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Research Paper

Understanding the local impact of urban park plans and park typology on housing price: A case study of the Busan metropolitan region, Korea

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ABSTRACT

The valuation of urban parks using hedonic pricing has been thoroughly documented in a number of studies set in many cities. Just as the value of existing parks can be estimated by investigating the relationship between housing prices and parks, the value of future parks can also be estimated using this approach. This study recognized that a series of planning processes and land use transitions to create urban parks not only influences the perceptions of real estate buyers but also the quality of the local environment. From the apartment sales data for the Busan metropolitan region of Korea, data on 11,498 sales of apartments within walking distance to planned parks (as well as existing parks) were collected. These data were applied in an analysis comprising three categories describing different planning contexts for the parks: "comprehensive plans," "implementation plans," and "completed parks." A set of explanatory variables representing housing, park, and neighborhood characteristics was selected, with additional remarks regarding the planning specifications that might influence apartment buyers' perceptions, such as the park type and the age of a plan, as defined in the official plans of the city. The results showed that smaller park types in residential settings were preferred throughout the processes of park planning, while all types were preferred once the processes were completed. The preference in park types is likely associated with the quality of the planning guidelines as well as the size of the project and the duration of planning.

1. Introduction

The urban park system is a crucial element of the urban fabric that enhances quality of life by promoting a healthy lifestyle, relaxation, and social engagement. Beyond the traditional value of a park space, urban park systems contribute to the larger urban objective of improving the quality of urban living. The broader view of the urban park system emphasizes the social benefits of reducing disorder and crime and strengthening ties among community members (Choi, 1999; Kuo, Sullivan, Coley, & Brunson, 1998; Kweon, Sullivan, & Wiley, 1998; Payne, Orsega-Smith, Godbey, & Roy, 1998; Sampson, Raudenbush, & Earls, 1997; Sturm & Cohen, 2014; Walker, 2004). Furthermore, vegetation, water bodies, and green spaces are valued components of the regional ecosystem and can also act as buffers against common urban nuisances, such as noise, air pollution, and congestion (Bayer, Keohane, & Timmins, 2009; Chiesura, 2004; Harnik & Welle, 2009; Kim, Park, & Kweon, 2007; Luttik, 2000).

In the past few decades, a number of studies set in multiple cities have found that urban parks have a positive impact on real estate prices. These studies have used various empirical methodologies to determine the valuation of parks. Hedonic pricing allows us to capture the value of environmental amenities by estimating the marginal price included in the price of real estate. Assisted by the improved capability of dealing with spatial data and more sophisticated tools, the recent body of research has advanced the use of the hedonic price method, especially in an investigation into the proximity effect and a more detailed and diverse characterization of environmental amenities. An overview of the previous literature, with a focus on the proximity effect and the different characterizations of parks in urban settings, lays the groundwork for the valuation of urban parks in different planning contexts.

Previous studies have employed different ways to define proximity in the application of the hedonic pricing method. The studies used different cutoff distances to examine the distance decay effect and found a significant and positive relationship between the proximity to urban parks and housing prices. Lutzenhiser and Netusil (2001) analyzed housing prices in Portland, Oregon, within 1500 feet (approx. 450 m) from park spaces and estimated an increase of $1926 for a decrease in every 200 feet (approx. 60 m) from urban parks. Czembrowski and Kronenberg (2016) analyzed areas in Lodz, Poland, within 500 m

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from parks and found that the proximity to parks had a significant and positive effect on housing prices. In a similar study in the city of Prague in the Czech Republic, Melichar and Kaprová (2013) expanded the distance to 2000 m and found that the proximity effect still applied to housing prices. While there are various ways to define proximity, several studies have identified a significant relationship between park proximity and increases in property value, and it is clear that the distance at which the proximity effect becomes applicable is, in fact, site-specific (Crompton, 2005; More, Steven, & Allen, 1982, 1988; Tyrväinen & Miettinen, 2000).

Along with proximity, the characterization of park spaces also plays an important role in the determination of housing prices. Multiple studies have found that characteristics such as the physical features, spatial context, and typology of park spaces influence housing prices differently. In two studies set in Portland (Oregon), Bolitzer and Netusil (2000) and Lutzenhiser and Netusil (2001) studied property values within 1500 feet of park spaces; both studies found that parks with natural vegetation had the largest positive impact on housing prices. Studies of two Finnish cities yielded analogous findings: a one-kilometer increase in the distance from a park equated to a 5.9% loss of property value on average, and natural forests were preferred (Tyrväinen & Miettinen, 2000; Tyrväinen & Väänänen, 1998). A nationwide investigation in Japan found that increasing property prices reflected people's preference for preserved natural space but were not significantly related to the size of the park (Ishikawa & Fukushige, 2012). Morancho (2003) also found that park size was not significantly related to the price of the surrounding houses in Castellón, Spain, suggesting the inclusion of smaller urban park spaces rather than a few large ones. Czembrowski and Kronenberg (2016) presented conflicting results on park size, as small urban forests had a stronger positive effect on housing prices in Lodz than large parks. The spatial context of parks is another factor that influences housing prices. Anderson and West (2006) found that housing prices in the Minneapolis–St. Paul metropolitan area were higher in dense neighborhoods and near central business districts (hereafter "CBD"). Similarly, studies have found that the proximity effect is more prominent in urban environments than in suburban or rural environments, where natural amenities are often more prevalent (Hammer, Coughlin, & Horn, 1974; Irwin, 2002).

Several studies have further diversified the characterization of park spaces by incorporating a typological classification based on both objective and subjective standards. Bolitzer and Netusil (2000) and Lutzenhiser and Netusil (2001) distinguished between public and private parks and included different types of green spaces such as cemeteries, urban parks, natural area parks, golf courses, and specialty parks. However, the classification considers green spaces in general, rather than a detailed classification of public parks in the context of densely populated urban areas. Panduro and Veie (2013) and Melichar and Kaprová (2013) also included a few specific park types, such as sports fields and urban parks, but did not focus on differentiating park spaces in more detail, leaving much of park spaces uniform. Czembrowski, Kronenberg, and Czepkiewicz (2016) refer to park classifications based on the subjective criteria of greenery features by considering user perceptions of the quality of park spaces, and provide insights on alternative methods of valuation as well as the characterization of park spaces. Their study found that the perceived value of green spaces and its influence on nearby housing prices are generally positively related. One noteworthy finding for our study is that an inverse relationship can also be observed, for example, in certain areas with traditional and cultural significance where negatively-perceived informal greenspaces assert a positive effect on housing prices. As Czembrowski et al. (2016) pointed out, the perceived value can extend beyond the typical characterization of green spaces; thus, this study applies their logic using the different planning contexts of park plans. Although the valuation of urban parks on housing prices has been thoroughly studied, a vast majority of studies have only examined existing parks, while the impact of proposed parks or parks still in the planning stages has not been considered. Urban parks, a crucial environmental amenity for urban residents, are the product of diligent planning involving significant time and many public resources. This study considers the impact of both existing and planned urban parks.

Our study took place in the Busan metropolitan region of the Republic of Korea (hereafter, Korea). The main objective of the study was to investigate the impact of both planned and existing urban parks on housing prices in proximity, using the hedonic price method. The study established the proximity cutoff as the zone located within 1 km of the urban park. Although the geographical boundary of the analysis may be arbitrary in terms of measuring the proximity effect, establishing a boundary was deemed necessary since much of our data reflected planned parks that were not yet available to users. In addition, the walking distance of 1 km specified in the Act on Urban Parks, Greenbelts, etc., the law that governs the design standards for urban parks, is equivalent to the distance used to specify the extent of a service area for most urban park types. Network analysis using ESRI's ArcGIS™ software delineated the study area and captured data on 12,197 apartment sales in the Busan metropolitan region, which were reduced to 11,498 sales for the final analysis. We then divided the data into three categories corresponding to stages in the park planning and development process: "comprehensive plans," "implementation plans," and "completed parks." (For details, see the "Methods" section.) For each category, we examined the relationship of apartment sales prices to housing, urban park, and neighborhood characteristics, which included a set of the structural, environmental, and locational attributes of the apartments. This study departed from the approaches adopted in previous research by considering the effect of planned parks on apartment sales as well as the characterization of urban park spaces. That is, we attempted to measure the value of not only existing parks but also planned parks, while simultaneously considering a set of variables that describe the planning context of urban parks, such as the park typology defined in planning practices, the status and age of park plans, and whether a plan had devised a masterplan. Our hypotheses can be summarized as follows:

H1: Planned parks will have a positive effect on nearby housing prices, similar to that of existing parks.
H2: Different characteristics of urban parks will have different effects in different planning contexts.
H3: The proximity effect in the study area will apply for the planned parks, similar to how it does for existing parks.

2. Methods

2.1. Categorization of park plans

The planning process of urban parks varies from city to city, project to project, and site to site. For Busan, the process follows the legal terms as presented in the Act on Urban Parks, Greenbelts, etc. (Ministry of Land, Infrastructure and Transport, 2017). It begins with the identification of needs, followed by the designation of a suitable location for the urban park. At this stage, the planning bodies identify areas in need of park spaces and those with potential suitability. These are then incorporated into the city's parks, green space, and recreation plan, which is the city's comprehensive plan for managing park spaces. Once the plan is approved at the regional level, technical processes follow. Community and local needs are revisited; physical and economic feasibilities are analyzed; and various funding options, land acquisition plans, qualifying contractors, and consultants are explored. The implementation plan is developed based on the findings, and the practical aspects of park construction at the local level are carried out accordingly, which include land acquisition, design, and construction processes.

According to Moreno (2017), whose study features a set of interviews with planning officials in different US cities, the general process

Fig. 1. General planning process of urban parks.

of park planning is similar everywhere, while the specific procedures may vary depending on the type and size of the project. The process begins with the identification of needs, which is reflected in the city's comprehensive plan or the parks and recreation plans for the region. Then, specific issues such as land acquisition and funding options are considered through planning efforts involving the planning bodies, stakeholders, and the public. The implementation plan, including a set of technical documents, is produced, and upon its approval by the city council, the construction process begins. Based on the review of the guidelines and materials in contemporary urban planning in different cities, including Busan, this study recognized two sets of processes in park planning: comprehensive plans and implementation plans. *Comprehensive plans* present broader urban objectives, with almost no reference to specific information on when and how the park will be created. That information is obtained in the *implementation plans*, which result from further planning efforts at the local level. The general process of park planning is summarized in Fig. 1.

2.2. Transformation of land use throughout park planning processes

Creating an urban park involves a series of planning processes, followed by transformations in corresponding land use. Changes in land use, found in the terms of the land use regulations, are very specific regarding the legal and planning processes of a city. This section describes the changes in land use throughout the planning processes of urban parks in Korea in accordance with the categories used in the study.

The official planning process of a new urban park begins when it is adopted into the city-wide comprehensive plan for parks. Once the park plan has been adopted, the land is zoned as an "urban planning facility"; this prohibits any private activity for the land, such as development or sale. If the land is privately owned, compensation for the property owner is discussed; however, the process does not dictate any specific terms for resolution. More specific details are determined when the plan is adopted into an "urban management plan" that corresponds with the city-wide implementation plan. While any private activities regarding the land are still restricted, the information provided by the implementation plan is more practical and realizable.

Based on our review of planning records in Busan, there are two prominent ways to acquire land for a new urban park. One relies on the purchase of land using the government budget, which is usually the process followed for large projects. This generally takes longer as the compensation processes for land acquisition could lead to complications, especially for a large area of land with multiple land owners. This explains why the land designated for a park is typically a publicly owned open space such as brownfields, an informal greenspace, or previously designated development-restricted zones that include greenbelts. The other way is to ensure that new developments dedicate a portion of their land for urban parks through a set of regulations. Larger development projects, including those in the residential sector, are subject to the requirements. Table 1 presents the summary of the regulatory standards of securing land for an urban park. This can alleviate the burden imposed by the complications of land acquisition and make the planning processes more efficient. We have identified that most of the land for the smaller park types considered in this study was acquired in this way. Once the land is secured, the planning processes begin.

From the perspective of considering current or future park users, each type of plan may indicate a different sense of availability. The comprehensive plan informs citizens that a park will be available in the future; however, it may not specify when the park will be available or even when construction will begin. Alternatively, the implementation plan informs citizens and community members of the park's expected availability and furnishes more details on the park's features and characteristics. Several studies have stated that urban park systems have a positive impact on property value; however, the impact of park plans—the future availability of a park's amenities—has not been studied extensively. While we expected implementation plans to have a clear impact on housing prices, given that they provide more detailed information on a park's status than comprehensive plans do, we were interested in determining the impact of the intrinsic factors of the plans.

2.3. Classification of urban park typology

This study considered a detailed typology of urban parks, as specified in the Act on Urban Parks, Greenbelts, etc. According to Article 15 of the Act, "Subdivision and Scale of Urban Parks," urban parks are subcategorized according to their functions and themes. This establishes the structure that effectively distributes public resources throughout all levels of the urban fabric. The main reason that we incorporated the unique classification system is that it logically involves the main user groups, activities, facilities, and spatial context of urban parks. More importantly, park plans may correspond to different land use regulations and planning procedures depending on the park type. According to our review of planning documents and records, the larger types generally require more time, involve stricter procedures, and

Table 1
Regulatory Standards for Securing the Land for Urban Parks.

Type of Development	Standards for Securing Urban Parks and Green Space
Development plan by the Urban Development Act	A. Development plan of more than 10,000 square meters and less than 300,000 square meters: more than 3 square meters per resident population or more than 5 percent of the development site area, whichever is larger B. Development plan of more than 300,000 square meters but less than 1 million square meters: more than 6 square meters per resident population or more than 9 percent of the development site area, whichever is larger C. Over 1 million square meters: more than 9 square meters per resident population or more than 12 percent of the development site area, whichever is larger
Housing construction plan by Housing Act	Plans for housing construction projects of more than one thousand households: more than 3 square meters per generation or more than 5 percent of the development site area, whichever is larger
Land development plan by Housing Act	100,000 square meters or more of land development plan: larger than 3 square meters per generation or more than 5 percent of development land area, whichever is larger
Rearrangement project plan by Act on the Maintenance and Improvement of Urban Areas and Dwelling Conditions for Residents	More than 50,000 square meters maintenance plan: more than 2 square meters per generation or more than 5 percent of the development site area, whichever is larger
Site development plan by Sites and Development Act	A. Development plan of 100,000 square meters or more but less than 300,000 square meters: residential area of more than 6 square meters per resident population or more than 12 percent of the development site area, whichever is larger B. Development plan of more than 300,000 square meters and less than 1 million square meters: more than 7 square meters per resident population or more than 15 percent of the development site area, whichever is larger C. Development plan of more than one million square meters and less than 3.3 million square meters: more than 9 square meters per resident population or more than 18 percent of the development site area, whichever is larger D. Development plan of more than 3.3 million square meters: more than 12 square meters per resident population or more than 20 percent of the development site area, whichever is larger
Other development plan stated by Subparagraph 9	Residential zones: more than 3 square meters per resident population

Note: Extracted and summarized from Appendix 2, regarding Article 5, Enforcement decree of the Act on urban parks, green areas, etc.

afford fewer options for acquiring land, than the smaller types do (See Table 2).

According to the Act, there are two types of urban parks: living zone parks and theme parks. *Living zone parks* are subcategorized into three types: neighborhood parks, children's parks, and small parks. *Theme parks* are subcategorized into six types: historic parks, cultural parks, waterside parks, cemetery parks, sports parks, and urban-agricultural parks. Neighborhood parks can be further classified as living zone parks, walking zone parks, and city/regional zone parks, based on size: a living zone park is smaller than 30,000 m^2; a walking zone park is larger than 30,000 m^2 but smaller than 100,000 m^2; and a city/regional zone park is larger than 100,000 m^2. All three types share the common purpose of serving the public as a space for resting, fostering comfort, and promoting healthy lifestyles; however, they correspond to different service areas and design standards.

This study considered all park types except the cemetery park and the urban-agricultural park types. Although cemetery parks include a few resting areas and facilities, we excluded them from the study because of their distinct use, as they are used mainly by visitors who may live outside of the designated proximity and may not walk to the cemetery. Similarly, urban-agricultural parks are small plots of land meant for a community garden, open space, or other facilities; we excluded these because of their lack of availability in the study area. Busan's theme parks are designed with unique identities, and include cultural, historic, and natural landmarks. Each subcategory is distinct in terms of its physical characteristics and designed activities; however, we did not further subcategorize theme parks because the sample size for each type was too small.

2.4. Delineation of study area

Research for the study was conducted in the Busan metropolitan region of Korea, which had a population of approximately 3.4 million and a total area of 767 square kilometers in 2015. It is the second largest metropolitan region in Korea and has experienced an increase in the number of urban parks over the past decade, according to the city's 2030 Comprehensive Plan (Busan Metropolitan Government, 2011a,b).

The study area was delineated by identifying apartments within walking distance of any of the urban parks on the street network. According to the design standards for urban park spaces in the city's 2030 Master Plans for Parks and Greenbelts (Busan Metropolitan Government, 2011a,b), the walking distance to urban parks can be up to 1 km but is limited to 250 m for children's parks. Consistent with this standard, the network analysis delineated sales data for apartments within 1 km of all urban parks, except for the children's park, for which the delineation was reduced to 250 m.

The origin and destination nodes used in our network analysis represent the access points of a park. Unfortunately, the park data we used in the study only provided geocoordinates for the parks, and not polygon data. This limitation made it difficult to locate the true access points, especially for the planned parks, although it was possible to make some adjustments for the completed parks that have designated entrances. For existing parks that could only be accessed through designated entrances, we relocated the access points to the entrances rather than the geocoordinates that were supplied.

Fig. 2 shows the distribution of the urban parks and the apartment sales data used in the analysis. Although the park spaces were dispersed throughout the metropolitan region, the apartments captured by the analysis were concentrated in clusters around the edges of the Busan metropolitan region (See Table 3).

In total, 965 urban parks and park plans were considered in the study. In the Busan metropolitan region, there were 430 completed parks, 128 parks under implementation plans, and 407 parks under comprehensive plans. As a result of the network analysis and data processing, we captured the data related to a total of 12,197 apartment sales for the three park status categories: 8886 sales for the completed parks category, 299 sales for the implementation plans category, and 3012 sales for the comprehensive plans category.

Table 2
Urban Park Typology as Specified in the Act on Urban Parks, Greenbelts, etc.

Park Type		Design Emphasis (according to the definition)	Characteristics	Example Photos
Living Zone Park	Neighborhood Park	– improvement of health, recreation, and mental health of local residents	– include three categories by size – $10,000\ m^2$–$30,000\ m^2$ – $30,000\ m^2$–$100,000\ m^2$ – larger than $100,000\ m^2$ – located in residential area – feature open space, resting area, walkways, trails	
	Children's park	– improvement of physical and mental health of children	– small in size – larger than $1,500\ m^2$ – located in residential area – feature playground facilities for children, resting area	
	Small park	– park space using small area of land to foster feelings of restfulness and peace for urban citizens	– small in size – generally smaller than $3,000\ m^2$ – typically located near residential area – feature resting area, exercise facilities	
Theme Park	Historic park	– relaxation area for local residents – education of urban citizens through the practical use of historic sites, establishments, ruins, relics, etc., of a city	– large in size – generally larger than $100,000\ m^2$ – typically include, or are located near, commercial areas – feature historic sites, monuments, contents, formal landscape	
	Cultural park	– relaxation area for local residents – education of urban citizens through the practical use of cultural features of a city	– moderate in size – generally smaller than $50,000\ m^2$ – typically include, or are located near, commercial areas – feature cultural contents, monuments, formal landscape	
	Waterside park	– leisure and relaxation for urban citizens through the practical use of waterside space, including the riverside and lakeside of a city	– medium to large in size – include beaches, riverside, waterfront features – typically include, or are located near, commercial areas – feature recreational facilities, resting area, exercise facilities	
	Sports park	– parks built to foster sound body and mind through sports activities, including athletic events and outdoor activities	– large in size – larger than $10,000\ m^2$ – typically located near residential area – feature exercise facilities, sports fields, resting area	

Note: Design emphasis of each park type refers to the official definition as specified in the Act of Urban Parks, Greenbelts, etc. Park size presented in this table refers to the technical requirement for each park type as specified in the Act. Park facilities listed in the table are not required, but are recommended by the Act. The example images are actual images of corresponding park types located in Busan, and were obtained from various online sources.

2.5. Data and variables

The sales data used in the study included all apartments sold in 2015 in the Busan metropolitan region. According to the most recent statistics, apartments account for more than 60% of all housing types in Korea, thereby dominating the housing market. This percentage is slightly higher in Busan, where apartments account for up to 63% of all housing types (Korean Statistical Information Services, 2016). This trend makes the apartment market the most active and reliable record of home-buying activity in the city.

2.5.1. Dependent variable: transaction price

The dependent variable of the study was the transaction price of apartments, expressed as $10,000\ KRW/m^2$, and explained by three bodies of independent variables: housing characteristics, park characteristics, and neighborhood characteristics.

2.5.2. Independent variables: housing characteristics

This consisted of five attributes, which included three structural attributes for individual apartment units (i.e., housing size, age of apartment, and floor level) and two attributes for apartment complexes (i.e., total number of units and constructor ranking). Constructor ranking is a comprehensive measure that summarizes the performance of construction firms, and is used in the study as a proxy variable for the brand value of apartments. It is common to see slight changes in constructor rankings from year to year because the rankings rely on the yearly number of contracts secured by construction firms. However, considering that the top 100 firms are relatively stable from the yearly variation, we expressed the constructor ranking variable as a dummy variable indicating whether an apartment was built by one of the top 100 firms. All variables related to housing characteristics were obtained from the official data provided by the Ministry of Land, Infrastructure, and Transport and the Construction Association of Korea.

2.5.3. Independent variables: park characteristics

The park characteristics we used corresponded to the environmental attributes of the urban parks within walking distance of the apartments and consisted of the urban park types listed in the city's comprehensive

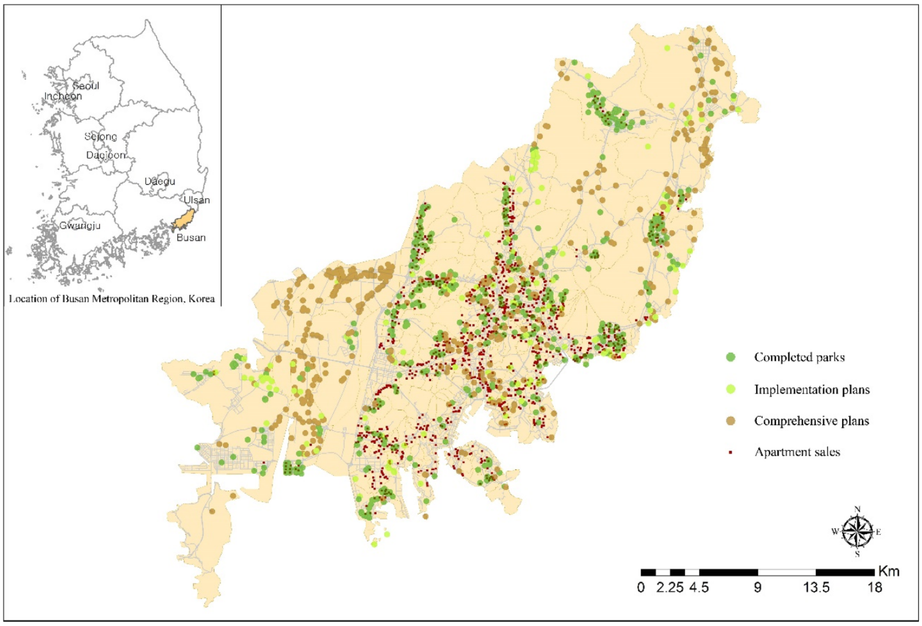

Fig. 2. Distribution of urban parks and apartment sales data in Busan Metropolitan Region.

plan, along with the parks' size, age, pedestrian distance from apartments, and whether a master plan had been devised for the planned park categories. These variables referred to the city's 2030 Master Plans for Parks and Greenbelts (Busan Metropolitan Government, 2011a,b), which provides collective data on existing and planned urban parks drawn from the city's 2030 Comprehensive Plan (Busan Metropolitan Government, 2011a,b) as well as from official announcements regarding park plans. We analyzed a total of five park types in the study, as described in Table 1, which are expressed as dummy variables to distinguish the park type located within walking distance from an apartment.

The park age variable covered the age of completed parks and the age of a plan for planned parks, both of which were measured in years.

The master plan variable indicated whether a master plan had been devised for the park. A park-specific master plan described the design and supplied details regarding construction and management; this document could be prepared anytime during the comprehensive planning process to either inform the public or for use in an evaluation conducted by the planning commission; once approved, it would be adopted into the implementation plan. (Note: In some cases—for example, when the area is too small or is public land—the master planning process is eliminated to simplify the planning process.)

2.5.4. Independent variables: neighborhood characteristics

The neighborhood characteristics we used in the study corresponded to the socioeconomic and locational attributes of the apartments: housing transaction index, employment, distance to the nearest CBD, and transit. The housing transaction index and employment were measured in the spatial unit of *dong*, the smallest administrative unit for which the data are collected. While the unit varies in size and population depending on the administrative capacity, the average size and population of one dong are approximately 4 km^2 and 17,302 residents, respectively. The housing transaction index is an effective measure for comparing housing sales data at the local level, and it improves the interpretability of the model since it accounts for regional variation in housing sales data when spatial effects are not considered. Given that income data are not available at the regional level, the housing transaction index is a commonly used proxy variable for describing the local income as well. Two locational attributes of the apartments were also included in the neighborhood characteristics to account for the locational influence on the price: distance from the apartments to the nearest central business district (CBD) and transit. There are two primary CBDs and five secondary CBDs in Busan; we measured the Euclidean distance from the apartments to the center of the nearest CBDs. Similarly, we measured the distance to the nearest metro station.

Table 4 presents a summary of the variables used in the analysis. It shows that all the variables were in a similar range except for the park size and age variables. The average size of the parks in the implementation plans category was much larger than that of the other two categories, mainly due to the plans for large neighborhood parks exceeding 100,000 km^2 in size.

2.6. Data processing and robustness

The sample size for the three categories presented in the study was quite different, which may not produce optimal comparability. As we

Table 3
Statistics of Urban Parks Employed in the Analysis.

Park Type		Completed Parks		Implementation plans		Comprehensive plans	
		No. of Parks	No. of Apts. in Proximity	No. of Parks	No. of Apts. in Proximity	No. of Parks	No. of Apts. in Proximity
Neighborhood park	10,000 m^2–30,000 m^2	62	1262	22	42	12	274
	30,000 m^2–100,000 m^2	14	201	12	64	8	38
Children's park		295	6719	27	24	108	946
Small park		33	385	30	37	256	1688
Theme park		11	88	18	80	19	42
Total		430	8886	128	299	407	3012

Table 4
Variables Used in the Analysis.

Variables			Unit	Completed parks (N = 8420)		Implementation plans (N = 276)		Comprehensive plans (N = 2802)	
				Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Apartment characteristics	Apartment price		[10,000 KRW/m^2]	301.24	87.83	326.00	102.60	306.55	94.14
	Housing size		[m^2]	78.06	30.27	79.62	33.05	75.10	31.35
	Apartment age		[years]	15.68	8.86	15.03	8.77	16.34	9.79
	Floor level		[floor number]	9.76	6.76	9.71	7.27	10.08	7.61
	Total number of units		[units]	947.87	891.43	835.38	1276.15	600.59	653.07
	Constructor ranking		[dummy]	0.45	0.50	0.36	0.48	0.42	0.49
Park (plan) characteristics	Neighborhood park	10,000 m^2–30,000 m^2	[dummy]	0.16	0.37	0.11	0.31	0.03	0.17
		30,000 m^2–100,000 m^2	[dummy]	0.01	0.08	0.18	0.39	0.04	0.21
		larger than 100,000 m2	[dummy]	0.01	0.11	0.25	0.43	0.03	0.17
	Children's park		[dummy]	0.09	0.28	0.02	0.06	0.03	0.16
	Small park		[dummy]	0.03	0.18	0.12	0.33	0.58	0.49
	Theme park		[dummy]	0.01	0.08	0.25	0.44	0.01	0.08
	Park size		[1000 m^2]	18.09	180.15	156.64	250.83	9.18	28.69
	Park (or park plan) age		[years]	26.45	11.63	n/a	n/a	n/a	n/a
			[years]	n/a	n/a	36.84	25.64	10.91	10.31
	Masterplan	Existing park	[dummy]	n/a	n/a	0.76	0.43	0.25	0.44
	Distance to park	Planned park	[m]	630.43	260.33	661.02	226.78	666.22	242.50
Neighborhood characteristics	Housing transaction index		[number]	105.12	2.01	106.17	1.48	105.59	1.66
	Employment		[10,000 employments]	1.64	9.57	1.86	1.33	1.75	1.20
	Distance to nearest CBD		[m]	4774.90	4390.62	3301.15	2173.26	2702.59	1937.95
	Distance to nearest transit		[m]	2119.51	2625.43	820.95	919.07	973.25	1127.53

designed the analysis to understand the impact of urban parks in different planning contexts, a balanced sample size would have been optimal; however, we had to make our inferences regarding the effect of the variables based on all data in our possession.

In processing the data for analysis, we detected some extreme values during the assessment of residual normality. To determine that those extreme values were outliers, we identified a set of observations through an assessment of local influence (Cook, 1986), and found that the majority of these involved special circumstances, such as apartment complexes subject to redevelopment projects. Given that those were still actual transactions, we could have included them in the analysis and employed alternative analytic methods (e.g., robust regression or weighted least square method) to lessen the effect of outlying variables. However, we believed that under such circumstances, transaction prices could vary widely due to several causes not included in our analysis. Hence, we excluded the outliers from the analysis.

Thus, our final data sample comprised 11,498 total apartment sales, which we assigned to our three categories related to park status: 8420 sales near completed parks; 276 sales near implementation plan parks; and 2802 sales near comprehensive plan parks.

We employed a combination of tests to test the normality of the error terms. It was confirmed that the skewness and kurtosis, as well as the graphical summary of fit diagnostics, matched those having a normal distribution in all categories. We then employed the Kolmogorov-Smirnov test to the data in the completed parks and comprehensive plans categories, and the Shapiro-Wilk test to the data in the implementation plans category. The implementation plans category, which had the least number of samples, failed to reject the null at the 5% level, thereby confirming normality. Conversely, the Kolmogorov-Smirnov test revealed the opposite for the other two categories. Considering that both the completed parks and comprehensive plans categories had a large sample size, and the initial fit diagnostics conformed to the normal distribution, our data were fairly robust in the face of departures from normality. Furthermore, White (1980) test revealed heteroscedasticity at the 5% level, and the analysis used the heteroscedasticity-consistent standard errors (HC_0) to confirm the robustness of the estimates.

Upon examination of the correlation matrix, we identified some correlation between park size and city/regional zone parks, the largest class of neighborhood park. Further examination of variance inflation factors (VIF) revealed multicollinearity, and the largest class of neighborhood park was omitted from the analysis. We confirmed that the remaining variables did not reveal a correlation as they had a VIF lower than 10. The results of VIF test are available from the authors upon request.

Analyzing spatial data requires the examination of spatial dependency to produce conclusive results. Our data included some overlapping data points due to the presence of multiple sales in the same apartment building on different floor levels. Thus, we had to rely on the average of apartment sales per apartment complex to test for spatial autocorrelation. A global Moran's I was produced in ArcGIS, where we tested the spatial pattern with a distance-based spatial weight matrix. In all categories, the z-score ranged from 0.70 to 1.80; however, we could not reject the null hypothesis at the 5% level.

2.7. Empirical model

The market value of housing is affected by multiple factors, including structural components and access to various amenities and services. The hedonic pricing method interprets housing price as a composite good that reflects a set of implicit component prices. The main advantage of the empirical model is that it isolates the impact of a good's constituent characteristics on its market price; it is especially useful for the valuation of environmental goods, such as parks, and their influence on the value of real estate in a given area (Bayer et al., 2009; Goodman, 1978; Melichar & Kaprová, 2013; Rosen, 1974).

The application of the model required several assumptions about the housing market, including the equilibrium of the market and the homogeneity of housing services in the study area. Due to the complex nature of the dynamics of the housing market, several econometric issues arise in the estimation of hedonic functions. To address the possibility of a nonlinear relationship between the attributes housing prices and amenity, a flexible functional form has been explored to estimate hedonic prices functions (Halvorsen & Pollakowski, 1981; Rasmussen &

Zuehlke, 1990; Tyrväinen & Miettinen, 2000). Cropper, Deck, and McConnell (1988) suggest that simpler functional forms such as linear, semi-log, double-log, and linear Box-Cox models perform best when variables are omitted or replaced by proxy variables. Cassel and Mendelsohn (1985) suggest that it may not be appropriate to rely on the Box-Cox transforms, especially for policy analysis, due to the complexity of the resulting parameters, which are often too strenuous for proper interpretation.

For this study, we tested several different functional forms, including linear, semi-log, and double-log models. The results were consistent in the three models and revealed similar levels of significance and R-squared values. Although the linear specification may provide the simplest interpretability, it is restricted by the assumption that the marginal price for an additional unit of explanatory variable remains constant. This is a critical assumption given the nonlinear pricing structure (Rosen, 1974). To account for the elasticity in the nonlinear relationship, the study presents the results of a logarithmic model along with the linear model. We found that the R-squared value of the double-log model was slightly lower than that of the semi-log model, and no significant differences were revealed in their respective interpretations. In the end, we selected the linear and semi-log models as the most appropriate, and used the latter to explain apartment prices. The model estimated the relationship following the multiple regressions model:

$$\ln(\mathrm{P}) = \alpha \mathrm{A} + \beta \mathrm{G} + \gamma \mathrm{N} + \varepsilon$$

In this model, P is the vector of the transaction price of apartments; and A, G, and N are the sets of vectors of the housing, urban park, and neighborhood characteristics, respectively. The housing characteristics consisted of five structural attributes of apartments: housing size, age, floor, total number of units, and constructor ranking. The urban park characteristics consisted of seven attributes: three types of urban park, park size, age of park or park plan, whether a park plan had a devised masterplan, and walking distance to park. The neighborhood characteristics consisted of five demographic/socioeconomic attributes and two locational attributes: population, number of households, local tax payment per household, housing transaction index, employment, and distance to nearest CBD and transit. The symbols α, β, and γ represented the regression coefficients for the corresponding terms, while ε represented the random error (See Table 5).

3. Results

The results indicated some common relationships across all the categories considered in the study. These findings were mainly related to the apartment characteristics that aligned with our expectations. Five variables—housing size, age of apartment, floor level, total units, and constructor ranking—were determined to have a significant relationship at the 1% level. All variables except housing size and age were positively related to the unit price of apartments. As expected, other characteristics related to higher sales price were the following: newer units, higher-floor units, inclusion in larger apartment complexes, and construction by high-ranking constructors. Because we used the unit price of apartments, the negative sign for housing size aligned with our expectation. Prices increased for the newer and higher units because these offered better infrastructure and views, and the larger apartment complexes generally offered more amenities and services. The constructor ranking variable showed the largest positive impact on housing price among apartment characteristics, which translated to a 12%–13% increase in housing price in all categories. It may be that high-ranking constructors possess better designs, techniques, or access to higher-end materials and components and are thus able to produce more profitable products in the higher-end housing market. Furthermore, it is also very likely that the higher brand premium of high-ranking constructors translates into higher unit sale prices, especially considering the trend toward apartment living in Korea.

Urban park characteristics showed slightly different results across the categories. For completed parks, all park types had a positive effect. The larger class of neighborhood park had a significant effect at the 1% level, which translates to an increase of more than 6% in housing price. Theme park, which is relatively large with more formally-used spaces, also had a significant effect at the 5% level, corresponding to an increase of more than 3% in housing price. Lastly, small park and children's park were positively associated at the 10% level, with more than 2% and 0.4%, respectively. It is noteworthy that all park types had a positive effect when they were completed, while some park types had a negative effect when they existed only as planned parks. The results showed that apartments located within walking distance of a small park sold at more than 2% above the average in the completed parks category. Conversely, the direction and magnitude of the influence of walking distance changed in the implementation plans category. The children's park was the only park type with a consistently positive effect in all three categories. Furthermore, at least one of the two types of neighborhood parks was associated with a positive effect in the categories we considered, while the larger of the two also showed a contrasting effect in the implementation plans category. In the comprehensive plans category, a negative relationship was also revealed between the park size variable and price, which indicates that the earlier planning processes of larger parks generally asserted a negative impact on surrounding apartment prices. The age of park plans in both the comprehensive and implementation plans categories showed a significant relationship with apartment prices, but in different directions.

A set of neighborhood characteristics of apartments was included in the analysis; the sets consisted of two socioeconomic variables and two locational variables, respectively. The locational variables (i.e., distance to the nearest CBD and transit) conformed to our expectations, thereby confirming that the apartments with better accessibility to public transit and urban centers would be sold at higher prices. The housing transaction index, which refers to the relative level and intensity of housing transactions, was positively related to apartment prices, as expected, as was the number of employment opportunities.

4. Discussion and conclusions

In this study, we applied the hedonic pricing method to measure the value of existing and planned parks in the urban environment and the effect of their respective values on housing prices. We created three categories of planning contexts to represent the three stages of park creation; for each category, we analyzed the relationship between apartment sales data and a set of variables describing the apartments, parks, and neighborhoods. We hypothesized that park plans would have a positive impact on apartment sales in proximity, similar to the effect of existing parks, with a varying impact from the two different planning stages. By the end of the study, we had identified some findings that aligned with our hypotheses, and some that remain unresolved.

Although we expected to find a proximity effect between urban parks and an increase in housing prices throughout the categories, we did not find a significant relationship for the completed parks. According to the OLS model, the distance-to-park variable in the planned parks categories revealed a significant relationship with price in both park plans categories. While small in magnitude, the negative relationship indicates that the proximity effect still applies within the area of analysis. Considering that the effect was not significant in the completed parks category, we suspect that the cutoff distance of 1 km, which translates to the walking range or service area of urban parks, was not an appropriate measure (see Table 6).

One of the prominent findings of this study was that the perceived value of an urban park gradually increases throughout the planning processes. According to our analyses, only a few park types correlated with higher apartment prices while the parks were still in one of the two planning stages, but all park types bore a correlation if they had been completed. Out of the five types of urban parks considered in this study,

Table 5
Result of Semi-Log Model.

Variables		Completed parks				Park plan: Implementation plans				Park plan: Comprehensive plans			
		Coeff.		S.E.	p-value	Coeff.		S.E.	p-value	Coeff.		S.E.	p-value
Intercept		0.7983	***	0.1449	< 0.01	0.5521		1.1970	0.645	2.5717	***	0.2714	< 0.01
Apartment characteristics													
Housing size		−0.0013	***	0.0001	< 0.01	−0.0015	***	0.0004	< 0.01	−0.0005	***	0.0001	< 0.01
Apartment age		−0.0175	***	0.0003	< 0.01	−0.0123	***	0.0017	< 0.01	−0.0145	***	0.0005	< 0.01
Floor level		0.0059	***	0.0003	< 0.01	0.0085	***	0.0014	< 0.01	0.0049	***	0.0005	< 0.01
Total number of units		6.90E−05	***	2.47E−06	< 0.01	6.98E−05	***	1.33E−05	< 0.01	1.39E−04	***	6.22E−06	< 0.01
Constructor ranking		0.1219	***	0.0044	< 0.01	0.1344	***	0.0308	< 0.01	0.1232	***	0.0082	< 0.01
Park (plan) characteristics													
Neighborhood park	10,000 m²–30,000 m²	0.0193	***	0.0053	< 0.01	0.0999		0.0669	0.137	−0.0094		0.0204	0.645
	30,000 m²–100,000 m²	0.0639	***	0.0149	< 0.01	−0.1098	**	0.0532	0.040	0.0435	**	0.0168	0.010
Children's park		0.0046	*	0.0092	0.061	0.1827	***	0.0516	< 0.01	0.0535	**	0.0240	0.026
Small park		0.0208	*	0.0120	0.083	−0.1073	**	0.0540	0.048	0.0018		0.0092	0.848
Theme park		0.0370	**	0.0156	0.017	0.0036		0.0516	0.945	0.0131		0.0329	0.691
Park size		−1.06E−05		6.68E−06	0.112	−9.15E−05		9.07E−05	0.314	−4.23E−04	***	1.24E−04	< 0.01
Park (or park plan) age	Existing park	−0.0007	***	0.0002	< 0.01	–	–	–	–	–	–	–	–
	Planned park	–	–	–	–	0.0030	***	0.0006	< 0.01	−0.0020	***	0.0004	< 0.01
Masterplan		–	–	–	–	−0.0635		0.0435	0.146	0.0464	***	0.0115	< 0.01
Distance to park		6.80E−06		9.55E−06	0.477	−1.30E−04	***	5.29E−05	0.015	−2.48E−05		1.62E−05	0.125
Neighborhood characteristics													
Housing transaction index		0.0497	***	0.0014	< 0.01	0.0516	***	0.0115	< 0.01	0.0308	***	0.0026	< 0.01
Employment		0.0187	***	0.0030	< 0.01	−0.0108		0.0091	0.238	0.0256	***	0.0034	< 0.01
Distance to nearest CBD		−2.38E−05	***	9.98E−07	< 0.01	−1.72E−05	**	8.06E−06	0.034	−5.47E−06	**	2.73E−06	0.045
Distance to nearest transit		1.11E−06		1.81E−06	0.539	−4.16E−05	**	1.94E−05	0.033	−6.16E−05	***	4.30E−06	< 0.01
N		8420				276				2802			
R^2		0.60				0.69				0.62			
F value		712.19	***			31.23	***			255.51	***		

***Indicates $p < 0.01$, **indicates $p < 0.05$, *indicates $p < 0.10$.

the two types that consistently revealed increased housing prices in proximity were the neighborhood and children's parks. These two park types were also the most common park types throughout the city, located directly within the neighborhoods. We found that the planning processes for the two types was more involved with specific design standards, such as the specification of service areas, minimum area

Table 6
Result of Ordinary Least Squares Model.

Variables		Completed parks				Park plan: Implementation plans				Park plan: Comprehensive plans			
		Coeff.		S.E.	p-value	Coeff.		S.E.	p-value	Coeff.		S.E.	p-value
Intercept		−1223.98	***	45.61	< 0.01	−1571.99	***	391.87	< 0.01	−722.56	***	83.54	< 0.01
Apartment characteristics													
Housing size		−0.37	***	0.02	< 0.01	−0.47	***	0.13	< 0.01	−0.09	**	0.04	0.038
Apartment age		−5.15	***	0.09	< 0.01	−3.89	***	0.57	< 0.01	−3.93	***	0.13	< 0.01
Floor level		2.03	***	0.11	< 0.01	3.09	***	0.52	< 0.01	1.83	***	0.23	< 0.01
Total number of units		0.02	***	0.00	< 0.01	0.02	***	0.00	< 0.01	0.04	***	0.00	< 0.01
Constructor ranking		33.77	***	1.40	< 0.01	56.65	***	10.95	< 0.01	38.77	***	2.84	< 0.01
Park (plan) characteristics													
Neighborhood park	10,000 m²–30,000 m²	4.85	***	1.64	< 0.01	39.13	*	21.73	0.073	−5.40		5.84	0.355
	30,000 m²–100,000 m²	13.69	***	4.88	< 0.01	−34.22	**	16.96	0.045	9.39	*	5.20	0.071
Children's park		0.07	*	2.68	0.098	52.55	***	15.77	< 0.01	8.99		7.95	0.258
Small park		9.13	**	4.17	0.028	−29.99	*	17.19	0.082	−1.78		2.99	0.550
Theme park		3.18		4.91	0.517	8.26		16.82	0.624	−13.04		10.98	0.235
Park size		−4.21E−03	*	2.32E−03	0.069	−0.03		0.03	0.336	−0.14	***	0.04	< 0.01
Park (or park plan) age	Existing park	−0.25	***	0.07	< 0.01	–	–	–	–	–	–	–	–
	Planned park	–	–	–	–	1.04	***	0.18	< 0.01	−0.72	***	0.11	< 0.01
Masterplan		–	–	–	–	−23.11		14.48	0.112	16.63	***	3.73	< 0.01
Distance to park		3.40E−04		2.88E−03	0.906	−4.33E−02	**	1.74E−02	0.014	−1.70E−02	***	0.01	< 0.01
Neighborhood characteristics													
Housing transaction index		15.56	***	0.43	< 0.01	18.62	***	3.75	< 0.01	10.04	***	0.80	< 0.01
Employment		6.51	***	0.94	< 0.01	−5.65		2.98	0.159	9.48	***	1.07	< 0.01
Distance to nearest CBD		−7.22E−03	***	2.90E−04	< 0.01	−4.12E−03		2.52E−03	0.103	−9.42E−04		0.00	0.274
Distance to nearest transit		−5.30E−04		5.14E−04	0.302	−1.53E−02	**	5.89E−03	0.010	−1.88E−02	***	0.00	< 0.01
N		8420				276				2802			
R^2		0.61				0.69				0.61			
F value		735.50	***			31.02	***			241.00	***		

***Indicates $p < 0.01$, **indicates $p < 0.05$, *indicates $p < 0.10$.

requirements, safety standards, and considerations for walkability (Busan Metropolitan Government, 2011a,b). Thus, we have concluded that more detailed planning guidelines are key in building a valued park space. For small parks, we observed that these sometimes revealed a negative effect during the planning processes, which did not align with our expectations. Further investigation led us to the understanding that there was a difference in effect between what are generally called small parks and miniparks, which were even smaller and could be characterized as small park spaces installed on leftover pieces of land; miniparks are usually after-the-fact add-ons to other construction projects; therefore, they do not fit into the typical municipal planning process, have no design specifications or standards, and are often too small to use as activity spaces. This suggests that miniparks (and plans for miniparks) are former empty lots, which are relatively tiny and are abundant in certain areas. The property prices in such environments are likely lower overall, which could explain the price-lowering effect of the outcome. Lastly, the negative effect observed with regard to park size and age in the comprehensive plans category may be the result of the negative spillover of perceptions related to other large construction projects that require long periods of time; that is, apartment buyers may not believe that a park that has languished in the comprehensive planning stage for a long time will ever be built or may doubt that it will be constructed during the time that the prospective buyers are living in the apartment. While the study cannot be used to explain the temporal effect, and we cannot assume that the effect of construction affected apartment sales, it is understood that larger projects require more time to plan and construct, which translates into longer periods for land use restrictions. Furthermore, given that during the comprehensive planning processes, information regarding a park's construction schedule is limited or considered unreliable, it is possible that housing prices might be affected by the perception that a planned park has been intentionally delayed or is behind schedule for some reason. This possibility is supported by our findings, which revealed that having a devised masterplan asserts a positive effect in the comprehensive plans categories, while it is not significant in the implementation plans category. We expected that having a devised masterplan—a reliable source of information about a future amenity—would have a positive effect on apartment prices throughout the planning processes. Although our expectation was correct in the earlier planning stages, it is difficult to determine the effect using this result because park-specific master planning is not always required. The precise juncture on the planning spectrum at which the masterplans are created is also unclear. In any case, the negative effects associated with park size and the age of a park plan serve as a valid admonition for not delaying the planning processes of urban parks. As the study showed, even parks that are still in the planning stages assert notable impacts on the local environment. This means that it is possible to derive meaningful information related to parks and housing prices from the outcome, from both academic and practical perspectives.

4.1. Valuation of planning processes and hedonic pricing

The capability of measuring the value of an environmental amenity through hedonic pricing is widely accepted in planning literature, and our study shows the possibility of expanding the application to the valuation of an amenity while still engaged in the planning process. In this study, we have broken down the process of park planning into different contexts, planning terms, and progress stages. Based on the limitations of this study, it is clear that the inclusion of more information to characterize these processes could very well be an empirical indicator of the quality of urban planning. For example, more detailed information regarding the timeline of the individual components of the planning procedure, such as the approval phases of a plan, establishment of a masterplan, expected completion milestones, and periodic updates of progress, could allow an enhanced and updated version of our study to investigate the temporal effects of park planning, which could constitute a significant contribution to understanding the time-dependent, and spatially oriented interactions between community building efforts and outcomes (Szumilo, Laszkiewicz, & Fuerst, 2017).

4.2. Evaluation of planning processes and policy implications

The valuation of planning processes would involve more direct options in practice, as it could produce empirically driven knowledge with policy implications. We believe that employing such a tool, to evaluate the planning processes for not only parks but also other similar endeavors in an urban context, would greatly improve the effectiveness of the overall urban planning process. One of the key findings of this study is the connection between the detailed planning guidelines for neighborhood parks and children's parks; that is, the finding that potential residents' knowledge of a future neighborhood or children's park leads to an increase in property values. This finding could be the groundwork for improving the contents of planning guidelines.

Although it is not yet clear from this study if a delay during the planning processes is associated with a negative effect on housing prices, this is also valuable information, as it suggests the need to undertake a more thorough investigation on this topic and, based on the results, prepare any necessary preventative measures. A recent issue regarding park planning processes in Korea could very well illustrate this possibility. In revisiting the land use transitions throughout the park planning processes, the Ministry of Land, Infrastructure, and Transport found that most exercises related to land ownership are restricted when a city-led park plan has been imposed on that land. This brought up a number of legal issues; consequently, a set of laws constituting Article 48(2) of the National Land Planning and Utilization Act was enacted to invalidate the designation of a piece of land as the site of an urban planning facility if the related plan is not implemented within 20 years of this designation (Ministry of Land, Infrastructure and Transport, 1999). The first set of invalidations is set for enforcement in July 2020; in Busan's case, up to 40 urban park plans will be subject to invalidation, meaning that more than 900,000 square meters of protected greenspace and nature will once again be privately owned. Without any preventative measure for conserving this greenspace (that is, completing the planning for the parks and their construction), the consequences could be devastating for the quality of the urban environment. Our study provides empirical evidence that parks improve public satisfaction with the urban environment. Further advancement of our model with additional characterizations of the physical, social, and environmental contexts of urban parks and plans will be able to produce still more accurate estimations of the value that is added by parks and lost in the abandonment of the plans and land designated for the 40 proposed parks. Such data could support decision-making efforts related to the prioritization of land acquisition, budget management, and evaluation of policy alternatives. As evidence now exists showing that even planned parks affect housing valuations, this provides information that is critical to the processes and personnel involved in planning procedures and regulations. In the end, this study verified the strength of the planning link in the continuous chain of recalibrating the valuation of environmental amenities and the urban landscape.

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