Dissertation for the Degree of
Master of Landscape Architecture

Valuation of Olympic Park and Boramae Park by using Hedonic Price Method

특성가격법(HPM)을 이용한 올림픽공원과 보라매공원의 가치평가

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Graduate School of Seoul National University
Department of Landscape Architecture

Jin Han Park

■ Abstract

Valuation of Olympic Park and Boramae Park
by using Hedonic Price Method

Advising Professor : DongKun, LEE
Graduate School of Seoul National University
Department of Landscape Architecture
JinHan, PARK

The ecosystem provides individuals with a variety of benefits. Parks in particular provide a number of benefits, including recreational, leisure, and educational opportunities. Generally speaking, people are well aware of the value of the benefits that urban parks offer.

This study estimates, through the use of hedonic price methods (HPM), the populace's willingness to pay (WTP) for Olympic Park and Boramae Park in Seoul, South Korea. HPM constitute one type of valuation method for nonmarket goods. All else being equal, individuals generally prefer to live in a house located near a park; this preference is seen in the prices of apartment rentals and real estate. It makes sense, then, that this study would use an HPM model.

The dataset used comprises real transaction prices from Sungnae-dong and Sindaebang-dong in 2012, and four function types are used. Variables were chosen after undertaking a literature review and expert interviews. The independent

variables include square area of a household, the age of the building (i.e., year of completion), the floor of a household within a building, the number of households in an apartment complex, the distance to the nearest entrance of an elementary school, the distance to the nearest subway station, the distance to the nearest bus stop, whether or not there is a park view from a household, and the distance to the nearest park entrance.

The results of regression analyses were as follows. When someone who lives in Sungnae-dong buys a house, the household's WTP to be 1 m closer to Olympic Park is equal to 1% of the unit price. At the same time, this factor can be considered to have a monetary value: about 1,000 won (KRW) per 1 m closer in the log function regression, and about KRW 2,000 in the linear regression. For Boramae Park, residents who live in Sindaebang-dong assign a WTP value that equals 2% of the unit price of a home; that monetary value is about KRW 2,000 by log function regression and about KRW 3,500 by linear regression. The price of an apartment that has a view of Boramae Park can be as much as 9.5% higher than one that does not.

In addition, this study determines mathematically the range of influence of park proximity on an apartment's value. The value of is 212.42 m (semi-log function of Olympic Park), 337.17 m (log function of Olympic Park), 578.23 m (semi-log function of Boramae Park), and 900.35 m (log function of Boramae Park). These results indicate that the range of influence of Boramae Park is larger than that of Olympic Park.

The monetary value of living within the vicinity of one of these two parks is not of significant size. The value is "set" by the users, and so the value of the park

relates to accessibility. The study results indicate that Boramae Park is more valuable to those that live in its vicinity than Olympic Park is for its residents.

The number of studies that work to quantify ecosystems and their valuations has been increasing worldwide in recent years, largely because the results of quantification and valuation are useful in creating policy that protects or preserves the ecosystem, and in creating parks. This study is about park, ecosystem, and ecosystem services valuation, and about the allocation of greenspace; it makes a significant contribution to the literature, in that its results bear implications with regard to the estimated value of these parks. These figures also allow for comparisons of the value ranges of the two parks.

- *Keywords : Urban Park, Assessment, Ecosystem Services, Hedonic Price Method(HPM), South Korea*
- *Student Number : 2010-21203*

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I. Introduction

The ecosystem provides a variety of benefits; these are often called "ecosystem services." Urban ecosystems (e.g., parks) in particular offer some benefits that relate to the well-being of the populace (Plieninger *et al.*, 2013). Parks provide visitors with recreational and leisure opportunities; they also provide educational opportunities to children when they play there. Moreover, parks help ameliorate stress, fear and violence among the populace (Vandermeulen *et al.*, 2011). Generally speaking, people are well aware of the value of the benefits provided by parks (Sander *et al.*, 2012).

Rapid urbanization has led to an increased lack of greenspace in cities. The World Health Organization (WHO) and the United Nations Food and Agriculture Organization (UNFAO) encourage the existence within a city of at least 9 ㎡ of greenspace per resident (Kuchelmeister, 1998). According to the current state of urban planning by its Ministry of Land, Infrastructure, and Transport, South Korea's urban park area per capita was 8.9 ㎡/person. The number and/or size of urban parks and green spaces have been increasing over the last 10 years; nevertheless, the created area comprises just 40.4% of that which had been planned (Statistics Korea).

Today, demand for ecosystem services has been increasing. The number of visitors who have visited South Korea's national parks increased from 25 million in 2007 to 41 million in 2012 (Ministry of the Environment, 2013)[1]. These

1) 21 places are designated a national park in Korea. The area of national parks is 6,656 ㎢ and about 6.6% of the area of the South Korea(100,188㎢) in 2013. And population of the South Korea are 50 million in 2012 (Statistics Korea).

numbers suggest that individuals look to resolve their dissatisfaction with the residential environment by “getting back to nature” (Lee, 2000); needless to say, parks place a crucial role in this.

This constant and increased demand for ecosystem services has driven increases in the size and/or number of urban parks. Of course, creating a park incurs an opportunity cost; however, the value of that park often exceeds this cost, and this value often takes intangible forms. Additionally, evaluations are critical to securing funding (Vandermeulen *et al.*, 2011; Acreman *et al.*, 2008). Ecosystems and parks tend to be ignored during urban planning and policy formulation (Sander *et al.*, 2012). In some countries, the value of nature is judged objectively and estimated in concrete terms, in support of policy creation (Ahn *et al.*, 2009).

This thesis looks to evaluate parks in terms of residential-unit distance from a park; it also looks to determine the relationship between real estate value and the park area or shape. The results herein have significant implications with regard to comparison analyses of parks in Seoul. As such, these results can assist in park creation, based as they are on valuation assessments of the ecosystem or ecosystem services. Finally, this study will help support the allocation of greenspace and hence improve the quality of urban life among the populace.

II. Literature Review

1. Urban parks

1.1. Definition

The term “green park area” is defined as a space or facility that is used to create a pleasant urban environment and foster residents’ sense of restfulness and peace (「Act on Urban Parks, Greenbelt, etc.」 article 2). The subdivisions of parks in South Korea are shown in Table 1.

Table 1. South Korean park subdivision schema by 「Act on urban parks, greenbelts, etc.」

Subdivision	
Habitat zone parks	Small parks
	Children’s park
	Neighborhood parks
Theme parks	Historical parks
	Cultural parks
	Waterside parks
	Cemetery parks
	Sports parks
	Other parks

Open spaces, urban forests, street trees, school forests, and so-called greenroofs are concepts similar to parks (Park, 2003; Zhang, 2012; Cho *et al.*, 2000; Park, 2006; Payton *et al.*, 2008; Lee *et al.*, 2010); however, this study refers only to the term as defined by law.

1.2. Current conditions and related policy

For the residents of a city, urban parks, urban forests, small parks, and neighborhood parks are spaces that can be easily accessed in the course of day-to-day life, to help reduce their mental or physical burdens. However, in South Korea, the per-capita urban forest area (including amusement parks) is only 7.95㎡ ; in the major cities, that number is often much lower, but sometimes higher: 4.01 ㎡/person in Seoul, 10.19 ㎡/person in Busan, 5.65 ㎡/person in Daegu, 6.23 ㎡/person in Incheon, 8.8 ㎡/person in Gwanju, 11.95 ㎡/person in Daejeon and 6.29 ㎡/person in Gyeonggi-do (Korean Forest Service, 2012).

South Korea's central government (2013) suggests the application of two policies with regard to urban parks. One is the establishment of city parks as resting places that are safe and comfortable; the other is that city parks be established by leveraging private capital.

In Seoul, the city government has announced the formulation of policy by which to create natural environments that instill in the populace a feeling of dynamism. Specific plans relate to the designation and management of ecological landscape conservation areas; creating routes to greenspace areas that are otherwise isolated; the promotion of sustainable natural-river use; the increased management of private buildings' greenspaces; the establishment of a policy wherein no residential unit is further than a five-minute walk from a park; and the promotion of biodiversity within urban parks (Seoul Metropolitan Government, 2011).

2. Valuation methods of non-market goods

Environmental valuations of ecosystem services are typically divided into those that consider use value, and those that consider nonuse value. "Use value" is a reclassification of direct use value, indirect use value, option value, or vicarious value, while "nonuse value" reclassifies bequest value and existence value (Freeman, 2003).

Economic valuation methods can be divided into three different categories: market methods, revealed preference methods, and stated preference methods (EC, 2001; Freeman, 2003; Kwon, 2012). The ecosystem is a public good; it is also a nonmarket good. Therefore, it can be evaluated through the use of market methods. Today, the valuation methods used with nonmarket goods consider a variety of economic values and make use of modified methods likes meta-analysis (Brander *et al.*, 2013). Overall, a number of methods are widely used (Table 2).

Table 2. Widely used valuation methodologies

Category	Methods
Revealed preference methods	Hedonic price methods
	Travel cost methods
	Random utility model
Stated preference methods	Contingent valuation methods
	Choice experiment

2.1. Hedonic price methods

An important assumption inherent in microeconomics is that all goods are homogeneous; however, two goods can certainly bear different characteristics, even if in reality they are included in the same category of goods. Hedonic price methods (HPM) suppose that the price of goods is the sum of the characteristics' values. So, any separation of the value of the characteristics based on market price involves HPM. A house price, as an example, contains the value of the environment, as well as the value of the estate itself (Freeman, 2003; Kim, 2004; Jang, 2005; Kwon, 2012).

If the structural characteristics of house is S_i, the characteristics of neighborhood in which the house is located is N_i, the characteristics of specific environmental is Q_i and the price of house is P_i, the regression equation is as follows;

$$P_i = \alpha + \beta S_i + \gamma N_i + \delta Q_i + \epsilon \qquad \text{Equation (1)}$$

2.2. Travel cost methods

Travel cost methods (TCM) work by analyzing visitor expenditures related to visiting various sites (Freeman, 2003; Kim *et al.*, 2004; Jang, 2005; Kim and Kim, 2007; Kwon, 2012). Travel requires both time and money. We assume that the number of times of travel is r, income is M, the environmental characteristics of the sights is q, and the travel cost is p and that the travel demand function follows Equation 2 (Freeman, 2003; Kwon, 2012).

$$r = r(p_r, M, q) \qquad \text{Equation (2)}$$

2.3. Random utility model

The random utility model (RUM) is an improvement method used to remedy the limitations inherent in TCM. The RUM has a limitation, in that when using it, one is forced to recall from memory the number of times one has traveled, or the order of travel attractions visited. Nonetheless, it is a very useful method in analyzing selection among a variety of competing sites (Freeman, 2003; Kwon, 2012). The income of the visitor is M, the individual's socioeconomic characteristics is S_i, the characteristics of the site's environment is Q_i, and the cost that i as a visitor incurs by going to the site j is C_{ij}. The RUM function follows Equation 3 (Freeman, 2003).

$$u_{ij} = v_i(M_i - C_{ij}, Q_j, S_i) + \epsilon_{ij} \qquad \text{Equation (3)}$$

2.4. Contingent valuation methods

The aforementioned methods make use of the market price, which is a revealed preference. In contrast, contingent valuation methods (CVM) can be used to estimate the value of the environment among those who can supply a value directly when asked about WTP. It can be used to estimate the value of various kinds of nonmarket goods, and so it is no surprise that CVM is in general use (Freeman, 2003; Kim *et al.*, 2004; Jang, 2005; Kim and Kim, 2007; Kwon, 2012).

2.5. Choice experiment

A choice experiment (CE) is a means of inducing WTP by 's preference among combinations of environmental qualities and opportunity costs (Adamowicz *et al.*, 1998; Freeman, 2003; Kim *et al.*, 2004; Kwon, 2012). This method is also called conjoint analysis, and it well known in the field of marketing.

It is possible to derive the probability of one of the various options being selected, calculate the marginal WTP through a conditional logit model, and then estimate the value of the environment (Freeman, 2003) as follows:

$$P(i) = \frac{e^{V_1}}{\sum_{i=1}^{n} e^{V_i}} \qquad \text{Equation (4)}$$

3. Valuations of the parks: a literature review

Sander *et al.* (2012) analyzes the effect of parks on house prices, while examining the North Dakoda–South Dakota region of the United States; Payton *et al.* (2008) derive the value of urban forests by using HPM. Voke *et al.* (2013) estimates the value of the Pembrokeshire Coast National Park in the David region of the United Kingdom by using TCM. Using RUM, Bennett and Mwebaze (2012) estimate the value of botanical gardens in Canberra, Melbourne and Sydney, in Australia; Nanang *et al.* (2008) estimate the convenience of forest management in Alberta, Canada; and Knoche *et al.* (2007) estimate enjoyment among deer hunters in Michigan, in the United States. Tyrvainen *et al.* (1998) estimate the valuation of amenities offered by the urban forest of Joensuu in the North Karelia region of Finland, and Loomis *et al.* (2013) use CVM to analyze changes in value according to the quality of the coast. Kuriyama *et al.* (2000) estimate the value of recycled lumber by using CE.

In South Korea, Kim (2002) analyzes the effects of the greenspace environment on the value of a home, based on apartment price data in Seoul; Kim *et al.* (2007) estimate the value of the park in Daegu by using HPM. Park (2009) measures the economic value of the Mt. Palgong Gatbawi travel course in Daegu by using TCM; Yoo *et al.* (2004) estimate the total value of the tourism resources of the Daeho tourism recreation complex in the same manner. Kwon (2005) evaluates the economic value of a national park by using RUM. Rho (2009) analyzes the value of environmental materials and how they impact the residence—mainly, the distance between housing and environmental material; Lee (2013), meanwhile, evaluates the ecological park in Suncheon Bay, and Sung (1999) estimates the value of 10 parks in Seoul. Sin (2008) estimates the value of Gwanghwamun Square, Lee (2002) evaluates the preservation value of Mt. Bongsuh in Chunahn, and Lee and Park (2005) estimate the benefits of the reclamation of public greenspace from metropolitan landfills. Finally, Jang (2005) estimates the value of city center greenspace in Seoul by using CVM. Yoo *et al.* (2003) estimate the environmental cost of the impact of air pollution in Seoul, and Hong *et al.* (2010), using CE, estimate the economic value of arboretums in the multifunctional administrative city.

III. Data and Methods

1. Data scope

1.1. Study sites

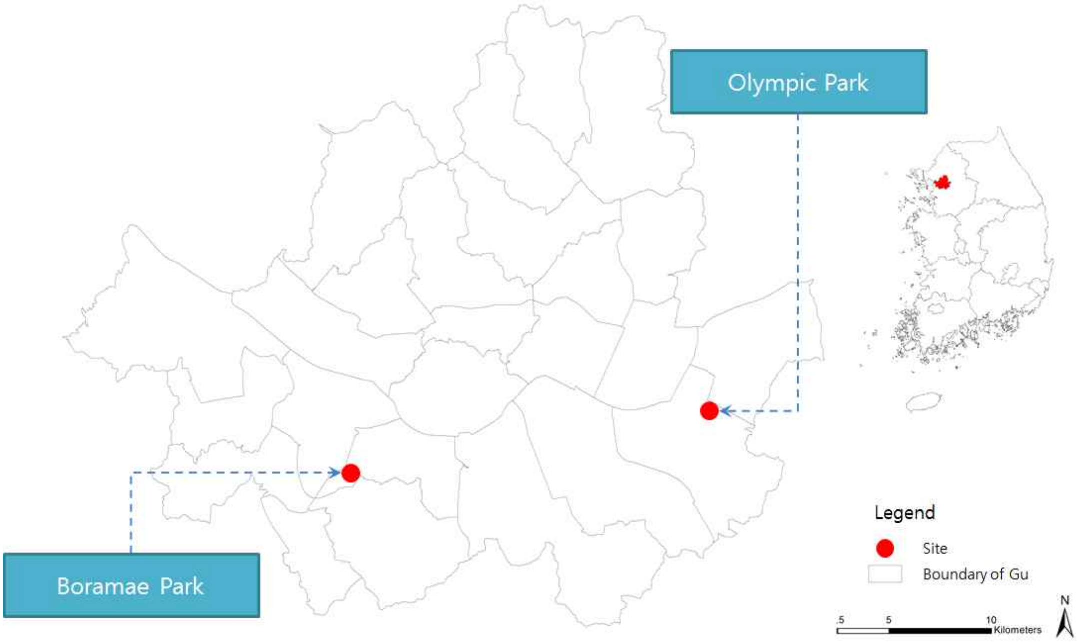


Figure 1. Study sites

In Seoul, 108 parks are managed by the Seoul metropolitan government. The sizes of the parks vary: the smallest park is Maehwa Park (1,980 ㎡), and the largest is Mt. Gwanak Park (12,376,211 ㎡); the average park size is 768,871 ㎡. The locations are also diverse.

For the current study, I acknowledged beforehand that the parks studied should be in different areas and locations and that they should be located far from the Han River. For these reasons, Olympic Park and Boramae Park were selected (Figure 1).

The general characteristics of the parks are listed in Table 3. Olympic Park was constructed to commemorate the 1988 Seoul Olympic Games, and it is one of the large parks in Seoul. Besides greenspace, the park includes many physical training facilities.

Boramae Park consists of several different facilities, including grassy squares, a pond with a musical fountain, playgrounds, soccer fields, and an artificial rock wall, *inter alia*. Eleven organizations are located within Boramae Park.

Table 3. Condition of the sites

Name of the park	Location	Area(㎡)	Opening
Olympic Park	424 Olympic-ro, Songpa-gu, Seoul	1,477,122	1979.11.15
Boramae Park	33 20Gil, Yeouidaebang-ro, Dongjak-gu, Seoul	424,106	1986.05.05

The areas of Sungnae-dong, Pungnap-dong, Dunchon-dong, Bangi-dong, Ogeum-dong, and Sincheon-dong all surround Olympic Park. I used residential-unit price data from Sungnae-dong, in order to minimize the impact of other "green" elements like the Han River or mountains; these elements would work as confounding factors, if we were to use data from the other areas.

For the same reasons, I used data from Sindaebang-dong to estimate the value of Boramae Park.

1.2. Time range

The data used in this study comprise actual transaction prices from January to December 2012, inclusive; this dataset was provided by the Seoul metropolitan government.

2. Methods

The workflow of this study occurs in four phases (Figure 2). First, I selected the valuation methods that I would use from among the valuation methods of nonmarket goods. As discussed, HPM was selected for use in this study. Second, I collected data, and then selected variables following the execution of literature reviews and expert interviews. Third, I analyzed the data by using four function types. Fourth, I plotted a price curve and estimated the values of these two parks.

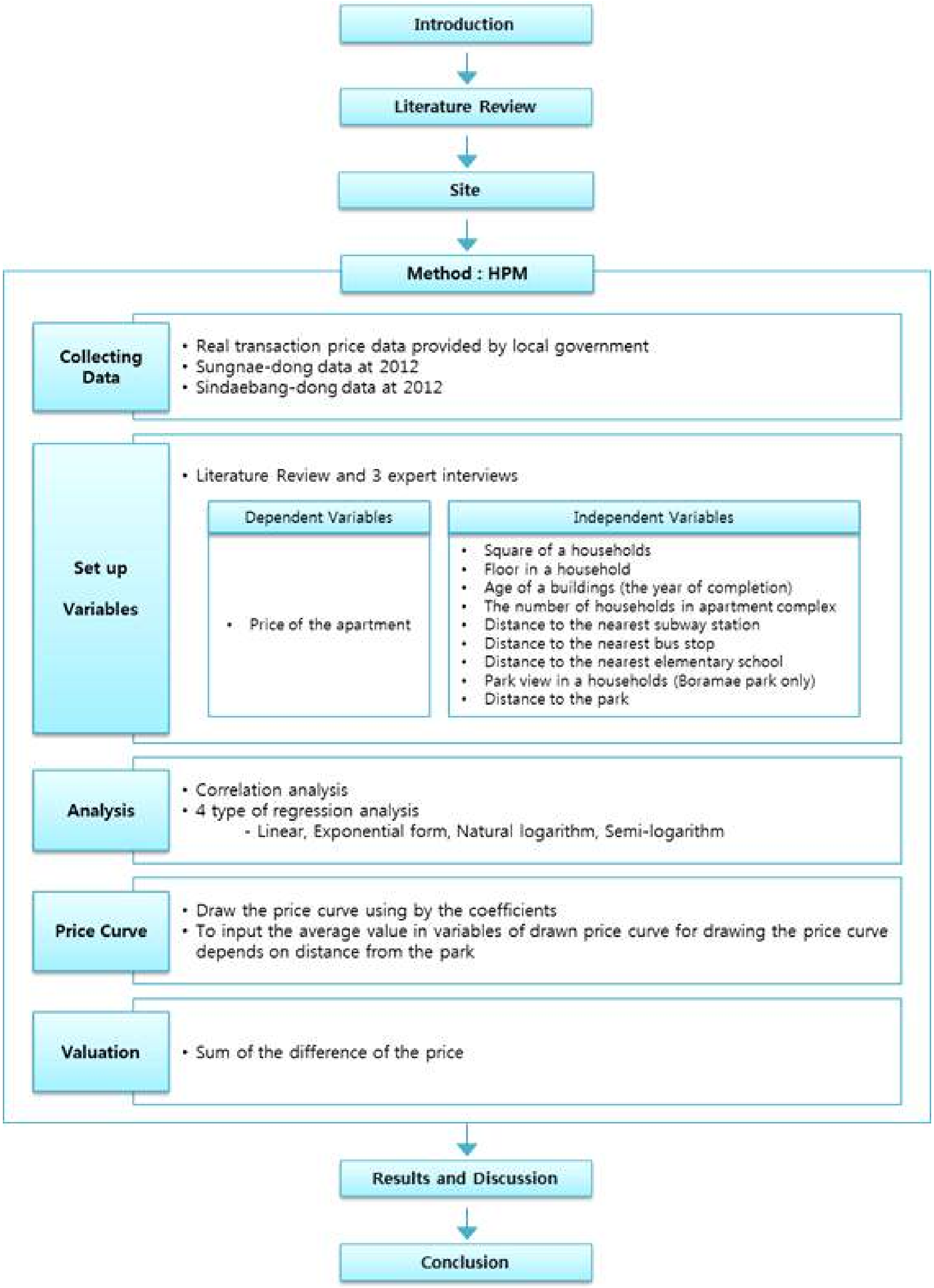


Figure 2. Workflow of study

2.1. Selection of valuation methods

There are five methodologies by which to estimate the value of nonmarket goods: HPM, TCM, RUM, CVM, and CE (Table 4).

The two methodologies most commonly used to evaluate nonmarket goods are HPM and CVM. The difference between the two methods is in whether or not respondents reveal their preferences. CVM is typically used to estimate intangible value, as determined through the execution of user surveys.

This study analyzes the prices of apartments by using HPM to estimate the value of parks' cultural services. People prefer homes that are located near parks; for this reason, I presume that preferences are revealed in the price of the apartment selected. Therefore, HPM is suitable for estimating the value inherent in a preference.

Table 4. Methodologies used to estimate the value of nonmarket goods

	HPM	TCM	RUM	CVM	CE
Mehods	Estimate the value of the green infrastructure by using house price	Estimate the value of the site by using travel costs	Estimate the value of the site by using travel costs	Estimate the value of the environment among those who value it directly, by asking about WTP	Estimate the value by package selecting combination of variables and the corresponding cost
Characteri–stic	Possibility of valuating variety of ecosystem services according to variables set up	Travel costs used by individual depend on the site characteristics; the value of the site can be estimated	Possibility of value estimation in consideration of individual characteristics that researchers can not observe	Possibility of estimating value of a variety of ecosystems	As it is possible to control the characteristics of target evaluated, it is possible to separate the variables in terms of characteristics
Limitation	Impossible for consumers who purchase a home to know all the characteristics of that home	Travel time and cost allocation when visitors go on multiple trips may be inappropriate	Difficult to build variables related to environmental characteristics between the candidate and several features	Depend on the survey, results can be induced in line with survey design intention or overestimated by the memory limits of the respondents	Variable too divers; difficult to survey combination of all subsequent
Applicable Scale	Small–scale (urban greenspace)	Large–scale (national of city park)	Large–scale (national of city park)	Various scale	Various scale

2.2. Variable selection

I selected the variables by first undertaking literature reviews and expert interviews. Initially, I collected nine variables pertaining to the structural characteristics of the homes, 12 variables pertaining to the characteristics of the neighborhood in which the home was located, and seven variables pertaining to location-specific environmental amenities.

I then established the dependent variable and the various independent variables. The house price is the dependent variable. The square area of a household, the age of the building (the year of completion), the floor of a household within a building, the number of households in the apartment complex, the distance to the nearest entrance of an elementary school, the distance to the nearest subway station, the distance to the nearest bus stop, whether or not the household has a park view, and the distance to the nearest park entrance are the independent variables.

2.3. Function type

To estimate the value of a park, four function types were used in regression analyses: linear function, exponential function, log function, and semi-log function (Table 5).

Table 5. Four function types

Function	Equation
Linear	$y = ax + b$
Exponential	$y = ae^{x} + b$
Semi-log	$y = a\ln x + b$
Log	$\ln y = a\ln x + b$

2.4. Concept of value estimation

If all other conditions are the same, the price of an apartment will change with its distance from a park. If my hypothesis is correct, differences in apartment price can be considered a WTP value, *ceteris paribus* (Figure 3). The total sum of price differences can then be used to estimate the value of the parks' cultural services.

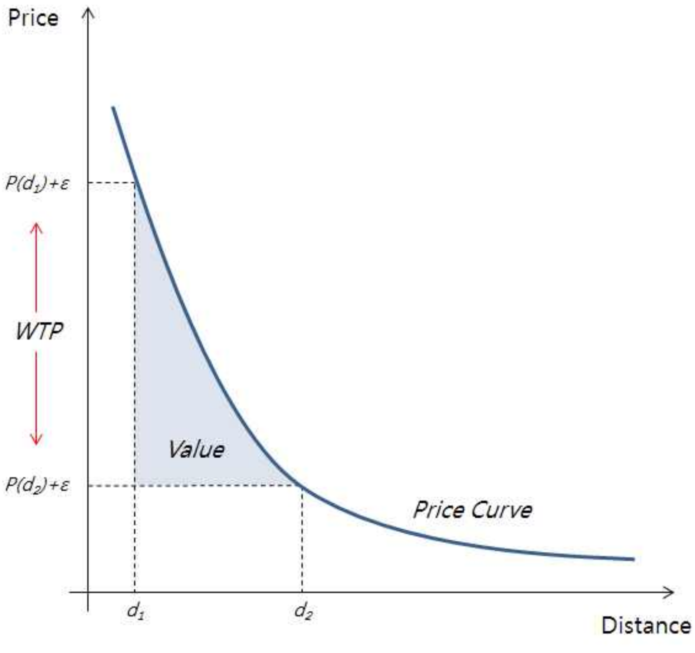


Figure 3. Willingness to pay, as a function of distance from a park

IV. Results and Discussion

1. Results with the constructed variables

1.1. Square area of a household

The square area of households within the data vary widely in the areas of Sungnae-dong and Sindaebang-dong, from 15.94 ㎡ to 226.94 ㎡. When analyzing the price per square meter, a large home will often be more expensive than smaller ones, typically due to external apartment characteristics (e.g., those pertaining to ostentation). Thus, data pertaining to homes with square areas exceeding 132.55 ㎡ are excluded, to remove bias.

1.2. Floor of a household

The floor of a household within a building is a significant variable. For example, in a skyscraper, some homes located on higher floors are more expensive than those sited lower in the building. This study therefore uses the floor of a household, "as is."

1.3. Age of the building

The age of a given building is an important variable that one considers when purchasing a home. Most people prefer to live in the latest or most up-to-date apartments. Although the life expectancy of buildings in South Korea often exceeds 30 years, most people prefer newer buildings to older ones. Some older apartments are preposterously expensive, because of related reconstruction costs. In Seoul, for example, buildings must be reconstructed after 40 years (「Seoul Ordinance on Urban and Residential Environment Maintenance」), but this criterion differs by local government (「Act on Urban and Residential Environment Maintenance」). Therefore, I limit the dataset to those homes whose buildings were less than 20 years old.

1.4. Number of households in an apartment complex

By law, the nature of the amenities or the number of convenience facilities available depend on the number of households within an apartment complex. Data on the number of households must be used restrictively, due to differences in the number of households with access to various amenities. I selected apartment complexes containing fewer than 150 households in the case of Sungnae-dong, and fewer than 500 households in the case of Sindaebang-dong. There are few differences between these two districts, but while Sungnae-dong consists mostly of five-story villas, Sindaebang-dong largely comprises large-scale apartment complexes.

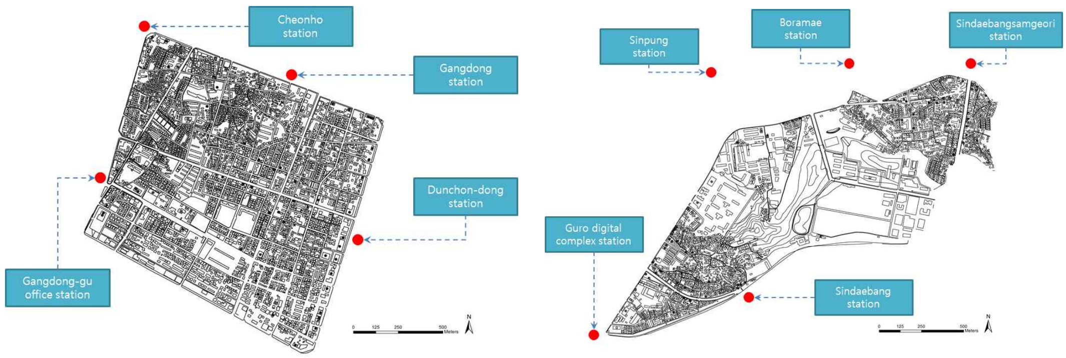
(a) Sungnae-dong

(b) Sindaebang-dong

Figure 4. Condition of the construction on each site
(Left : 25 September 2013, Right : 13 October 2013 by JinHan Park)

1.5. Distance to nearest subway station

The distance to a subway station has an effect on the price of a home. There are four subway stations in Sungnae-dong, and five in Sindaebang-dong. All the distances calculated consider certain restrictions, like crosswalks and road width. The locations of the subway stations in these districts are shown in Figure 5.



(a) Sungnae-dong (b) Sindaebang-dong

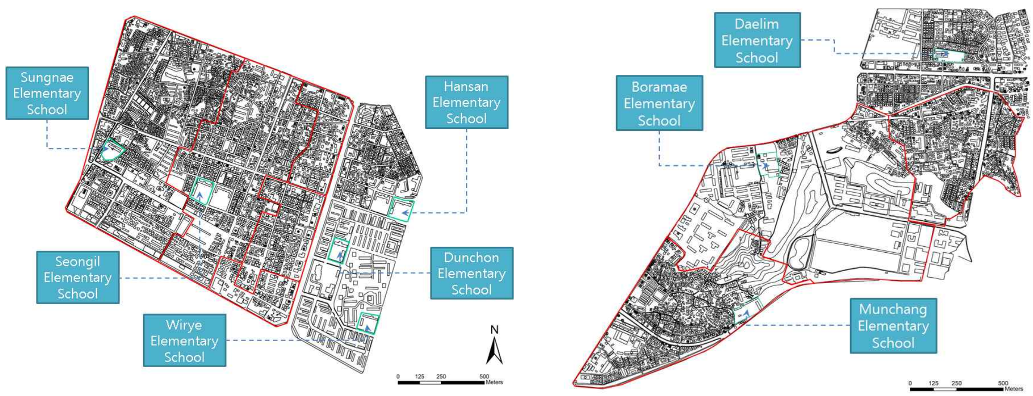
Figure 5. Condition of the subway station on each site

1.6. Distance to nearest bus stop

Three types of bus stop are found throughout Sungnae-dong and Sindaebang-dong. One is the island-type bus stop found in medians, for red, blue, and green buses. Another is the general bus stop, which is found in pedestrian areas and is for blue and green buses. Yet another is the bus stop for town buses. The distance between the home and the nearest bus stop is measured, regardless of stop type. In cases where there are multiple stops, I select the distance to the bus stop related to the largest number of bus lines.

1.7. Distance to elementary school

School siting is another consideration when people purchase a home. Middle school and high school students can use public transportation safely, but elementary school students in particular require safety when they travel to school. Therefore, in the current study, the distance from the home to the closest elementary school is a significant factor to consider. Elementary schools are assigned to households according to administrative districts and school districts—what in North America and elsewhere are known as “catchment areas” —as shown in Figure 6 and Table 6.



(a) Sungnae-dong (b) Sindaebang-dong

Figure 6. Condition of the elementary school on each site

Each school has several entrances. Therefore, the gates actually used by students are confirmed through the execution of a field survey (Appendix 1).

Table 6. Elementary school district of each site

Admini -strative district	Elementary school	School district	
Sung nae -dong	Sungnae elementary school	Sungnae1 dong	1-7tong, 18-24tong
		Sungnae2 dong	1-19tong, 27-29tong, 30tong(1-6ban, 11ban), 31tong
	Sungil elementary school	Sungnae1 dong	8-17tong
		Sungnae2 dong	20-26tong, 30tong(7-10ban), 32-37tong
		Sungnae3 dong	1tong(5-9ban), 2tong, 4-5tong, 7tong, 9tong, 12tong, 13tong(8-12ban), 15tong, 18tong, 19tong(7-8ban), 22tong, 25tong(1-3ban), 25tong(5-8ban)
	Hansan elementary school	Sungnae3 dong	1tong(1-4ban), 3tong, 6tong, 8tong, 10~11tong
	Dunchon elementary school	Sungnae3 dong	13tong(1-7ban), 14tong, 16-17tong, 19tong(1-6ban), 20-21tong, 23-24tong, 26(3-6ban,8ban)
	Wirye elementary school	Sungnae3 dong	25tong(4ban), 26tong(1,2,7ban), 27~28tong
Sin dae bang -dong	Munchang elementary school	Sindaebang1 dong	1~12tong, 14~16tong, 19tong, 24~28tong, 37tong
	Boramae elementary school	Sindaebang1 dong	13tong, 17~18tong, 20~23tong, 29~36tong, 38tong
		Sindaebang2 dong	1~4tong, 9tong, 19~22tong
	Daelim elementary school	Sindaebang2 dong	5~8tong, 10~18tong, 23tong

1.8. Park view from a household

As has been found in recent research, having a park view is an important variable that many individuals consider when purchasing a home. The "park view" variable, unlike the others, is qualitative in nature; therefore, a dummy variable was created by referencing the direction of the building and the floor on which the home was located.

In Sungnae-dong, most households have no park view. The first reason for this is that most views are blocked by office buildings, which are taller than apartment complexes. The second is the direction of the buildings: almost all buildings are constructed parallel to roads, which means that, in general, only apartments located directly across the road from the park itself will have a park view.

In Sindaebang-dong, however, all apartments built in the vicinity of Boramae Park can look into the park. In this study, the "park view" variable is used only in the regression analysis of Boramae Park.

1.9. Distance to the park

Two parks in Seoul are of the large-scale type. The identification of various entrances to these parks is important to measuring the distance from the home to the park. In the case of Olympic Park, there are nine authorized entrances. Residents of Sungnae-dong use some of the entrances that are located to the north. The field survey located an additional gate that passes through the Korea

National Sport University (Figure 7).

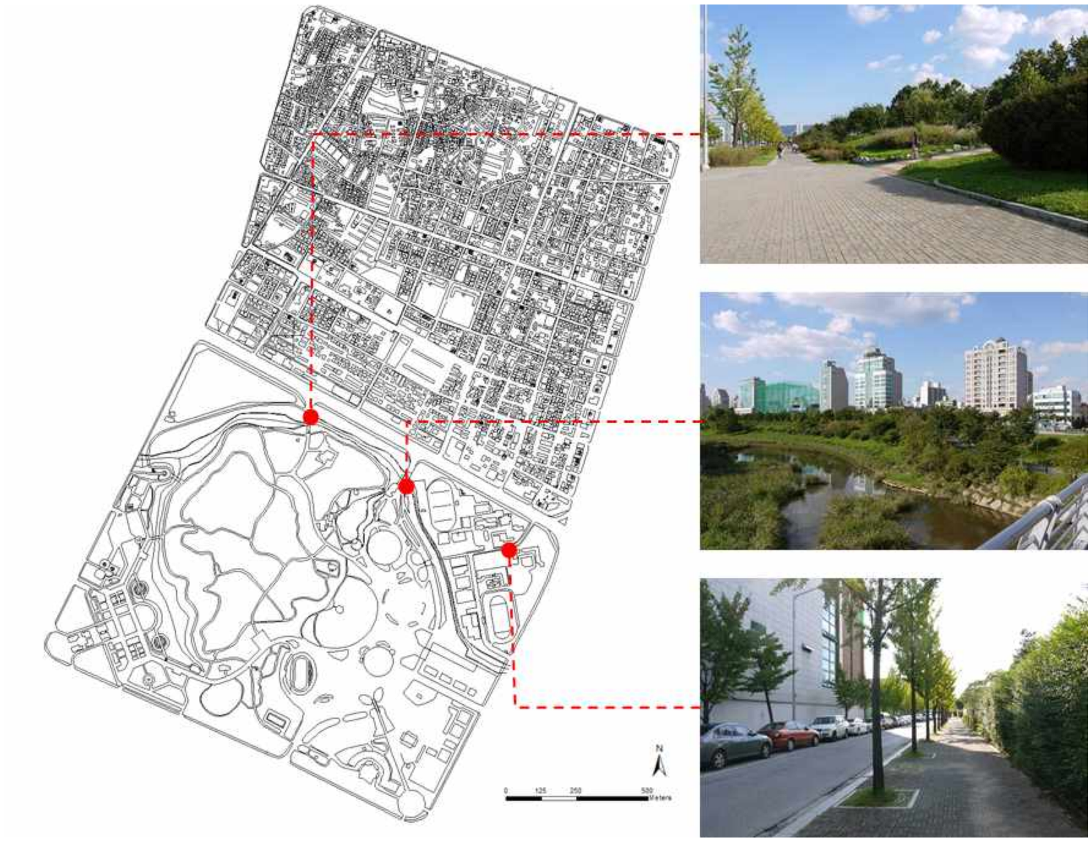


Figure 7. Entrances of Olympic Park (25 September 2013 by JinHan Park)

Next, Boramae Park has six main entrances, but there are additional narrow paths along its east side (Figure 8). The distance from a home to the park is based on the results of the field survey, and it considers both crosswalks and road width.

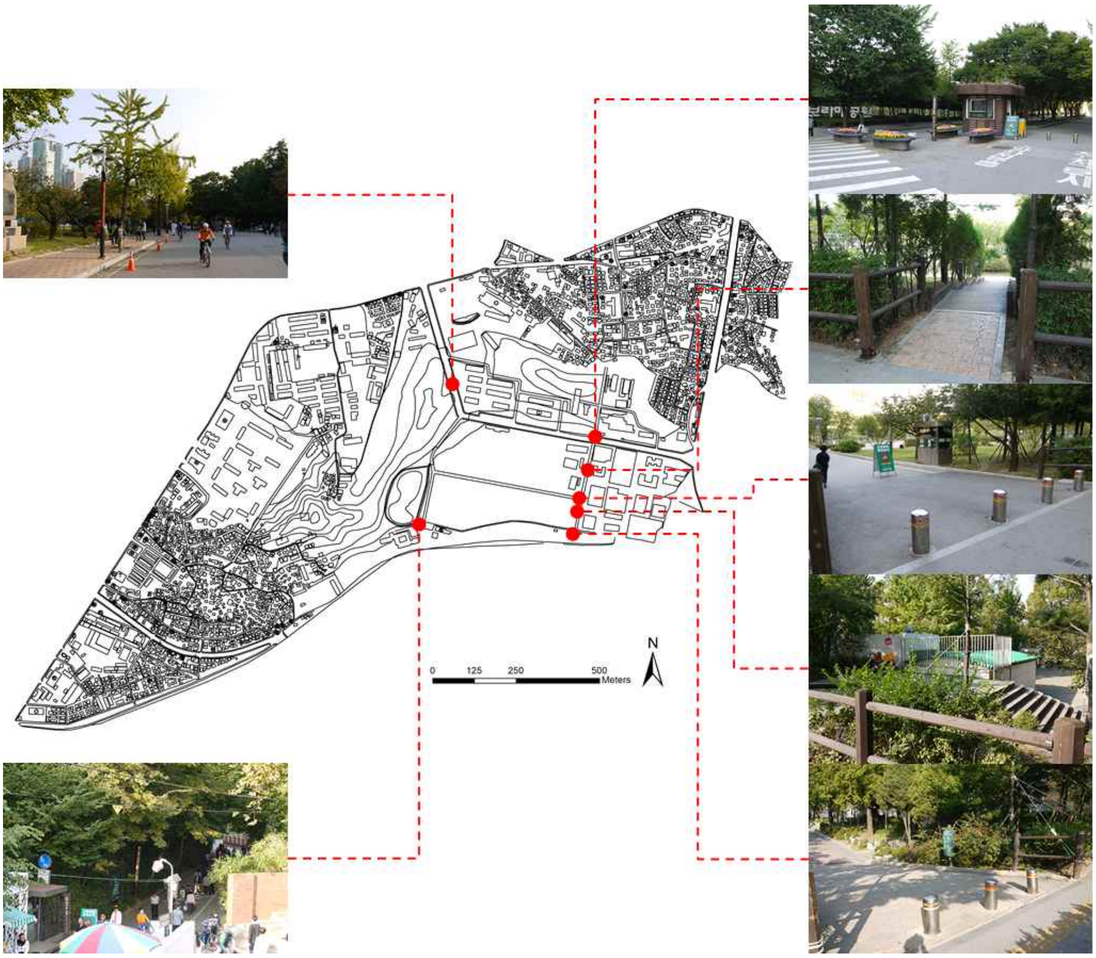


Figure 8. Entrance of Boramae Park (14 October 2013 by JinHan Park)

2. Analytical results by function type

2.1. Olympic Park

The summary statistics of the data are shown in Table 7. The total number of households surveyed in Sungnae-dong is 126.

Table 7. Summary statistics: Olympic Park households (N=126)

Variables	Minimum	Maximum	Mean	Std. Deviation
House price (ten thousand KRW)	12,500	56,500	36,101.59	8,038.36
Household's square area (㎡)	15.94	127.55	79.03	16.65
Household floor (floor)	1	16	6.72	3.49
Age of the building (year)	1	18	9.32	3.79
The number of households in apartment complex (households)	12	135	56.12	31.55
Distance to nearest subway station (m)	71	1,090	503.21	232.60
Distance to nearest bus stop (m)	52	586	282.43	141.42
Distance to elementary school (m)	74	1,040	531.48	217.56
Distance to park (m)	208	1,740	844.14	430.27

The average price of a home in the vicinity of Olympic Park is about KRW 361,010,000. The average square area of a household in the area is 79 ㎡ and most buildings there are less than 10 years of age. The average distances to the nearest subway station and the assigned elementary school are similar, at about 500 m each. Most bus stops are close by, at less than five minutes of walking from each home. However, the distance to the park entrance is farther than I had originally thought, largely because people must cross two-way, 10-lane roads (50 m across) to access the park. Due to characteristics being different, the park and other elements likes subway station, bus stop and elementary school that they are located here and there.

The regression results indicate general results for all function types. If a household has a larger square area, is on a higher floor, is in a newer building, and is in a bigger apartment complex, it will tend to be more expensive. In addition, closer proximity to a subway station, bus stop, elementary school, and park will also lead to a higher home price.

Before using regression analysis, correlation analysis between independent variables should first be performed. If there is a high correlation among independent variables, use of the model may not give rise to statistically significant results, even if its R^2 is high. Commonly, multicollinearity can be checked by determining the value of tolerance and the variance inflation factor (VIF). If the value of tolerance exceeds 0.10 and the VIF is less than 10, then the model can be considered to have no collinearity (Seo *et al.*, 1999; Ahn and Im, 2011).

For the same reason, multicollinearity does not exist among the independent variables in the results. The R^2 values of the models are 0.776 (linear), 0.753 (exponential), 0.832 (semi-log), and 0.843 (log) (Appendix 2).

As a result of the log regression analysis, the regression equation becomes as follows:

$$\begin{aligned} \mathrm{Pr}ice = 7.094 + 0.751X_{square} + 0.066X_{floor} - 0.146X_{age} + 0.125X_{households} \\ - 0.005X_{subway} + 0.007X_{bus} - 0.019X_{school} - 0.010X_{park} \end{aligned} \quad \text{Equation (5)}$$

The coefficients of the square area of a household, the floor of a household, the number of households in an apartment complex, and the distance to the nearest bus stop all have positive signs; this means that the price increases as the length or size of these factors increase. On the other hand, the coefficients of the age of the building, the distance to the nearest subway station, the distance to an elementary school, and the distance to the park all have negative signs; this means that new houses are more expensive than old ones, and that an apartment located near the park is considered more valuable.

2.2. Boramae Park

The summary statistics of the households in the vicinity of Boramae Park are in Table 8. The number of households within the Sindaebang-dong sample is 120.

The average price of a home in this area is KRW 491,775,000. This value is higher than that in Sungnae-dong, as the characteristics of the homes are reflected in the price. The average square area here is larger than that in Sungnae-dong, as is the average floor. These home characteristics are factors crucial to home pricing. The average number of households in an apartment complex relates to how Sindaebang-dong residential units largely comprise large-scale apartment complexes. The other variables are similar to those of Sungnae-dong.

The regression analysis generates results that are generally similar to those of Sungnae-dong, and here also a lack of multicollinearity. The R^2 values of the models are 0.889 (linear), 0.887 (exponential), 0.912 (semi-log), and 0.922 (log) (Appendix 2).

Table 8. Summary statistics: Boramae Park households (N=120)

Variables	Minimum	Maximum	Mean	Std. Deviation
House price (ten thousand KRW)	18,500	80,000	49,177.50	15,532.33
Household's square area (㎡)	56	132.43	90.46	25.21954
Household floor (floor)	1	37	10.57	7.07
Age of the building (year)	3	18	10.22	5.35
The number of households in apartment complex (households)	10	475	286.78	122.46
Distance to nearest subway station (m)	271	1,230	664.30	230.85
Distance to nearest bus stop (m)	209	801	340.73	138.77
Distance to elementary school (m)	179	1170	656.05	276.56
Distance to park (m)	117	1,002	725.01	230.56

The regression equation of Sindaebang-dong is as follows:

$$\begin{aligned} Price = 6.605 + 0.645X_{square} + 0.046X_{floor} - 0.284X_{age} + 0.114X_{households} \\ + 0.070X_{subway} + 0.224X_{bus} - 0.071X_{school} - 0.021X_{park} \end{aligned} \quad \text{Equation (6)}$$

The signs of the coefficients are similar to those of Sungnae-dong, but the sign of the distance to the nearest subway station is the opposite. This difference can be explained by the shape of the administrative district and the number of subway stations therein: Sungnae-dong is square, but Sindaebang-dong is not. Additionally, the area of Sindaebang-dong is smaller than that of Sungnae-dong, but there is one additional subway station. These results suggest that the residents of Sindaebang-dong chose their homes based on criteria other than subway stations.

3. Price curve and the value of the parks

3.1. Price curve

The purpose of this thesis is to determine how much a park influences the price of the homes in its vicinity, and therefore also the value of the park. Coefficients derived from regression analyses can be made into regression equations. I inputted the average variable values of the regression equations to create a price curve that is dependent on a home's distance to the park.

Price curves can be derived by using the data in Table 9. All the coefficients of distance to the park have minus signs; this means that the farther from the park a home is, the cheaper its purchase price will be.

The absolute value of the coefficient of the log regression refers to the proportion of the home price explained by proximity to the park. When someone wishing to live in Sungnae-dong buys a home there, 1% of the unit price is the individual's WTP for living 1 m closer to Olympic Park; this can be considered, at the same time, this figure relates to the value of the park. In the log function regression, the value is about KRW 1,000 per 1 m closer, and about KRW 2,000 in the linear regression. In the same way, the residents of Sindaebang-dong consider 2% of their unit prices the WTP of Boramae Park, and the value of that park. The value is about KRW 2,000 in Sindaebang-dong in the log function regression, and about KRW 3,500 in the linear regression.

In this case, the WTP of each household for being closer to the park is KRW 3,610,000 in Sungnae-dong and KRW 4,918,000 in Sindaebang-dong. Olympic Park is larger than Boramae Park, but the WTP of Boramae Park is higher than that of Olympic Park. The accessibility of the parks and their shapes differ, and this may largely explain these differences in WTP. Olympic Park is surrounded by a two-way, 10-lane road that is almost 50 m across; on the other hand, Boramae Park is surrounded by residential areas or streets. Thus, residents who wish to use Boramae Park may find it easier to access than Olympic Park.

Table 9. Price curve by model

Park	Function	Price Curve
The Olympic park	Linear	$P = 37816.53 - 2.03d_x + \epsilon$
	Exponential	$P = e\,\hat{}\,(10.62 - 6.8E - 0.5d_x + \epsilon)$
	Semi-Log	$P = 37500.65 - 212.42\ln(d_x) + \epsilon$
	Log	$\ln P = 10.53 - 0.01\ln(d_x) + \epsilon$
The Boramae park	Linear	$P = 51747.19 - 3.55d_x + \epsilon$
	Exponential	$P = e\,\hat{}\,(10.74 - 7.15E - 0.5d_x + \epsilon)$
	Semi-Log	$P = 52940.64 - 578.23\ln(d_x) + \epsilon$
	Log	$\ln P = 10.89 - 0.021\ln(d_x) + \epsilon$

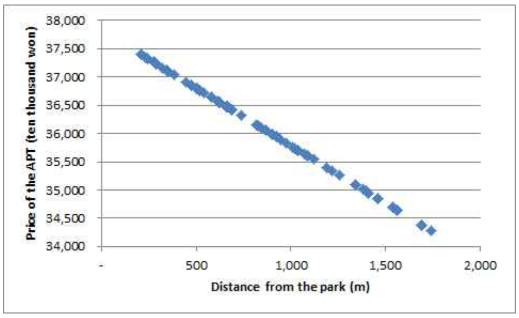
※ d_x : Distance to the park

Figures 9 and 10 are graphs showing the prices of homes as a function of differences in distance from the park. All graphs show that the prices of homes in the vicinity of the park are higher than those located farther away. In addition, we can determine the influence of the distance from the park by examining the slope of the semi-log type function or of the log type function. I focus on the number -1, which is the slope of the graph: I chose a slope of -1 because this is the point at which the relationship between home price and the distance from the park changes. If the slope of the graph exceeds -1, the price variance is larger, even if the distance range is small; if it is less than -1, the opposite results can be obtained.

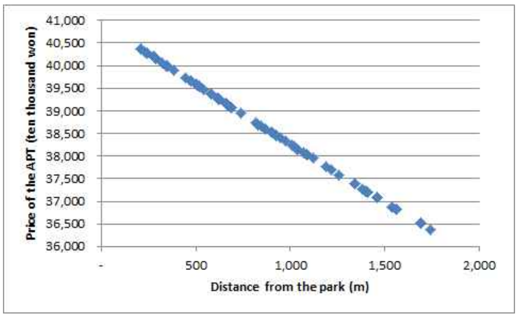
When the slope is -1 for each model and for each park, the values of are

212.42 m (semi-log function of Olympic Park), 337.17 m (log function of Olympic Park), 578.23 m (semi-log function of Boramae Park), and 900.35 m (log function of Boramae Park). These numbers provide insight into the influence of distance from the park on home price: the influence range of Boramae Park is high, and about 2.7-fold larger than that of Olympic Park. This finding aligns with earlier findings that the WTP of Sindaebang-dong residents is higher than that of the residents of Sungnae-dong.

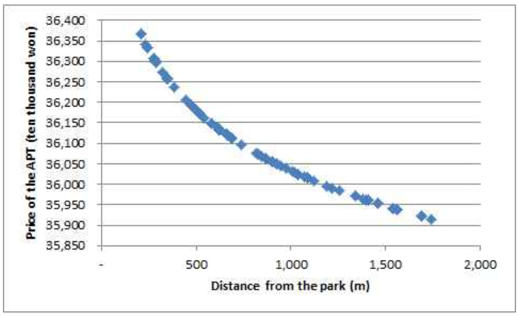
Overall, in terms of resident-assigned value, Boramae Park appears to be more valuable than Olympic Park.



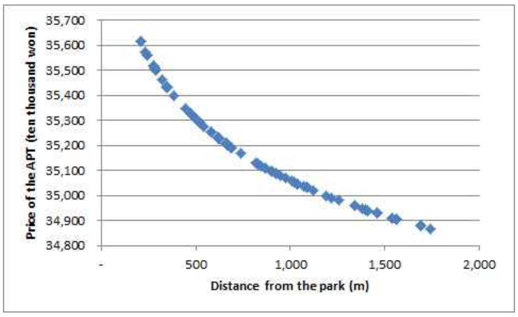
(a) Linear



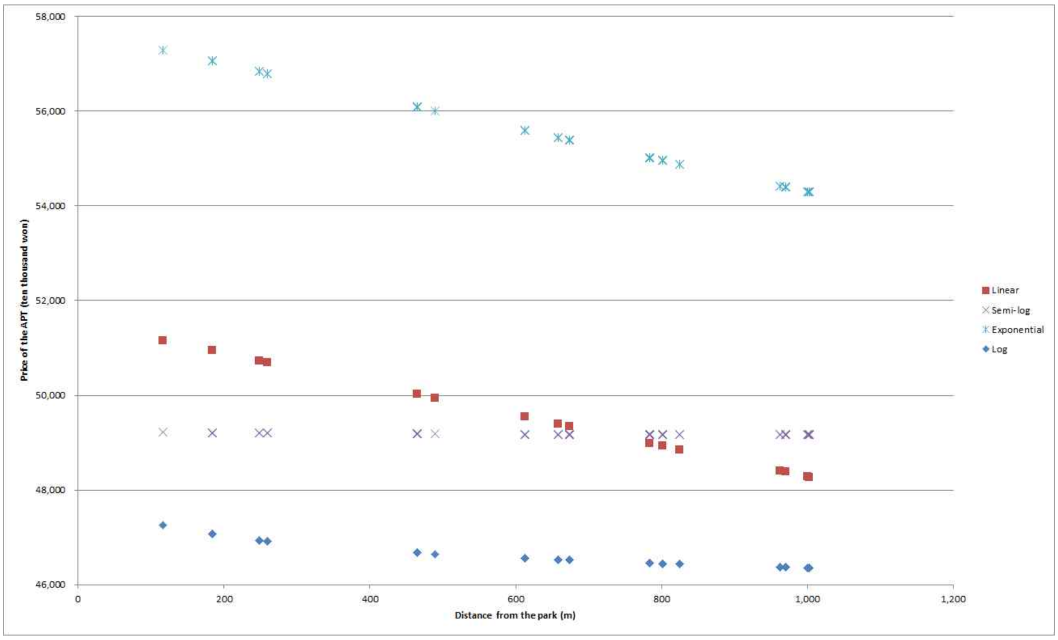
(b) Exponential



(c) Semi-log

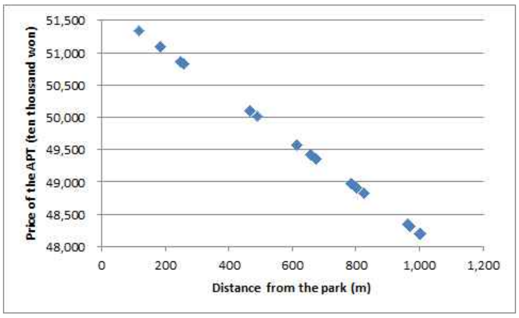


(d) Log

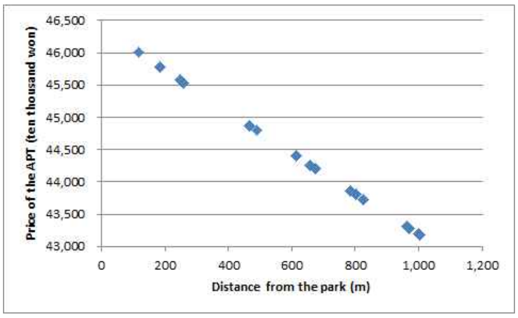


(e) Comparison of the price curve

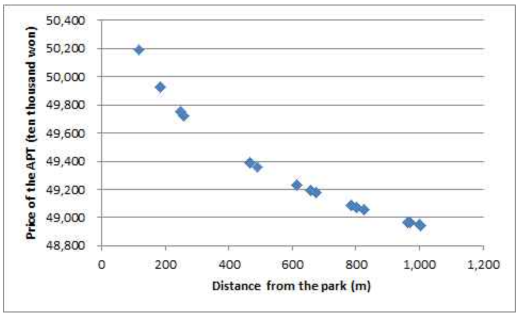
Figure 9. Graph of the price curve in Olympic Park



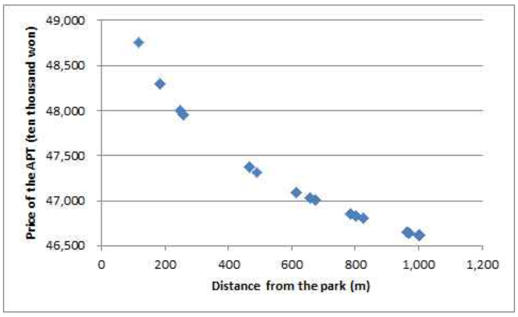
(a) Linear



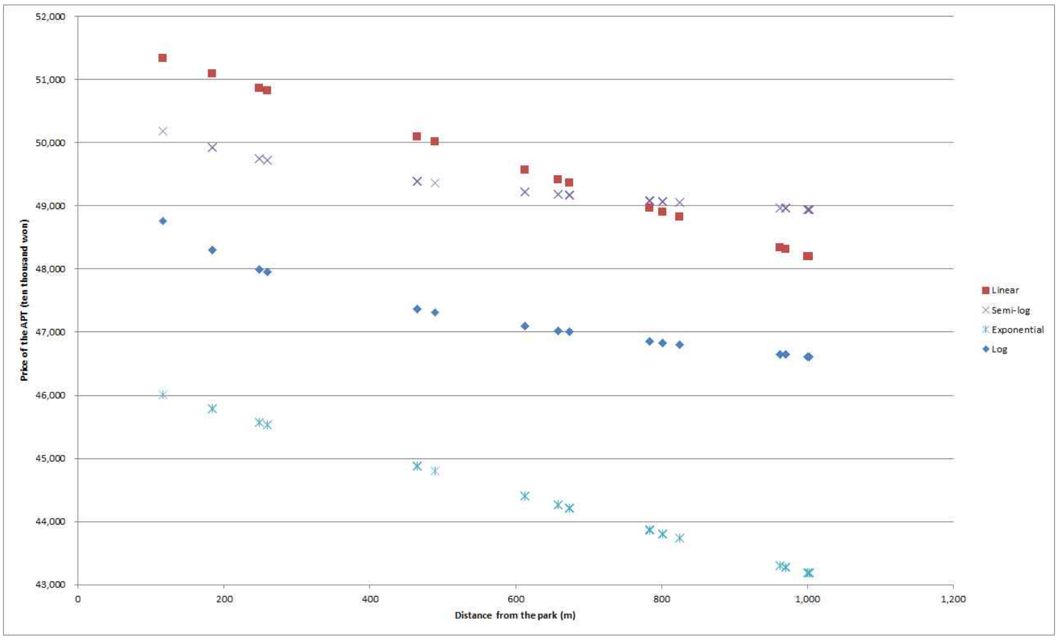
(b) Exponential



(c) Semi-log



(d) Log



(e) Comparison of the price curve

Figure 10. Graph of the price curve in Boramae Park

3.2. Willingness to pay for park

By referencing the price curve, I determined which park is deemed to be more valuable. I took another approach to estimating park value. For example, within the Sungnae-dong dataset, the house farthest from the park is 1,740 m away; its price is KRW 348,681,000. The nearest house is 208 m from the park; its price is KRW 356,167,000. The difference in price between these two houses is KRW 7,485,000, which we can interpret as the WTP of the nearest house. In this case, WTP is a relative concept. Table 10 shows the sum of the total WTP of each park, by function type. The minimum WTP of Olympic Park is KRW 23,387,000, and the maximum is KRW 290,000,000. For Boramae Park, the minimum and maximum values are KRW 27,861,000 and KRW 117,832,000, respectively.

Table 10. Willingness to pay by park and function (Unit : One thousand won)

Park	Function	Willingness to pay
Olympic Park	Linear	229,368
	Exponential	290,000
	Semi-Log	23,387
	Log	38,631
Boramae Park	Linear	117,832
	Exponential	104,366
	Semi-Log	27,861
	Log	47,616

The absolute WTP of Olympic Park is higher than that of Boramae Park in the linear and exponential functions; however, the results of the semi-log and log functions suggest that the value of Boramae Park is higher. I considered some possible explanations for these findings. First, these two parks differ in terms of the range of distance from homes to the park: in Sungnae-dong, as mentioned, the range is 208 – 1,740 m, but in Sindaebang-dong, the range is 117 – 1,002 m. This means that the WTP of the nearest house is similar between the two districts, but the distance to the farthest houses is almost two-fold. Therefore, the value of Olympic Park is higher than that of Boramae Park in the linear and exponential functions. In the case of the semi-log and log functions, the price gap between the homes located near and far from the park is reduced by the characteristics of the functions themselves. Furthermore, the higher WTP in each household in Sindaebang-dong is reflected in the difference in the nearest house prices. Consequently, the value of Boramae Park is higher than that of Olympic Park. All model types have an explanatory power exceeding 75%, but the semi-log and log functions have the greatest explanatory power. Therefore, in my opinion, models that feature the semi-log or log function are best for describing the value of each park.

The difference in the value when transformed to the value per square meter increases when we make simple comparisons of the parks' aggregate value. The value of Boramae Park is about 1.2-fold greater than that of Olympic Park, but the value per square meter is about four times higher in the semi-log or log function.

Table 11. Willingness to pay and value per square meter

Park	Function	Total WTP (thousand KRW)	Value per ㎡ (KRW/㎡)
Olympic Park	Semi-Log	23,387	15.8
	Log	38,631	26.2
Boramae Park	Semi-Log	27,861	65.7
	Log	47,616	112.3

The results of this study show that the value of the park is related to park accessibility or proximity, rather than to the scale of the park itself. This can be explained by the fact that ease of accessibility relates directly to use, and that these values are the only WTP measures of the sample houses. However, the number of park visitors and users very much exceed the household sample, and so the real value of the parks will be higher than those indicated by the results.

4. Supplemental analysis including the "park view" variable

Finally, this study analyzes the differences between these two parks, including the variable of "park view," which must be considered when using home-price data.

The environs of Olympic Park and Boramae Park differ; therefore, the "park view" variable was applied only to Boramae Park. The equation of the log regression is as follows:

$$\begin{aligned}\Pr ice = 6.178 + 0.668X_{square} + 0.034X_{floor} - 0.252X_{age} + 0.123X_{households} \\ + 0.137X_{subway} + 0.115X_{bus} - 0.077X_{school} + 0.095X_{view} + 0.045X_{park}\end{aligned} \quad \text{Equation (7)}$$

The value of the coefficient of “park view” is positive (0.095); this coefficient value means that the price of apartments located near Boramae Park is influenced by whether or not they have a park view. According to my hypothesis, the sign of the coefficient with regard to distance to a park should be negative, but within the actual results, it is positive. The park view in itself explains the difference: while some homes are located far from the park entrances, they can nonetheless see the park.

Equation (7) can be divided into two cases: residents who can see the park from their homes, and those who cannot. Equation (8) relates to the former, and Equation (9) to the latter.

$$\begin{aligned}\Pr ice = 6.237 + 0.668X_{square} + 0.034X_{floor} - 0.252X_{age} + 0.123X_{households} \\ + 0.137X_{subway} + 0.115X_{bus} - 0.077X_{school} + 0.045X_{park}\end{aligned} \quad \text{Equation (8)}$$

$$\begin{aligned}\Pr ice = 6.178 + 0.668X_{square} + 0.034X_{floor} - 0.252X_{age} + 0.123X_{households} \\ + 0.137X_{subway} + 0.115X_{bus} - 0.077X_{school} + 0.045X_{park}\end{aligned} \quad \text{Equation (9)}$$

The price of a home can be estimated as an average, to input into Equations (8) and (9). The price of a house is KRW 480,650,000 and KRW 453,110,000 for houses that do and do not have a view of the park, respectively (Table 12).

Table 12. House-price differentials based on park view

	Park view	No park view
Price of a house (ten thousand won)	48,065	45,311

This means that the WTP of residents who live in the vicinity of Boramae Park and have a park view is about KRW 27,540,000.

The results presented in section 3 show the relationship between home prices and the distance to a park. In this section, the results indicate that a park view in itself holds a measurable value.

V. Conclusion

In this study, I estimated the value of Olympic Park and Boramae Park by using HPM. Variables were selected following a literature review and the execution of expert interviews, and an appropriate dataset was constructed. Then, the soundness of some variables concerning location or situation was verified by executing field studies and interviews of public officials. I then chose the appropriate model and analyzed the dataset. Finally, I estimated the WTP of households and evaluated the value of the parks themselves.

According to the 「Act on Urban Parks, Greenbelts, etc.」, Olympic Park is a metropolitan area neighborhood park with habitat-zone parks, and Boramae Park is a city area neighborhood park with habitat-zone parks. We are apt to think that the bigger the park, the more valuable it is; however, the results of this study suggest that the value of these parks does not significantly correlate with size. The value of a park is decided by its users, and so the value of a park relates to its accessibility. As a result, for residents that live in the vicinity of these parks, Boramae Park is more valuable than Olympic Park.

These results suggest that if user satisfaction were the criterion to be satisfied, when policy-makers create a park in an urban area, enhancing park accessibility is more important than creating a large park. Creating more entrances, or locating them in the middle of residential areas, are good directions to take.

This study, despite its contributions to the literature, does have limitations. The number of households in the sample, for example, is one limitation: there are

29,963 households in Sungnae-dong and 18,388 households in Sindaebang-dong, and these two parks host many more visitors than the dataset would suggest. Therefore, the results of this study may be underestimated. Another limitation is the distance range of the influence of the park. The homes that are located farther away from the park are not affected. In this study, I determined the distance range by analyzing the slope of a graph. If a survey were done by targeting the residents or visitors and the extent to which the park has an impact on their lives, estimations of the value of the park or of WTP would be more accurate. In addition, not all the characteristics of the variables can be considered here, and all the variables are assumed to be linear.

This thesis makes a significant contribution to the literature, as follows. The value of a park is very difficult to estimate; for this reason, research into such assessments is consistently ongoing. The results have meaning: they help us estimate the value of a park and, by extension, they allow us to compare the value range of two parks. I also determined mathematically the distance of influence from each of the two parks.

Recently, the number of studies that look to quantify and evaluate ecosystems has been increasing worldwide. Because the results of quantification or valuation are useful to policy-makers or decision-makers in creating policy that protects or preserves the ecosystem and parks, I believe that this study will serve as a basis in park, ecosystem, and ecosystem services valuation and hence assist in allocating greenspace.

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Appendix 1. Entrance of the elementary school

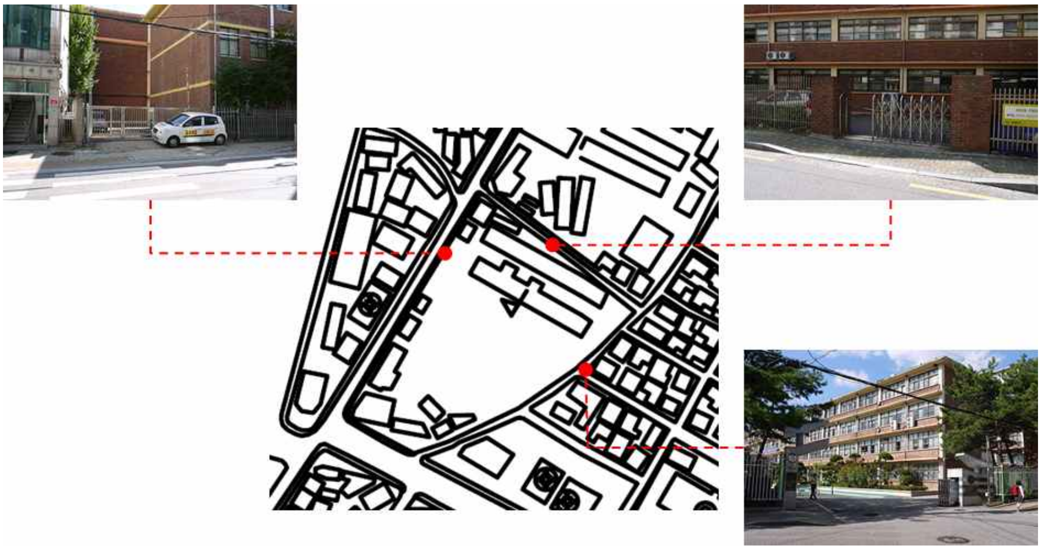

Figure 1. Sungnae elementary school in Sungnae-dong
(25 September 2013 by JinHan Park)

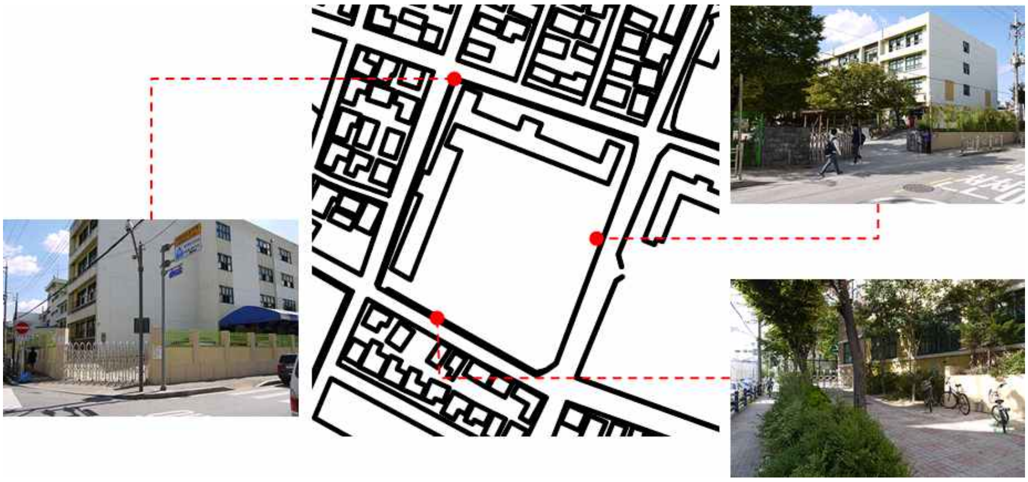

Figure 2. Sungil elementary school in Sungnae-dong
(25 September 2013 by JinHan Park)

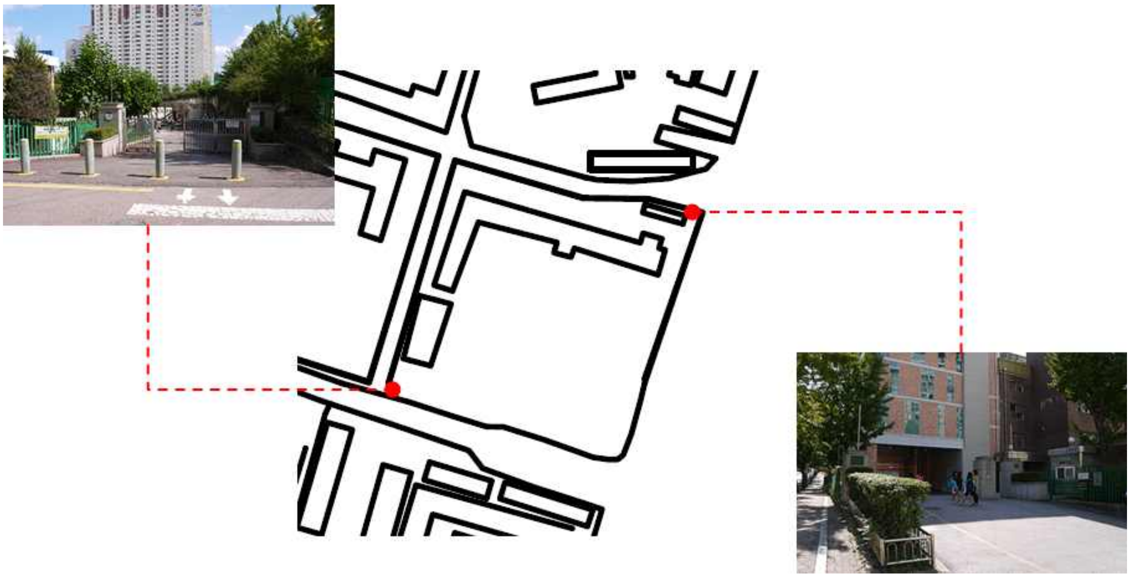

Figure 3. Hansan elementary school in Sungnae-dong
(25 September 2013 by JinHan Park)

Figure 4. Dunchon elementary school in Sungnae-dong
(25 September 2013 by JinHan Park)

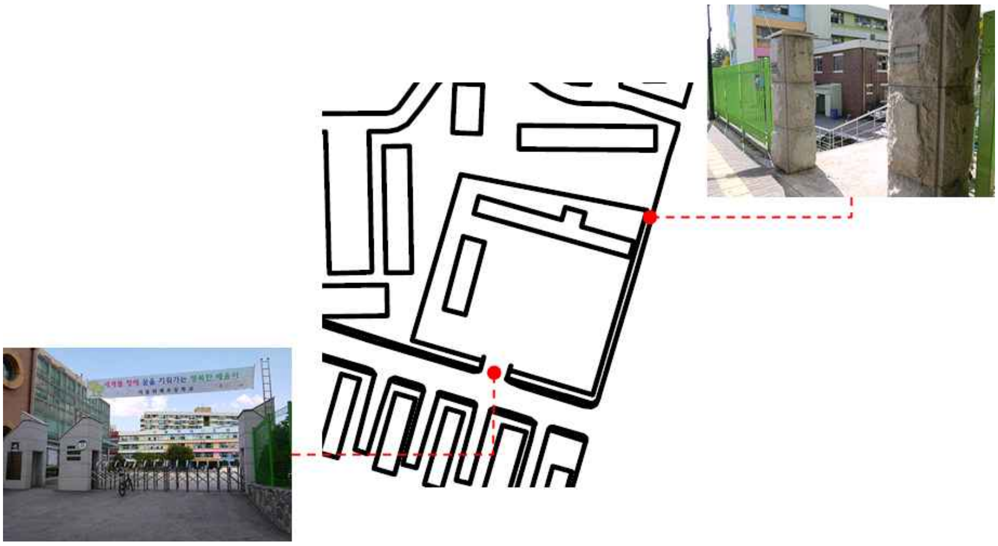

Figure 5. Wirye elementary school in Sungnae-dong
(25 September 2013 by JinHan Park)

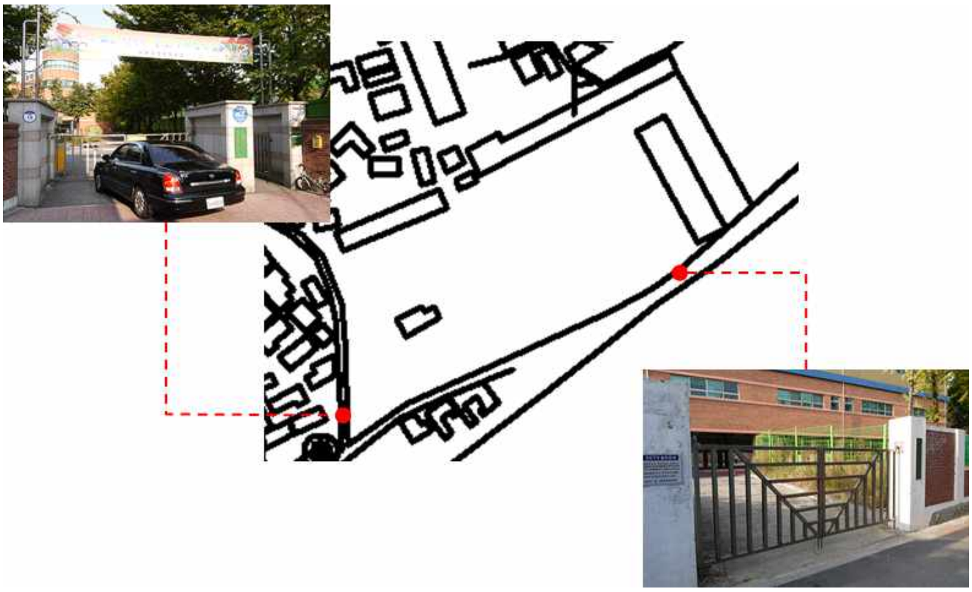

Figure 6. Munchang elementary school in Sindaebang-dong
(13 October 2013 by JinHan Park)

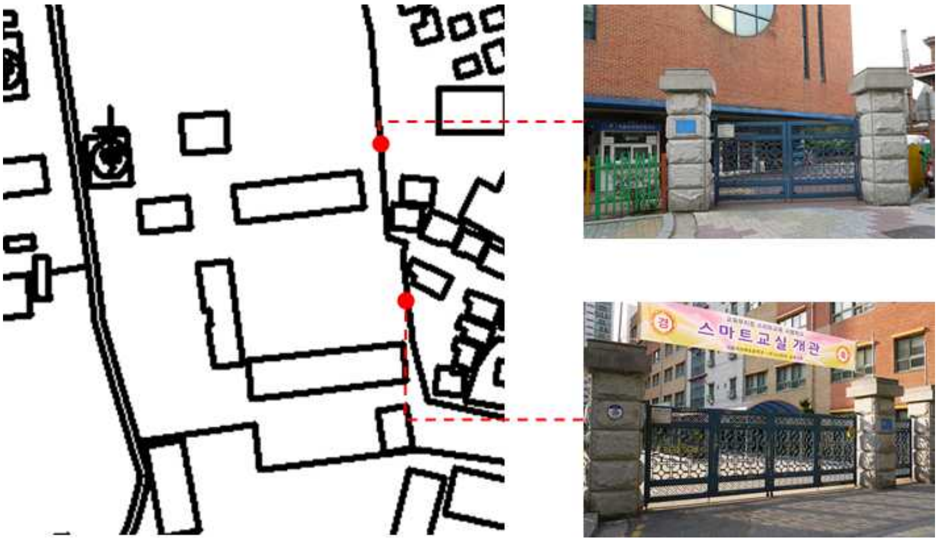

Figure 7. Boramae elementary school in Sindaebang-dong
(13 October 2013 by JinHan Park)

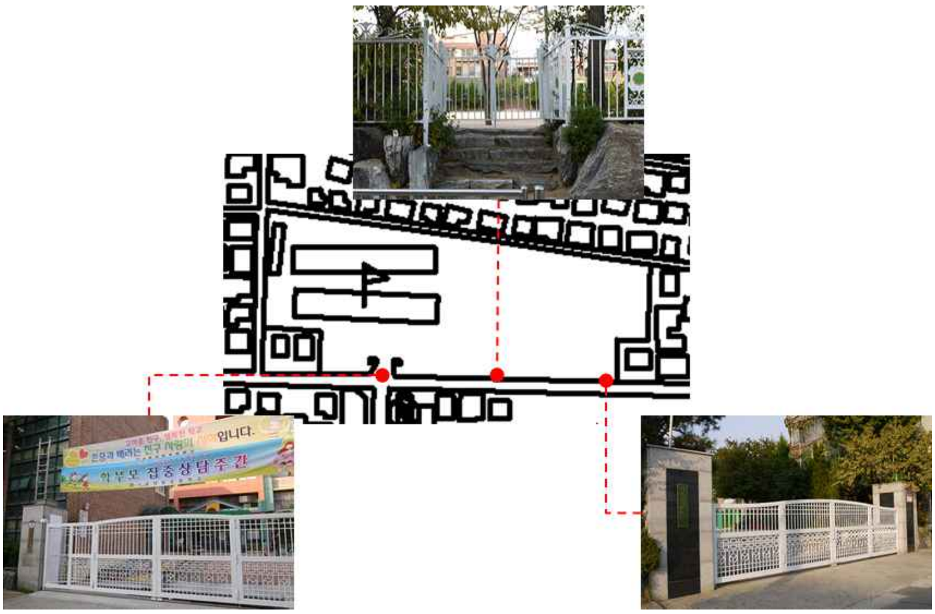

Figure 8. Daelim elementary school in Sindaebang-dong
(13 October 2013 by JinHan Park)

Appendix 2. The result of regression

1. Olympic Park

Table 1. The result of regression (Linear function, R^2 : 0.776)

	Coefficients	Standardized Coefficients	t	Significant	Tolerance	VIF
(Constant)	16811.390		5.947	0.000		
Household's square area	302.161	0.626	13.416	0.000	0.882	1.134
Household floor	329.654	0.143	2.854	0.005	0.763	1.310
Age of the building	−739.625	−0.349	−6.694	0.000	0.706	1.416
The number of households in apartment complex	96.668	0.379	7.674	0.000	0.785	1.274
Distance to nearest subway station	−4.307	−0.125	−1.842	0.068	0.419	2.385
Distance to nearest bus stop	−3.088	−0.054	−1.172	0.244	0.892	1.121
Distance to elementary school	−1.088	−0.029	−0.518	0.606	0.593	1.686
Distance to park	−2.032	−0.109	−1.481	0.141	0.356	2.811

* Dependent variable : House price

Table 2. The result of regression (Exponential function, R^2 : 0.753)

	Coefficients	Standardized Coefficients	t	Significant	Tolerance	VIF
(Constant)	9.803		108.319	0.000		
Household's square area	0.010	0.681	13.899	0.000	0.882	1.134
Household floor	0.007	0.093	1.775	0.078	0.763	1.310
Age of the building	−0.017	−0.269	−4.920	0.000	0.706	1.416
The number of households in apartment complex	0.003	0.349	6.721	0.000	0.785	1.274
Distance to nearest subway station	0.000	−0.142	−2.002	0.048	0.419	2.385
Distance to nearest bus stop	−9.88E−05	−0.057	−1.171	0.244	0.892	1.121
Distance to elementary school	−3.97E−06	−0.004	−0.059	0.953	0.593	1.686
Distance to park	−6.80E−05	−0.119	−1.549	0.124	0.356	2.811

* Dependent variable : House price

Table 3. The result of regression (Semi-log function, R^2 : 0.832)

	Coefficients	Standardized Coefficients	t	Significant	Tolerance	VIF
(Constant)	−67394.802		−6.780	0.000		
Household's square area	22339.226	0.711	18.425	0.000	0.962	1.039
Household floor	2675.957	0.215	5.197	0.000	0.838	1.193
Age of the building	−6186.747	−0.396	−8.740	0.000	0.697	1.434
The number of households in apartment complex	4546.475	0.333	8.470	0.000	0.924	1.082
Distance to nearest subway station	289.668	0.020	0.329	0.742	0.374	2.677
Distance to nearest bus stop	318.535	0.023	0.512	0.610	0.687	1.455
Distance to elementary school	−764.532	−0.056	−1.259	0.210	0.737	1.357
Distance to park	−212.423	−0.015	−0.260	0.796	0.409	2.444

* Dependent variable : House price

Table 4. The result of regression (Log function, R^2 : 0.843)

	Coefficients	Standardized Coefficients	t	Significant	Tolerance	VIF
(Constant)	7.094		24.182	0.000		
Household's square area	0.751	0.784	20.984	0.000	0.962	1.039
Household floor	0.066	0.173	4.318	0.000	0.838	1.193
Age of the building	−0.146	−0.305	−6.966	0.000	0.697	1.434
The number of households in apartment complex	0.125	0.301	7.891	0.000	0.924	1.082
Distance to nearest subway station	−0.005	−0.011	−0.180	0.858	0.374	2.677
Distance to nearest bus stop	0.007	0.017	0.391	0.697	0.687	1.455
Distance to elementary school	−0.019	−0.046	−1.067	0.288	0.737	1.357
Distance to park	−0.010	−0.025	−0.432	0.667	0.409	2.444

* Dependent variable : House price

2. Boramae Park

Table 5. The result of regression (Linear function, R^2 : 0.889)

	Coefficients	Standardized Coefficients	t	Significant	Tolerance	VIF
(Constant)	18746.180		3.395	0.001		
Household's square area	388.318	0.631	15.740	0.000	0.623	1.605
Household floor	29.124	0.013	0.369	0.713	0.773	1.294
Age of the building	−1282.47	−0.442	−8.799	0.000	0.397	2.521
The number of households in apartment complex	15.347	0.121	2.592	0.011	0.459	2.180
Distance to nearest subway station	4.244	0.063	1.151	0.252	0.333	3.002
Distance to nearest bus stop	19.296	0.172	3.994	0.000	0.537	1.863
Distance to elementary school	−4.765	−0.085	−1.824	0.071	0.462	2.163
Distance to park	−3.545	−0.053	−1.214	0.227	0.532	1.879

* Dependent variable : House price

Table 6. The result of regression (Exponential function, R^2 : 0.887)

	Coefficients	Standardized Coefficients	t	Significant	Tolerance	VIF
(Constant)	10.100		85.093	0.000		
Household's square area	0.007	0.571	14.111	0.000	0.623	1.605
Household floor	0.002	0.048	1.322	0.189	0.773	1.294
Age of the building	−0.029	−0.466	−9.189	0.000	0.397	2.521
The number of households in apartment complex	0.001	0.187	3.967	0.000	0.459	2.180
Distance to nearest subway station	0.000	0.141	2.541	0.012	0.333	3.002
Distance to nearest bus stop	0.000	0.166	3.818	0.000	0.537	1.863
Distance to elementary school	0.000	−0.149	−3.172	0.002	0.462	2.163
Distance to park	−7.15E−05	−0.050	−1.138	0.257	0.532	1.879

* Dependent variable : House price

Table 7. The result of regression (Semi-log function, R^2 : 0.912)

	Coefficients	Standardized Coefficients	t	Significant	Tolerance	VIF
(Constant)	−129186		−5.681	0.000		
Household's square area	33156.830	0.600	16.626	0.000	0.610	1.640
Household floor	2067.483	0.097	3.074	0.003	0.791	1.264
Age of the building	−14082.400	−0.582	−11.753	0.000	0.325	3.081
The number of households in apartment complex	2250.781	0.081	2.068	0.041	0.513	1.948
Distance to nearest subway station	1891.989	0.043	1.064	0.290	0.491	2.035
Distance to nearest bus stop	9765.538	0.223	5.161	0.000	0.426	2.349
Distance to elementary school	−3305.650	−0.118	−2.845	0.005	0.459	2.179
Distance to park	−578.233	−0.017	−0.426	0.671	0.511	1.958

* Dependent variable : House price

Table 8. The result of regression (Log function, R^2 : 0.922)

	Coefficients	Standardized Coefficients	t	Significant	Tolerance	VIF
(Constant)	6.605		14.495	0.000		
Household's square area	0.645	0.548	16.134	0.000	0.610	1.640
Household floor	0.046	0.101	3.397	0.001	0.791	1.264
Age of the building	−0.284	−0.552	−11.849	0.000	0.325	3.081
The number of households in apartment complex	0.114	0.193	5.213	0.000	0.513	1.948
Distance to nearest subway station	0.070	0.074	1.952	0.053	0.491	2.035
Distance to nearest bus stop	0.224	0.240	5.912	0.000	0.426	2.349
Distance to elementary school	−0.071	−0.120	−3.064	0.003	0.459	2.179
Distance to park	−0.021	−0.028	−0.762	0.447	0.511	1.958

* Dependent variable : House price

Table 9. The result of regression included variable of park view in a household (Log function, R^2 : 0.926)

	Coefficients	Standardized Coefficients	t	Significant	Tolerance	VIF
(Constant)	6.178		12.988	0		
Household's square area	0.668	0.568	16.67	0	0.578	1.73
Household floor	0.034	0.074	2.394	0.018	0.694	1.441
Age of the building	−0.252	−0.488	−9.383	0	0.248	4.036
The number of households in apartment complex	0.123	0.209	5.694	0	0.498	2.006
Distance to nearest subway station	0.137	0.146	3.124	0.002	0.308	3.243
Distance to nearest bus stop	0.115	0.124	2.031	0.045	0.18	5.541
Distance to elementary school	−0.077	−0.129	−3.358	0.001	0.456	2.195
Park view from a house	0.095	0.122	2.523	0.013	0.286	3.498
Distance to park	0.045	0.062	1.22	0.225	0.259	3.861

* Dependent variable : House price

■ 국문초록

특성가격법(HPM)을 이용한 올림픽공원과 보라매공원의 가치평가

지도교수 : 이동근
서울대학교 대학원
생태조경·지역시스템공학부 (생태조경학)
박 진 한

생태계는 인간에게 다양한 혜택을 제공한다. 생태계가 제공하는 생태계서비스의 종류는 녹지에 따라 그 종류와 가치가 달라질 수 있다. 그 중 도시 내 녹지가 제공하는 생태계서비스는 이용객들에게 레크리에이션과 레저의 기회를 제공하고, 어린이들에게는 놀이하고 머물면서 배울 수 있는 교육의 효과가 있으며, 스트레스와 공포, 폭력성을 줄여주는 등 주로 인간의 웰빙에 직접적으로 관련이 있는 서비스이다.

본 연구에서는 특성가격법을 사용하여 올림픽공원과 보라매공원의 가치를 지불의사금액을 통하여 추정하였다. 특성가격법은 비시장재화의 가치평가 방법 중 많이 이용되는 것 중의 하나로 사람들이 주택의 특성에 따라 지불하고자 하는 가치가 다른 것을 이용하여 가치를 추정하는 방법이다.

가치추정에 사용한 데이터는 서울시에서 제공하고 있는 2012년 성내동과 신대방동의 주택 실거래가를 이용하였으며, 분석에는 선형함수, 지수형함수, 준로그함수, 로그함수 등 4가지 종류의 함수를 사용하였다. 변수는 문헌리뷰 및 전문가 인터뷰를 통하여 선정하였으며, 그 결과 아파트 가격은 종속변수로, 주거세대의 면적, 아파트 건물의 나이,

해당세대의 층수, 아파트 단지의 규모, 초등학교까지의 거리, 가장 가까운 지하철역까지의 거리, 가장 가까운 버스정류장까지의 거리, 공원까지의 거리, 각 세대에서의 공원 조망권의 유무 등을 독립변수로 설정하였다.

연구 결과는 다음과 같다. 본 연구에 사용한 성내동의 120세대가 생각하는 올림픽공원의 가치는 최소 23,387천원에서 최대 290,000천원의 가치를 가지며, 신대방동의 126세대가 생각하는 보라매공원의 가치는 최소 27,861천원에서 최대 117,832천원의 가치를 가지는 것으로 나타났다. 이를 공원의 면적당 가치로 환산해보면 올림픽공원은 15.8~26.2원/㎡이며, 보라매공원은 65.7~112.3원/㎡으로 나타났다.

또한 성내동의 주민들은 올림픽공원에 1m 가까워질 때마다 집값의 1%정도를 더 지불할 용의가 있는 것으로 나타났다. 이는 로그 함수의 회귀분석에서는 약 1,000원, 선형 함수의 회귀분석에서는 약 2,000원 정도로 나타났다. 같은 방법으로 신대방동의 주민은 보라매공원이 1m 가까워질수록 집값의 약 2% 정도를 더 지불할 용의가 있는 것으로 나타났으며, 마찬가지로 로그 함수의 회귀분석에서는 약 2,000원, 선형 함수의 회귀분석에서는 약 3,500원의 지불용의가 나타났다. 또한 보라매공원의 경우 공원 조망권의 유무에 따라서 집값의 차이는 약 9.5%정도로 나타났다.

그리고 공원의 영향이 미치는 범위를 수학적으로 풀어보면, 올림픽공원의 경우 212,42m(준로그함수)에서 337.17m(로그함수)까지 주택가격에 영향을 미치는 것으로 나타났으며, 보라매공원의 경우 578.23m(준로그함수)에서 900.35m(로그함수)까지 영향을 미치는 것으로 나타났다. 이는 보라매공원이 인근 주택 가격에 영향을 미치는 범위가 올림픽공원보다 더 크다는 것을 의미한다.

즉, 올림픽공원과 보라매공원을 비교하였을 때, 공원의 가치는 공원의 크기와 비례하지 않았으며, 공원의 이용자, 즉, 공원의 접근성에 더 큰 영향을 받는 다는 것을 알 수 있었다. 즉, 각각의 공원 인근의 주민들에게는 보라매공원이 올림픽공원보다 더 가치있는 것이다.

본 연구는 주택가격을 이용하여 두 공원의 가치를 추정하였고, 더 나아가 두 공원의 가치의 범위를 비교하였다는 의의를 지닌다.

또한 본 연구의 결과는 도시 생태계 가치평가의 기초자료로 사용될 수 있으며, 정책결정자에게 경제학적으로 도움을 줄 수 있을 것이다. 궁극적으로는 도시 녹지의 재분배에도 기여할 수 있을 것이다.

❑ *주요어 : 도시공원, 가치평가, 생태계서비스, 특성가격법, 헤도닉 가격모형*

❑ *학　번 : 2010-21203*