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Economic Rents and Betterment Tax: The Case of Condominium Projects Near Sky Train Stations in Bangkok

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Abstract

This study presents a new potential financial resource for Thailand called the property value capture mechanism. The mechanism could be applied to finance a public infrastructure project by capturing either some or all of the incremental value of real estate generated by a public scheme. The first step in this study is to investigate the amount of economic rent for condominium projects located along the sky train station (Light Green Line Extension, On Nut to Bearing station) by employing the hedonic price method. The economic rents of condominium units are between 176.17 to 183.38 baht per unit for every meter closer to the sky train station. The second step is to apply a concept of a betterment tax imposed on property holders who received a benefit from the sky train station in an assessment area within 1,500 meters of a station. The betterment tax rate is 8.95% of the economic rent.

Keywords: Property Value Capture, Betterment Tax

1. Introduction

The costs associated with public projects are increasing while government revenues are decreasing. Understandably, the key question is: Who should pay for public project investments, particularly public transportation projects? Should the cost of the projects be carried by all taxpayers or only those taxpayers who received a direct and documentable benefit from the public projects?

Public transportation projects are an unprofitable business. Therefore, in most developing countries, funding for a transportation investment project in a capital city like Bangkok is usually allocated from the central government budget (Ubbels & Nijkamp, 2002). In this sense, project funding comes from all revenue sources, such as taxes, fees, and even from public debt. Funding for a mega project typically comes from external debt because project costs are extremely high. Therefore, the total cost of investment is carried by the whole economy. However, the benefits derived, particularly from a public transportation project, are typically enjoyed by a smaller, more localized segment of the total population who live near the development project either as commuters or as residents. Understandably, citizens living outside of the development area might wonder why they must share in the cost of a transportation system that delivers no direct benefit to them. Many view this as an inequity of the government system. Moreover, many argue that in the absence of a localized project, the money could be used for other development projects that would deliver a broader scope of benefits to a larger segment of the total population. For example, the Thai government can apply the same budget to finance other public infrastructure projects like sanitary sewer lines in urban areas and improvements in agriculture logistics or irrigation systems in rural areas. Generally, it is recognized that inadequate infrastructure development leads to slower economic growth and a loss of competitiveness. To restore fairness in taxation, public policymakers should establish new financial mechanisms that reimburse the public for development projects. The reimbursement would come from the segment of the population who realizes the greatest value or gain from the development project. This can be achieved using the “beneficiary-pays principle.” This principle promotes a simple concept: those who receive a windfall gain from a public development project should also share in the cost of that project through an appropriate supplemental tax structure that reimburses the public for part or all of the development project costs.

As a general comment regarding transportation development projects, improved accessibility to public transportation produces a variety of direct and indirect benefits, including a reduction in travel time, an increase in leisure time, and an increase in property values for land and buildings adjacent to the development project. Data from many countries confirm a relationship between public transportation projects and enhanced property values. Research shows that transportation projects can be profitable, provided they are structured to return public investment funds from the primary beneficiaries of the project. For example, Jakarta, Cervero, and Susantono (1999) indicated that offices located within a half kilometer of a freeway interchange rented for approximately 3,823 rupiah more per square meter per month than offices located 2.5 kilometers away from an interchange. McMillen and McDonald (2004) found the value of residential structures located within 1.5 miles of the Midway Rapid Transit Line in Chicago increased in absolute value by approximately $6,000 per structure compared to similar structures located farther away from the transit line. In Eastern Massachusetts, it was estimated that the value of properties located in municipalities with one or more rail stations is between 9.6 and 10.1% higher than other properties in municipalities without a station (Armstrong and Rodriquez, 2006). Data from Thailand (Wattana, 2007) show that an office building located one kilometer farther from a mass transit station generates approximately 19 baht per square meter less in monthly rent than an office building located closer to a transit station. Lastly, the construction of new public infrastructures, such as roads, railways, and highways, will produce a corresponding rise in land rents (Coleman & Grimes, 2010). Thus, a real capital gain or "unearned incremental value" increase for landowners will occur as a result of infrastructure projects. In the absence of any land taxes, the windfall gains arising from the unearned incremental land value gains have always been a major source of speculation and an incentive to hold vacant lands rather than develop them. This type of land speculation provides no real benefit to society.

To eliminate dangerous land speculation and encourage development, including transportation investment, policymakers can capture a portion of the surplus windfall gains from property owners through "value capture"[1] mechanisms using a land value tax, a land value incremental tax, a capital gains tax, a special assessment district or a betterment tax, etc. Batt (2001, p. 1) stated that "…value capture is a means by which to finance capital infrastructure, particularly transportation services, in a way that allows for efficient economic performance, simple administration, financial justice, and social facility…" A value capture mechanism allows the government to capture some or all of the infrastructure investment from the property owner who realized an unearned incremental gain in property adjacent to a public infrastructure project (Batt, 2001). Value capture strategies are based on the "beneficiary-pays principle" where the property owners who received the unearned gain from an infrastructure investment, without making an investment in the public project, pay a portion of the project cost through a value capture mechanism. These strategies discourage land speculation. Policymakers can use the value capture method to finance public infrastructure development because these methods stretch the development dollar. Moreover, value capture mechanisms will increase the holding cost to landowners and developers; an increase in the holding cost will motivate landowners and developers to develop rather than hold their land for speculative gains (Batt, 2001). Currently, several countries are confronted with financial constraints, including higher construction costs; these factors hinder the expansion of existing transportation systems and the development of new systems. The recent trend in many areas, such as Europe, the United States, and Latin America, is to reduce the government support of public transportation by imposing land value capture methodologies (Ubbels & Nijkamp, 2002). The best examples of successful public transportation projects are found in Brazil, Columbia, and Uruguay where roads have been constructed using value capture strategies (Smith & Gihring, 2006). In the Colombia Despaz case, Otoya and Loaiza (2000) estimated the revenue from the land value increment tax in the zoning area to be about $8.341 billion.

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[1] Recent trends in many countries, especially in developed countries, show an interest in the "value capture" mechanisms to finance the public infrastructure investment, such as transit stations, highways, etc., to reduce their government expenditure, including reducing the burden of taxpayers in the whole country.

Thailand is not only challenged by funding public infrastructure project constraints, but also by land-holding activities. Currently, there are two major causes of land holding in Thailand. (1) Asymmetric information. That is, rent-seeking land speculators who possess insider information obtained from government sources on public infrastructure projects before the information reaches the public domain (Thailand Development Forum, 2013). The land speculator, armed with insider information and intent on taking all the economic rent from the public development project, rushes to purchase available land in the targeted development area before the project becomes public knowledge. Moreover, some landlords with political power can even dictate the type and location of the infrastructure project. The rent seeking land speculator armed with the asymmetric information hinders healthy income distribution and creates inequality among citizens (Ratanawaraha, 2015). (2) The absence of an efficient and equitable tax system (Uttamapokin, 2010). Even though Thailand has a variety of land taxes, which include a local maintenance tax, a house and land tax, and a specific business tax, these tax policies do not help much to solve either the rent seeking land speculation problem, or the income distribution problem efficiently because of poor tax design with a lot of loopholes. Relative to the local maintenance tax: the four-year tax period, the tax rate which is extremely small (Suksai, 2013) are insufficient to deter the land speculation problem. Relative to the house and land tax, this tax is imposed on property owners at the rate of 12.5 per annum on the annual cost, which is extremely high and duplicate with income tax; therefore, these might lead to tax evasion (Uttamapokin, 2010). Moreover, these tax policies are out-of-date and inappropriate for current conditions (Kwanguer, 2010). Further, the tax base is often underestimated and is not an accurate reflection of the real market value of land or structure. When considering the specific business tax, this tax is levied on individuals who sell their property, especially condominiums when holding the property for less than five years. The tax is computed on the selling price at the rate of 3.3%. Selling expenses are not considered when computing the specific business tax. This tax is viewed as an unfair tax because it is levied on all real estate sales, even if the property owner sold at a loss. Therefore, Thailand needs new tax mechanisms to solve the funding problem for public infrastructure projects and land speculation problem. A value capture mechanism might be the best answer to address these two issues in Thailand.

In the case of Thailand, the utilization of the value capture mechanism for recouping part or all of the public investment has never occurred. Although the Seventh National Economic and Social Development Plan of 1992-1996 did impose the collection of a special fee from landowners who benefitted from a public infrastructure project to recover project costs (Office of the National Economic and Social Development Board, n.d.), policymakers have never utilized this policy as a general practice. Thailand lacks efficient tools to support a mega project like a new public transportation system because most of the funding resources come from general taxes (Ratanawaraha, 2015). Most economists usually argue that the general tax increases the tax burden on many taxpayers who never receive a direct benefit from the project; economists also argue that it creates inequities and distortions in the Thai economy.

In this study, we will apply the value capture idea to refinancing existing public project through a betterment tax, which is collected directly from the beneficiaries of the public transportation project, the Light Green Line Extension (On Nut to Bearing Station), based upon their geography proximity to the project. As previously mentioned, the public infrastructure projects produce an increase in property and land values so the property owner will receive more economic rents than other landowners with properties located farther away from the public project. In the absence of the value capture mechanisms; this will lead to an increase in rent seeking from land speculation. Therefore, to refinance a public transportation project and reduce the rent seeking from land speculation, we should capture a portion of the windfall gain from the property owners who benefitted from the project, but made no investment in the project.

The purpose of this study is to answer two key questions: 1) How much does the sky train station (Light Green Lines Extensions, On Nut to Bearing station) impact the value of adjacent properties? 2) What is an appropriated betterment tax rate to recover the public transportation scheme? The target population in this study is any condominium unit located in either the Pra Khanong district or the Bang Na district, through which the extension lines are connected. This study randomly sampled 441 units of condominiums.

2. Literature Review: A Betterment Tax

Betterment Tax (or Betterment Levy[2]), sometimes also referred to as Special Assessment, Special Assessment District (SAD), Benefit Assessment District (BAD), Local Improvement District (LID), is an area in which a special charge (or betterment tax) is imposed on property owners who received windfall gains from public investment projects based on their geographic proximity to a public facility (Reconnecting America's Center for Transit-Oriented Development, 2008). The first use of special assessments in the United States occurred in New York City in 1961 to fund the construction of a street pavement and drainage system projects (Zhao & Larson, 2011). Special assessment is used mostly to fund public investments, such as roads, police stations, fire protections, etc. The concept behind a special assessment is that the land owners whose properties are located near a public facility will receive property value appreciation; therefore, they should be charged for this benefit (Lari et al., 2009). However, it should be noted that the amount of the assessment must be related to the cost of the investment, including the expected benefit to the property owner.

The concept of betterment taxes under forming the special assessment district has two aspects. The first aspect is that they are applied only on the incremental value resulting from the public infrastructure improvement, which differs from annual property taxes (Walters, 2012), and the second is additional special tax or assessment on the incremental value of property that is usually paid by property owners located within a special assessment district. For example, commercial and industrial property owners in Tysons Corner, Washington, D.C., are charged an additional 22 cents per US$100 of an assessed value to finance the Dulles Metrorail expansion (Metropolitan Planning Council, 2012).

The key characteristic of special assessment is that it requires at least a majority vote of affected property owners to be implemented (Reconnecting America's Center for Transit- Oriented Development, 2008) because this kind of charge is usually imposed by the local government. Normally, a special charge or betterment tax for 25-30 years is usually imposed annually on

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[2] betterment tax or betterment levy as known in United Kingdom

properties within the assessment district (http://www.govincentives.com/special.htm). The betterment tax often ranges from 30-60% of the value increment (Walters, 2012). The special charge might be used to fund both capital costs and ongoing operating costs through issuing bonds. For example, Seattle established a local improvements district (LID) to finance a portion of the capital costs of a streetcar project (Lari et al., 2009), which generates a special assessment revenue of US$25 million, half of the total cost of the streetcar line (Gihring, 2009). Los Angeles developed a benefit assessment to finance the first construction phase of the Los Angeles Metro Rail project. The initial benefit assessment districts are set up to raise US$130 million of the cost of the first 4.4 miles of this project (Stopher, 1993). However, a special assessment district is more difficult to apply across larger areas, particularly across multiple municipalities, as a larger assessment district would not be able to receive sufficient funding. Table 1 presents seven case studies that utilize a special assessment or betterment tax to fund various public projects; the tax is imposed on property owners who realized a windfall gain from the public project.

Table 1: Summary of Value Capture Mechanism Case Studies: A Betterment Tax

Cities/ Country	Source	Details	Type of Value Capture	Note
Denmark	Walters (2012)	- Before 2004, when farmland was transferred to an urban zone legally, if land owners needed to sell their land they would be required to pay for a special land development gains tax.	Special land development gains tax	50% of the increase in land value resulting from the change in zoning - One-time charges
Portland, the U.S.	S. B. Friedman & Company (2010)	- The City of Portland has invested several new streetcar lines by using value capture strategies; special assessment and tax increment financing, funding part of a 4-mile streetcar route.	Special Assessment District and Tax Increment Financing	- The revenue generated from the value capture mechanisms was $41 million (or 40% of total investment cost), completed project - Annual charges

Table 1: Summary of Value Capture Mechanism Case Studies: A Betterment Tax (cont.)

Cities/ Country	Source	Details	Type of Value Capture	Note
Bogotá, Colombia	Peterson (2009)	- Between 1997 and 2007, Colombia imposed the betterment fees on all properties in Bogotá affecting the Main Street and bridge improvement to finance the construction projects. The tax revenue generated from this program was US$1.1 billion.	Betterment fees	- Funding 1/2 of street and bridge improvement - Annual charges
Singapore	Medda (2012)	- Land value capture mechanisms are the main source for funding transport infrastructure and services such as metro systems.	Betterment tax	- A betterment tax is based on 50% of the full market value
United Kingdom	Peterson (2009)	- The U.K. imposes betterment levies on land value gain resulting from public investment to recover construction costs.	Betterment tax	- 40% of incremental land value
Australia	Peterson (2009)	- Sydney, Australia imposed a betterment tax on the land owners whose gains resulted from planning authorization to convert land to urban use. Since then, the increment values of land were estimated from a baseline of August 1969 to indicate which land was rezoned.	Betterment tax	- 30% tax rate on land value gains (annual charges) - The revenue from betterment levy was used to fund infrastructure investment required for urban uses such as water supply
Washington D.C., the US.	Metropolitan Planning Council (2012)	- The commercial and industrial property owners in Tysons Corner, Washington D.C. were collected a special charge for financing the Dulles Metrorail expansion.	Special assessment	- The additional special charge is 22 cents per $100 of assessed value (annual tax). The revenue generated from this strategy was $25 million or 23% of total project cost (completed project).

3. Research Design

This research has two important hypothetical questions: How much does the public transportation scheme impact the value of adjacent properties? What is an appropriate betterment tax rate to recover the public transportation scheme? This study is divided into two steps to answer these two questions. The first step employs the hedonic price method (HPM) to estimate the economic rent of any property located along a sky train, the Light Green Line Extension (On Nut to Bearing station). Then, the empirical results, which are estimated from the HPM, will be used to apply a concept of value capture to refinance the Light Green Line Extension project.

3.1 Hedonic Prices Model

The impact of transportation on property prices has been tested by many researches using various techniques. However, one of the most popular techniques is using the HPM to evaluate the impact of transportation on property or land values. The hedonic price function can be written as follows:

$$P_i = \alpha_0 + \sum_{i=1}^{h} \beta_i H_i + \sum_{j=1}^{n} \beta_j N_j + \sum_{k=1}^{L} \beta_k L_k + \varepsilon \qquad (1)$$

Where P_i is the property sale price of observation i, H_i stands for structural and housing attributes of observation i (e.g., number of bedrooms, number of bathrooms, lot size, age of the house, etc.); N_j represents neighborhood characteristics, such as the quality of schools and ambient air quality; and L_k represents location characteristics, for example, the proximity to the central business district, distance to the transit station, and the proximity to environmental amenities and dis-amenities.

3.2 Box-Cox Transformation

The purpose of this study is to use the HPM to estimate public transportation effects. We employ the common functional forms of the HPM, Box-Cox transformation forms. In hedonic analysis, Box-Cox regression has been a particularly popular technique of searching for a suitable functional form based on goodness of fit (Williams, 2008). The Box-Cox transformation can obtain the residuals more closely normality and less heteroskedasticity problem. The strength of the Box-Cox function is that it can be used as a testing functional form and as a form in itself (Williams, 2008, p. 37). Cropper, Deck, and McConnell (1988) found that the linear Box-Cox functional form is better than linear, semi-log, double-log, quadratic, and quadratic Box-Cox functions for the hedonic research. For $Y^{(\lambda)}$, the general linear Box-Cox transformation on a single variable is defined as:

$$Y^{(\lambda)} = \frac{Y^{\lambda} - 1}{\lambda} \quad \text{for} \quad \lambda \neq 0 \quad \text{or} \qquad (2)$$
$$Y^{(\lambda)} = \ln Y \quad \text{for} \quad \lambda = 0$$

However, for the complex version, which transforms both sides of the equation with different parameters, θ stands for the Box-Cox transformation parameter on the dependent variable, and λ denotes the Box-Cox transformation parameter on the independent variables.

$$\frac{Y^{\theta} - 1}{\theta} = \alpha + \sum_{i=1}^{K} \beta_i \frac{X_i^{\lambda} - 1}{\lambda} + \sum_{s=1}^{J} \gamma_s D_s + \varepsilon \ \textit{for } \theta \textit{ and } \lambda \neq 0 \qquad (3)$$

where $\varepsilon \sim N(0, \sigma^2)$ and equation (3) is referred as an unrestricted Box-Cox (UBC) model. A restricted Box-Cox (RBC) model transforms both sided of the equation with the same parameter, excluding the dummy variables (D_s). It should be note that the RBC model will be equal to the UBC model if $\theta = \lambda$. The restricted Box-Cox model can be written as:

$$\frac{Y^{\lambda} - 1}{\lambda} = \alpha + \sum_{i=1}^{K} \beta_i \frac{X_i^{\lambda} - 1}{\lambda} + \sum_{s=1}^{J} \gamma_s D_s + \varepsilon \ \textit{ for } \lambda \neq 0 \ \textit{ or} \qquad (4)$$

$$\ln Y = \alpha + \sum_{i=1}^{K} \beta_i \ln X_i + \sum_{s=1}^{J} \gamma_s D_s + \varepsilon \ \textit{ for } \lambda = 0$$

The estimated Box-Cox model from equations (3) and (4) can be applied to explore implicit prices (or economic rent) of any housing characteristic. For equation (3), which represents the UBC model, the economic rent or implicit price is calculated by taking the partial derivative of the market sale price, Y, with respect to X_i:

$$\frac{\partial Y}{\partial X_i} = \beta_i X_i^{\lambda - 1} Y^{1 - \theta} \tag{5}$$

For partial derivative with respect to dummy variable characteristics (D_s) (Williams, 2008, p. 40),

$$\frac{\partial Y}{\partial D_S} = \gamma_S Y^{1 - \theta} \tag{6}$$

These formulas can be adopted for the RBC model by replacing the transformation parameter $\lambda = \theta$.

3.3 Applying a Betterment Tax to Refinance a Public Investment

In this step, we need to compute an appropriate property value capture tax rate, or betterment tax, for refinancing a public project based on the investment cost of the public construction. The tax burden for each property owner will be calculated from the amount of an implicit price, or the economic rent of public transportation. In this case, the estimated betterment tax is collected from an individual whose property is located within the selected assessment area, 1,500 meters[3] from five stations[4] of the sky train (Light Green Line Extension)[5]. The extension line, 5.25 kilometers long, were constructed from September 1, 2006 to August 11, 2011 and opened on August 12, 2011 (http://www.bts.co.th/corporate/en/01-about-history.aspx). Therefore, we need to adjust the construction costs incurred in 2006 to the future value in 2013 because the construction of our samples was completed in 2013. The future value (FV) of initial cost in several periods is as follows:

$$FV = C_0 (1 + r)^t \tag{7}$$

[3] In Bangkok, most people prefer to use motorcycle taxis to go to a desired destination if a distance is not too long; for example, 1,000 or 2,000 meters to the destination. Therefore, this study decided to choose the 1,500 meters of sky train stations as the assessment area because the stations might still impact the price of condominium projects located within 1,500 meters.

[4] Bang Chak station, Punnawhiti station, Udom Suk station, Bang Na station, and Bearing station.

[5] The Light Green Line Extension (On Nut to Bearing station) is invested by the Bangkok Metropolitan.

FV stands for the future value of an initial cost of public investment, C_0 is an initial cost of construction in 2006 (at the starting year), r stands for a 7% interest rate[6], and t is the 7-year construction period. To ensure fairness to property owners, we cannot impose the total amount of the construction cost on the condominium's owners because the beneficiaries of the public project are not only the condominium's owners. Other groups of real-estate holders, such as landholders, single-family home owners, and commercial building owners, also benefitted from windfall gains. Thus, a suitable tax burden for the condominium holders should be calculated from a portion of the condominium's land area to the entire land area in the assessment area; that is, owners whose property is located within 1,500 meters from the stations. This implies that the portion of total betterment tax imposed is in proportion to the land use. The formula is as follows:

$$Tax_{portion} = \frac{L_{condominium}}{L_{total}} \tag{8}$$

$Tax_{portion}$ stands for the portion of the tax burden which the property owner should bear, $L_{condominium}$ is the condominium's land area in a target zone, and Ltotal is an entire land area in the assessment area. The total tax burden for condominium projects located within the assessment area will be calculated from the tax portion multiplied by an initial cost of the sky train station's construction. The formula is as follows:

$$Tax_{burden} = C \times Tax_{portion} \tag{9}$$

Tax_{burden} stands for the total tax burden the property owner should bear, and C is the initial cost of the public project investment. After we calculate the tax burden, we can use that amount of tax to estimate the betterment tax rate for each property owner using the following formula:

$$\textit{Total tax burden} = \textit{tax rate} \times \textit{economic rent} \tag{10}$$

6 The average MLR rate is about 7% in 2013.

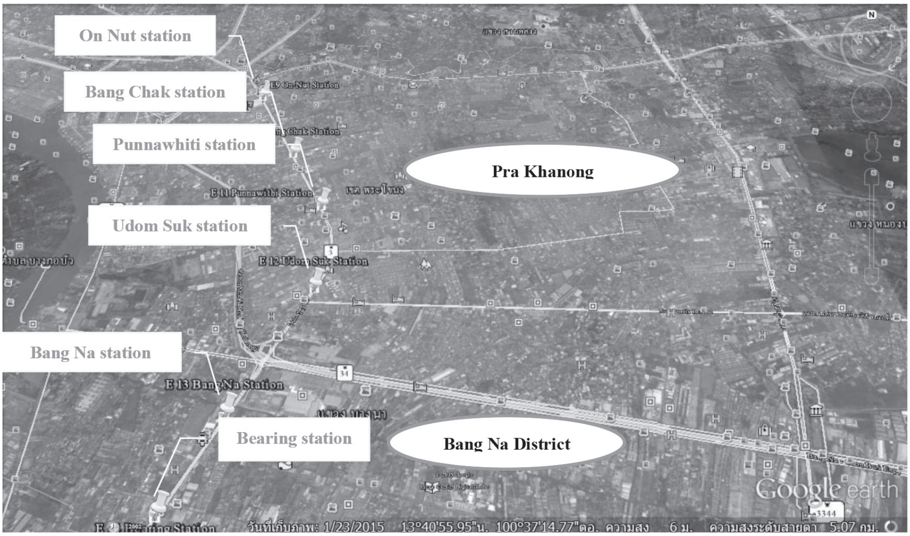
From equation (10), we can calculate a one-time tax rate that will be levied on the condominium's holder because we already have the economic rent, or implicit price of public transportation, which is estimated from equation (5) and the tax burden from equation (9).

4. Data

The data used in this analysis were collected from three sources; the first source was the Department of Land, via http://condosearch.dol.go.th/Search/. This website was used to search for the primary profile of condominium projects located within Pra Khanong district and Bang Na district due to their proximity to the Light Green Line Extension (On Nut to Bearing station). Our targeted properties for this study were condominium projects that were complete in 2013. The second source was condominium brokers. To ascertain market prices and structure characteristics of condominiums, we searched for broker advertisements on http://www.kobkid.com/bts_condo.php, http://www.checkraka.com, and http://thinkofliving.com/ to determine the market sale price and structural characteristics. We contacted the broker if the advertisement lacked the specific information we needed on the condominium attributes. The third source was the geographic information system (GIS) of Bangkok through the database of the Google Earth to measure a straight-line distance from the condominium proxy to the nearest accessibility variable—the main-road, sky train station, and central business district (CBD). The total number of condominium projects located within both districts was 205 projects including 43,609 units[7]. In this study, we chose the stratified random sampling method, which is a method of sampling from a population. The datasets in this study include 441 observations, 303 units from the Pra Khanong district, and 138 units from the Bang Na district. Data were collected over an eight-month period from December 2013 to August 2014.

[7] The total number of condominium units in Pra Khanong district is 35,578 units and 8,031 units in Bang Na district.

Figure 1. The Light Green Line Extension (On Nut to Bearing station)



5. Variables and Assumptions

The variables and assumptions for the HPM can be separated into the following: 1) the dependent variable is the market sale price of condominium units in both study districts, and 2) the independent variables include several impact factors that influenced the price of our sample. The details are shown as follows:

5.1 Dependent Variable

PRICE is a measure of the market value of condominium units in district j, in terms of baht per unit. The data are collected by asking the condominium broker or property owner about the sale price, which is published in various pamphlets, brochures, and the website of condominium projects in district j.

5.2 Independent Variables

The nineteen independent variables in this study include structure variables, neighborhood variables, and accessibility variables.

5.2.1 Structure Variables

(1) AGE is a continuous variable that represents the age of the condominium building in years calculated from the date of construction completion. The assumption is that if the age of the building is higher, the market sale price of room units will decrease.

(2) HEIGHT is a continuous variable representing the number of the condominium's stories. The assumption is that the more stories contained in the condominium structure, the higher the price.

(3) NOBUILD stands for the number of buildings in the condominium project. As the number of buildings in the complex increases, the selling price of condominium units will decrease because the average cost of construction per room might be lower.

(4) UNIT is the number of units in each condominium structure. This variable might have a negative effect on the market price because more units imply a lower average construction cost.

(5) SQM_AREA represents the gross land area in square meters for each condominium project. The assumption is that if the condominium project has more land area, the selling price of each condominium unit might increase.

(6) RFLOOR stands for floor level. The assumption is that a room located on a higher floor might be more expensive than a room located on a lower floor because the higher floor has a better view.

(7) LOTSIZE represents the size of a unit in square meters. This variable might have a positive impact on the market sale price because a larger gross area implies more utility area for residents.

(8) POOL stands for swimming pools, which are offered by condominiums, indicated by dummy variables. The dummy variable is 1 if the project has at least one swimming pool; otherwise it is 0. The assumption is that the POOL variable might have a positive effect on the selling price.

(9) FITNESS is a fitness room provided by the condominium project, indicated by dummy variables. The value of the dummy variable is equal to 1 if the condominium has at least one fitness room; otherwise it is equal to 0. The assumption is that the variable might have a positive effect on the market sale price.

(10) GREEN_ENVI represents a good environmental quality, such as a park or green area, indicated by dummy variables. If the condominium includes a green area in its project, the dummy variable value is given to 1; otherwise it is 0. The assumption is that the GREEN_ENVI variable might have a positive effect on the market sale price.

(11) DUPPH stands for type of unit, indicated by a dummy variable. If the room is a duplex or penthouse, the value of dummy variable is 1; otherwise it is 0. The assumption is that the DUPPH variable might have a positive effect on the market sale price because the duplex and penthouse types should be more expensive than other types of rooms.

(12) NEWROOM is a dummy variable that stands for a new unit. If the unit is a new unit, the dummy variable value is equal to 1; otherwise it is equal to 0. The assumption is that if the condominium unit is new, the market sale price might be higher than a previously owned unit.

(13) BATH is a continuous variable, which represents the number of bathrooms in each unit. This variable might have a positive impact on the selling price of condominiums because more bathrooms represent a greater cost of construction.

(14) BEDROOM stands for the number of bedrooms, which is a continuous variable. If a condominium unit has more bedrooms, the market sale price will increase.

(15) FUR represents a room that is fully furnished, which is a dummy variable. If the condominium unit is fully furnished, the value of the dummy variable is 1; otherwise it is 0. This variable might have a positive impact on the selling price of a condominium because the cost of construction might be higher than a vacant unit.

5.2.2 Neighborhood Variable

MALL_DIST stands for a straight-line distance to the shopping mall, which is a continuous variable. Our study area included four malls: Lotus Supper Center, Big C Supper Store, Seacon Square, and Central Bang-Na. The assumption is that if a condominium is located adjacent to a shopping mall, the selling price of the units might be higher because residents spend less time purchasing goods. Thus, the variable's coefficient should have a negative sign.

5.2.3 Accessibility Variables

(1) MAINROAD_DIST represents a straight-line distance, in meters, to the nearest main road; it is a continuous variable. The main road in this study includes the Sukhumvit Rd., the Srinakharin Rd., and the Bangna-Trad Rd. Due to the increased accessibility of the property, if a condominium is located in proximity to a main road, the market sale price of the unit should be higher than the same unit that is located farther away from a main road. Therefore, the variable's coefficient should have a negative sign.

(2) CBD_DIST stands for a straight-line distance, in meters, to the Asoka station, which the central business district of Bangkok. The assumption is that if a condominium is located closer to the Asoka station, the market price of condominium units should be more expensive. Thus, the CBD_DIST variable should provide a negative sign on the condominium's price.

(3) BTS_DIST stands for a straight-line distance, in meters, to the nearest five sky train stations: Bang Chak, Punnawithi, Udom Suk, Bang Na, and Bearing. The market price of condominium units adjacent to a sky train station should be higher due to the increased accessibility of the property. Therefore, the variable's coefficient should be negative. In this study, we chose a straight-line distance instead of a walking distance because the longest distance from our sample to the nearest sky train station is 7,563.38 meters; therefore, the straight-line distance is more appropriate and consistent in reality than the walking distance. Moreover, the straight-line distance has been used in several works of hedonic pricing, such as those by Henneberry (1998), Boarnet and Chalermpong (2001), Bae et al (2003), McMillen and McDonald (2004), Debrezion et al (2006), Anderson, Shyr, and Fu (2010), Wang (2010), and Cervero and Kang (2011).

The descriptive statistics of the variables are shown in Table 2. The average market sale price of the 441 samples is 2,955,497.02 baht per unit when 10,500,000 baht per unit is the maximum market sale price, and a minimum value is 310,000.00 baht per unit. The data for sample condominiums indicate that the average age of samples was 5.311 years. The maximum structure age was 22 years, while the minimum age was one year. The number of stories ranged from five floors to 39 floors. The average lot size of the proxies was 45.789 square meters, while the maximum size was 150.00 square meters. The average distance from the property to the nearest mall was 1,786.87 meters and the minimum distance was 210.14 meters. The accessibility variables included three main variables: a straight-line distance to the main road, a straight-line distance to the nearest BTS station, and a straight-line distance to the Asoka station (this variable stands for the distance to the CBD. The ranking distance to the nearest BTS station of the samples is between 54.92 and 7,563.38 meters since the average distance is 1,433.72 meters. See Table 2 below for further details.

Table 2: Descriptive Statics

4	Descriptive	Unit of measurement	mean	Min	Max	S.D.	Expected sign
Dependent variable							
PRICE	Market sale price	Baht/unit	2,955,497.02	310,000.00	10,500,000.00	1,680,787.69	
1. Structure variables							
AGE	Age of building	Years	5.311	1.000	22.000	5.084	(-)
HEIGHT	Number of stories	Floors	12.662	5.000	39.000	7.818	(+)
NOBUILD	Number of buildings	Building	2.222	1.00	9.000	1.776	(+)
UNIT	Total number of units	Units	519.746	55.000	4046.000	646.040	(-)
SQM_AREA	Size of land area	Square meters	11,307.93	1,017.76	59,585.56	10,583.37	(+)
RFLOOR	Level of floor room	Level	7.580	1.000	31.000	5.556	(+)
LOTSIZE	Size of room	Square meters	45.789	20.800	150.000	19.404	(+)
BATH	Number of bathrooms	Units	1.143	1.000	4.000	0.387	(+)
BEDROOM	Number of bedrooms (studio = 0 unit)	Units	1.150	0.000	3.00	0.640	(+)

Table 2: Descriptive Statics (cont.)

4	Descriptive	Unit of measurement	mean	Min	Max	S.D.	Expected sign
Dummy variables							
POOL	Swimming pool	Yes = 1: No = 0	0.912	0.000	1.000	0.284	(+)
FITNESS	Fitness room	Yes = 1: No = 0	0.909	0.000	1.000	0.288	(+)
GREEN_ENVI	Park or green area	Yes = 1: No = 0	0.771	0.000	1.000	0.421	(+)
DUPPH	Type of room	= 1 if a duplex or penthouse = 0 if otherwise	0.018	0.000	1.000	0.134	(+)
NEWROOM	New room	Yes = 1: No = 0	0.197	0.000	1.000	0.398	(+)
FUR	Fully furnished	Yes = 1: No = 0	0.732	0.000	1.000	0.443	(+)
2. Neighborhood variable							
MALL_DIST	Distance to the nearest shopping mall	Meters	1,786.87	210.14	3,874.65	1,026.59	(-)
3. Accessibility variable							
MAINROAD_ DIST	Distance to the nearest main road	Meters	321.223	0.005	1652.210	357.231	(-)
BTS_ DIST	Distance to the nearest sky train station	Meters	1,433.72	54.92	7,563.38	1,786.38	(-)
CBD_DIST	Distance to the Asoka station	Meters	8,119.84	3,843.48	15,159.38	2,362.87	(-)

Source: From Survey

6. Results

6.1 Hedonic Price Model Results

Table 3 illustrates the results from hedonic price functions from the restricted Box-Cox (RBC) model and the unrestricted Box-Cox (UBC) model. All estimated coefficients have the correct sign as expected, except for swimming pool (POOL). Thirteen of 19 coefficients, from both equations, are statistically significant at a 95% confidence level. Positive coefficients—including the number of building's stories (HEIGHT), the number of buildings in the condominium project (NOBULID), the size of land parcels in square meters (SQM_AREA), the presence of a fitness room in the project (FITNESS), the presence of a park around the condominium (GREEN_ENVI), the size of rooms (LOTSIZE), the number of bedrooms (BEDROOM), and fully furnished rooms (FUR); imply that the greater the value of these variables in a sample, the higher the price of that sample will be. As expected, negative coefficients for all accessibility attributes imply that a residential property tends to be more expensive when increasing in accessibility.

A test of Box-Cox functional forms for the best fit transformation is considered by values of the Akaike information criterion (AIC*)* and the Bayesian information criterion (BIC*)*. As shown in Table 3, the restricted Box-Cox (RBC) model has the lowest AIC and BIC values, which suggests that it is the best transformation.

The coefficients from the models in Table 3 can be used to estimate the implicit price of any attributes that determine the price of condominium units. According to the results from the RBC model, if the age of a condominium project increases by 1 year, the market price of condominium units will decrease by 79,330.43 baht. The price of condominium units calculated by the RBC model will increase by 62,903.31 baht if the height of the condominium increases by one floor. If the condominium project increases the number of units by one unit, the market price will decrease by 1,473.96 baht per unit due to a reduction in the average cost of construction per unit. If the condominium's unit is a fully furnished type, the market price will increase by 353,490.84 baht per unit. If the size of a unit is increased by 1 square meter, the market price will increase by 47,869.40 baht per unit.

Considering the accessibility variable, if a condominium project is located farther away from the main street by 1 meter, the price of the condominium will decrease by 389.53 baht per unit. If the number of bedrooms is increased by one bedroom, the market sale price per room will increase by 294,525.51 baht.

Table 3: Hedonic Price Functions for the Residential Property Market in the Light-Green Lines Extension Area.

Variable	Box-Cox transformed functional forms	
	Separate both-side Box-Cox model: RBC Coefficient (t-value)	**Basic both-side Box-Cox model: UBC Coefficient (t-value)**
Constant	35.51236*** (13.40)	65.27256*** (4.72)
Structure variable		
AGE	-0.8219836*** (-6.07)	-2.665493*** (-5.90)
HEIGHT	1.385005*** (5.44)	6.049077*** (5.59)
NOBUILD	0.8289193*** (3.16)	1.97823*** (2.69)
UNIT	-0.8145221*** (-7.34)	-6.671937*** (-7.58)
SQM_AREA	0.1165501** (2.35)	2.090704*** (2.80)
POOL	-1.676158*** (-4.19)	-4.069158*** (-4.04)
FITNESS	2.802948*** (5.85)	6.881229*** (5.76)
GREEN_ENVI	1.115849*** (4.01)	2.889914*** (4.07)
RFLOOR	0.1641884 (1.22)	0.6400628 (1.36)
LOTSIZE	3.214874*** (12.17)	18.50248*** (12.74)
DUPPH	1.071716 (1.52)	3.0283* (1.71)

Table 3: Hedonic Price Functions for the Residential Property Market in the Light-Green Lines Extension Area. (cont.)

Variable	Box-Cox transformed functional forms	
	Separate both-side Box-Cox model: RBC Coefficient (t-value)	**Basic both-side Box-Cox model: UBC Coefficient (t-value)**
NEWROOM	0.4480564* (1.66)	1.207714* (1.75)
BATH	0.2158519 (0.51)	1.582299 (1.38)
BEDROOM	0.8092137*** (3.56)	1.748897*** (3.04)
FUR	0.8603181*** (3.78)	2.014689*** (3.50)
Neighborhood variable		
MALL_DIST	-0.1326404** (-2.06)	-1.561898** (-2.40)
Accessibility variable		
MAINROAD_DIST	-0.1417854*** (-3.93)	-0.4378797*** (-3.34)
CBD_DIST	-0.1311131 (-0.80)	-2.601837 (-1.09)
BTS_DIST	-0.2347787*** (-4.89)	-2.787523*** (-6.96)
Transformation parameters	$\lambda = \theta = 0.1324309$ (p-value = 0.001)	$\lambda = -0.0721928$ (p-value = 0.399) $\theta = 0.1959884$ (p-value = 0.000)
R^2	0.8158	0.8184
Adjusted R^2	0.8075	0.8102
SSR	1,340.37283	8,563.49437
AIC	1,781.745	2,599.606
BIC	1,863.526	2,681.387
Number of obs.	441	441

Note: * Represents a significant result at the one-tailed 0.001 confidence level
** Represents a significant result at the one-tailed 0.05 confidence level
*** Represents a significant result at the one-tailed 0.01 confidence level

When we consider only the effect of distance to the Light Green Line Extension (BTS_DIST) in both models, the results from the models indicate that the stations' impact is negative and implies that if a condominium is located close to the sky train station, the price of condominium units will be higher if other things remain equal. The empirical results from this study also related to several researches such as McMillen and McDonald (2004), Armstrong and Rodriguez (2006), Debrezion, Pels, and Rietveld (2006), Wattana (2007), and Chalermpong (2007). Table 4 illustrates that the average implicit price, or economic rent, of the sky train station in each model does not significantly differ; the estimated economic rent for both equations is between 176.17 to 183.38 baht per condominium unit for every meter closer to the BTS station. It should be noted that an average size of condominium units in this study is 45.789 square meters. Therefore, if a condominium is located immediately adjacent to the BTS station, the price of the units is roughly 176,170 to 183,380 baht more than an identical condominium located 1,000 meters away.

Table 4: Average Economic Rent of the BTS Sky Train Station in Each Model

	Box-Cox Transformed Functional Forms	
	Restricted Box-Cox (RBC)	**Unrestricted Box-Cox (UBC)**
Economic rent at the average price per unit of condominiums (baht/meter)	-176.17	-183.38

6.2 Betterment Tax Results

In this segment, we will apply the value capture principle via a betterment tax to capture a portion of the windfall gain or economic rent from property owners who live along the sky train stations to refinance the construction costs of public infrastructure projects, the Light Green Line Extension (On Nut to Barring station). First, we need to estimate the total value of the economic rent of condominium units from the restricted Box-Cox (RBC)[8] equation. After we know the exact magnitude of the total economic

8 Because the RBC model has the lowest AIC and BIC values, it is the best transformation form.

rent of the property owners, then we can estimate the betterment tax rate collected from the property owners in the assessment area. The RBC equation is shown as follows:

$$\frac{P^{0.1324309}-1}{0.1324309} = 35.51236 - 1.676158POOL + 2.802948FITNESS + 1.115849GREEN\_ENVI + 0.4480564NEWROOM + 0.860318FUR - \frac{0.82198AGE^{0.1324309}-1}{0.1324309} - \frac{0.14179MAINROAD\_DIST^{0.1324309}-1}{0.1324309} + \frac{1.385005HIGHT^{0.1324309}-1}{0.1324309} + \frac{0.828919NOBUILD^{0.1324309}-1}{0.1324309} - \frac{0.81452UNIT^{0.1324309}-1}{0.1324309} - \frac{0.234779BTS\_DIST^{0.1324309}-1}{0.1324309} - \frac{0.13264MALL\_DIST^{0.1324309}-1}{0.1324309} + \frac{0.1165501SQM\_AREA^{0.1324309}-1}{0.1324309} + \frac{3.214874LOTSIZE^{0.1324309}-1}{0.1324309} + \frac{0.809214BEDROOM^{0.1324309}-1}{0.1324309} \quad (11)$$

By re-arranging equation (11), we can estimate the price of condominium units at each distance by setting the other variables as constants. The change in each unit's price is compared to the estimated price at a boundary area, or 1,500 meters from the Light Green Line Extension. The estimated price of condominium units at 1,500 meters from the sky train station is 2,963,844.59[9] baht per unit. The estimated "economic rent" of the sky train station at each distance is calculated from the "incremental value" between a condominium unit's price at the boundary area and the estimated price at each distance. For example, if one condominium project is located 100 meters from

[9] The estimated price of condominium units located at 1,500 meters is calculated by substituting the average values of other variables, except the distance to the nearest sky train station is substituted by 1,500 meters, in equation (11); POOL (= 0.912), FITNESS (= 0.909), GREEN_ENVI (= 0.771), NEWROOM (= 0.197), FUR (= 0.732), MAINROAD_DIST (= 321.223), HIGHT (= 12.662), NOBUILD (= 2.222), UNIT (= 519.746), BTS_DIST (= 1,500), MALL_DIST (1,786.87), SQM_AREA (= 11,307.93), LOTSIZE (= 45.789), and BEDROOM (= 1.150)

the nearest sky train station, we can substitute the 100 meters in equation (11) and set the other variables as constants. Hence, the estimated price of condominium units in this case will be 3,595,087.38 baht per room unit, which is higher than the identical property located at the 1,500-meter boundary area by 631,242.79 baht per room unit. If the sample condominium project has 100 room units, the economic rent for the whole project will be 63 million baht, for instance.

The incremental value between the price of condominium units in the assessment area and the estimated price of any condominium at each distance is implied to an "economic rent" or a "windfall gain" that belong to the condominium owners. The estimated economic rent of 59 condominium projects; which include 14,624 condominium units, located within the assessment area is shown in Table 5.

Table 5: Summary of the Estimated Economic Rent of Condominium Projects Located within the Assessment Area.

	Economic rent per unit (baht)	**Economic rent per condominium project (baht)**	**Distance to the station (m)**	**Number of units**	**Land area (sqm.)**
Minimum	3,527.15	105,814.63	54.92	30.00	401.80
Maximum	754,266.87	622,421,341.51	1,476.36	1,172.00	37,830.03
Average	275,929.02	77,432,826.48	593.72	247.86	7,889.37
Total value	-	4,568,536,762.11	-	14,624.00	465,472.63

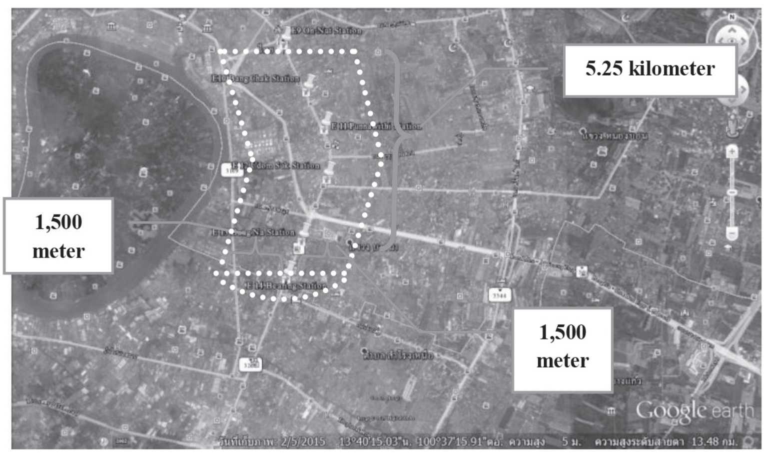
The estimated results from Table 5 demonstrate the significant degree of impact of the public infrastructure project to individual property owners in close proximity to the Light Green Line Extension. The results confirm that this is the right time for the Thai government to implement a new tax mechanism (property value capture or betterment tax) on the un- earned gains generated from a public project.

6.2.1 Tax Mapping

To estimate the betterment tax rate that might be collected from the property owners who live in proximity to the Light Green Line Extension

(On Nut to Bearing station), a tax map must be drawn to calculate the total space of the assessment area. After establishing the tax map, we will use the space data to compute an appropriate tax rate by applying the land use in Bangkok (determined by the 2009 survey by the Department of City Planning) to calculate the condominium land space in terms of the percentage of a total land use in the targeted area. The total space of the assessment area is approximately 19,285,714.29 square meters. A tax map for the assessment area is shown below.

Figure 2. The Tax Mapping of an Assessment Area; Condominium Projects Located within 1,500 meters of the Sky Train Stations



Estimated betterment tax

In this step, it is necessary to calculate the percentage of condominium land area versus total land use and apply that percentage to compute the portion of the investment cost that will be collect from the condominium owners. This implies that the portion of land use is same as the portion of investment cost. Thus, the tax burden and the betterment tax rate for the property owners can be calculated. An important assumption for this analysis is that the percentage of land use in each area is not different. Thus, we can apply the land use in Bangkok using the latest 2009 survey data from the Department of City Planning.

Based on the feasibility study of the survey and design of the Bangkok mass rapid transit system by the Traffic and Transportation Department (1999), the evaluated initial cost of investment for the 5.25-kilometer extension was 8,541 million THB. Using the initial cost of investment (8,541 million THB) and an interest rate of 7%, we can calculate the cost of the initial investment in 2013 to be 13,714.98 million THB (please note that our estimate is based on properties with construction completion dates in the year 2013). Table 6 illustrates the percentage of land use in more detail. The available area used for calculating betterment tax is the entire area minus the non-tax area. The portion of condominium spaces in the assessment area is 2.98% of the total land area. Therefore, the tax burdens for 59 condominium projects located within 1,500 meters from the sky train stations is 408,918,475.90 baht, or equal to 2.98% of the initial cost of the investment.

Table 6: Land Use in Bangkok: The Latest Survey in 2009 and the Betterment Tax Burden.

Land use in Bangkok	**Assessment area: condominium project located within 1,500 meters of the sky train stations**
Entire area (sqm.)	19,285,714.29
Non-tax area:	1,440,642.86
(a) Road space = 7.47%	470,571.43
(b) Government compound area = 2.44%	239,142.86
(c) Educational institution area = 1.24%	109,928.57
(d) Religious institution area = 0.57%	273,857.14
(e) Recreation area = 1.42%	1,139,785.71
(f) Water resource area = 5.91%	3,673,928.57
(g) Total area (sqm.) = (a) + (b) +(c) + (d) + (e) + (f)	
(h) Available space is use for calculating betterment tax (sqm.) = Entire area – (g)	15,611,785.71
(i) Condominium area (sqm)	465,472.63
(j) Portion of condominium area (% of available space (h))	2.98
Tax burden for condominium (baht)	408,918,475.90

Source: From the Department of City Planning

6.2.2 Betterment Tax

The economic rent of 59 condominium projects produced by the sky train stations is 4,568,536,762.11 baht (Table 5), while the tax burden for condominium projects in the assessment area is 408,918,475.90 baht (Table 6). Therefore, we can estimate the betterment tax for an individual owner whose property is located within the assessment area using the economic rent in the assessment zone as a tax base. Hence, the betterment tax rate for a condominium unit located within this assessment area is 8.95% of the economic rent or because the windfall gains (or economic rents) are extremely high. The results confirm that an absence of the efficient and equitable land tax system in Thailand leads to the rent-seeking land speculation problem.

Table 7: Estimated Betterment Tax of Condominium Units Located within the Assessment Area.

Total economic rent of 59 condominium projects (baht)	Total tax burden (baht)	Betterment tax rate (% of economic rent)	Average betterment tax per condominium units (baht)	Minimum betterment tax per condominium units (baht)	Maximum betterment tax per condominium units(baht)
4,568,536,762.11	408,918,475.90	8.95%	24,698.41	315.72	67,514.43

7. Conclusion

The empirical results from both models indicate that accessibility to the nearest station had a negative impact on the condominium unit price. This implies that if a condominium is located near a station, the price of condominium units will be higher, other things being equal. The average economic rents from both equations were not significantly different; the estimated economic rent ranged from 176.17 to 183.38 baht per condominium unit for every meter closer to the Light Green Line Extension (On Nut to Bearing station). Therefore, if a condominium was located immediately adjacent to the sky train station, the condominium value was roughly 176,170 to 183,380 baht per unit more than an identical condominium located 1,000 meters away than the average value. The total amount of the economic rent of 59 condominium projects located within 1,500 meters was

4,568,536,762.11 baht. The second step of our study was to estimate an appropriate betterment tax rate by applying an idea of a value capture strategy through the property value up-lift. The total betterment tax burden for the assessment area, condominium projects located within 1,500 meters from a sky train station, was equivalent to 408,918,475.90 baht, or 8.95% of their economic rent or implicit price. Therefore, our results confirmed that, based on the significant property value increment generated by the public infrastructure project, there is a realistic opportunity for Thai policymakers to implement a betterment tax that captures a portion of the windfall gains from individuals whose property is located adjacent to a public transportation project.

The betterment tax not only generates income to fund public transportation projects, but also discourages rent seeking on land speculation because this tax will increase the holding cost of the property owners and reduce their speculative gains. The betterment tax is based on the concept of the "beneficiary-pays principle," which implies that those who received windfall gains from a public scheme should share some portion of their gains to support the investment cost. Therefore, to some degree, this type of tax does restore fairness in taxation. Moreover, revenue received from the betterment tax also helps to reduce the sky train fares, thereby extending accessibility to low-income people.

The successful implementation of a betterment tax strategy in Thailand depends upon two issues. First, the betterment tax rate, particularly from taxpayers' point of view, should not be excessively high; otherwise they will oppose a public development project in their neighborhood. Hence, the local government and the stakeholders should both be involved in setting the appropriate tax rate, including the assessment area. Second, to obtain social acceptance, the local government must actively work to promote the benefits, positive aspects, and fairness of the tax.

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