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The Value of an Apartment with Sunlight and a View: A Quasi-Experimental Analysis*

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The Vert-Vill apartments consist of two 32-story buildings of similar structure: Vert-Vill 101 and 102. The tenants enjoyed a beautiful view and sunlight without interruption. However, the construction of The Lucky Golden Suite three meters from Vert-Vill 101 removed Vert-Vill 101's sunlight and view entirely without impacting Vert-Vill 102. We performed a difference-in-difference analysis using this experimental circumstance and found that access to sunlight and a view account for 18.0% of apartment prices. Our findings suggest that conventional hedonic analysis, which contains the risk of omitted variable bias, may generate biased estimates

JEL Classification: R3, K1, K2
Keywords: House Price, Sunlight, View, Amenity, Difference-in-differences, Hedonic Pricing

I. Introduction

People value a variety of residential amenities that offer environmental, aesthetic, and health benefits (D'Acci, 2014; Maller et al., 2006; Nutsford et al., 2013). Of such benefits, access to sunlight and a scenic view is considered essential, as it enhances a

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property's atmosphere and positively affects occupants mentally and physically (Aries et al., 2015). Therefore, it is reasonable for a property with sunlight and a view to be valued higher on the market (Ambrey and Fleming, 2011; Fleming et al., 2018).

Establishing the extent to which sunlight and a view contribute to housing prices is not simply a question of academic curiosity; it can also contribute to urban planning by calculating the marginal benefits and costs of building heights. It also provides useful information for resolving growing legal disputes on the rights to sunlight and views. Because many factors determine housing market values, it is difficult to accurately discern the contribution of a particular factor, such as sunlight and a view, to the value of a residence. Scholars have overcome this problem using the hedonic pricing method (Freeman, 1979; Rosen, 1974; Sheppard, 1999; Waltert and Schläpfer, 2010). However, data limitations and omitted variable problems make it difficult to obtain an agreeable estimate.

We complement previous studies with a novel approach. We measure the market value of sunlight and views for an apartment using the difference-in-differences (DID) estimation by exploiting a natural experimental circumstance in South Korea. We investigate the case of the Beach Vert-Vill apartment complex (Vert-Vill, hereafter) in Busan, South Korea's second-largest city. Vert-Vill was established in 2005, comprising two 32-story buildings: Vert-Vill 101 and Vert-Vill 102. Its location near Haeundae Beach provided tenants with a beautiful view and sunlight for all apartments without interruption. However, the construction of The Lucky Golden Suite, a 23-story apartment building, was announced in 2015. Its location is only 3 meters from Vert-Vill 101, completely blocking its sunlight and view. This unexpected event caused variations in sunlight exposure and view access between households in Vert-Vill 101 and 102, which otherwise share similar characteristics. Analyzing this quasi-experimental situation can accurately measure the value of sunlight and apartment views, complementing the previous literature.

Our DID estimates show that the market value of Vert-Vill 101 decreased by approximately KRW 42 million following the construction of the Lucky Golden Suite in 2015.[1] This means that access to sunlight and a scenic view accounted for 18.0% of the overall property price. The decrease in price is more noticeable for lower floors, where exposure to sunlight and views has been more severely affected. Overall, our results suggest that although useful, generic hedonic analysis can generate a non-trivially biased estimate.

The remainder of this paper is organized as follows. Section 2 reviews the previous literature. Section 3 describes the case of Vert-Vill. Section 4 explains the data, introduces the empirical strategy, and provides estimation results. Section 5 discusses the implications of the results, and the conclusions are presented in Section 6.

[1] One USD was approximately 1,105 KRW during the analysis period.

II. Literature Review

Various scholars have investigated the value of housing attributes associated with higher property values. These include scenic views (see Ambrey and Fleming, 2011; Benson et al., 1998; Bourassa et al., 2004; Filippova, 2009; Lake et al., 2000; McLeod, 1984; Sander and Polasky, 2009, Waltert and Schläpfer, 2010), open spaces (see Acharya and Bennett, 2001; Anderson and West, 2006; Bolitzer and Netusil, 2000; Brander and Koetse, 2011; Geoghegan, 2002; Irwin, 2002; Lutzenhiser and Netusil, 2001; Smith et al., 2002), urban greenery (see Franco and Macdonald, 2018; Liebelt et al., 2018; Morancho, 2003; Saphores and Li, 2012; Tyrväinen and Miettinen, 2000), city trees (see Anderson and Cordell, 1988; Donovan and Butry, 2010; Pandit et al., 2013; Sander et al., 2010), environmental pollution ranging from noise to air quality (see Bayer et al., 2009; Brandt and Maennig, 2011; Jensen et al., 2014; Kim et al., 2003), and housing type's influence on accessibility to amenities (see Chau et al., 2007; Hui et al., 2012; Wong et al., 2011). Researchers have widely used the hedonic pricing model for this research agenda (Rosen, 1974; Freeman, 1979). The hedonic pricing model breaks down the various traits of complex goods (such as a house) into variables and measures the contributory value of each factor. Specifically, a generic specification adopted from the related literature is as follows:

$$P_{it} = \beta V_{it} + \theta Z_{it} + \mu_t + \varepsilon_{it} \tag{1}$$

where P_{it} is the price of house i at time t and V_{it} is the number of amenities of house i at time t on which a researcher focuses. The coefficient β reflects the marginal value of V_{it} and Z_{it} represents the other attributes of house i at time t. μ_t is the period fixed effect and ε_{it} is an error term.

Many studies have estimated the value of sunlight and a view based on this hedonic pricing model, providing evidence that access to sunlight and a scenic view is associated with a higher property value (see Table 1). However, because their estimates differ significantly by case or data set, it is hard to find a widely accepted figure or the bounds on the value of these factors. A reason for this is the difficulty in establishing a proper proxy. Compared to observable and quantifiable traits (such as property size and distance to transportation), sunlight and a scenic view are not easy to quantify. This difficulty has resulted in many studies simply dismissing these factors in their estimation. Endogeneity from missing variables is also an issue, although few studies have treated it formally.

We can consider various strategies to resolve these limitations and obtain a better measure. In this paper, we investigated a unique case in Korea by which the concerns mentioned above were ameliorated. In the following sections, we present the study context, explain our approach, and report the results of our analysis.

[Table 1] Summary of Previous Studies on the Value of Sunlight and a View

Study	Location	Data	Key findings
Fleming et al. (2018)	Wellington, New Zealand	Over 5,000 house sales from 2008–2014	An additional hour of sunlight exposure per day is associated with a 2.6% increase in a dwelling's market value.
Turan et al. (2020)	Manhattan, New York, USA	5,154 office spaces in 905 buildings	The tenant pays 5%–6% more for a daylight premium.
Benson et al. (1998)	Bellingham, Washington, USA	7,305 property sales from 1984–1994 and 687 sales in 1993	Increases in property values range from 8.2 to 58.9%, depending on the quality of the scenic view.
Sander and Polasky (2009)	Ramsey County, Minnesota, USA	4,918 single-family residential properties in 2005	The implicit marginal price of increasing the percentage of a home's view is around 10%.
Baranzini and Schaerer (2011)	Geneva, Switzerland	12,932 observations in 2005	The value of a water view is up to 57%.
Jim and Chen (2009)	Hong Kong	1,474 residences in 18 private housing estates from 2005–2006	A harbor view increases the value of an apartment by 2.97%.
Conroy and Milosch (2011)	San Diego, USA	9,755 home sales in 2005	There is a premium of about 101.9% if a dwelling is within 500 feet of the coast.
Jeong and Park (2016)	Busan, Korea	2,504 court auction data items from 2006–2014	The ocean view premium is about 22.6%, and the river view premium is about 8.2%.
Bae et al. (2018)	Seoul, Korea	155,410 apartment transactions from 2012–2016	The premium of a Han River view is about 1.8%–5.7%.
Jeong et al. (2019).	Seoul and Busan, Korea	4,962 court auction cases from 2006–2014	A water view in Seoul or an ocean view in Busan positively affects housing prices. A mountain view has negative effects in a coastal city like Busan but positive effects in an inland city like Seoul.
Kim and Ji (2019)	Seoul, Korea	342 transactions from 2013–2017	Sales prices increase by 2% annually when an apartment has a mountain view.

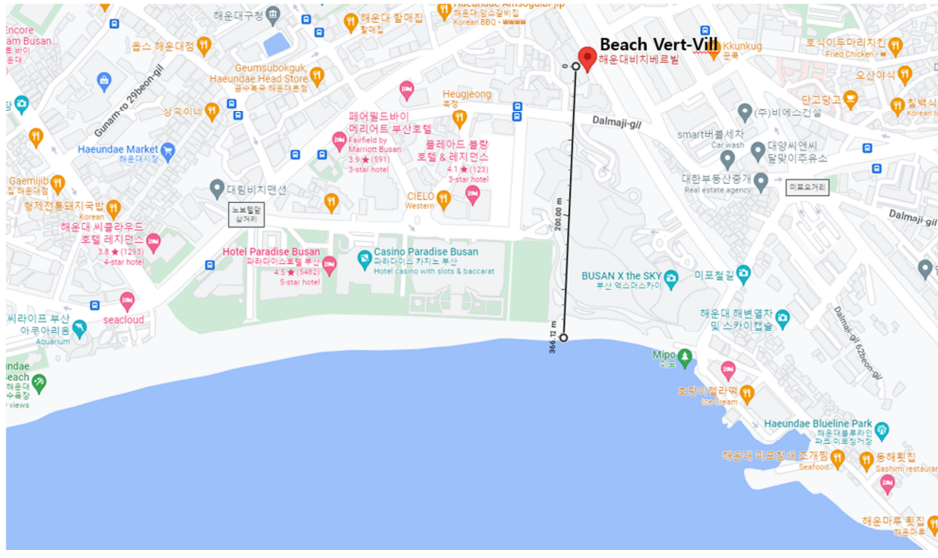
III. The Case of the Beach Vert-Vill Apartment Complex

Vert-Vill was constructed in Haeundae, Busan, in 2005 (see Figure 1). Busan is a port city located on the southeastern seashore of the Korean Peninsula and is the second largest city with a population of 3.4 million. Vert-Vill consists of two 32-

story buildings: 101 and 102 (see Table 2). Vert-Vill 101 has 108 apartments, each 85m^2 in size, and Vert-Vill 102 has 56 apartments that are 102m^2 and 56 apartments that are 123m^2. Apartments of the same size share an identical floor plan. Apartments of 85m^2 and 102m^2 comprise one living room, three bedrooms, and two bathrooms, and those of 123m^2 have one living room, four bedrooms, and two bathrooms. Those that are 85m^2 and 102m^2 have a similar floor plan, although the former has smaller rooms than the latter. Overall, Vert-Vill's units are almost identical, and there are few house-specific discrepancies other than size and floor, which is important information to consider when determining the housing market value. In 2022, the average price of apartments sized 80m^2 to 130m^2 in Busan was 424 million KRW (Ministry of Land, Infrastructure and Transport), and Vert-Vill's transaction prices were around 500 million KRW per apartment (Figure 3). The higher price of a Vert-Vill apartment than an average Busan apartment can mostly be explained by the location and attributes described below.

A noticeable feature of Vert-Vill was that the tenants could enjoy unhampered sunlight and a scenic view of Haeundae Beach through their southwest-facing expansive living room window (see Figure 1). Vert-Vill is only 400 meters from the seashore, and there were no other high-rise buildings in the direction of Haeundae Beach when the apartment block was constructed. The construction company emphasized this as a main attraction in the advertisement.

[Figure 1] Location and Neighborhood of the Beach Vert-Vill Apartment Complex, Haeundae, Busan, South Korea

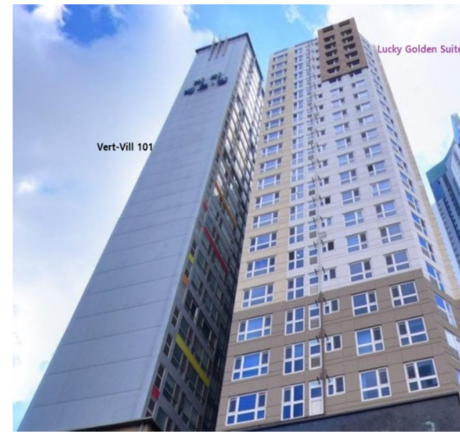


Source: Google Maps.

[Figure 2] Depiction of the Beach Vert-Vill Apartment Complex and the Lucky Golden Suite

Panel A. Map

Panel B. Photo Image



Source: Google Maps.

[Table 2] The Structure of the Beach Vert-Vill Apartment Complex

	Vert-Vill 101	Vert-Vill 102	
Floors	32	32	
Apartment size (m^2)	85	102	123
Number of apartments	108	56	56
Specifications	one living room three bedrooms two bathrooms	one living room three bedrooms two bathrooms	one living room four bedrooms two bathrooms
Floor plan			

Source: Naver Real Estate (https://land.naver.com/).

In 2015, residents of the Vert-Vill received a significant negative shock. During the housing boom that occurred around 2015, the Lucky Development Company, Inc. applied for a building permit to develop the Lucky Golden Suite, a 23-storey apartment building located only 3 meters distant in the southwest direction of the Vert-Vill 101 building. In Figure 2, Panel A presents a map to illustrate the location of the Vert-Vill and the Lucky Golden Suite, and Panel B presents photo images of the buildings. The Lucky Golden Suite completely blocked sunlight and view of the Vert-Vill 101, but it did not affect the Vert-Vill 102 at all.

The residents of Vert-Vill 101 raised a lawsuit to prevent the construction of the Lucky Golden Suite. Based on Article 61 of the Building Act, the plaintiffs claimed that constructing the Lucky Golden Suite would infringe on their right to access sunlight. However, the referred clause applies only to buildings in residential zones. As Vert-Vill and the Lucky Golden Suite are in a commercial zone according to the Building Act, this argument did not stand. The plaintiffs also argued that the Lucky Golden Suite was located too close to Vert-Vill. According to Article 242 of the Civil Act, no less than 0.5 meters must be retained between buildings except in special circumstances. However, the defendant did not break the law because the Lucky Golden Suite was located approximately three meters from Vert-Vill. Consequently, the Lucky Golden Suite did not violate any laws or infringe on the right to sunlight and views of residents of Vert-Vill 101. The court made a final decision in 2017, allowing the construction of the Lucky Golden Suite, which was completed in 2019.

This case provides an interesting situation. The accommodation type and neighboring environments of Vert-Vill 101 and 102 apartments are almost the same. However, the construction of the Luck Golden Suite next to Vert-Vill 101 resulted in a disparity in access to sunlight and views between Vert-Vill 101 and 102. Using the DID method, this quasi-experimental situation enables rigorous measurement of the value of sunlight and views to residential apartments in Vert-Vill 101.

IV. Difference-In-Differences Estimation

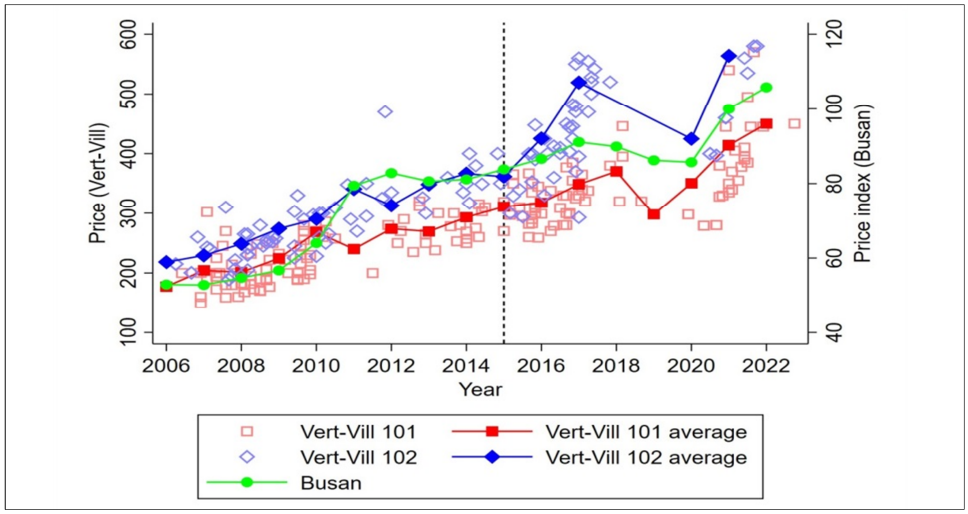
To conduct the DID estimation, we modified Equation (1) as follows:

$$P_{it} = \{\beta_1 V_i + \beta_2 S_t + \beta_3 V_i \cdot S_t\} + \theta Z_{it} + \mu_t + \varepsilon_{it} \quad (2)$$

Equation (2) is the same as Equation (1) except for the bracketed part. P_{it} is the price of house i at time t. V_i is a dummy variable for the treatment and control groups and is equal to 1 if apartment i is in Vert-Vill 101 and 0 otherwise. S_t is a dummy variable for the period and is equal to 1 if the year of sale is after the construction plan of the Lucky Golden Suite and 0 otherwise. The coefficient of interaction term β_3 captures the value of the sunlight and view of house i.

We collected data from the Actual Real Estate Transaction Data provided by the Ministry of Land, Infrastructure and Transport. The data contain transaction information on each apartment's price, size, floor, and transaction date. Figure 3 shows the prices of every Vert-Vill apartment transaction from 2006 to 2022, our analysis period, and Table 3 presents the summary statistics. A total of 239 transactions occurred during the period under consideration. The price of Vert-Vill 102 apartments was approximately KRW 55 million higher than that of Vert-Vill 101 before 2015 because of the larger apartments. The prices of the Vert-Vill 101 and 102 apartments demonstrated mild parallel growth until 2015. However, a divergence occurred after that time. Due to the housing boom, the prices of apartments in the Busan area began to grow significantly around 2015, and the

[Figure 3] Transactions and Price Trends of the Vert-Vill Apartments



Source: Ministry of Land, Infrastructure and Transport.
Note: The unit of price is one million KRW.

[Table 3] Summary Statistics: Transactions and Values of the Vert-Vill Apartments

Period	Total			Treatment group Vert-Vill 101			Control group Vert-Vill 102		
	Obs.	Mean	S.D.	Obs.	Mean	S.D.	Obs.	Mean	S.D.
2006∼2022	239	316.6	96.4	136	286.7	80.1	103	356.1	102.2
2006∼2014	128	255.7	57.8	72	231.6	44.0	56	286.6	59.1
2015∼2022	111	386.9	83.3	64	348.8	64.7	47	438.9	78.0

Source: Ministry of Land, Infrastructure and Transport.
Note: The unit of price is one million KRW.

prices of Vert-Vill 102 apartments followed this trend.[2] However, the prices for Vert-Vill 101 stagnated relative to Vert-Vill 102, particularly for the three years right after the construction of the Lucky Golden Suite. As a result, the gap between Vert-Vill 101 and Vert-Vill 102 prices increased to KRW 100 million after 2015.

The regression analysis presented in Table 4 confirms these results.[3] Tables 4 (A) and (B) use nominal price and CPI-adjusted price as dependent variables, which are essentially the same. For convenience, we will discuss our results based on the former.

When the control variables are not included, the coefficient of the interaction term shows that the value of Vert-Vill 101 decreased by KRW 49.9 million after the construction of the Lucky Golden Suite (column 1). This becomes KRW 41.8 million when the covariates are controlled (column 2). Considering the average apartment price of Vert-Vill 101 was KRW 231.6 million before 2015, this implies that the value of sunlight and views accounts for 18.0% (=41.8/231.6) of the housing price.

We checked the robustness of the main results in several ways. First, we investigated the negative impact of the blockage according to the floor. The Lucky Golden Suite is a 23-story building, whereas Vert-Vill is a 32-story building. Thus, damage from the construction of the Lucky Golden Suite might be concentrated on Vert-Vill 101's apartments below the 24th floor, while apartments above the 24th floor may not lose as much sunlight and view access. We ran regressions for above and below the 24th floor separately and found that the price reduction occurred

[2] Housing prices rose by 10% from 2015 to 2018 in the Haeundae region (National Housing Price Trend Survey).

[3] This study's purpose as well as real estate transaction characteristics lead us to adopt apartments' absolute market value rather than the logarithm value as the primary dependent variable. First, the study aims to analyze the extent to which sunlight and views contribute to the housing market value, rather than examining the growth rate of apartment prices. Second, in situations where there is a low transaction volume for a particular apartment type, such as for the Vert-Vill apartments, outliers may significantly influence the market price; thus, it is crucial to account for these outliers. Third, the value of sunlight and views is often traded as a lump-sum payment, which may not be directly proportional to the total value of the apartment.

[Table 4] Difference-In-Differences Estimation

Dependent variable = nominal price

Variable	(1) W/o controls	(2) With controls	(3) Below 24	(4) 24 and above	(5) Narrow window	(6) Announcement
Treat (V_i)	-49.566**	13.704	6.052	23.796	6.161	-0.742
	(5.994)	(10.516)	(12.968)	(19.603)	(17.948)	(10.313)
Period (S_t)	323.244**	283.186**	285.543**	245.572**	129.964**	281.271**
	(14.735)	(11.752)	(16.022)	(25.242)	(21.131)	(20.162)
$V_i \times S_t$	-49.854**	-41.768**	-40.686**	-30.090*	-24.532*	-34.635+
	(12.241)	(9.110)	(11.632)	(14.503)	(12.289)	(17.674)
Size		2.410**	2.094**	3.268**	2.627**	2.376**
		(0.352)	(0.422)	(0.741)	(0.671)	(0.361)
Floor		4.876**	5.538	56.733	3.485	4.772**
		(1.419)	(3.585)	(36.324)	(2.463)	(1.482)
Floor^2		-0.054	-0.086	-0.988	-0.018	-0.048
		(0.038)	(0.128)	(0.650)	(0.069)	(0.039)
Constant	226.176**	-91.279*	-59.114	-898.380+	-7.881	-79.403+
	(10.159)	(42.451)	(53.519)	(531.616)	(74.936)	(43.508)
Year dummy	Y	Y	Y	Y	Y	Y
Mean Dep.	316.631	316.631	298.082	354.917	354.789	316.631
R^2	0.804	0.881	0.866	0.921	0.834	0.875
N	239	239	161	78	102	239

Dependent variable = CPI-adjusted price

Variable	(1) W/o controls	(2) With controls	(3) Below 24	(4) 24 and above	(5) Narrow window	(6) Announcement
Treat (V_i)	-42.742**	15.530	8.941	25.763	7.669	-0.192
	(5.163)	(10.129)	(12.453)	(18.920)	(17.196)	(9.906)
Period (S_t)	407.096**	370.206**	372.371**	309.180**	149.672**	370.951**
	(13.177)	(11.139)	(15.338)	(23.396)	(20.993)	(20.235)
$V_i \times S_t$	-54.694**	-47.304**	-46.885**	-35.302*	-25.311*	-42.276*
	(11.708)	(8.973)	(11.454)	(13.934)	(11.821)	(17.922)
Control variables	Y	Y	Y	Y	Y	Y
Year dummy	Y	Y	Y	Y	Y	Y
Mean Dep.	293.867	293.867	275.201	332.396	338.132	293.867
R^2	0.860	0.912	0.900	0.947	0.847	0.906
N	239	239	161	78	102	239

Note: Robust standard errors in parentheses, + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.
Source: Ministry of Land, Infrastructure and Transport.

only for the lower-floor apartments. Specifically, the price of Vert-Vill 101 apartments in the lower 24 floors declined by KRW 40.7 million (column 3), while

the prices of those on the 24th floor and above still show a statistically significant decrease but with a smaller magnitude (column 4). This difference within the building demonstrates that the value of sunlight and views is transformed into property value, and these effects are more prominent when the right to sunlight and a view is infringed upon.

Second, to minimize the impact of government policies and macroeconomic trends, we shortened the analysis period (initially 2006–2022) to between 2012 and 2018 and ran the same regression (column 5). Here, the value of the apartments is reduced by approximately KRW 24.5 million but is still statistically significant.

We also checked whether the construction information of the Lucky Golden Suite in 2015 is responsible for the results. To do so, we alternatively coded the treatment period to 1 after 2019, when the construction of the Lucky Golden Suite was completed (column 6) and zero otherwise. In this case, the statistical significance decreased, and the coefficient size also diminished, reaffirming our findings that the 2015 announcement of the construction of the Lucky Golden Suite was responsible for the results.

V. Discussion

People have increasingly resided in cities since the industrial revolution. The share of urban dwellers is expected to be as much as two-thirds of the global population by 2050 (United Nations, 2018). Agglomeration is a key driving force of economic growth. However, as population density in urban areas increases, newer and more complex problems emerge. Conflicts regarding new buildings blocking sunlight and views is one of these problems.

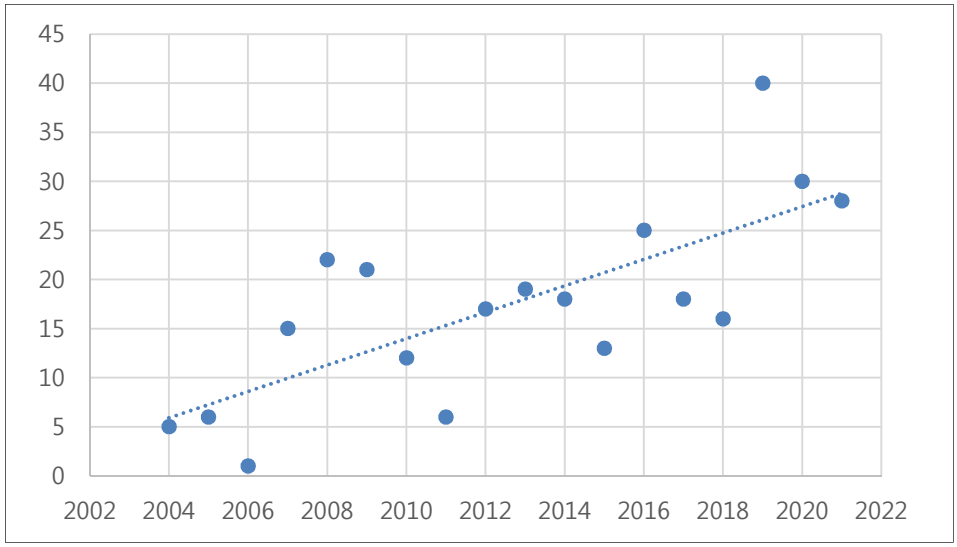
Measures to address this problem differ widely by country. In Korea, the government has taken a Coasean approach. In 1984, they included a clause in the *Building Act* that the owner of a house in a residential area has a right to access sunlight for at least four hours, even during the winter solstice when daylight is the shortest. This means that if a landowner builds in a residential area, the height should be limited accordingly, or they should negotiate with the neighbors and compensate for any damages before construction.

This property rights approach has generally been successful. However, disputes on this topic continue to grow (Figure 4). This might be because the disputing parties have different evaluations of what constitutes sunlight and a view, which might hinder smooth bargaining. From this point of view, a more precise measure of sunlight and views can help prevent related conflict or accommodate resolutions; accordingly, our estimate can contribute to this.

Better estimates of what constitutes sunlight and views can be helpful not only for

dispute resolution but also for urban planning. People care about their quality of life when deciding where to live. Thus, policymakers and urban planners should consider various factors when implementing regulations or institutions. However, it is important to ensure a balanced trade-off. More regulations can enhance the life quality of city dwellers, but this can go against economic growth (Hsieh & Moretti, 2019). Our efforts to obtain more precise information can help ameliorate this trade-off or create a harmonized solution.

[**Figure 4**] The Number of Disputes Submitted to the Central Environmental Dispute Mediation Committee, 2004–2021 (case)



Source: Central Environmental Dispute Mediation Committee (https://ecc.me.go.kr/front/board/boardContentsView.do).

VI. Conclusion

This study examined the market value of sunlight and views for apartments by exploiting a quasi-experimental situation in which only part of the same apartment complex had been infringed upon in terms of the right to sunlight and views. Using DID estimation, we found that the market value of Vert-Vill 101, which had lost access to sunlight and views due to the construction of the Lucky Golden Suite, decreased in value by KRW 42 million, amounting to 18.0% of the housing price. Various robustness checks ascertained the result.

The provided evidence has added novel information on the contribution of sunlight and views to housing values. Moreover, this study identifies this more rigorously by minimizing the confounding effects of differences in buildings and

environments. From these perspectives, the DID estimation shown in this study has external validity and can be referred to in other contexts where there is reason to believe that circumstances would yield a different valuation of sunshine and views.

Of course, this study has several limitations. First, although we enhanced the accuracy of the estimates, our experiment is building- and region-specific. Second, we could not separate the values of sunlight and views. Overcoming these factors with better data and methods will be the goal of the subsequent study.

Finally, this paper can provide practical guidelines for the government with respect to urban planning and judicial decision-making. Our results can be used as a reference for making more effective zoning and land-use regulation policies by considering the negative externalities caused by new development. If the values of these amenities are better recognized and incorporated into land use planning, any negative impact associated with urbanization can be minimized. This study is also of great help in terms of applicability to legal matters because it can provide a standard for calculating the compensation value where similar legal disputes arise due to externalities.

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일조조망권의 가치 추정: 준실험적 사례의 활용

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초 록 2005년 건축된 비치베르빌 아파트는 32층 건물 두 동으로 구성되어 있는데, 입주자들은 해운대를 볼 수 있는 멋진 전망을 누릴 수 있었다. 그런데 2015년에 불과 3미터 앞에 들어선 럭키골든스위트로 인해 101동은 햇볕과 조망을 모두 잃은 반면 102동은 전혀 영향을 받지 않았다. 이런 실험적 상황을 활용해서 DID 분석을 실시한 결과, 우리는 일조와 조망이 아파트 가격의 18%를 설명한다는 사실을 파악하였다. 이 결과는 일조 및 조망의 가치를 추정하는데 통상적으로 활용되는 헤도닉 분석이 누락변수 문제로 인해 적지 않은 편의를 발생시킬 수 있음을 보여준다.

핵심 주제어: 아파트 가격, 일조권, 조망권, 어메니티, 이중차분법, 헤도닉 가격
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