

Article

Green Space and Apartment Prices: Exploring the Effects of the Green Space Ratio and Visual Greenery

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Abstract: Urban green spaces provide various social, economic, health, aesthetic, environmental, and ecological benefits. This study aimed to investigate the influence of green spaces on apartment prices, with a particular emphasis on visual greenery and the proportion of green spaces. Hedonic pricing models have often been used to assess the impact of green spaces on housing prices. Herein, 16 variables were considered as factors affecting housing prices and divided into housing, neighborhood, and green space characteristics. The findings indicate that the presence of green spaces enhanced the value of apartment complexes. Moreover, both visual greenery and the proportion of green spaces within apartment complexes influenced housing prices. Additional analysis demonstrated the impact of green space characteristics within Seoul apartment complexes on housing price changes from 2016 to 2022, finding that higher green space proportions and visual greenery led to approximately 20% higher price increases, and structural equation modeling revealed that the proportion of green spaces within apartment complexes, directly and indirectly, influenced housing prices through visual greenery. Overall, this study emphasized the importance of ensuring well-managed green spaces within and around apartment complexes.

Keywords: urban green area; visual greenery; real estate price; hedonic price model; apartment complexes



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1. Introduction

Urban green spaces within cities exist in various forms, such as parks, riparian green spaces, community gardens, street trees, vertical gardens, apartment complex green spaces, and rooftop gardens [1–4]. The various benefits of urban green spaces, including social, economic, health, aesthetic, environmental, ecological, and visual benefits, have been well documented [1]. Specifically, urban green spaces play a role in environmental and ecological functions, such as controlling air pollution, regulating microclimate, reducing heat island effects, purifying water quality, and enhancing urban resilience in response to environmental and climate change [2–4].

In South Korea, the majority of the population (more than 25 million people, representing more than 50% of the total population) is concentrated in metropolitan areas. Here, urban green spaces contribute to improving the quality of life and emotional well-being of residents as these spaces can be easily accessed. Particularly, green spaces in communities and apartment complexes, such as community gardens and neighborhood parks, play a key role in reducing stress, crime, and antisocial behavior, improve physical health, and provide educational and aesthetic benefits by connecting with nature [5–8]. Because of these values of urban green spaces, the need for more of such spaces is increasing; additionally, urban residents prefer green spaces closer to their residential areas and housing complexes [9,10].

Urban green spaces are not always equitably accessible. Concerns about the environmental equity of urban green spaces have led to studies evaluating the location and distribution of urban parks. For example, Wolch et al. [11] revealed disparities in park acreage among different racial and income groups, creating an inequality map in Los Angeles, USA. In Germany, Kabisch and Haase [12] examined the uneven allocation of urban green spaces and its relationship with the socio-economic conditions of neighboring communities. Previous studies that have focused on environmental inequality consider urban green spaces as tools to address social problems and environmental risks, underlining the significance of both the qualitative and quantitative expansion and management of these spaces [13–16].

In many countries, studies of the economic value of urban green spaces have been conducted using different methods and approaches. Hong et al. [17] and Hong et al. [18] estimated the economic value of urban green spaces and Yeouido Park in Seoul, South Korea. They estimated the willingness of residents to pay for such green spaces based on the contingent valuation method and analyzed variables that affected this willingness. According to these studies, the value of Yeouido Park was estimated to be approximately 33 million dollars, and the citizens of Seoul were willing to pay approximately 20 dollars for an additional 3.3 m² of urban green space in Seoul [17,18]. Tyrväinen and Hannu [19] also revealed that the majority of residents in Finland were willing to pay for urban forest use and to prevent forest conversion. Hedonic price models (HPMs), which can estimate the value of green spaces based on real estate prices, have also been applied in many previous studies [7,9,20]. Real estate prices are determined by various attributes, including structural, environmental, and location characteristics. Studies have shown that green features are one of the most important considerations of residents when deciding to purchase a home [21,22].

Various attributes of urban green spaces, including their size, accessibility, proximity, and visibility, have been considered when estimating housing prices. Housing prices increase with the size of green spaces and their proximity to houses. According to a study conducted in Roanoke, Virginia, USA, as the size of a city park increases, the proximity to the park becomes closer, and the housing price increased with the proximity to and size of a park in which the park size had a greater impact on housing prices [7]. In Lodz, central Poland, a study found that for every 1% increase in distance from urban green spaces such as forests and parks, the corresponding apartment prices decreased by 3% [23]. In addition to size, accessibility, and proximity, the visual characteristics of urban green areas impact housing prices. Sander and Stephen [24] found that in Ramsey County, Minnesota, USA, highly urban views significantly reduced property values, while the proximity to parks, trails, and natural features positively influenced home prices.

Although several studies have reported the impact of various characteristics of urban green spaces on housing prices, relatively few studies have considered the value of green spaces within housing complexes. Green areas in apartment complexes are generally regarded as private spaces, which may have limited impact on housing prices compared to public green spaces, which are more accessible to a larger number of people. However, in cities such as Seoul, green spaces within apartment complexes are as important as public green spaces because they can provide opportunities for daily natural experiences and spaces for cultural ecosystem services, such as social bonding, aesthetic value, and relaxation [25]. Kim and Jang [26] analyzed both public green spaces and green spaces in residential complexes and found that the latter also have an effect on determining property values.

Various metrics, including the percentage of green spaces, average distance to the nearest park, number of different types of parks, and number of species, have been used to quantify the characteristics of urban green spaces in previous studies. Specifically, aerial photography, satellite imagery, and street views are typically used to measure the absolute amount of green spaces [27–30]. While measuring the absolute amount of green space is critical, considering the visual amount of green space is crucial as well, which can provide a better understanding of the overall quality of urban green spaces [31,32]. However, studies

on the visibility of green spaces are challenging due to difficulties in measuring the visual amount and limitations such as subjectivity and scope.

The aim of the present study was to estimate the effects of objectively measured and visually observed green spaces within apartment complexes on housing prices in the real estate market, taking into account property attributes and neighborhood characteristics. Additionally, this study investigated both the direct and indirect impacts of green spaces on housing prices based on their visibility. Specifically, the authors hypothesized that green spaces have a positive effect on housing prices, both directly and indirectly. In addition, the authors hypothesized that the magnitude of the positive effect of green spaces on housing prices may vary depending on the amounts of green spaces viewed by residents. Although there is ample evidence suggesting the positive effects of various types of green spaces within neighborhoods on property values, our understanding of the mechanisms underlying the relationships between the presence of green spaces, the visibility of green spaces and housing prices remains limited. The findings of the present study could provide valuable insights that could facilitate landscape planning and design in apartment complexes located in densely developed urban environments where land for green spaces is limited.

2. Materials and Methods

2.1. Study Area

The study was conducted in Seoul, South Korea, the largest city in the country, with an area of 605.2 km² and a population of approximately 9.7 million residents [33]. In South Korea, apartments account for more than 60% of the total housing types, with more than 50% of residents living in apartments [33]. In 2020, Seoul had 2450 apartment complexes out of 17,173 in South Korea, making up approximately 14% of the total [33]. Seoul is surrounded by mountains such as Mt. Bukhansan, Mt. Dobongsan, and Mt. Gwanaksan. The city is bisected by the Han River and has several large parks, including Olympic Park, Namsan Park, and Seoul Forest (Figure 1). According to the 2020 data acquired from the Seoul Open Data Plaza (<https://data.seoul.go.kr/>, accessed on 14 November 2023), the park area per resident in Seoul is 17.3 m², which is more than the minimum amount of urban green space per person (9 m²) suggested by the World Health Organization. However, the area of parks within walking distance is insufficient, measuring 5.4 m², as reported by the Seoul Open Data Plaza.

2.2. Selecting Variables and Data Collection

In previous studies, housing prices have been determined by several factors, such as attributes of houses, locational characteristics, and neighborhood environmental quality [34–40]. Specifically, housing prices are largely determined by housing properties, including balconies, housing size, the number of bedrooms, floors, parking lots, construction years, and maintenance fees [7,36,41–46], as well as locational characteristics, such as the distance to public transportation, schools, parks, markets, railroads, and highways [7,36,41–44,47]. In addition, housing prices are affected by neighborhood environmental characteristics assessed through various types of green spaces (e.g., views of mountains, rivers, green spaces, and parks) [7,10,26,36,41–46,48–52]. Based on previous studies, we initially collected 16 variables representing three categories: housing, neighborhood, and green space characteristics. The collected variables were refined through preliminary analysis (e.g., number of missing values, correlation analysis, and multicollinearity test). The preliminary analysis resulted in 16 variables, including housing characteristics (4 variables), neighborhood characteristics (8 variables), and green space characteristics (4 variables).

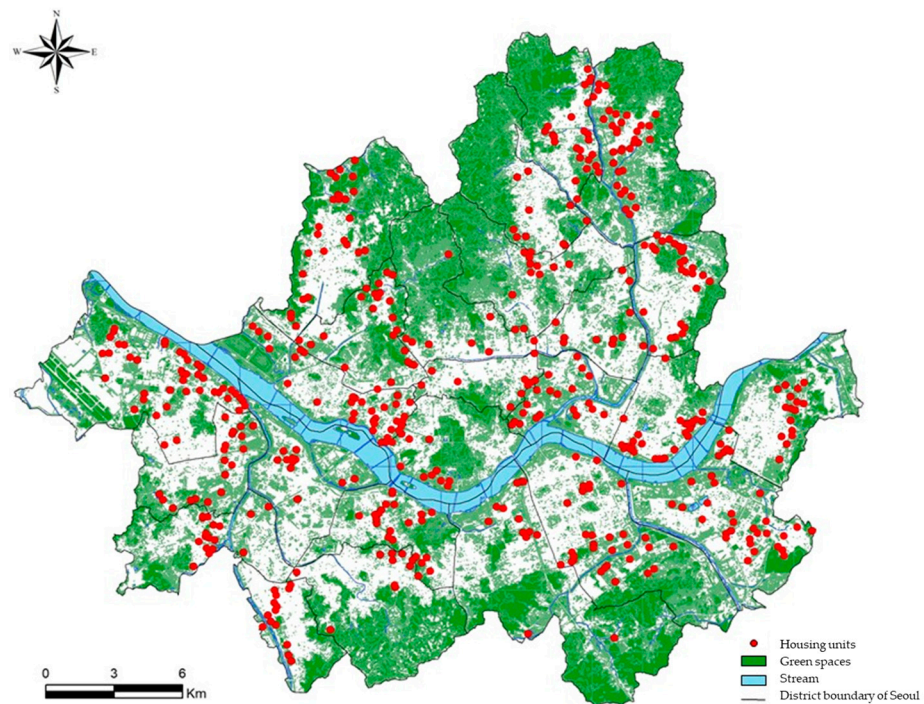


Figure 1. Map of Seoul and the location of housing units. Source: base map from the Environmental Geographic Information Service (<https://egis.me.go.kr/>, accessed on 14 November 2023).

The study targeted 826 apartment complexes in Seoul, and the actual transaction prices of the apartments were based on data from 2016, when there were relatively few social, economic, and political influences, such as housing bubbles and oversupply (Figure 2). Apartment prices and housing-related characteristics, including apartment area, the number of floors, and construction year were collected from the real estate transaction information system provided by the Ministry of Land, Infrastructure, and Transport (<http://rt.molit.go.kr/>, accessed on 14 November 2023).

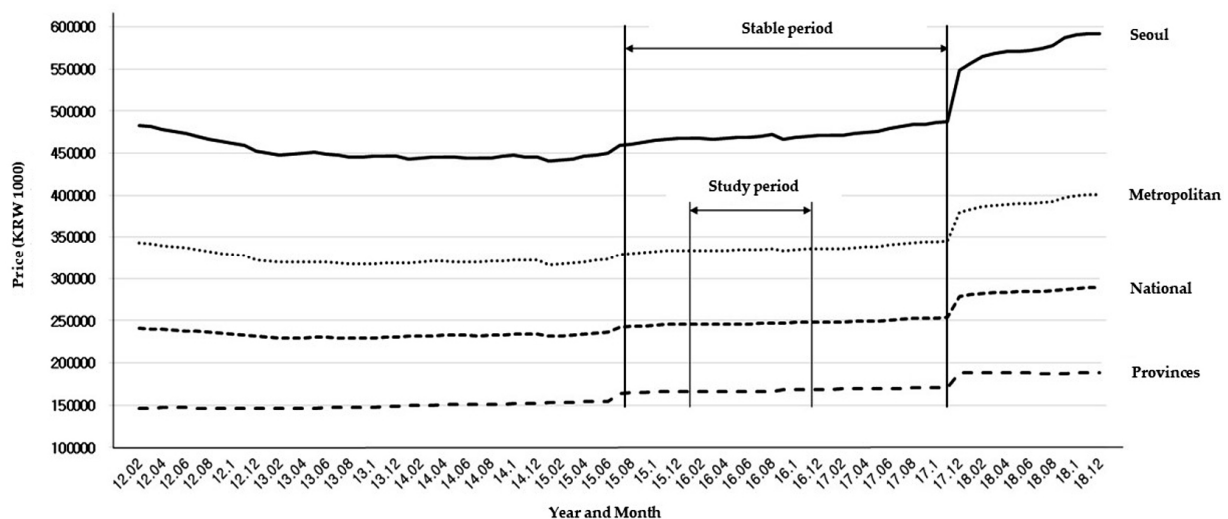


Figure 2. Average monthly fluctuations in housing prices for the entire country, metropolitan areas, provinces, and Seoul.

Data on neighborhood characteristics, such as the Euclidean distance to the nearest subway, park, and school, and the locations of industries, commercial areas, traditional markets, hospitals, and forests within a radius of 1 km, were obtained from the Seoul Open Data Plaza. Additionally, data on green space characteristics for apartment complexes,

including the proportion of visual greenery and maximum tree heights, were obtained based on field studies conducted from June to August 2018. The visual amount of green spaces in apartment complexes was analyzed based on actual field photos. All photos were captured at the main entrance of the respective apartment complex, which is most frequently used by residents. Photos were captured at eye level in a 1:1 square ratio using both iPhone and Android phone cameras (Figure 3). The proportion of green space in each photo was calculated using a 250 (50 × 50) grid. The number of green areas in the image relative to the total number of squares in the grid reflected the visual number of green spaces perceived by residents.



Figure 3. Example images and grids for analyzing the visual number of green spaces. (Left): An apartment with above-ground parking; (Right): An apartment with underground parking.

2.3. Data Analysis Tool

HPM is used to calculate the value of non-market goods based on multiple attributes. When purchasing a house, the buyer essentially acquires all the features associated with the house because the value of such goods is determined by a combination of their characteristics [53]. Apartments in particular exhibit various characteristics, encompassing not only physical attributes, such as the housing size and the number of floors and rooms, but also environmental elements, such as the proximity to amenities, green spaces, parks, rivers, and surrounding areas [54,55]. As the HPM can measure preferences towards attributes that are not directly traded in markets, such as urban green spaces, it has been frequently used to estimate the value of urban green spaces such as parks, street trees, and forests.

HPM employs a functional equation (Equation (1)) that relates the actual transaction price of an apartment (P_i) to housing characteristics (H_i), neighborhood characteristics (N_i), and green space characteristics (G_i). Using a regression formula, the real transaction price is represented as a fundamental function of these variables. House prices generally exhibit a log-normal distribution, and the semi-log format has been preferred in most studies [7,30,35,56–58] owing to the focus on changes rather than the absolute level of housing prices. Therefore, in this study, a semi-log function model that considers the logarithm of the dependent variable was used (Equation (2)).

$$P_i = \alpha + \beta H_i + \gamma N_i + \delta G_i + \varepsilon, \quad (1)$$

$$\log P_i = \alpha + \beta H_i + \gamma N_i + \delta G_i + \varepsilon. \quad (2)$$

In this study, the factors affecting housing prices were divided into three characteristics: housing, neighborhood, and green spaces, and 16 variables were considered based on previous studies to estimate the value of urban green spaces as reflected in housing prices [7,37,41,43,44,46]. Housing characteristics included four variables: housing size, the number of apartment complexes, construction year, and apartment floors, while neighborhood characteristics included eight variables: distance to park, public transportation, schools, industrial areas, commercial facilities, hospitals, traditional markets, and forests. Additionally, four variables were included to estimate the value of urban green spaces: visual area of green spaces, proportion of green spaces, and maximum height of trees (conifers and broad-leaf trees).

Two additional analyses were conducted and are presented in the discussion section to gain further insights. First, to examine the differences in housing prices between two groups categorized based on green space characteristics, we employed a two-sample t-test. This statistical test allowed us assessment of whether the group with higher green space proportions and visual greenery experienced significantly different housing price changes compared to the group with lower green space attributes. Additionally, we conducted a structural equation modeling (SEM) analysis to gain a deeper understanding of the complex relationships between various factors and housing prices. The SEM analysis involved the creation of a path diagram representing the hypothesized relationships between the variables. Three model fit evaluation indices were used: the root mean square error of approximation (RMSEA), which is considered reasonable when below 0.08; the goodness of fit index (GFI); and the adjusted goodness of fit index (AGFI), both indicating a good model fit when approaching a value of 1 [59,60]. IBM SPSS statistics 25 was used for statistical analysis, and ArcGIS 10.6 was used for spatial analysis.

3. Results

Table 1 reports descriptive statistics for the 16 explanatory variables in the model and the dependent variable, which was the housing price. The mean housing price in Seoul was 539,536,561 KRW (approximately 400,000 USD). Among the housing characteristics, the average housing size was 82.38 m², the average number of apartment complexes was 12, and the average apartment construction year was 1999. In terms of neighborhood characteristics, the average distance to the nearest subway, park, and elementary school was less than 1 km, specifically 594, 688, and 339 m, respectively. In addition, green space characteristics based on the field study revealed that the average proportions of green space and visual greenery in the apartments were 26 and 30%, respectively. The average maximum heights of coniferous and broad-leaf trees in apartment complexes were 12.7 and 11.0 m, respectively.

The F-statistic value was 138.408, which was statistically significant at the 99% confidence level. The Durbin–Watson statistic indicated the absence of autocorrelation. Table 2 presents the HPM results, including t-statistics and model coefficients. The estimation of the model reasonably represents the data profile, explaining 68% of the variation in housing prices. Most of the coefficients showed the expected values. All examined variables were statistically significant at the 95% confidence level, except for the distance to the nearest elementary school, the presence of a commercial area within 1 km, and the maximum height of conifers. All variance inflation factor values were smaller than two, confirming the absence of multicollinearity issues.

Unsurprisingly, all four housing characteristics showed positive signs. The higher the housing size, the floor on which the apartment is located, the number of apartment complexes, and the year of completion of the apartment, the higher the housing price. Particularly, housing size appeared to be the dominant factor affecting housing prices. When the housing size increased by 1 m, housing prices increased by approximately 1.1% (approximately USD 4600; 5,934,902 KRW).

Table 1. Descriptive statistics of the variables for different housing characteristics.

Variables	Description	Mean	SD
Housing price	Sale price of the house in KRW (Won)	539,536,561	304,399,900
Housing characteristics			
Housing size	The area of the property (m ²)	82.38	27.29
Floor	The floor on which the apartment is located	9.64	6.28
Apartment complex size	The number of buildings within the apartment complex	12.43	13.56
Construction year	The year of completion of apartment construction	1999.35	8.18
Neighborhood characteristics			
Distance to the subway	Distance to the nearest subway (m)	594.09	362.25
Distance to the park	Distance to the nearest park (m)	688.23	500.95
Distance to the school	Distance to the nearest elementary school (m)	339.74	170.20
Hospital	Number of hospitals within 1 km	0.42	0.73
Industrial area	Presence of each type within 1 km	0.23	0.42
Commercial area		0.85	0.36
Forest		0.60	0.49
Traditional market		0.74	0.43
Green space characteristics			
Visual greenery	Proportion of visual greenery (%)	30.72	13.46
Green space	Proportion of green space (%)	26.35	14.90
Conifers	Maximum height of conifers (m)	12.70	6.06
Broad-leaf trees	Maximum height of broadleaf trees (m)	11.03	4.16

n = 826, SD: standard deviation for each variable.

Table 2. Hedonic price estimation results.

Variables	Coefficient	Std. Coefficient	t-Value	VIF
(Constant)	5.13		2.101 *	
Housing size	0.011	0.624	30.771 **	1.073
Floor	0.003	0.043	2.132 *	1.058
Apartment complex size	0.003	0.075	3.468 **	1.232
Construction year	0.007	0.126	5.795 **	1.229
Distance to the subway	−0.0002	−0.132	−6.263 **	1.156
Distance to the park	−0.0001	−0.082	−3.964 **	1.121
Hospital	0.063	0.099	5.001 **	1.033
Industrial area	−0.154	−0.141	−6.864 **	1.103
Forest	−0.228	−0.242	−11.854 **	1.088
Traditional market	−0.071	−0.067	−3.337 **	1.057
Visual greenery	0.004	0.104	4.901 **	1.171
Green space	0.002	0.061	2.722 **	1.290
Broad-leaf trees	−0.006	−0.053	−2.508 *	1.172
F values	138.408 **			
Adjusted R Square	0.68			
Durbin–Watson	1.205			

** *p* < 0.01, * *p* < 0.05. VIF: Variance inflation factor.

Neighborhood characteristics also affected the housing price models. The closer the distance to the nearest subway station and park, the higher the housing prices, indicating the willingness of homebuyers to pay for the proximity to key public services. According to the model in this study, as the distance to a subway station decreased by 1 m, housing prices increased by 0.02% (approximately USD 91; 107,907 KRW), and as the distance to a park decreased by 1 m, housing prices increased by 0.01% (approximately USD 45; 53,953 KRW). The number of hospitals within 1 km positively affected housing prices, implying that a higher number of hospitals led to an increase in housing prices. Conversely, the presence of industrial areas, forests, and traditional markets within 1 km had a negative impact on housing prices. Therefore, housing prices decreased if there was an industrial area, forest, or traditional market within 1 km. Among neighborhood characteristics, the distance to the

nearest elementary school and the presence of a commercial area did not have a significant impact on housing prices.

The economic effects of green spaces in apartments varied depending on their characteristics. Apartments with a higher proportion of green space, which represented the absolute amount of greenery, tended to have higher values. Similarly, apartments with a higher proportion of visual green space, which indicated the relative amount of greenery, were associated with higher values. Contrastingly, the maximum heights of broad-leaf trees showed negative values, indicating that the higher the maximum heights of broadleaf trees, the lower the value of apartments. However, the maximum height of conifers did not have a significant impact on housing prices.

4. Discussion

4.1. Housing and Neighborhood Characteristics That Influence Apartment Prices

The effect of housing characteristics on housing prices determined in this study supported the findings of previous studies. Housing size was the factor with the greatest impact on apartment prices. A larger housing size offered more living space, additional rooms, and amenities, allowing greater comfort and convenience [61]. An increasing number of apartment complexes was associated with higher apartment prices, as it indicates a developed community with amenities and facilities, such as shops and services. Newly constructed apartments were priced higher because they offer modern amenities, advanced infrastructure, and attractive design elements [61]. In the same apartment building, housing prices tended to increase with the number of floors. This is likely due to the fact that people prefer apartments on higher floors due to various advantages, such as more sunlight, better air quality, increased privacy, noise reduction, and panoramic views. While some studies indicated that floor level does not significantly impact housing prices, in densely populated areas such as Seoul, floor height becomes an important factor because the above stated advantages are crucial criteria for purchasing an apartment [43,46,62].

Similar to numerous previous studies, our data also indicated that the closer and more abundant the presence of facilities, such as public transportation, parks, and hospitals, the higher the housing price [37]. Conversely, the presence of industrial areas was associated with lower housing prices because industrial areas generate significant noise, air pollution, odor, and hazardous substances, which reduce the aesthetic value of the areas. While traditional markets were expected to increase housing prices by contributing to the neighborhood's identity and character and by offering a range of amenities, we found that the presence of traditional markets decreased housing prices. This could be because many traditional markets in Seoul are located in relatively less developed old towns.

Contrary to our expectations, the distance to the nearest school had no significant effect on housing prices. In Seoul, the overall quality of school education is believed to have a greater influence on housing prices than the mere accessibility to schools, resulting in the absence of a discernible effect, as reported in a previous study [61]. Unexpectedly, the presence of commercial areas had no impact on housing prices. The commercial area considered in this study was a district in which several commercial facilities were located. As certain commercial facilities also occur in residential areas in which apartments are located, the presence of commercial areas does not appear to have an impact on housing prices. Notably, the presence of mountains within a 1 km radius also had a negative influence on housing prices. This finding differs from the results reported in previous studies. For instance, one study highlighted that the price of an apartment would increase by approximately 4% if one could observe Mt. Bukhansan, one of Seoul's main mountains [63]. However, if a mountain is within a distance of 1 km of an apartment, that apartment may be located on the slope around the mountain instead of having a good view of the mountain. In such cases, both pedestrian and vehicular accessibility may be limited, leading to a decrease in apartment prices [64].

4.2. Green Space Characteristics That Influence Apartment Prices

Among the green space characteristics within apartment complexes, both the proportion of green areas to the total area of the complex and the proportion of visual greenery from the main entrance of the complex appeared to increase apartment prices. Notably, the amount of visual greenery was a more significant variable than the absolute quantity of greenery. This finding was consistent with that of a previous study [28] conducted in Shanghai, China, which estimated the economic value of street trees visible at the eye level. The maximum heights of conifers and broad-leaf trees, another greenspace characteristic, were also included in the model. Higher maximum broad-leaf tree heights were associated with higher apartment prices. Typically, taller trees are related to older apartments, which might explain this result. The correlation analysis between the apartment's construction year and the height of broadleaf trees produced a coefficient of -0.18 , suggesting that as the construction year becomes more recent, the height of broadleaf trees tends to decrease. However, no significant effect was observed for conifer trees. In the case of recently constructed apartments, more expensive and higher adult pine trees, which are favored by residents, are often planted to enhance privacy between buildings or create a luxurious apartment image. Thus, depending on the year in which construction was completed, significant differences among conifers may not exist.

In recent years, Korean apartments have been equipped with underground parking lots to eliminate vehicle traffic within complexes. Consequently, open spaces in apartments are primarily used for landscape purposes. Compared to older apartment buildings, newer buildings feature wider landscaping and green spaces. However, although newer apartments have overall more green spaces, they may have less visually perceived greenery. Therefore, considering the number of visually perceived green spaces is important when designing such spaces in the future.

According to a report published by the Korea Housing and Urban Guarantee Corporation (HUG), housing prices in Seoul from May 2017 to April 2022 increased by approximately 70.7%, rising from KRW 535.87 million to KRW 914.75 million [65]. While various factors can contribute to an increase in housing prices, we conducted the current study to test the hypothesis that higher green space ratios and visual greenery within apartment complexes are associated with greater increases in housing prices. To this end, we collected the most recent housing price data for 2022 and calculated the price increase rate compared to 2016. Out of the 826 data entries initially used, those without apartment transaction records for 2022 were excluded, resulting in a total of 704 data entries for analysis. The data were categorized into two groups: one group had a higher green space proportion and visual greenery than the average, and the other group had a lower green space proportion and visual greenery than the average. The findings indicate that the group with a higher proportion of green spaces and visual greenery experienced a housing price increase that was approximately 20% higher than the average (Table 3). Therefore, high proportions of green space and visual greenery within apartment complexes not only correspond to higher apartment prices, but also contribute to an increase in apartment prices.

Table 3. Comparison of housing price increase between groups of high and low proportions of visual greenery and green spaces.

Variable	Group	Descriptive Statistics			Paired <i>t</i> -Test Statistics	
		Obs.	Mean	Std. Dev.	<i>t</i> -Value	<i>p</i> -Value
Visual Greenery	High	364	575,918,873	323,955,688	−3.869	0.001
	Low	340	693,145,676	462,694,559		
Green Space Proportion	High	321	571,656,729	356,772,675	−3.780	0.001
	Low	383	683,556,631	428,587,246		

4.3. Mechanisms Underlying the Characteristics That Influence Apartment Prices

Additional structural equation modeling (SEM) analysis was conducted to explain how housing prices are influenced by multidimensional factors. SEM is a powerful statistical technique that can assess and model complex relationships between variables, often represented using path diagrams that visually depict these relationships with connecting arrows. The model exhibited a root mean square error of approximation (RMSEA) of 0.07, along with goodness-of-fit index (GFI) and adjusted goodness-of-fit index (AGFI) values of 0.84 and 0.91, respectively, demonstrating good model fit. Figure 4 presents the path diagram, with all path coefficients being statistically significant. The magnitude and direction of these coefficients align with the HPM. Specifically, variables related to housing characteristics, such as housing size, floor, apartment complex size, and construction year, emerged as the most influential latent variables affecting housing prices. In contrast, latent variables related to neighborhood characteristics such as distance to the subway and distance to a park indicated that housing prices decreased as these distances increased. Notably, within the path model, the proportion of green spaces within apartment complexes directly impacted housing prices and also exerted an indirect influence through visual greenery. These findings support the idea that managing not only the quantity but also the visual quality of green spaces within apartment complexes is essential.

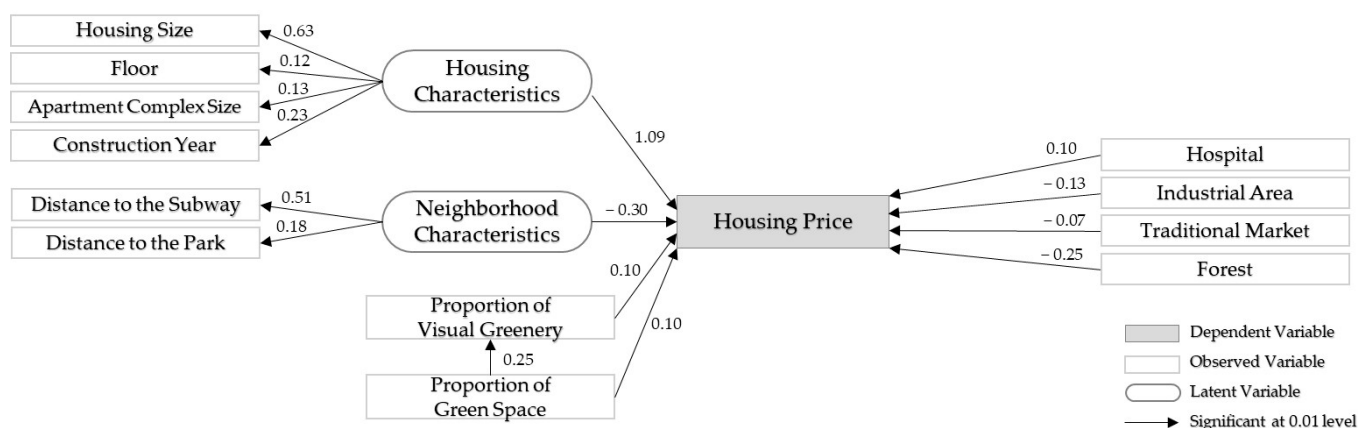


Figure 4. Path diagram of the structural equation model (SEM) showing direct and indirect effects that explained housing prices.

5. Conclusions

The number of apartments in Seoul is increasing annually, and the landscape area is expanding. The study found that green space proportions and visual greenery led to above-average housing price increases. Additionally, it was evident that the green space proportions within apartment complexes directly affected housing prices and exerted an indirect influence through visual greenery. Our results highlight the following two key points: first, parks and green spaces near apartments are crucial. Second, although increases in the overall green area within an apartment complex are important, equal attention should be paid to securing visual greenery. In conclusion, developers, urban planners, and landscape designers should consider the presence and quality of green spaces within apartment complexes to enhance property values and improve the overall quality of life of residents.

However, this study has some limitations. Only visual greenery, maximum tree height, and the proportion of green spaces were used as green space characteristics within apartment complexes, and more diverse green space characteristics should be included in future studies. In particular, although the measurement of visual greenery in this study was limited to the main entrance of an apartment complex due to limitations such as the survey period, resources, and costs, measuring the overall visual greenery of an apartment complex is necessary. Indeed, it is essential to account for the variations in greenery view depending

on factors such as the floor level and the specific location of the apartment building. Such an approach can provide a more comprehensive understanding of the relationship between green spaces and apartment prices. Nevertheless, the positive effect observed in this study for the ‘floor’ variable on housing prices does underscore the importance of considering the greenery view from the apartment. Furthermore, as visual aspects are intricately linked with the structural characteristics of green spaces, it is vital to account for the features of the elements constituting green spaces, including tree type, shape, placement, and design [66,67].

Overall, generalizing the results of this study may be challenging because we targeted Seoul and used single-year housing price data. Future research can expand on our results by incorporating multi-year real estate data for other cities in Korea and conducting comparisons across different cities or periods. Furthermore, there is potential for spatial expansion to apply these findings to other countries and different cities.

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References

1. Livesley, S.J.; McPherson, E.G.; Calfapietra, C. The urban forest and ecosystem services: Impacts on urban water, heat, and pollution cycles at the tree, street, and city scale. *J. Environ. Qual.* **2016**, *45*, 119–124. [\[CrossRef\]](#)
2. Wood, E.; Harsant, A.; Dallimer, M.; Cronin de Chavez, A.; McEachan, R.R.C.; Hassall, C. Not all green space is created equal: Biodiversity predicts psychological restorative benefits from urban green space. *Front. Psychol.* **2018**, *9*, 2320. [\[CrossRef\]](#)
3. Nowak, D.J.; Crane, D.E.; Stevens, J.C. Air pollution removal by urban trees and shrubs in the United States. *Urban For. Urban Green.* **2006**, *4*, 115–123. [\[CrossRef\]](#)
4. Norton, B.A.; Coutts, A.M.; Livesley, S.J.; Harris, R.J.; Hunter, A.M.; Williams, N.S.G. Planning for cooler cities: A framework to prioritise green infrastructure to mitigate high temperatures in urban landscapes. *Landsc. Urban Plan.* **2015**, *134*, 127–138. [\[CrossRef\]](#)
5. Zhou, X.; Rana, M.P. Social benefits of urban green space: A conceptual framework of valuation and accessibility measurements. *Manag. Environ. Qual.* **2012**, *23*, 173–189. [\[CrossRef\]](#)
6. Dadvand, P.; Bartoll, X.; Basagaña, X.; Dalmau-Bueno, A.; Martinez, D.; Ambros, A.; Cirach, M.; Triguero-Mas, M.; Gascon, M.; Borrell, C. Green spaces and general health: Roles of mental health status, social support, and physical activity. *Environ. Int.* **2016**, *91*, 161–167. [\[CrossRef\]](#)
7. Poudyal, N.C.; Hodges, D.G.; Merrett, C.D. A hedonic analysis of the demand for and benefits of urban recreation parks. *Land Use Policy* **2009**, *26*, 975–983. [\[CrossRef\]](#)
8. James, P.; Tzoulas, K.; Adams, M.D.; Barber, A.; Box, J.; Breuste, J.; Elmqvist, T.; Frith, M.; Gordon, C.; Greening, K.L. Towards an integrated understanding of green space in the European built environment. *Urban For. Urban Green.* **2009**, *8*, 65–75. [\[CrossRef\]](#)
9. Eom, Y.S.; Choi, A.S.; Kim, S.G.; Kim, J.O. A hedonic valuation of urban green space in Seoul, Korea. *Environ. Resour. Econ. Rev.* **2019**, *28*, 61–93.
10. Park, I.S.; Eom, Y.S.; Eom, S.W. Apartment in green area index calculation and analysis of the impact of housing prices: The case of the Jeonju. *J. Korean Reg. Econ.* **2016**, *34*, 113–129.
11. Wolch, J.; Wilson, J.P.; Fehrenbach, J. Parks and park funding in Los Angeles: An equity-mapping analysis. *Urban Geogr.* **2005**, *26*, 4–35. [\[CrossRef\]](#)
12. Kabisch, N.; Haase, D. Green justice or just green? Provision of urban green spaces in Berlin, Germany. *Landsc. Urban Plan.* **2014**, *122*, 129–139. [\[CrossRef\]](#)
13. Jalkanen, J.; Fabritius, H.; Vierikko, K.; Moilanen, A.; Toivonen, T. Analyzing fair access to urban green areas using multimodal accessibility measures and spatial prioritization. *Appl. Geogr.* **2020**, *124*, 102320. [\[CrossRef\]](#)
14. Nghiem, L.T.P.; Zhang, Y.; Oh, R.R.Y.; Chang, C.; Tan, C.L.Y.; Shannahan, D.F.; Lin, B.B.; Gaston, K.J.; Fuller, R.A.; Carrasco, L.R. Equity in green and blue spaces availability in Singapore. *Landsc. Urban Plan.* **2021**, *210*, 104083. [\[CrossRef\]](#)

15. Astell-Burt, T.; Feng, X.; Mavoa, S.; Badland, H.M.; Giles-Corti, B. Do low-income neighbourhoods have the least green space a cross-sectional study of Australia's most populous cities. *BMC Public Health* **2014**, *14*, 292. [CrossRef] [PubMed]
16. Jones, A.; Hillsdon, M.; Coombes, E. Greenspace Access, Use, and Physical Activity: Understanding the effects of area deprivation. *Prev. Med.* **2009**, *49*, 500–505. [CrossRef] [PubMed]
17. Hong, S.K. Economic valuation of Yeido Park: Application of double-bounded dichotomous choice contingent valuation method. *J. Korean Inst. Landsc. Archit.* **1998**, *26*, 90–103.
18. Hong, S.K.; Kim, J.H.; Jo, H.K. Economic valuation of an urban green space using double-bounded dichotomous choice CVM. *J. Korean Inst. Landsc. Archit.* **2005**, *32*, 1–13.
19. Tyrväinen, L.; Väänänen, H. The economic value of urban forest amenities: An application of the contingent valuation method. *Landsc. Urban Plan.* **1998**, *43*, 105–118. [CrossRef]
20. Zhang, Y.; Dong, R. Impacts of street-visible greenery on housing prices: Evidence from a hedonic price model and a massive street view image dataset in Beijing. *ISPRS Int. J. Geoinf.* **2018**, *7*, 104. [CrossRef]
21. He, C.; Yu, S.; Han, Q.; de Vries, B. How to attract customers to buy green housing? their heterogeneous willingness to pay for different attributes. *J. Clean. Prod.* **2019**, *230*, 709–719. [CrossRef]
22. Daams, M.N.; Sijtsma, F.J.; Veneri, P. Mixed monetary and non-monetary valuation of attractive urban green space: A case study using Amsterdam house prices. *Ecol. Econ.* **2019**, *166*, 106430. [CrossRef]
23. Czembrowski, P.; Kronenberg, J. Hedonic pricing and different urban green space types and sizes: Insights into the discussion on valuing ecosystem services. *Landsc. Urban Plan.* **2016**, *146*, 11–19. [CrossRef]
24. Sander, H.; Polasky, S.; Haight, R.G. The value of urban tree cover: A hedonic property price model in Ramsey and Dakota Counties, Minnesota, USA. *Ecol. Econ.* **2010**, *69*, 1646–1656. [CrossRef]
25. Tae, J.; Jeong, D.; Chon, J. How can apartment-complex landscaping space improve residents' psychological well-being? The case of the capital region in South Korea. *Int. J. Environ. Res. Public Health* **2022**, *19*, 10231. [CrossRef]
26. Kim, T.B.; Jang, H.S. The effect of green areas and urban parks on housing prices in complexes-apartment housing in Uijeongbu City. *J. Resid. Environ. Instit. Korea* **2021**, *19*, 57–74. [CrossRef]
27. Chen, W.Y.; Wang, D.T. Urban forest development in China: Natural endowment or socioeconomic product? *Cities* **2013**, *35*, 62–68. [CrossRef]
28. Ye, Y.; Richards, D.; Lu, Y.; Song, X.; Zhuang, Y.; Zeng, W.; Zhong, T. Measuring daily accessed street greenery: A human-scale approach for informing better urban planning practices. *Landsc. Urban Plan.* **2019**, *191*, 103434. [CrossRef]
29. Ye, Y.; Xie, H.; Fang, J.; Jiang, H.; Wang, D. Daily accessed street greenery and housing price: Measuring economic performance of human-scale streetscapes via new urban data. *Sustainability* **2019**, *11*, 1741. [CrossRef]
30. Xu, L.; You, H.; Li, D.; Yu, K. Urban green spaces, their spatial pattern, and ecosystem service value: The case of Beijing. *Habitat Int.* **2016**, *56*, 84–95. [CrossRef]
31. Yang, J.; Zhao, L.; McBride, J.; Gong, P. Can you see green? Assessing the visibility of urban forests in cities. *Landsc. Urban Plan.* **2009**, *91*, 97–104. [CrossRef]
32. Jiang, B.; Deal, B.; Pan, H.; Larsen, L.; Hsieh, C.H.; Chang, C.Y.; Sullivan, W.C. Remotely-sensed imagery vs. eye-level photography: Evaluating associations among measurements of tree cover density. *Landsc. Urban Plan.* **2017**, *157*, 270–281. [CrossRef]
33. Korean Statistical Information Service. Population, Households and Housing Units. Available online: <https://kosis.kr/eng/> (accessed on 30 September 2023).
34. Li, H.; Wei, Y.D.; Wu, Y.; Tian, G. Analyzing housing prices in shanghai with open data: Amenity, accessibility and urban structure. *Cities* **2019**, *91*, 165–179. [CrossRef]
35. Kolbe, J.; Wüstemann, H. *Estimating the Value of Urban Green Space: A Hedonic Pricing Analysis of the Housing Market in Cologne, Germany*; SFB 649 Discussion Papers; Humboldt University of Berlin, Collaborative Research Center 649-Economic Risk: Berlin, Germany, 2014.
36. Schläpfer, F.; Waltert, F.; Segura, L.; Kienast, F. Valuation of landscape amenities: A hedonic pricing analysis of housing rents in urban, suburban and periurban Switzerland. *Landsc. Urban Plan.* **2015**, *141*, 24–40. [CrossRef]
37. Kong, F.; Yin, H.; Nakagoshi, N. Using GIS and landscape metrics in the hedonic price modeling of the amenity value of urban green space: A case study in Jinan City, China. *Landsc. Urban Plan.* **2007**, *79*, 240–252. [CrossRef]
38. Yuan, F.; Wei, Y.D.; Wu, J. Amenity effects of urban facilities on housing prices in China: Accessibility, scarcity, and urban spaces. *Cities* **2020**, *96*, 102433. [CrossRef]
39. Van Oijstaeijen, W.; Van Passel, S.; Cools, J. Urban green infrastructure: A review on valuation toolkits from an urban planning perspective. *J. Environ. Manag.* **2020**, *267*, 110603. [CrossRef] [PubMed]
40. Chen, Y.; Yue, W.; La Rosa, D. Which communities have better accessibility to green space? An investigation into environmental inequality using big data. *Landsc. Urban Plan.* **2020**, *204*, 103919. [CrossRef]
41. Wu, C.; Ye, X.; Du, Q.; Luo, P. Spatial effects of accessibility to parks on housing prices in Shenzhen, China. *Habitat Int.* **2017**, *63*, 45–54. [CrossRef]
42. Ko, H.J.; Yun, K.B.; Shim, Y.J.; Hwang, H.Y. Impact analysis of an eco-park on the adjacent apartment unit price by using the hedonic model-with a focus on the Cheongju Wonheung-Ee Park and adjacent apartments. *J. Korean Hous. Assoc.* **2011**, *22*, 47–57. [CrossRef]

43. Morancho, A.B. A Hedonic valuation of urban green areas. *Landsc. Urban Plan.* **2003**, *66*, 35–41. [\[CrossRef\]](#)
44. Panduro, T.E.; Veie, K.L. Classification and valuation of urban green spaces—A hedonic house price valuation. *Landsc. Urban Plan.* **2013**, *120*, 119–128. [\[CrossRef\]](#)
45. Oh, D.H.; Lee, C.B. An analysis on the effect of view and story on the price of Hanriver Riverside Apartments. *J. Korea Plan. Assoc.* **2003**, *38*, 247–257.
46. Jim, C.Y.; Chen, W.Y. External effects of neighbourhood parks and landscape elements on high-rise residential value. *Land Use Policy* **2010**, *27*, 662–670. [\[CrossRef\]](#)
47. Seo, W.; Nam, H.K. Trade-off relationship between public transportation accessibility and household economy: Analysis of subway access values by housing size. *Cities* **2019**, *87*, 247–258. [\[CrossRef\]](#)
48. Li, X.; Zhang, C.; Li, W.; Kuzovkina, Y.A.; Weiner, D. Who lives in greener neighborhoods? the distribution of street greenery and its association with residents' socioeconomic conditions in Hartford, Connecticut, USA. *Urban For. Urban Green.* **2015**, *14*, 751–759. [\[CrossRef\]](#)
49. Georgiou, M.; Tiegies, Z.; Morison, G.; Smith, N.; Chastin, S. A Population-based retrospective study of the modifying effect of urban blue space on the impact of socioeconomic deprivation on mental health, 2009–2018. *Sci. Rep.* **2022**, *12*, 13040. [\[CrossRef\]](#)
50. Tuofu, H.; Qingyun, H.; Dongxiao, Y.; Xiao, O. Evaluating the impact of urban blue space accessibility on housing price: A spatial quantile regression approach applied in Changsha, China. *Front. Environ. Sci.* **2021**, *9*, 164. [\[CrossRef\]](#)
51. Peng, C.; Xiang, Y.; Chen, L.; Zhang, Y.; Zhou, Z. The impact of the type and abundance of urban blue space on house prices: A case study of eight megacities in China. *Land* **2023**, *12*, 865. [\[CrossRef\]](#)
52. Chen, Y.; Jones, C.A.; Dunse, N.A.; Li, E.; Liu, Y. Housing prices and the characteristics of nearby green space: Does landscape pattern index matter? evidence from metropolitan area. *Land* **2023**, *12*, 496. [\[CrossRef\]](#)
53. Rosen, S. Hedonic prices and implicit markets: Product differentiation in pure competition. *J. Polit. Econ.* **1974**, *82*, 34–55. [\[CrossRef\]](#)
54. Law, S. Defining street-based local area and measuring its effect on house price using a hedonic price approach: The case study of metropolitan London. *Cities* **2017**, *60*, 166–179. [\[CrossRef\]](#)
55. Park, J.H.; Lee, D.K.; Park, C.; Kim, H.G.; Jung, T.Y.; Kim, S. Park accessibility impacts housing prices in Seoul. *Sustainability* **2017**, *9*, 185. [\[CrossRef\]](#)
56. Triplett, J.E. *The Economic Interpretation of Hedonic Methods*; US Department of Commerce: Washington, DC, USA, 1986.
57. Malpezzi, S. Hedonic pricing models: A selective and applied review. *Hous. Econ. Public Policy* **2003**, *1*, 67–89.
58. McCord, J.; McCord, M.; McCluskey, W.; Davis, P.T.; McIlhatton, D.; Haran, M. Effect of public green space on residential property values in Belfast metropolitan area. *J. Financ. Manag. Prop. Constr.* **2014**, *19*, 117–137. [\[CrossRef\]](#)
59. Browne, M.W.; Cudeck, R. Alternative Ways of Assessing Model Fit. *Sociol. Methods Res.* **1992**, *21*, 230–258.
60. Baumgartner, H.; Homburg, C. Applications of structural equation modeling in marketing and consumer research: A review. *Int. J. Res. Mark.* **1996**, *13*, 139–161. [\[CrossRef\]](#)
61. Xiao, Y.; Li, Z.; Webster, C. Estimating the mediating effect of privately-supplied green space on the relationship between urban public green space and property value: Evidence from Shanghai, China. *Land Use Policy* **2016**, *54*, 439–447. [\[CrossRef\]](#)
62. Jiao, L.; Liu, Y. Geographic field model based hedonic valuation of urban open spaces in Wuhan, China. *Landsc. Urban Plan.* **2010**, *98*, 47–55. [\[CrossRef\]](#)
63. Jung, H.K.; Yun, S.D.; Kim, T.K.; Kim, S.G. Estimating values of urban green space in Seoul: Application of hierarchical linear regression model on hedonic housing price analysis. *J. Environ. Policy Adm.* **2020**, *28*, 213–242.
64. Lee, H. A study on the effect of slope on housing prices: Focusing on apartment complexes in Seoul area. *J. Korea Plan. Assoc.* **2018**, *53*, 153. [\[CrossRef\]](#)
65. Son, J.; Kim, K. *Real Estate Finance in Korea: Achievements and Challenges*; Housing and Urban Guarantee Corporation (HUG): Busan, Republic of Korea, 2023.
66. Nordh, H.; Hartig, T.; Hagerhall, C.M.; Fry, G. Components of small urban parks that predict the possibility for restoration. *Urban For. Urban Green.* **2009**, *8*, 225–235. [\[CrossRef\]](#)
67. Schmid, H.-L.; Säumel, I. Outlook and insights: Perception of residential greenery in multistorey housing estates in Berlin, Germany. *Urban For. Urban Green.* **2021**, *63*, 127231. [\[CrossRef\]](#)

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