLES	(1) price	(2) price	(3) price	(4) price	(5) price	(6) price
distance	-0.00236*	-0.00257**	-0.00234*	-0.00250**	-0.00225*	-0.00183
	-0.00116	-0.00116	-0.00121	-0.00115	-0.00116	-0.00121
size	0.0658	0.119				0.262
	-0.174	-0.176				-0.188
age		-3.145	-2.646	-2.6	-2.586	-3.152
		-2.314	-2.264	-2.241	-2.227	-2.286
developer			2.693			2.648
			-3.678			-3.821
garden				-6.77	-9.404	-11.55
				-6.335	-6.678	-6.82
view					4.4	5.723
					-3.719	-4.121
Constant	62.74***	67.44***	69.01***	76.72***	76.26***	67.08***
	-7.107	-7.822	-6.297	-7.64	-7.603	-9.737
Observations	36	36	36	36	36	36
R-squared	0.117	0.166	0.168	0.183	0.218	0.275

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

The result is much different from Sukhumvit zone. From analyzing the T statistics and the adjusted R squared, size and developer should be dropped as they are not statistically significant and reduce the adjusted R squared. Even though view is significant only at 25 percent level, it is included in the model to avoid omitted variable bias. Thus, the final choice of model is the model (5). Notice that only distance is significant at 10 percent level in the Ratchada zone while in the Sukhumvit zone size and developer are also significant at 10

percent level. It is difficult to interpret why size is less statistically significant in this zone. One possible explanation is that the variation of size of the room for condominiums in Ratchada zone is not as high as in Sukhumvit zone. In addition, the possible explanation of developer variable in Ratchada which is not statistically significant might be the reason that some developers in this zone are recently established even though they have gained the top ten percent market share in the Bangkok condominium market. Thus, this would contribute less to the developer's reputation factor in buying decision. According to the adjusted R squared, the variables in model (5) explains about 12% for the variation in price, which slightly lower than the regression results of model(3) in Sukhumvit zone.

Model(5):

$$P = \beta_0 + \beta_1(distance) + \beta_2(age) + \beta_3(garden) + \beta_4(view) + \varepsilon$$

From regression results: P= 76.26 -0.00225(distance) -2.586(age) -9.404(garden)+ 4.4(view)

The negative sign of coefficient for distance is expected. The magnitude of distance coefficient is also low as in the Sukhumvit zone. The negative sign of age coefficient in this model implies that within 2003 to 2008 buyer still prefer newer over older condominiums. The negative sign of coefficient for garden is unexpected. In addition, the magnitude of garden's coefficient is also high. In addition, the positive sign of view's coefficient implies that buyer prefer view from condominiums which is higher than 10 floors. The magnitude of view coefficient is higher than distance and age but lower than garden.

Suhkumvit and Ratchada zones

The Box Cox transformation analysis is used in this section to determine the best specification of hedonic price model. The Box Cox analysis predicts $\lambda = 0.123$ as the best specification for the model:

$$\frac{\left(P^{\lambda}-1\right)}{\lambda} = \beta_0 + \beta_1(distance)^{\lambda} + \beta_2(age)^{\lambda} + \beta_3(size)^{\lambda} + \beta_4(neigbor)^{\lambda} + \beta_5(garden)^{\lambda} + \beta_6(view)^{\lambda} + \beta_7(developer)^{\lambda}$$

However, $\lambda = 0.123$ is not significantly different from $\lambda=0$ (logarithmic form). Therefore, the logarithmic form is used as the final model.

VARIABLES	(1) (λ=1) price	(2) (λ=0) lnprice	(3) (λ=0) lnprice
distance	-0.00223**	-0.0558**	-2.93e-05**
	-0.00107	-0.0226	-1.23E-05
neigbor	41.02***	0.479***	0.524***
	-3.927	-0.0522	-0.0452
age	-0.323	-0.0203	-0.00409
	-1.212	-0.0377	-0.014
size	0.0827*	0.105*	0.000782
	-0.0462	-0.0529	-0.000532
view	2.838	0.0402	0.0329
	-3.501	-0.04	-0.0403
garden	-4.826	-0.0515	-0.0472
	-4.271	-0.0478	-0.0492
developer	5.511	0.0592	0.0658
	-3.428	-0.0392	-0.0395
Constant	62.81***	4.130***	4.117***
	-6.243	-0.254	-0.0719
Observations	78	78	78
R-squared	0.761	0.789	0.785

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

(1) λ = 1 for all variable

(2) λ = 0 for dependent variable and all independent continuous variables

(3) λ = 0 for dependent variable

When λ = 1(model 1), the hedonic equation is equivalent to linear specification and when λ = 0 (model 2), the functional form approaches natural logarithmic. In the model (3), the specification is log linear form. The coefficients of the three specifications are not directly comparable because of different functional forms. However, their signs and t-

statistics are consistent and comparable. The sign of the regression coefficients for distance, neigbor, size, view are as expected. In all models, the neighbor coefficients are significant at 1 percent level while distance coefficients are significant at 5 percent level. In model (1) and 2), size is also significant at 10 percent level. In addition, developer is significant at 15 percent level in all models. The magnitude and significant level of 1 percent for neighbor coefficient implies a strong positive relationship between neighborhood (in this case between Sukhumvit and Ratchada) and price of condominiums. Consumers are willing to pay more for desirable neighborhood like Sukhumvit as it is closer to central business district and major shopping malls. Although the signs of distance coefficients are negative across models but the magnitudes are also very small in all three models.

Comparing with regression models in Sukhumvit and Ratchda zones, the adjusted R squared improves by a large when combining two zones together. In the logarithmic specification model (2), the adjusted R squared implies that variables explains about 77% of variation in price on average, which is highest among the three models. In addition, the Box Cox analysis predicts $\lambda = 0.123$ in hedonic price equation which is higher than $\lambda = 0$ found in Tokyo (Edmonds, 1985) and $\lambda = 0.2$ in US cities (Linneman, 1980). The $\lambda = 0.123$ which is close to zero indicates that the condominium market in Sukhumvit and Ratchada zones are tight.

Conclusion

The hedonic price model and the Box-Cox analysis indicate that the valuation of condominiums in Bangkok is sensitive to changes in the locational, structural, and neighborhood traits. The distance to the mass transit route variable is statistically significant across three final models. This supports the initial hypothesis that consumers are willing to pay more for condominiums near mass transit stations as they can save time, commuting costs, and avoid severe traffic congestion in the centre of city. Although, the distance to the mass transit route variable is significant in both high and lower density zones, but the magnitude of the coefficients are low in all models. When combining two zones together, neighborhood variable is highly significant even at 1percent level. This suggests consumers' preference to live in the high density area closer to business district like Sukhumvit more than the lower density area further away like Ratchada increases the price of condominiums. The structural variables such as minimum size of room and developer are also significant but

less than distance to the mass transit and neighborhood variables. However, the magnitude of developer variable coefficient is highest in all models indicating that customers based their buying decision strongly on the developer's reputation. In examining the benefits of the BTS and MTA systems, this study has provided some empirical support for the inverse relationship between price of real estate properties such as condominiums in both high and lower density zones and distance from the BTS and MTA transit stations. The empirical evidences also support the thesis that the proposed expansion plan of the BTS and MTA not only will increase in capital value of existing real estate properties near mass transit but also expect to bring new housing and commercial developments to communities.

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