pISSN: 1226-7147, eISSN: 2383-9171
https://doi.org/10.17208/jkpa.2022.02.57.1.103

Journal of Korea Planning Association Vol.57, No.1 (2022)
대한국토 · 도시계획학회지 「국토계획」 제57권 제1호 pp.103-114

Check for updates

Spatio-Temporal Impacts of Block-Unit Housing Rearrangement Project on Neighboring Housing Prices
: A Triple Difference Approach

Yoo, Jaehyun** · Seo, Wonseok***

Abstract

This study empirically analyzed the spatio-temporal effect of the block-unit housing rearrangement project on neighboring housing prices in Seoul, where the need for housing supply is highest, based on the triple difference method. In particular, this study examined the microscopic effects of the project by estimating whether the price impact appear differently according to regions, particularly between Gangnam and non-Gangnam areas. The main results are as follows: First, it was found that the housing and complex characteristics had a similar effect on housing prices as in previous studies. Second, the block-unit housing rearrangement project in Seoul had a significant effect on nearby apartment prices. This implied that the project has a significant ripple effect on the local housing market in that it improved the physical environment of the area. Third, it was confirmed that the block-unit housing rearrangement project in the Gangnam area significantly increased the nearby apartment prices, when compared to the non-Gangnam area. This study confirmed that the small-scale housing improvement project such as the block-unit housing rearrangement project in Seoul has a significant effect on neighboring housing prices, and this effect can be differentiated and complex depending on the regional features.

Keywords Block-Unit Housing Rearrangement Project, Small-Scale Housing Improvement Project, Housing Price, Apartment, Triple Differences

주제어 가로주택정비사업, 소규모주택정비사업, 주택가격, 아파트, 삼중차분법

Ⅰ. Introduction

Industrialization and urbanization, which progressed rapidly after the Korean war, caused the large supply of housing around Seoul for a short period of time. Over time, however, aged houses have significantly increased in number, thus causing various urban and housing problems, such as deteriorating residential environments, disfiguring the aesthetic aspect of urban spaces, leading to increased vulnerability to disasters and the risk of fire, and making housing circulation more and more difficult (Lim and Lee, 2019; Cheong et al., 2019).

* This research was prepared by modifying and supplementing a paper that was granted the Best Paper Award at the 2021 Korea Planning Association Autumn Conference.
** Master's Student, Department of Urban Planning and Real Estate, Chung-Ang University (First Author: rhffpadl@naver.com)
*** Professor, Department of Urban Planning and Real Estate, Chung-Ang University (Corresponding Author: wseo@cau.ac.kr)
※ This paper is a translation of a paper written in Korean into English, and a Korean version is released on the website (www.kpa1959.or.kr).

To overcome these issues, the government has pushed forward a range of major development projects to facilitate housing supply, such as New Town development projects, redevelopment projects, and reconstruction projects. Large-scale urban development projects may have positive effects, for example, by promoting urban functions and improving the quality of life for residents, but at the same time, negative consequences may occur, e.g., difficulty in implementing projects in areas where new and aged houses coexist, the imbalance between supply and demand resulting from excessive and overcrowded development efforts, and rapid increase in housing prices (Ko and Hur, 2015; Kim and Seo, 2017).

Given that development projects are essential to improving the quality of life for residents in areas filled with aged and unqualified houses, small-scale housing improvement projects allowed under the Act on Special Cases Concerning Unoccupied House or Small-scale Housing Improvement, which was enacted in February 2017, have been garnering significant attention as an alternative to existing development projects. Small-scale housing improvement projects refer to projects that are conducted in accordance with the act in areas or block units that fulfill the requirements prescribed by the Presidential Decree for such a reason as the presence of densely packed aged or unqualified buildings (Article 2 of the Act on Special Cases Concerning Unoccupied House or Small-scale Housing Improvement). Among various small-scale housing improvement project types, block-unit housing rearrangement projects aim to improve the residential environment on a small scale while, at the same time, maintaining the existing block units. Given that these projects are conducted on a small scale, project durations are relatively short, and overall project costs may be reduced, thereby providing flexibility to the operation of the process. In addition, in this type of project, project operators are residents, e.g., landowners, and thus it is advantageous for the existing residents to re-move in later (Kwon et al., 2017). Further, block-unit housing rearrangement projects are performed on a small scale, unlike large-scale development and improvement projects, and therefore a rapid increase in the price of neighboring houses is not followed. In this respect, this type of project is suitable not only to expand housing supply where needed, e.g., in Seoul, but also to improve the residential environment at the same time.

However, these projects still remain controversial in that they are similar in nature to urban improvement projects, such as reconstruction or urban regeneration, and thus may be accompanied by an increase in housing prices in neighboring areas (Lee et al., 2017; Park and Kim, 2020).

Recently, competition in the housing market has been peaking in Seoul due to a lack of housing supply, and at the heart of this issue is a variation in housing prices in the Gangnam area. In order to solve this problem, housing supply needs to be made around the Gangnam, but no suitable policy measures have been proposed in that large-scale development such as reconstruction can lead to a sharp rise in local housing prices and at the same time cause confusion in the Seoul housing market (Kim and Seo, 2021). In this regard, the government and politicians have recently proposed the promotion of small-scale housing improvement projects as a way to expand the housing supply.

Thus, it is timely and appropriate to segment Seoul's housing market into detailed subgroups and further analyzes the effect of block-unit housing rearrangement projects, among the major residential environment improvement programs of small-scale housing improvement projects, on the neighboring areas. Previous studies, however, have focused mainly on the effect of large-scale redevelopment or reconstruction projects on the neighboring areas, and thus they were not able to effectively review the issue of house price increases, especially resulting from block-unit housing rearrangement projects, in an objective manner. Another reason that these previous studies have failed to examine such effects is that it has not been so long since block-unit housing rearrangement projects were first conducted.

In this study, Seoul was selected as the target area because the city has the highest demand for houses and has thus far completed the largest number of block-unit housing rearrangement projects. The temporal and spatial effect of these projects on the price of neighboring houses was empirically analyzed accordingly. Notably, the price ripple effect of the block-unit housing rearrangement projects was examined in detail by checking whether the impact of housing supply was differentiated according to regions by dividing it into the Gangnam where is the core area of price variation and the non-Gangnam area. More specifically, this study empirically analyzed the effect of block-unit housing rearrangement projects using a triple difference (TD) method before and after the project implementation, especially with regard to the scope of influence (500 m) and also by region (the Gangnam and non-Gangnam areas). Based on the results, the implications of block-unit housing rearrangement projects as part of Seoul's policy measures for housing supply were examined in detail.

Ⅱ. Literature Review

Previous studies relevant to this study can be largely divided into ones focusing on policies for block-unit housing rearrangement projects and others concerning the effect of reconstruction and redevelopment projects on housing prices. Those on block-unit housing rearrangement project policies have mainly focused on project promotion, underlying systems, feasibility, etc. First of all, Kwon et al. (2016) highlighted the importance of policy considerations to ease the burden of residents in successfully pushing forward small-scale housing improvement projects by studying the role of the public sector in an attempt to promote such projects in areas with poor residential environments. Chang and Cho (2019) also conducted a study on policy support to promote small-scale housing improvement projects and concluded that small-scale housing improvement projects, and especially those supported by the public sector, were essential to improving the residential environment of areas with densely packed aged houses where urban restoration projects cannot be applied.

Kwon et al. (2017) examined ways to supply public rental housing through block-unit housing rearrangement projects. They analyzed the business feasibility by management and disposal method, i.e., by categorizing the target housing into semi-public rental houses, semi-public rental houses based on land lease, and Happy Housing. The results indicated that the land lease-based model showed the highest feasibility and thus may be an effective alternative to existing approaches for expanding the supply of rental housing in urban spaces.

Kim and Park (2018) attempted to identify why block-unit housing rearrangement projects had not been effectively put in place in the field even though they were introduced as an alternative to address various problems of existing urban housing projects in which houses are completely torn down. By doing so, the researchers came up with methods for promoting such projects. More specifically, they highlighted the need to minimize the required contribution of each union member, ease the legal restrictions to improve feasibility for private-sector contractors, and require active promotion by the public sector; it was then concluded that all these would contribute to facilitating the restoration of aged residential areas.

Jin and Yu (2019) emphasized the necessity of professional management to address the risk of unsold houses, as well as the need for loan support to ensure the stable implementation of block-unit housing rearrangement projects, if one intended to effectively address risks that might occur during these projects while at the same time promoting them. The researchers also stressed that detailed work guidelines must be established to prevent possible legal disputes so that such projects could be promoted at the local level. Kim (2020) pointed to the necessity to focus more on technical aspects when dealing with the promotion of block-unit housing rearrangement projects. Given that these projects are typically conducted on a small scale and thus involve limitations in terms of costs and time, they emphasized the need to thoroughly examine their characteristics, e.g., business requirements and feasibility, by using the latest technology, including AI.

Finally, Hong (2021) reviewed legal issues concerning the public utility of block-unit housing rearrangement projects, especially in terms of how these projects had been implemented as public projects. They concluded that clear standards for issues such as the public utility of project implementation methods and the necessity for acceptance must be established in advance to ensure that these projects could be executed in an appropriate manner.

Meanwhile, previous studies on the effect of reconstruction and redevelopment projects on housing prices were mainly focused on urban regeneration, reconstruction or redevelopment projects that were similar in nature to block-unit housing rearrangement projects. The effect of these projects can be divided into two categories: positive and negative effects. Among the recent studies focusing on their positive effect, a study by Lee et al. (2017) examined the effect of urban regeneration projects on apartment prices in the neighboring regions, including the cities of Jeonju and Changwon. The results confirmed that, in both regions, the effect of urban restoration projects on the price of neighboring apartments became significantly larger after about one year had passed since the commencement of the projects. Kim and Ro (2019) also empirically analyzed the effect of urban restoration projects in Seoul on the price of neighboring houses by region and concluded that this effect varied depending on the urban restoration project type. More specifically, negative (-) effects were shown in the downtown area, while positive (+) effects appeared in the southeast and northeast areas. The results confirmed that these projects were effective in densely populated residential areas where the implementation of such projects clearly led to a significant improvement in residential environments.

Kim et al. (2020) studied the effect of reconstruction procedures on reconstructed apartments in Seoul and found that the house price was positively (+) affected by procedures such as the establishment of project promotion committees, project implementation approval, and approval of management and disposal plans. The results showed that in the transaction of reconstructed apartments in Seoul, the implementation of these projects led to an increase in their price on the surface; however, the effect of each procedure on the price varied.

Park and Kim (2020) conducted an empirical analysis on the effect of urban regeneration projects on apartment prices in the corresponding area and its neighboring areas via a difference-in-difference approach. The results showed that urban regeneration projects posed a significant positive (+) effect on apartment price increases in the neighboring areas. This confirmed the need to consider the risk of a possible housing market overheating when pushing forward such urban regeneration projects.

The following studies are those reporting the negative effect of reconstruction and redevelopment projects on housing prices. Gu et al. (2009) used a panel model to determine the effect of new town development projects on housing prices. It was then found that areas in the proximity of areas subject to new town development projects were negatively affected to a significant extent. Based on the results, they concluded that the general perception that new town projects increase asset value in the neighboring area should be changed. Jeong and Yoon (2016) studied the Changsin-dong and Sungin-dong areas as a new town district and analyzed the effect of new town projects on housing prices in the neighboring areas. They found that being designated as a new town district itself did not significantly affect housing prices in the corresponding and neighboring regions.

Finally, Koh and Kang (2019) examined the regional characteristics of reconstructed apartments in Seoul, which affect their price and price increase. It was concluded that the housing price increase rates in the four Gangnam districts were not significantly affected compared to other areas in Seoul because the districts were already home to many high-priced apartments.

Ⅲ. Research Framework

1. Research Area and Housing Price Trends

Seoul was selected as a research target because the city had the highest demand for housing and had already completed the largest number of block-unit housing rearrangement projects. As the capital city of Korea, Seoul is the most densely populated residential area in the country, and thus its housing market is increasingly overheating over time (Seo and Kim, 2020). At the heart of this overheated market is the Gangnam area. In this regard, this study examined the effect of block-unit housing rearrangement projects and determined how such effects varied in the Gangnam area and non-Gangnam area in a microscopic manner. Given that institutional systems relevant to these block-unit housing rearrangement projects were established in 2017, there were not many housing (apartments) that were built through these projects. Thus, in this study, two districts in the Gangnam area (Seocho-gu and Gangdong-gu) and two districts in the non-Gangnam area (Gangseo-gu and Guro-gu) were selected and examined (see Figure 1).

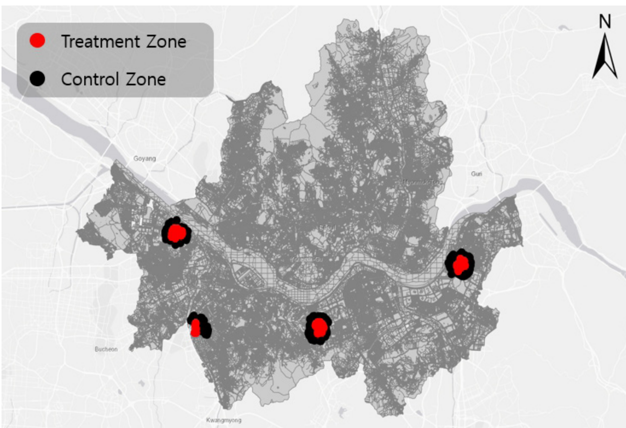

Figure 1. Research area

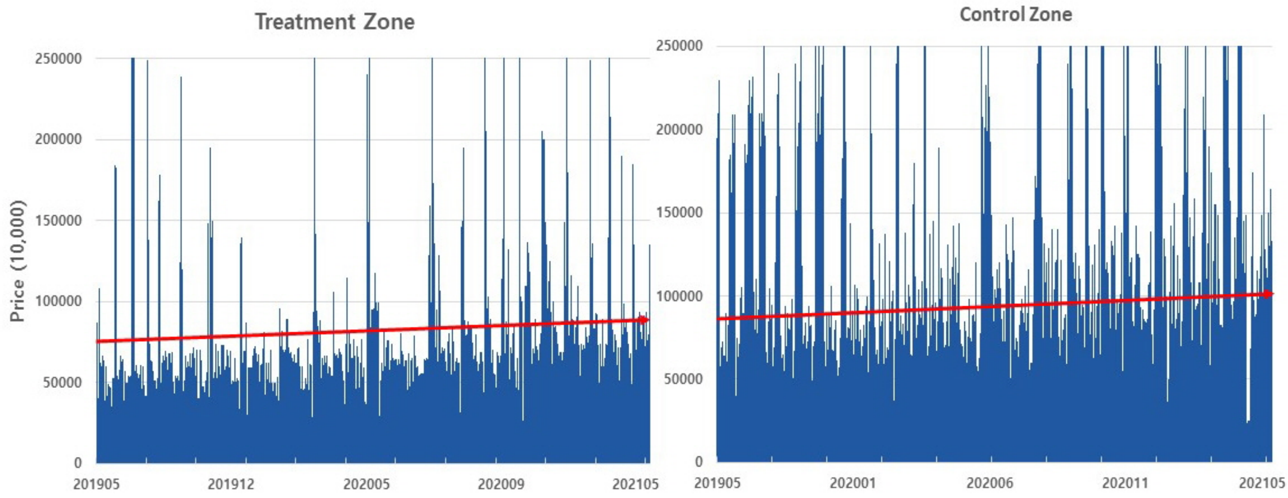

Figure 2. Trends of housing price in the research area

The scope of influence of block-unit housing rearrangement projects (treatment zone) was set to a radius of 500 m of the site based on the residential neighborhood concept proposed by Perry (1929). Here, a control zone, which is not affected by these projects, was set to up to 1,000 m away from the site to minimize the effect of areas other than the research area. The temporal scope was set as the period of May 2019 to July 2021, when the selected cases of block-unit housing rearrangement projects were all completed.

Before conducting empirical analysis, the housing prices included in this research should be compared to determine whether factors other than the implementation of block-unit housing rearrangement projects may affect housing prices in the region. If, as a result, housing price trends in the treatment and control zones turn out to vary, there is a possibility that the effect of block-unit housing rearrangement projects on housing prices may be overestimated or underestimated (Sohn and Lee, 2018; Kim and Seo, 2020). The price trend analysis of this study, however, showed that the housing prices similarly increased both in the treatment and control zones, indicating that the obtained data were valid with no trend issues (see Figure 2).

2. Methogology

In this study, a triple difference (TD) method was employed to determine whether the effect of block-unit housing rearrangement projects on the price of neighboring houses (apartments) would vary by region. The TD method is a modified version of a difference-in-difference (DID) method with one more condition added. The TD method is required to evaluate the effect of variables for comparison other than the treatment and control groups used in the DID method (Kang and Sung, 2018). The DID method is used to identify the unique features or characteristics of the target object using both cross-section data and time-series data at the same time. Simply put, the method refers to a difference in differences; changes measured in the treatment group subjected to a policy measure (project) are directly compared with changes measured in the control group not subjected to the policy (Kim and Seo, 2020). Although the DID method uses differences between two temporal or spatial points, this approach may be modified to use multiple regression analysis (Oh and Cho, 2016; Kim and Seo, 2020).

Take the approach used in this study for example. The time variable (T) refers to before and after the implementation of a block-unit housing rearrangement project depending on its dummy value: T = 1 (after the project) and T = 0 (before the project). Similarly, when the temporal variable S is 1 and 0, the corresponding area is the treatment zone or the control zone, respectively. Here, given that each of T and S refers to a difference, the interactive term TS ends up being a difference in differences. Thus, (beta), the coefficient of TS, corresponds to the effect of the implementation of the project in the DID model. Accordingly, the basic form of a DID model can be expressed as Eq. (1) (Oh and Cho, 2016; Kim and Seo, 2020).

$$Y_{it} = \alpha + \beta_1 T_t + \beta_2 S_i + \beta_4 (T_t \times S_i) + \sum_{c}^{n} \gamma_c X_c + e_{it} \qquad (1)$$

Here, Y_{it} is the dependent variable, which refers to the actual transaction price of an apartment in the i region at the time of t. α is a constant, β, and γ are coefficient values, and e is the error term. T_t is the temporal dummy variable that determines whether or not the project has been conducted, while S_i is the spatial dummy variable that determines whether the target area is included in the treatment zone or the control zone. X_c is the characteristic variable of the apartments examined in this study, concerning their housing characteristics, such as exclusive area, heating method, and entrance type; apartment complex characteristics, such as floor area ratios, the number of households, and the year of construction; and accessibility i.e., the proximity to subway station, bus station, park, hospital, elementary school, university, district office, and department store.

This study additionally examined whether the effect of block-unit housing rearrangement projects on housing prices varied depending on the region, i.e., between the Gangnam area and non-Gangnam area, by modifying the DID model in Eq. (1) to consider the project region variable R, as shown in Eq. (2), the TD model (Kim et al., 2014; Oh and Cho, 2016; Kang and Sung, 2018).

$$\begin{aligned} Y_{it} &= \alpha + \beta_1 T_t + \beta_2 S_i + \beta_3 R_i + \beta_4 (T_t \times S_i) \\ &+ \beta_5 (T_t \times R_i) + \beta_6 (S_i \times R_i) \\ &+ \beta_7 (T_t \times S_i \times R_i) + \sum_c^n \gamma_c X_c + e_{it} \end{aligned} \quad (2)$$

Here, R_i is the regional dummy variable that determines whether the target region is included in the Gangnam area (i region). Also, as one of the core variables, $T_t \times S_i \times R_i$ is the interactive term that is composed of the time variable multiplied by the spatial and regional variables. This variable indicates changes in the apartment prices within a radius of 500 m of the project site after the implementation of a block-unit housing rearrangement project.

3. Variables and Descriptive Statistics

Data on actual transaction prices of apartments within the research area that were provided by the Ministry of Land, Infrastructure, and Transport were collected, and among them, incomplete ones were excluded. As a result, a total of 3,494 data (1,104 data for the treatment zone and 2,390 data for the control zone) were obtained. These data were then used as dependent variable.

Meanwhile, as independent variables, the housing characteristics, complex characteristics, accessibility, and spatial and temporal characteristics were used. The housing and complex characteristics, e.g., area for exclusive use, floor, and the year of construction, were gathered based on the data on actual transaction prices provided by the Ministry of Land, Infrastructure, and Transport. The heating method, entrance type, and the number of rooms and baths were referenced to data provided by Naver Real Estate which is one of the largest real estate data providers in Korea.

Values of the accessibility-related variables were determined via Geocoding and ArcGIS proximity analysis by measuring the shortest straight-line distance from the target apartment.

Among the spatial and temporal variables, the temporal variable T was set to 0 before the block-unit housing rearrangement project was executed. The variable was then set to 1 after the execution of the project. The spatial variable S was set to 1 if the corresponding area was within a radius of 500 m of the apartment subject to the block-unit housing rearrangement project, i.e., included in the treatment zone. If the distance was 500 to 1,000 m, i.e., the area was included in the control zone, the variable was set to 0. Finally, the region variable R was set to 1 if the corresponding area was located at an address in the Gangnam area (Seocho-gu and Gangdong-gu) and 0 if the target area was located in the non-Gangnam area (Gangseo-gu and Guro-gu). The TD term (T×S×R) is a characteristic variable that describes the temporal, spatial, and regional characteristics of a block-unit housing rearrangement project. Based on this term, the execution time of the block-unit housing rearrangement project, spatial accessibility, and changes in the housing prices by region (included in the Gangnam area or not) can be determined.

Specific descriptions of each variable and descriptive statistics are presented in Table 1. The dependent variable PRICE, which refers to the actual transaction price of apartments, ranged from 100 million won to 3.4 billion won and was 848.79 million won on average.

Among independent variables, the variable AREA ranged from 12.14 to 273.31 m^2, and the heating method variable HEAT (1 for individual heating and 0 for the others) was 79%

Table 1. Variables and descriptive statistics

Variable		Unit	Description	Mean	SD	Min	Max
Price		10,000 won	Apartment transaction price	84,879.13	49,539.92	10,000	340,000
Housing characteristics	Area	m^2	Exclusive private area	81.45	39.07	12.14	273.31
	Heat	Dummy	Individual heating system=1, else=0	.76	.43	0	1
	Enter	Dummy	Stairway type=1, else=0	.68	.47	0	1
	Room	Number	Number of rooms	2.90	.80	1	6
	Bath	Number	Number of bath room	1.59	.55	1	3
	Story	Number	Trading story	8.68	5.72	1	43
Complex characteristics	Floor	%	Floor area ratio	297.67	129.04	131	846
	Household	Number	Number of household	403.11	373.47	6	1476
	Year	Year	Construction year	20.72	8.35	0	44
	Year2	Year	$(\text{Construction year})^2$	498.86	337.94	0	1936
Accessibility	Subway	100 m	Distance to the nearest subway station	6.11	3.95	.40	17.52
	Bus	100 m	Distance to the nearest bus stop	1.20	.61	.12	4.41
	Park	100 m	Distance to the nearest park	11.13	5.93	2.06	26.44
	Hospital	100 m	Distance to the nearest hospital	10.98	6.22	1.28	29.79
	Elementary	100 m	Distance to the nearest elementary school	3.91	1.76	.47	9.45
	Univ	100 m	Distance to the nearest university	14.06	5.20	1.76	25.41
	Office	100 m	Distance to the nearest borough office	14.56	9.59	.54	39.07
	Depart	100 m	Distance to the nearest department store	15.13	6.39	1.36	29.76
Spatial and temporal characteristics	Time (T)	Dummy	After construction=1, before=0	.43	.49	0	1
	Space (S)	Dummy	Within 500 m=1, else=0	.32	.47	0	1
	Region (R)	Dummy	Gangnam area=1, else=0	.46	.50	0	1
	T×S	Dummy	Time×Space (DID)	.14	.34	0	1
	T×R	Dummy	Time×Region	.16	.37	0	1
	S×R	Dummy	Space×Region	.08	.27	0	1
	T×S×R	Dummy	Time×Space×Region (TD)	.03	.16	0	1

on average, indicating that individual heating was predominant. The entrance type variable ENTER (1 for staircase type and 0 for the others) was determined to be 68% on average, indicating the predominance of staircase type. The variable ROOM, which refers to the number of rooms, was up to 6, and the average value was 2.9. The variable BATH, which refers to the number of baths, was up to 3 and 1.59 on average. The variable STORY, which refers to the floor of the transacted apartment, was up to 43 and 8.68 on average. Among the apartment complex variables, the floor area ratio variable FLOOR ranged from 131 to 846% and was 298% on average. The variable HOUSEHOLD, which refers to the number of households, ranged from 1,476 to 6 and was 403 on average. The variable YEAR, which refers to the number of years elapsed since the construction of the transacted apartment, was 20.72 years on average. The variable YEAR2, which refers to the square of YEAR, was used to control the nonlinearity of price trends resulting from the deterioration of apartments over time.

Among the accessibility variables, the variable SUBWAY, which refers to the distance from subway stations, ranged from 1,752 to 40 m and was 611 m on average. The variable BUS, which refers to the distance from bus stations, ranged from 441 to 12 m and was 120 m on average. The variable PARK ranged from 2,644 to 206 m and was 1,113 on average. In addition, the variable HOSPITAL, which refers to the distance from hospitals, was 1,098 m on average. The variables ELEMENTARY and UNIV, which refer to the respective distance from elementary schools and universities, were 391 m and 1,406 m on average, respectively. The variables

OFFICE and DEPART, which refer to the respective distance from district offices and department stores, were 1,456 m and 1,513 m on average.

Finally, according to the spatial and temporal variables, 43% of the apartments were those for which block-unit housing rearrangement projects had already been completed. 32% of the apartments were included in the treatment zone, and 46% were included in the Gangnam area. 14% of the apartments were those in the treatment zone for which projects had already been completed. 3% of the apartments were those included in both the Gangnam area and treatment zone for which projects had already been completed.

Ⅳ. Effect of Block-unit Housing Rearrangement Projects on Housing Prices

In this study, the effect of block-unit housing rearrangement projects on the price of neighboring houses (apartments) was empirically analyzed. In the process, semi-log model were applied by taking a log of each dependent variable and then used as a functional form to improve the model fit. In the empirical analysis, all the following models were employed to obtain comprehensive results: DID1, a difference-in-difference model that can represent only the spatial and temporal effects; DID2, a difference-in-difference model with the regional effect controlled; and TD, a triple differences method with the complex regional effect considered. The housing and complex characteristics were analyzed based on the TD results, and the spatial and temporal characteristics were analyzed based on both DID and TD results.

The model fits of the analysis models were as follows. The R^2 value for the DID model ranged from 0.781 to 0.818, and the R^2 value for the TD model was 0.820. This result confirmed that the dependent variables were sufficiently represented by the independent variables in both models. The variance inflation factor VIF, which is used to verify the degree of multicollinearity, was less than 10 for all independent variables, except for the YEAR and YEAR2 variables for which the square of elapsed years was used to control the nonlinearity of price trends resulting from the deterioration of apartments over time. Overall, this result confirmed that no multicollinearity issues occurred in this study (see Table 2).

The empirical analysis results showed that the housing characteristics largely posed a positive (+) effect on apartment prices similar to previous studies. An increase of 1 m^2 in the AREA variable was found to increase the apartment price by about 0.4%. An addition of a room and a bathroom increased the price by 16.8% and 11.6%, respectively. Staircase-type apartments and high floors over low floors were found to have a positive (+) effect on apartment prices. Among the complex-specific variables, the variable YEAR had a negative (-) effect on apartment prices, but this result lacked statistical significance. However, as the number of elapsed years increased and became close to the reconstruction threshold, then the variable was found to have a positive (+) effect. This result was attributed to the fact that expectations for future redevelopment or reconstruction projects had already been reflected in the apartment prices, as explained in previous studies (Lee and Shin, 2001; Nam and Seo, 2017).

The accessibility variables largely showed similar results to previous studies. More specifically, the longer the distance from subway station and schools (elementary school and university) was, the more negatively (-) affected the apartment prices were. In contrast, the shorter the distance from bus station, district office, and department store was, the more positively (+) affected the apartment prices were due to noise and congestion.

Among the spatial and temporal variables as the core variables of this study, the temporal variable T was found to have a positive (+) effect on the apartment prices ranging from 10 to 19.6%. This result confirmed that the implementation of these projects did have a significant positive effect (+) on the price of apartments close to the project site. However, the spatial effect of block-unit housing rearrangement projects was found to lack statistical significance or negatively (-) affect the prices. Overall, poor spatial characteristics were found in areas in which apartment prices in both treatment and control zones were not affected by external factors other than the corresponding project, or in areas where block-unit housing rearrangement projects were required. Meanwhile, when the target apartments were located in the Gangnam area, their price was found to be positively (+) affected by about 41-46%, provided that all other conditions were the same.

Table 2. Result of empirical analysis

Variable		DID1		DID2		TD		VIF
		β	t	β	t	β	t	
Constant		10.054***	210.612	9.697***	213.635	9.684***	214.055	-
Housing characteristics	Area	.005***	20.445	.004***	19.514	.004***	19.820	5.112
	Heat	-.099***	-7.016	-.080***	-6.204	-.080***	-6.231	2.215
	Enter	.043***	3.764	.057***	5.548	.055***	5.313	1.686
	Room	.164***	16.670	.170***	19.006	.168***	18.837	3.78
	Bath	.105***	8.281	.116***	10.079	.116***	10.055	2.897
	Story	.012***	14.460	.013***	17.021	.012***	16.711	1.308
Complex characteristics	Floor	.000***	-6.107	.000***	-6.703	.000***	-6.711	1.779
	Household	.000***	16.168	.000***	22.582	.000***	22.768	1.787
	Year	-.005***	-2.681	-.002	-.882	-.002	-1.058	16.461
	Year2	8.811E-5*	1.675	.000**	2.580	.000**	2.581	19.384
Accessibility	Subway	-.018***	-9.892	-.009***	-5.241	-.009***	-5.150	3.457
	Bus	.035***	4.767	.021***	3.155	.021***	3.189	1.235
	Park	8.685E-5	.079	.000	.367	6.792E-5	.066	2.745
	Hospital	.025***	19.228	.001	.424	.001	.934	6.514
	Elementary	-.027***	-9.622	-.024***	-9.301	-.025***	-9.642	1.525
	Univ	.005***	4.852	-.004***	-4.047	-.005***	-4.230	2.322
	Office	.012***	14.346	.009***	11.518	.009***	11.718	4.393
	Depart	-.018***	-14.429	.009***	5.848	.008***	5.176	6.884
Spatial and temporal characteristics	Time (T)	.101***	9.862	.138***	14.624	.196***	14.619	3.242
	Space (S)	-.080***	-6.200	-.037***	-3.139	.009	.578	3.924
	Region (R)	-	-	.409***	26.950	.460***	26.708	5.423
	T×S	.092***	5.136	.065***	3.966	.000	-.022	3.583
	T×R	-	-	-	-	-.112***	-5.977	3.463
	S×R	-	-	-	-	-.087***	-3.592	3.250
	T×S×R	-	-	-	-	.129***	3.489	2.713
Model fit		R^2=0.782		R^2=0.820		R^2=0.822		-
		Adjusted R^2=0.781		Adjusted R^2=0.818		Adjusted R^2=0.820		
		F=592.451, Sig=0.000		F=716.670, Sig=0.000		F=638.731, Sig=0.000		

*p<0.10, **p<0.05, ***p<0.01

Based on the DID results, the temporal and spatial characteristics (TIME×SPACE) of block-unit housing rearrangement projects were found to have a positive (+) effect ranging from 6.5% to 9.2%. This provided evidence that block-unit housing rearrangement projects, when executed in Seoul, may also cause the price of neighboring apartments to increase to a significant extent, similar to reconstruction or redevelopment projects. This result was in sharp contrast to the results of previous studies that, unlike large-scale urban development projects, small-scale housing improvement projects were not the main cause of changes in the housing markets. As shown in this study, development projects in Seoul, whether small or large, contributed to improving the physical environment of the neighboring community; this implies that such projects may have a significant ripple effect on the neighboring areas. In this study, however, the scope of influence of block-unit housing rearrangement projects was limited to a radius of 500 m of the project site. Thus, it is considered necessary to further examine whether the scope of influence may vary depending on the project scale.

When block-unit housing rearrangement projects were executed in the Gangnam area, the TD (TIME×SPACE×REGION) characteristic was found to have a positive (+) effect, i.e., about 13%, on the price of neighboring apartments. This implies that these projects have a more significant positive (+) effect on the neighboring apartment prices when executed in the Gangnam area than in other areas. The major findings of this study suggest that the implementation of block-unit housing rearrangement projects may significantly affect the price of apartments in the neighborhood, and such a bubble effect may be even more pronounced in overheated housing markets, such as the Gangnam area.

Ⅴ. Conclusions and Implications

The government has been pushing forward various policy measures for housing supply in an attempt to stabilize Seoul's housing market, which has recently been subject to a rapid increase in housing prices. Many of these measures are focused on supplying a number of houses within a short period of time through large-scale development and improvement projects, such as third-phase new town development projects. These approaches, however, have added anxiety about the rapidly increasing housing prices in Seoul. For that reason, the government has also been implementing measures, such as small-scale housing improvement projects, in parallel.

This study empirically analyzed small-scale housing improvement projects as part of reconstruction efforts using a triple difference (TD) method, especially with regard to whether these projects may be an alternative to large-scale urban development projects or only add to instability in the housing market as previously concerned. The major findings of this study are as follows. First, the housing characteristics, complex characteristics, and accessibility were found to have a similar level of effect on the apartment prices to what was reported in previous studies. Second, block-unit housing rearrangement projects, when executed in Seoul, were found to have a significant effect on the price of apartments in the neighborhood. This result implied that the implantation of these projects also contributed to improving the physical environment of the neighboring community and thus may have a significant ripple effect on the corresponding housing market. Third, it was found that block-unit housing rearrangement projects increased the apartment prices more significantly when executed in the Gangnam area.

These results confirmed that, when implemented in Seoul, small-scale housing improvement projects, such as block-unit housing rearrangement projects, may have a significant effect on the price of apartments in the neighborhood, and this effect may also vary depending on the region in a complex manner. This result also suggested that small-scale housing improvement projects could have an even more significant ripple effect when implemented in overheated housing markets such as the Gangnam area. Another significant implication is that even small-scale policy measures for housing supply should be implemented while considering various conditions to stabilize the housing market at the same time. Simply put, block-unit housing rearrangement projects may further increase housing prices, especially in overheated housing markets. Therefore, a thorough review of conditions and issues associated with these projects needs to be conducted. Currently, when buildings and structures that are built through block-unit housing rearrangement projects are subject to the construction regulations in accordance with the Building Act and the Regulations on Standards, etc. of Housing Construction, the applied regulations are eased upon deliberation of local construction committees. Thus, it is considered necessary to come up with measures to ease anxiety about local housing markets, for example, by varying the degree of regulatory mitigation from region to region depending on the possibility of price increases.

This study differs from previous studies in that the region-specific effect of block-unit housing rearrangement projects on the price of houses in the neighborhood was empirically analyzed in a microscopic manner; however, it also involves limitations that the spatial scope was limited to Seoul, the scope of influence was set to a radius of 500 m of the project site, and there were not many cases to examine because such projects had been conducted relatively recently. These limitations are expected to be overcome as block-unit housing rearrangement projects start to be implemented in earnest and increase in number over time, and thus the number of relevant cases to study increases. In addition, although the effect of large-scale urban development projects on housing prices was examined through a review of previous studies, if the ripple effect of such large-scale urban development projects is directly compared to that of small-scale housing improvement projects in the same region, more significant conclusions may be drawn.

References

1. Chang, Y.B. and Cho, H.Y., 2019. *A Study on the Activation Policy for Renewal of Deteriorated Detached Houses*, Suwon: Gyeonggi Research Institute.
   장윤배·조하영, 2019.「소규모주택정비사업 활성화를 위한 공공지원 방안 연구」, 수원: 경기연구원.
2. Cheong, W.S., Song, S.J., and Shin, J.C., 2019. "A Study on the Influencing Factors on the House Prices in the Detached House Reconstruction Area", *Journal of The Residential Environment Institute of Korea*, 17(1): 103-119.
   정우성·송선주·신종칠, 2019. "단독주택 재건축지역의 주택가격 영향요인에 관한 연구", 「주거환경」, 17(1): 103-119.
3. Gu, K.M., Jeong, D.W., and Kim, H.S., 2009. "The Effects of New Town Projects on Neighborhood Housing Price in Seoul: Focusing on the Case of the Second and Third New Town Projects", *Journal of Korea Planning Association*, 44(4): 79-93.
   구경민·정다운·김흥순, 2009. "서울시 뉴타운 개발이 주변지역 주택가격에 미치는 영향 분석: 2·3차 뉴타운 개발 사업을 중심으로", 「국토계획」, 44(4): 79-93.
4. Hong, S.J., 2021. "Legal Issues Concerning the Application of Public Implementers in the Reconstruction Project and Housing Improvement Project in a City Block: The Boundary between the Expropriation and Request for Sale according to the 2· 4 Real Estate Policy", *Public land law Review*, 95: 45-71.
   홍성진, 2021. "재건축사업 및 가로주택정비사업에서의 공공사업시행방식 적용에 따른 법적 쟁점: 2·4대책에 따른 수용과 매도청구의 경계 문제", 「토지공법연구」, 95: 45-71.
5. Jeong, D.G. and Yoon, H.Y., 2016. "Impacts of a Newtown Project on Housing Prices from Designation to Withdrawal Process: In Case of Changsin·Sungin Newtown in Seoul, Korea", *Journal of the Architectural Institute of Korea Planning & Design*, 32(9): 37–48.
   정동규·윤희연, 2016. "뉴타운 사업의 지정과 해제과정이 인접지역 주택가격에 미치는 영향: 창신·숭인 뉴타운 지구를 대상으로", 「대한건축학회논문집 계획계」, 32(9): 37-48.
6. Jin, Y.H. and Yu, J.S., 2019. "The Valuation of Block-unit Housing Rearrangement Project using Fuzzy Real Options", *Housing Studies Review*, 27(3): 77-113.
   진연화·유정석, 2019. "퍼지 실물옵션을 이용한 가로주택정비사업의 가치평가", 「주택연구」, 27(3): 77-113.
7. Kang, J.W. and Sung, H.K., 2018. "Impact on Land Use Change in Rail Station Areas Using the Triple Difference Regression Modeling: Focusing on the Ten-Years Operation since Opening of Subway Line 1 in the Daejeon Metropolitan City", *Journal of Korea Planning Association*, 53(5): 171-183.
   강재원·성현곤, 2018. "삼중차분 회귀모형을 활용한 도시철도 역세권 토지이용 변화에 미치는 영향분석: 대전시 도시철도 1호선 개통 후 10년을 중심으로", 「국토계획」, 53(5): 171-183.
8. Kim, B.S., Nam, D.S., Kim, D.Y., and Kim, K.M., 2014. "The Effect of Expanding Urban Railway Infrastructure on Land Prices: A Case Study of Gyeongin-Line Quadruple Track", *Journal of Korea Planning Association*, 49(6): 95-209.
   김범식·남대식·김도연·김경민, 2014. "도시철도 인프라 확장이 지가에 미치는 영향: 경인선 복복선화를 사례로", 「국토계획」, 49(6): 95-209.
9. Kim, D.H. and Seo, W.S., 2020. "Space and Time Effects of Large-Scale Suburban Commercial Facility on Apartment Prices", *GRI Review*, 22(3): 29-48.
   김도희·서원석, 2020. "대규모 교외형 복합상업시설이 아파트 가격에 미치는 시공간 영향", 「GRI 연구논총」, 22(3): 29-48.
10. Kim, J.N. and Ro, S.H., 2019. "The Impact of Urban Regeneration on Local Housing Markets in Seoul", *The Journal of Korea Real Estate Analysists Association*, 25(2): 51-66.
    김지나·노승한, 2019. "서울시 도시재생사업이 주변 지역 주택시장에 미치는 영향에 관한 연구: 서울시 아파트를 중심으로", 「부동산학연구」, 25(2): 51-66.
11. Kim, J.N., Han, G.H., Cho, W.J., and Ro, S.H., 2020. "Reconstruction Project Phases and Housing Price in Seoul", *Review of Real Estate and Urban Studies*, 13(1): 85-104.
    김지나·한광호·조원진·노승한, 2020. "재건축사업 진행단계가 서울시 재건축 아파트 가격에 미치는 영향 분석", 「부동산·도시연구」, 13(1): 85-104.
12. Kim, L. and Seo, W., 2021. "Micro-Analysis of Price Spillover Effect among Regional Housing Submarkets in Korea: Evidence from the Seoul Metropolitan Area", *Land*, 10(8): 1-21.
13. Kim, P.S. and Park, T.J., 2018. "A Study on the House Maintenance Project for the Regeneration of Deteriorated Residential Areas", *Journal of the Korea Real Estate Management Review*, 18: 267-288.
    김필선·박태진, 2018. "노후주거지 재생을 위한 가로 주택정비사업에 관한 연구", 「부동산경영」, 18: 267-288.
14. Kim, S.W., 2020. "A Study on the Use of Artificial Intelligence in Block-unit Renewal Project: As an Example of the Current Situation in Uijeongbu City", *Real Estate Law Review*, 24(4): 55-82.
    김승욱, 2020. "가로주택정비사업에서 인공지능의 활용에 대한 연구: 의정부시의 현황을 사례로", 「부동산법학」, 24(4): 55-82.
15. Kim, W.J. and Seo, W.S., 2017. "The Impact of Space and Location Features on Regional Housing Market by New Development: Focused on Sejong City", *Journal of the Korea Real Estate Society*, 35(2): 89-106.
    김원준·서원석, 2017. "대규모 신도시개발에 따른 공간 및 입지

특성이 아파트시장에 미치는 시계열적 변화: 세종시를 중심으로”, 「대한부동산학회지」, 35(2): 89-106.

16. Ko, Y.K. and Hur, J.W., 2015. “Problems of Overdevelopment and Policy Directions in Population-Declining Era”, *Journal of the Korean Regional Economics*, 13(3): 87-103.
고영구 · 허재완, 2015. “인구감소시대, 과잉개발의 문제와 정책방향”, 「한국지역경제연구」, 13(3): 87-103.

17. Koh, J.H. and Kang, M.G., 2019. “A Comparison Study of Determinants of Real Estate Price and Determinants of Price Increase: Focused on the Reconstruction Apartments in Seoul”, *Journal of Korea Real Estate Analysists Association*, 25(2): 7-22.
고주형 · 강명구, 2019. “부동산 가격 요인과 가격상승률 요인 비교 연구: 서울시 재건축 아파트를 중심으로”, 「부동산학연구」, 25(2): 7-22.

18. Kwon, H.S., Kim, O.Y., and Kwon, C.H., 2017. “A Study on the Rental Housing Supply through Urban Block Renewal Projects: Focus on the Deteriorated Housing Purchased For Public Rental”, *Journal of the Urban Design Institute of Korea Urban Design*, 18(1): 19-34.
권혁삼 · 김옥연 · 권치흥, 2017. “가로주택정비사업을 통한 임대주택 공급방안 연구: 노후 공공매입임대주택을 중심으로”, 「한국도시설계학회지 도시설계」, 18(1): 19-34.

19. Kwon, H.S., Park, K.S., and Kim, S.H., 2016. “A Study on the Resident Survey for Revitalizing the Small-Scale Housing Rearrangements in the Areas of Residential Environment Improvement Projects”, *Journal of the Urban Design Institute of Korea Urban Design*, 17(1): 49-64.
권혁삼 · 박근석 · 김성훈, 2016. “주거환경개선사업 구역의 소단위 주택정비 활성화를 위한 주민의견조사 연구”, 「한국도시설계학회지 도시설계」, 17(1): 49-64.

20. Lee, J.H., Moon, T.H., and Heo, S.Y., 2017. “Impact on the Apartment Price by the Urban Regeneration Project in Project and Surrounding Area”, *Journal of The Residential Environment Institute of Korea*, 15(3): 47-59.
이진학 · 문태헌 · 허선영, 2017. “도시재생사업으로 인한 사업지역 및 주변지역 아파트가격 영향분석”, 「주거환경」, 15(3): 47-59.

21. Lee, S.K. and Shin, W.J., 2001. “The Effect of Reconstruction Probability on Apartment Price”, *Journal of Korea Planning Association*, 36(5): 101-110.
이상경 · 신우진, 2001. “재건축 가능성이 아파트 가격에 미치는 영향”, 「국토계획」, 36(5): 101-110.

22. Lim, J.W. and Lee, C.W., 2019. “A Study on the Factors Inhibiting Roadside Housing Redevelopment Project: Focused on Seoul Special City”, *Journal of the Korea Real Estate Society*, 37(3): 259-274.
임종욱 · 이춘원, 2019. “가로주택정비사업 저해요인에 관한 연구: 서울특별시 중심으로”, 「대한부동산학회지」, 37(3): 259-274.

23. Nam, H.K. and Seo, W.S., 2017. “Analyzing Time Series Value Change of Apartment Characteristics Based on Reconstruction Expectation”, *Journal of Korea Planning Association*, 52(5): 199-211.
남형권 · 서원석, 2017. “재건축 기대에 따른 아파트 특성요인의 시계열적 가치분석”, 「국토계획」, 52(5): 199-211.

24. Oh, M.K. and Cho, J.H., 2016. “A Study on Disamenity’s Impact on the Prices of Nearby Apartments: With the Goyangsi New Incineration Plant Case”, *Journal of Korea Planning Association*, 51(6): 169-180.
오민경 · 조주현, 2016. “혐오시설이 인근 아파트가격에 미치는 영향에 관한 연구: 고양환경에너지시설을 중심으로”, 「국토계획」, 51(6): 169-180.

25. Park, D.K. and Kim, H.S., 2020. “The Impact of Urban Regeneration Projects on Apartment Prices of the Target and Neighboring Areas: Targeting Suyu 1, 2 Dongs, Seoul, Korea”, *The Geographical Journal of Korea*, 54(2): 151–163.
박대근 · 김흥순, 2020. “이중차분법에 의한 도시재생사업의 아파트 가격에 미치는 영향 분석: 서울시 수유1동과 수유2동의 비교”, 「국토지리학회지」, 54(2): 151-163.

26. Perry, C., 1929. “City Planning for Neighborhood Life”, *Social Forces*, 8(1): 98-100.

27. Seo, W. and Kim, L., 2020. “Investigating the Ripple Effect through the Relationship between Housing Markets and Residential Migration in Seoul, South Korea”, *Sustainability*, 12(3): 1-22.

28. Sohn, H.S. and Lee, J.H., 2018. “The Application of and Issues in Difference in Difference Estimator in Public Administration and Policy Research”, *Modern Society and Public Administration*, 28(3): 1-31.
손호성 · 이재훈, 2018. “행정학 · 정책학 연구에서의 이중차분 추정기법의 활용과 쟁점”, 「현대사회와 행정」, 28(3): 1-31.

Date Received 2021-11-26
Date Reviewed 2022-01-03
Date Accepted 2022-01-03
Date Revised 2022-01-12
Final Received 2022-01-12