Master's Thesis of Landscape Architecture

# The impact of the Gyeongui Line Park project on residential property values in Seoul, Korea

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# Abstract

Gyeongui Line Park is an urban park project that the City of Seoul has adopted as a means to revitalize declining neighborhoods. This study aims to analyze the project’ s effects on housing prices. Unlike extant hedonic studies, this analysis focuses on revealing the heterogeneous effects of the project by the development process, from inception to completion, to understand when and to what extent the park has influenced housing values in the host neighborhood. Findings indicate that the Gyeongui Line Park project has resulted in generally positive externalities to both apartments and multi−family dwellings, with the magnitude varying by relative location. The effects differ according to the project’ s phase and housing type: in the apartment market, values increased about 15% per 100−meter approach to the park, starting with the announcement of the park’ s procurement plan in 2006; continued to increase through Phase I completion; then decelerated to 0-3% at the beginning of Phase II construction. For multi−family homes, the project corresponded with positive, but smaller, increases on housing values (about 2%) starting with Phase I construction in 2012, with the magnitude remaining at 1-2% from 2012 to the present. Findings from this study and its methodology will be valuable in determining the course of future planning efforts to maximize the positive effects of projects in urban revitalization practice.

**Keyword** : the Gyeongui Line Park, urban revitalization, rail−to−trail, random−coefficient multilevel modeling

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# 1. Introduction

Improving existing or introducing new urban amenities has been a common strategy that cities have adopted for revitalizing broader urban conditions. As Robertson (1995) argued, so−called “spatial activity generators” such as convention centers and sports stadiums can reinvigorate local economies by not only benefitting existing residents, but also attracting visitors and new businesses. Parks can be understood in this vein. As an attractive urban amenity, parks draw people into their vicinities, further attracting businesses and elite groups with higher recreational demands and sophisticated lifestyles and tastes, and may promote property developments by improving the images of host neighborhoods (Yoon, 2013b; Grodach & Loukaitou-Sideris, 2007; Miles & Paddison, 2005).

Since the turn of the 21st century, the Seoul Metropolitan Government has carried out various landscape projects following this trend. Some major examples include the CheongGyeCheon stream, an urban stream restoration project on the former site of an elevated freeway; the Han River Renaissance, a series of waterfront parks along the Han River; and the Seoul Station 7017 project, an elevated park on a freeway viaduct near Seoul Railway Station. All of these projects are, at least in part, on a dual mission to rehabilitate or repurpose derelict infrastructure and simultaneously revitalize the surrounding neighborhoods (Shin, Kim & Mok, 2006; Hu, 2014; Jeong & Kim, 2009).

Gyeongui Line Park is one such project in this fashion that started its development in 2005. As of 2015, two of the three phases have been completed. The Gyeongui railroad that ran through the core of Seoul city has long been blamed for physically dividing the host community and consequently causing imbalanced development among host neighborhoods (Seoul Metropolitan Government, 2009). The City planned to reroute the railroad to an underground tunnel and convert the street-level railroad tracks to a linear park, providing the public with recreational opportunities while creating positive developmental momentum within the neighborhood. The previous image of the neighborhood dominated by the defunct railway site has been accordingly transformed into one that is more welcoming. As the physical barrier of the railroad was removed, commercial districts around the Gongdeok, Hongik University, and Seogang stations have been revitalized to embrace more diversified businesses such as restaurants, tourist hotels, and shopping malls (I.O. Kim, 2015). These signs of neighborhood revitalization have been apparent even before the park was physically realized: since the 2006 park announcement, nearby residential units have sold at comparatively higher prices, and new small-scale multi-family housing developments have sprouted up along the completion of the first phase (Sung, 2013).

While amenity procurement strategies in urban revitalization have been of interest in extant hedonic studies, the focus has mainly been on investigating those effects either at a discrete point in time or a before-and-after comparison, typically using cross-sectional analyses. In particular, ex-post project assessment has been common, as researchers believe that projects' effects have taken place only after completion (Ki & Jayantha, 2010; Lai, Chau, Yiu, K.S. Wong, Wong & Chan, 2007; Yiu & Wong, 2005). There are indications, however, that these assumptions are incorrect, as parks can generate effects even before their physical realization, as the Gyeongui Line Park project suggests. Certain amenities can begin forecasting economic impacts from the point of announcement, as the plan itself raises residents' and property developers' expectations, promises an improvement in neighborhood reputation, and increases the neighborhood's visibility (Chau & Ng, 1998; Edelstein & Qian, 2014; Gurrib, 2008). The positive effect may continue, increase, or decline as construction progresses, and it may change again after a real evaluation of the amenity is enabled after the opening. In the practice of urban revitalization, it is important to explore a more comprehensive process of the economic impact of project development, as one of revitalization's aims is to stimulate lagging local economies (Bae, 2008; Altshuler & Luberoff, 2003; DeGiovanni, 1983).

In this study, we investigate the externalities of the Gyeongui Line Park project on residential property values of two housing types—apartments and multi-family housing units—throughout the development process, starting with the project's first public announcement in 2006 to the public opening of the second phase in 2015. Unlike extant studies, we consider that such a project exerts externalities at various levels, from before project commencement, during development phases, to after completion. Our unique modeling strategy—random-coefficient multilevel modeling and employing a multi-year dataset—enable us to fill gaps in the literature by providing empirical evidence.

Following are three sections: (1) a background of the project, followed by a literature review on the hedonic pricing model; (2) methodology and data sources with analytical results; and (3) discussion and policy implication.

# 2. Background

The Gyeongui railroad was originally built in 1906 to connect Seoul and Sinuiju, a city in what is now western North Korea. Since its inauguration, the railroad line has undergone several changes, including a truncated route following the division of Korea in 1945. In the late 1990s, as Seoul experienced rapid urban growth based on a strong national economy, the government planned to improve its railway system by building new lines and expanding operations of the then-lightly used existing lines such as the Gyeongui railroad (Han, 2005). Residents in the neighborhood, however, were against the idea, concerned about nuisances generated by the change, such as noise, dust, and fumes, not to mention ongoing community disturbance resulting from the railroad dividing the neighborhood from east to west (Lee, 2011).

In response to local opinion, the city government developed a new plan to reroute the railroad into an underground tunnel in 2005 and create a 6.3-km linear park on the remaining street-level rail track to revitalize its declining neighborhoods. The project was announced in 2006, with construction beginning of its Phase I and Phase II in 2011 and 2013, respectively; completions were in April 2012 and June 2015. Phase III is aiming for completion by the end of 2016. In the time between the termination of above-ground rail service in 2005 to the ground-breaking of each phase, the rail site was abandoned without sufficient maintenance by public agencies.

The vicinity soon became a source of many kinds of nuisances, such as illegal trash dumping and other misdemeanors. Residents in the neighborhood began avoiding the area and blamed the situation for delayed local development (Shon, 2015).

At the announcement of the park-conversion project in 2006, however, the situation changed drastically. Anecdotal evidence suggests that the Gyeongui Line Park project has reversed negative images of the neighborhood, attracted new residents and visitors, and led local economic development. Areas near the site have drawn the attention of real estate developers (Choi, 2012). During the first year following Phase I, after the first portion of the park was open to the public in 2012, land prices of the rail track vicinity rose from 2.5 million to 4 million Korean won per Pyung (a commonly used unit indicating area, which is about 3.3 square meters) or 0.75 to 1.21 million Korean won per square meter (Sung, 2013). Yeonnam-dong, one of the nearby residential districts that had once been home to a few small diners and a café, invited a substantial number of new restaurant businesses and earned the nickname "Yeontral Park," or "Central Park in Yeonnam" (Seok, 2015). While the number of Western food restaurants increased about 116.7%, and the number of cafés grew by 43.2% during the two-year period of 2014-2015 (Small Enterprise and Market Service, 2015), general sales revenues in this district have risen by 34% between 2012–2015 (Park, 2015). More than 50,000 people have visited the neighborhood after Phase II opened to the public in June 2015 (Lee, 2015b), after which many real estate analysts projected that the Gyeongui Line vicinity was fast becoming a rapidly emerging property market ("Old Railroad Is," 2015). Figure 1 shows the Gyeongui rail track before and after the park project.

Figure 1. The before (left) and after (right) the Gyeongui Line Park project (Source: Seoul Metropolitan Government)

# 3. Literature Review

The hedonic pricing model is one of the most common methodologies for economic valuation of environmental factors on property values. For example, the effects of structural attributes on property market values have well been documented. These effects include age, lot size, and the number of floors, bathrooms, and bedrooms (Liu, Xu, X. Zhang & Zhang, 2014; Owusu-Ansah, 2012); environmental attributes such as ocean view, air quality, noise level, and crime rates (Bishop & Murphy, 2011; Caudill, Affuso & Yang, 2015; Jim & Chen, 2010; Kemiki, Ojetunde & Ayoola, 2014); and locational attributes such as the accessibility of educational facilities, retail markets, and parks (Jang & Kang, 2015; Kolbe & Wustemann, 2015; Wen, Y. Zhang & Zhang, 2014);.

Since procuring, changing, and demolishing urban infrastructure has influenced the landscape of the neighborhood, the impact assessment of those projects has been a frequent topic in the hedonic literature. New additions or transportation facility upgrades have been common subjects. Lin & Hwang (2004), for example, examined the economic effects of the opening of the Taipei subway system on property values along the subway routes, about seven years after project completion. This study, using before-and-after comparisons of the analysis results, indicated that this new transportation facility significantly increased housing prices by improving accessibility to major public facilities. Ko & Cao (2013) investigated the impact of light rail transit (LRT) along the Hiawatha Line on commercial and industrial property values in Minneapolis, and revealed price premiums on properties near the station sites after about nine years following the completion, as compared with property values prior to construction. Cervero & Kang (2011) conducted a hedonic pricing analysis on Seoul's 2004 bus rapid transit (BRT) reforms, a project that involved converting regular bus operations to median-lane BRT systems, approximately seven years after the project's introduction. The study suggested that the nearby land value of BRT stops indicated positive externalities when compared to land values before the reforms.

Parks, as an adaptive reuse of other infrastructure, have been another subject of literature. Kang & Cervero (2009) researched the effects of the aforementioned CheongGyeCheon Park in Seoul on real estate market values about four years after the completion of the project. The study contrasted the negative effects of the then-urban disamenity—an elevated highway—before adaptation, with the positive effect of its transformation to an urban amenity—a restored creek and linear park—afterward. Cervero, Kang & Shively (2009) investigated property value impacts of the Octavia Boulevard Project in San Francisco, which rerouted elevated highways to surface lanes flanked with landscaped spaces, about four years after completion. By comparing the effects of the project before and after completion, they found that relatively low property values caused by proximity to the freeway increased following implementation of a landscaped buffer. Yoon (2013a) assessed the before−and−after externalities on nearby housing values along the High Line—a public park on a former elevated rail track in Manhattan, New York —after approximately two years after the completion of first and second sections, and suggested that the higher intensity of the positive effects – increased property value − accrued to the nearby census tracts by the change.

As suggested above, most of the studies have adopted a before−and−after comparison strategy, in which the subject outcomes in pre− and post−construction are measured independently and compared, in revealing the effect brought by a certain project. The underlying assumption is that externality effects of urban infrastructure projects are exerted only after their physical realization (Ki & Jayantha, 2010; Lai et al., 2007; Yiu & Wong, 2005). However, this assumption is not always correct by two essential measures. First, a pre−construction effect does exist in some urban projects or events. So−called announcement effects of major public projects or mega−events often influence real estate markets in surrounding areas by leveraging expectations of homebuyers, developers, and speculators, starting with the moment that the plan is announced to public (Chau & Ng, 1998). Projects that can have announcement effects include transportation facilities such as new airport hubs and light rail stations (Jud & Winkler, 2006; Knaap, Ding & Hopkins, 2001); sports stadiums (Dehring, Depken & Ward, 2007); and such major events as the Olympics (Kavetsos, 2012). Most of these studies showed positive externalities as a result of news of such changes.

Second, the level of influence of project externalities on property value changes is not a simple linear trajectory, but rather a more dynamic one. For example, before the beginning of a project's development, certain projects promise greater benefits than what they would actually generate in the end; as such, the magnitude of an externality would diminish by time (Buckles, 2013; McMillen & McDonald, 2004). Speculation is another factor creating variations in this matter. As mentioned in the introduction, property developers or land speculators tend to react to the news of projects faster than general buyers, and consequently, property prices can become inflated in a host neighborhood. This can lead to further market fluctuations with ongoing information of the projects' progress (Edelstein & Qian, 2014; Gurrib, 2008). Especially when a large-scale project is developed in multiple phases, where parts of the project are completed as the rest are under construction, the externalities would become even more complex.

Situations like the above require us to assess the project effect throughout the entirety of the development period, while ex-post analysis or before-and-after comparison still dominates hedonic literature. By using one of the most efficient modeling strategies—random-coefficient multilevel modeling—and the real transaction data of approximately ten years, we assess the heterogeneous externalities of a park on surrounding real estate values from the announcement until one of the milestone completion phases in greater detail. By examining a more complete picture of when and how much an urban amenity affects neighborhood real estate markets, this paper could yield more effective reference data to assist with urban revitalization planning.

# 4. Data Analysis

## 4.1. Site and Data

This study’ s investigation site was limited to four wards of 25 in Seoul that surround Gyeongui Line Park. For the purpose of comparison, this site includes both areas that have been anticipated to yield price premiums from the park, i.e., the Impact Zone, plus areas beyond this hypothetical boundary, i.e., the Unaffected Zone. The study period is from January 2006 to September 2015. This period embraces the entirety of the project’ s development, from the announcement of the park procurement in November 2006 to the completion of Phase I in April 2012 and Phase II in June 2015. While it would be advantageous to include a longer period prior to the announcement in better understanding the comprehensive effects of the project, those data were not publicly available. Figure 2 shows the temporal context of this analysis.

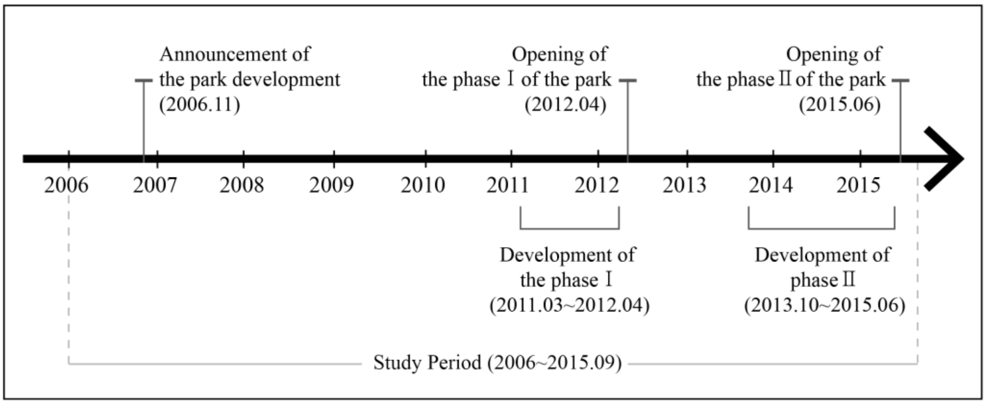


Figure 2. Gyeongui Line project development process

The primary data set for this study is residential sales data, or market transaction value of housing units in the study site, that was collected by the Ministry of Land Infrastructure and Transport during the study period. The sample includes 49,585 property market transaction records, of which 18,885 are apartment units and 30,700 are multi-family housing units. Note that in Korea, “apartment” refers to residential buildings of multiple units higher than five stories, and multi-family housing have fewer than five stories (“multi-unit dwelling,” n.d.). Both types can be sold or rented, but only sales records have been included in this analysis. All prices are adjusted to September 2015, based on the Consumer Price Index (CPI) from South Korea’s National Statistical Office. Figure 3 describes this study’s focus areas—both the Impact and Unaffected Zones—as well as the geographic distribution of apartments and multi-family housing units in our sample.

Building attributes (number of floors and year built) were sourced from Korea’s Ministry of Land Infrastructure and Transport, and unit attributes (number of bedrooms and bathrooms) came from “Real Estate 114,” a website of accumulated information on real estate market transactions. In addition, location information—such as the distance between Gyeongui Line Park and other urban features such as hospitals, police offices, fire stations, and shopping centers—was gathered from the Population and Housing Census by Korea’s National Statistical Office. Demographic characteristics were obtained from the same source, aggregated by census output area. Census output area is a minimum statistical district unit divided by about 500 people, provided by the National Statistical Office.

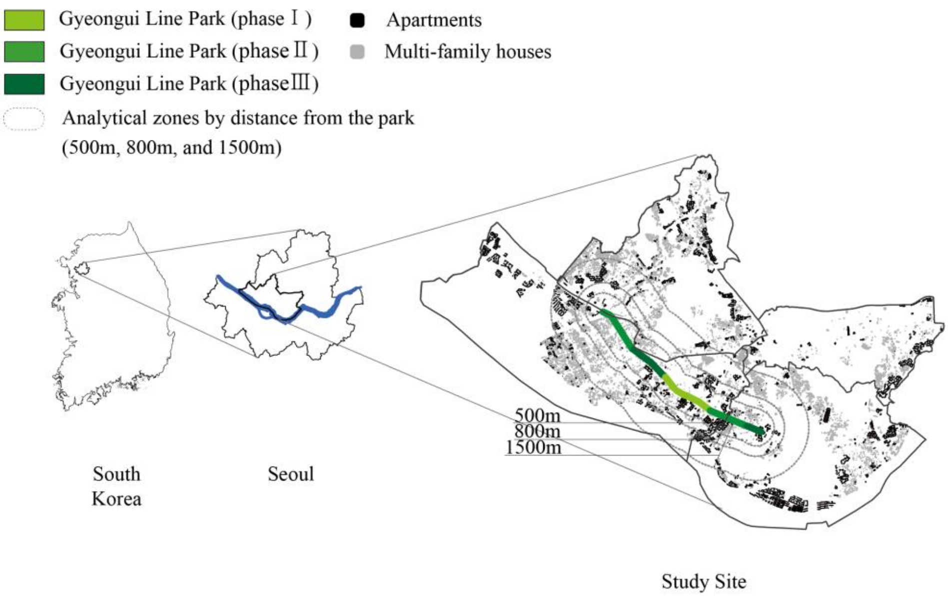


Figure 3. The boundary of study area and the location of apartments and multi-family housing units in the sample with reference to the Gyeongui Line Park

## 4.2. Measure

The dependent variable for the multilevel random−coefficient model for this study was determined to be the log of transaction value of housing units per square meters: ln(market transaction value per square meters). The question variable, *Dist_GLP*, is the Euclidean distance to the Gyeongui Line Park from each housing unit in the given sample. Also included are three categories of explanatory variables, i.e., factors that might influence residential property values: structural, locational, and demographic characteristics of the housing unit. Structural characteristics suggest building and unit attributes such as floor, year built, and the number of bedrooms and bathrooms. For the multi−family housing unit analysis, the number of bathrooms and bedrooms were excluded, due to their strong correlation with the net area (square meters) of each unit. Location characteristics represent the distance to urban features that could also result in an externality (positive or negative) on housing prices. Educational facilities, transportation options, and other urban factors such as hospitals, police offices, fire stations, and shopping centers are some of the examples that are included in our model. In addition, we included the distance to the Han River, the major river of Seoul, as a variable because the view and proximity to it has commonly added value to housing prices. In terms of demographics, included were educational attainment (the ratio of people with higher than a college degree), age composition (the ratio of population older than 65 or younger than 15), and population density (number of people per census tract). Finally, this study included fixed effects of the four wards of our study site to control for local characteristics. Detailed descriptive statistics are available upon request of the authors.

### 4.3. Analytical Design

Multilevel hedonic modeling is the main analytical tool of this study. Multilevel structuring is a useful alternative to Ordinary Least Square strategy when grouped data violate the assumption of independence (Christens & Speer, 2011; Hoffman, 2007; Jones & Bullen, 1994), since, by organizing data into multiple levels, this modeling grants within-group correlation (Snijders & Bosker, 1999). In a multilevel structure, it is possible to specify either a random-intercept model, in which each higher-level group has its own intercept, or a random-coefficient model, in which each group has its own intercept and coefficient of a variable (Rabe-Hesketh & Skrondal, 2008).

To assess the effects of the Gyeongui Line Park project in increasing housing values during the varying stages of its development process, random-coefficient multilevel modeling is the most efficient, pinpointing which milestones of development the park exerted positive externalities more significantly than others. For this model, individual transactions were grouped by a unit of time—one third of a month (1-10, 11-20 and 20-31)—as the higher level, within which their correlation is allowed. Thus, Level-1 is individual transaction record and Level-2 is transaction period. Level-1 consists of 49,585 property market transaction records divided into 351 Level-2 groups from January 2006 to September 2015. Each group, or approximately ten days of a transaction period, has its own coefficient of the question variable—the distance to the

Gyeongui Line Park (*Dist_GLP*)—describing how the effect of the park on residential values changed over the project development phase, as if we conducted 351 separate regression analyses.

Random-coefficient multilevel approach, however, is comparatively more advanced than separate numerous regression analyses, as it estimates group- (time-) specific effects by empirical Bayes estimation, as well as their overall mean by weighting more on groups with a larger number of members to reduce bias (Maas & Hox, 2004). Whilst extant studies have measured the externalities at only two points, i.e., the before and after of park development separately, in this study, we measure such effects at 351 points in time throughout the entirety and beyond of the development period, with the help of an empirical Bayes estimation.

The sample was stratified by housing type—apartments and multi-family housing units—due to their differences in transaction frequency, in overall values, and in appeal to differing homebuyer groups. To delineate the extent of the park's impact, and not to even out the impact by establishing a larger study area, the sample was analyzed in three geographic areas by distance: within 500 meters, 500–800 meters, and 800–1500 meters and beyond from the park, or 5-, 10-, 20-minute-plus walking distances.

Finally, to confirm the legitimacy of the Level-2 group unit, the intraclass correlation coefficient (ρ) was estimated for subsamples of apartment and multi-family housing units, which found that 23.1% and 24.4% of medium- to large-level variances are explained by the between-group variation, respectively (Van Schoten, Baines, Spreeuwenberg, De Bruijne, Groenewegen, Groeneweg & Wagner, 2014; Peugh, 2010). The multilevel regression models are shown in Function 1.

**Research question**: How the impact of the Gyeongui Line Park on housing price have changed along the development of the project—announcement, planning, and public opening—in three zones divided by the distance from the park.

Level-1 (individual transaction):

$$ln(market\ transaction\ value\ per\ square\ meters_{ij})$$
$$= \pi_0 + \pi_{1i} Dist\_GLP_{ij} + \beta_2 \boldsymbol{S}_{ij} + \beta_3 \boldsymbol{L}_{ij} + \beta_4 \boldsymbol{D}_{ij}$$
$$+ \ \gamma_5 W\_MP_{ij} + \gamma_6 W\_SD_{ij} + \gamma_7 W\_J_{ij} + \gamma_8 W\_YS_{ij} + \epsilon_{ij}$$

Level-2 (transaction period by one third of a month):

$$\pi_0 = \theta_0 + v_{0i}$$
$$\pi_{1i} = \theta_1 + v_{1i}$$

Composite model:

$$ln(market\ transaction\ value\ per\ square\ meters_{ij})$$
$$= \theta_0 + (\theta_1 + v_{1i}) Dist\_GLP_{ij} + \beta_2 \boldsymbol{S}_{ij} + \beta_3 \boldsymbol{L}_{ij} + \beta_4 \boldsymbol{D}_{ij}$$
$$+ \ \gamma_5 W\_MP_{ij} + \gamma_6 W\_SD_{ij} + \gamma_7 W\_J_{ij} + \gamma_8 W\_YS_{ij} + \epsilon_{ij} + v_{0i}$$

$Dist\_GLP_{ij}$ : distance to the Gyeongui Line Park

$\boldsymbol{S}_{ij}$ : a vector of structural factors

$\boldsymbol{L}_{ij}$ : a vector of location factors

$\boldsymbol{D}_{ij}$ : a vector of demographic factors for census tract

$W\_MP_{ij}, W\_SD_{ij}, W\_J_{ij}, W\_YS_{ij}$ : fixed effect of the wards

$\epsilon_{ij}$ : Level-1 residual

$v_{0i}$ : Level-2 residual for the intercept

$v_{1i}$ : Level-2 residual for the coefficient

(Function 1)

# 5. Findings

Our multilevel analytical results are presented from population mean coefficients, suggesting an averaged park effect during the entire study period, to group−specific coefficients, suggesting a time−specific park effect, of our question variable: the distance of a residential unit to the Gyeongui Line Park. Table 1 and Table 2 indicate the results of the multilevel regression analysis for apartment and multi−family housing units, respectively. The coefficient of the question variable—distance to the Gyeongui Line Park—presented in Table 1 and Table 2 is the population mean.

In the apartment market, Gyeongui Line Park appears to exert a positive economic influence within up to 800 meters from its boundary, whereas this was not the case for the areas beyond. Premiums to apartment transaction values located 100 meters closer to the Gyeongui Line Park were 4.26% within 500 meters and 0.77% within the zone of 500–800 meters. For multi−family housing units, the economic effects of the park were not statistically significant at the 5% level, while the park seemingly exerted negative externalities in the 500–800−meter zone. Thus, the result appears to be that the park generated positive externalities on the price of apartment units, but not to multi−family housing units throughout the entirety of the development process.

From the group−specific coefficient of the question variable presented in Figure 4, it was possible to unpack the influence of the park development process on transactions by time, i.e., the Level-2 group. This analysis was limited to areas within the Impact Zone (within 500 meters), where the effect was the clearest from the previous analysis.

In the analysis of apartment unit transactions shown in Figure 4 (marked by red dots), the magnitude of the coefficient dropped sharply from above zero to below zero, meaning the negative effect of the rail site on residential property values rapidly turned positive after the city government announced the park procurement plan in November 2006. Specifically, apartments that were 100 meters closer to Gyeongui Line Park saw an approximately 15% higher market value on average than those located further away, controlling for other price factors. This result suggests that the effect of the announcement of the Gyeongui Line Park appeared even before it was built, based on the anticipation of neighborhood improvement. The magnitude of the premium remained at an average of 10% by 100m-approach to the park from the point of announcement until the public opening in 2012 following Phase I construction. These externalities, however, became negative when Phase II construction began and remained around zero before the second public opening in June 2015. After the opening, there was no statistically significant deviation from the population mean, observed between the distance to the park and the market transaction values. This result was contrary to the original supposition that the influence on property values of Phase I of park development would have been the same during Phase II.

This discrepancy could be attributed to the uneven distribution of this study's sample housing unit types (Figure 3). The study site near Phase I primarily contains apartment units, while the Phase II site contained primarily multi-family housing units. Therefore, the park development's effects on apartment values were large when Phase I was under development, but not as such in the case of Phase II. Another explanation could be real estate speculation. If housing prices had already increased substantially due to real estate speculation after the park plan was announced and Phase I was completed, the development and completion of Phase II may no longer boost the nearby housing market at the same level. Another conjecture could be that Phase I indeed generated zero to negative externality by attracting larger numbers of visitors and causing inconveniences to residents, such as traffic congestion, noise pollution, and parking problems. If this conjecture holds, the onset of Phase II was not a significant favorable factor in housing prices anymore, as indicated by the results of this study.

In the analysis of multi-family housing units (marked by blue dots in Figure 4), the time-specific influences of park development differ from the results shown for apartment housing units. Unlike in the case of apartment units, the park did not generate announcement effects on multi-family housing units in 2006, and the initial negative externality continued until Phase I construction began. During and after Phase I construction, however, the park appeared to generate premiums, but by smaller magnitudes—up to a 2% incremental increase in property values associated with locations 100 meters closer to the park on average. This trend continued through Phase II of the project.

Contextual knowledge may contribute an explanation for the delayed and smaller economic effects of the park on multi-family housing units. As mentioned above, multi-family housing units are sparsely located around the first phase of the park, and therefore, the small sample size may have prevented this analytical model from capturing the effect at the given statistical level. The characteristics of multi-family housing may also provide clues. Because they are bought and sold at relatively cheaper prices than apartment units, multi-family housing units became more preferable after the economic downturn starting in late 2008. According to Ministry of Land, Transport and Maritime Affairs (2015), the number of construction permits of apartments has declined every year since early 2010 to the present, whereas that of multi-family housing has increased. Also, the conversion of multi-family housing units to commercial or retail properties has been increasingly popular in the area where park development has progressed; as such, the price of multi-family housing might become more sensitive to the distance to the park (D.W. Jeong, 2015). For restaurants, cafés, art shops, small boutiques, and lodgings, proximity to a park could be a critical location factor for successful operations (Lee, 2015a).

Table 1. Results of the random-coefficient multilevel regression model on apartment samples

| Variables | Apartment | | | |
|---|---|---|---|---|
| Distance to Gyeongui Line Park | < 500m | < 800m | < 1500m | > 1500m |
| *Dist_GLP* (in 10m increment) (Distance to Gyeongui Line Park) | −0.00426*** (0.00104) | −0.000766** (0.000373) | 0.000159 (0.000136) | 0.000216** (8.70e−05) |
| Ward Fixed Effects | | | | |
| *W_MP* (Mapo-Gu) | 0.235** (0.103) | 0.265*** (0.0430) | 0.105*** (0.0174) | −0.0996*** (0.0188) |
| *W_SD* (Seodaemun-Gu) | 0.146* (0.0845) | −0.0386 (0.0503) | −0.220*** (0.0202) | −0.149*** (0.0197) |
| *W_J* (Jung-Gu) | − | − | − | 0.0241 (0.0251) |
| *W_YS* (Yongsan-Gu) | − | − | − | − |
| Structural Variables | | | | |
| *Number of floors* | 0.00606*** (0.000401) | 0.00604*** (0.000351) | 0.00646*** (0.000280) | 0.00512*** (0.000264) |
| *Built year* | 0.0340*** (0.00239) | 0.0107*** (0.000812) | 0.00860*** (0.000434) | 0.00489*** (0.000264) |
| *Number of bathrooms* | −0.0159** (0.00697) | 0.0192*** (0.00599) | 0.0160*** (0.00478) | 0.0610*** (0.00362) |
| *Number of bedrooms* | −0.0428*** (0.00729) | −0.0366*** (0.00604) | −0.0240*** (0.00444) | 0.0205*** (0.00313) |
| Neighborhood Variables (in 10m increment) | | | | |
| *Distance to subway station* | −1.32e−05 (0.000544) | −0.00104*** (0.000294) | −0.000254 (0.000205) | −0.00238*** (8.13e−05) |
| *Distance to bus station* | −0.0134*** (0.00174) | 0.00227*** (0.000541) | 0.00170*** (0.000295) | −0.00143*** (0.000287) |
| *Distance to kindergarten* | −0.00607*** (0.00129) | 0.000761 (0.000767) | 0.000710* (0.000366) | −0.000821*** (0.000205) |
| *Distance to school* | −0.0166*** (0.00144) | 0.00444*** (0.000754) | 0.00536*** (0.000211) | −0.00102*** (0.000124) |
| *Distance to university* | 0.00471*** (0.000731) | 0.000245 (0.000392) | 0.00122*** (0.000139) | 0.00175*** (8.68e−05) |
| *Distance to other parks* | 0.000209 (0.000162) | −0.000289*** (9.94e−05) | 0.000176*** (4.89e−05) | −0.000789*** (3.14e−05) |
| *Distance to cultural asset(s)* | −1.77e−05 (0.000730) | −0.00440*** (0.000345) | −0.00303*** (0.000153) | 0.00149*** (5.18e−05) |
| *Distance to public institution* | −0.00246*** (0.000651) | −0.00101*** (0.000320) | −0.000587*** (0.000148) | −0.00203*** (8.52e−05) |
| *Distance to police & fire station* | 0.00426*** (0.00108) | 0.00264*** (0.000432) | −0.000760*** (0.000154) | 0.000479*** (0.000102) |
| *Distance to Han River* | 0.00109*** (0.000173) | −0.000476*** (3.75e−05) | −0.000394*** (2.12e−05) | −2.69e−05 (2.47e−05) |
| *Distance to factory* | −0.00319*** (0.00103) | −0.00220*** (0.000450) | 8.47e−05 (0.000109) | −0.000131*** (4.95e−05) |
| *Distance to shopping center* | −0.000814 (0.000565) | 0.00297*** (0.000380) | 0.00193*** (0.000193) | 0.00115*** (4.53e−05) |
| *Distance to sport facility* | 0.00358*** (0.000409) | −0.00147*** (0.000283) | −0.00162*** (0.000128) | 0.00156*** (5.74e−05) |

| | | | | |
|---|---|---|---|---|
| *Distance to hotel* | −0.000696 | 0.00175*** | −0.000264*** | −0.000854*** |
| | (0.000810) | (0.000288) | (0.000101) | (7.41e−05) |
| *Distance to main roads* | 0.0102*** | 0.00176** | 0.00160*** | 0.00294*** |
| | (0.00128) | (0.000711) | (0.000239) | (0.000287) |
| Demographic Variables | | | | |
| *Percentage with high education* | 0.787*** | 0.642*** | 0.638*** | −0.246*** |
| | (0.0679) | (0.0514) | (0.0273) | (0.0182) |
| *Percentage more than 65 years* | 1.867*** | 0.797*** | 0.835*** | 0.336*** |
| *old* | (0.230) | (0.0879) | (0.0502) | (0.0404) |
| *Percentage less than 15 years* | −0.695*** | −1.102*** | −0.865*** | 0.236*** |
| *old* | (0.193) | (0.0578) | (0.0377) | (0.0251) |
| *Population density* | 1.41e−06*** | −3.74e−07*** | −7.54e−09 | 5.28e−08 |
| | (2.35e−07) | (1.36e−07) | (5.00e−08) | (4.58e−08) |
| Constant | −61.84*** | −14.73*** | −11.13*** | −3.910*** |
| | (4.705) | (1.597) | (0.864) | (0.531) |
| Random effects | | | | |
| $\Sigma\ \mu$ | 0.176 (0.00715) | | | |
| $\Sigma\ \varepsilon$ | 0.321 (0.00167) | | | |
| $\rho$ | 0.231 (0.0146) | | | |
| Observations | 1,827 | 3,886 | 6,533 | 12,277 |
| Number of groups | 323 | 338 | 341 | 342 |

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 2. Results of the random-coefficient multilevel regression model on multi-family housing samples

| Variables | Apartment | | | |
|---|---|---|---|---|
| Distance to Gyeongui Line Park | < 500m | < 800m | < 1500m | > 1500m |
| *Dist_GLP* (in 10m increment) (Distance to Gyeongui Line Park) | −0.000963<br>(0.000960) | 0.00111**<br>(0.000435) | 0.00122***<br>(0.000131) | 0.000400***<br>(6.37e−05) |
| **Ward Fixed Effects** | | | | |
| *W_MP* (Mapo-Gu) | −0.480***<br>(0.0966) | −0.619***<br>(0.0463) | −0.412***<br>(0.0225) | −0.232***<br>(0.0147) |
| *W_SD* (Seodaemun-Gu) | −0.659***<br>(0.0903) | −0.840***<br>(0.0500) | −0.580***<br>(0.0258) | −0.592***<br>(0.0182) |
| *W_J* (Jung-Gu) | − | − | − | −0.428***<br>(0.0191) |
| *W_YS* (Yongsan-Gu) | − | − | − | − |
| **Structural Variables** | | | | |
| *Number of floors* | 0.0396***<br>(0.00400) | 0.0464***<br>(0.00333) | 0.0375***<br>(0.00221) | 0.0406***<br>(0.00151) |
| *Built year* | 0.0100***<br>(0.000860) | 0.00821***<br>(0.000679) | 0.00974***<br>(0.000418) | 0.00763***<br>(0.000275) |
| *Number of bathrooms* | − | − | − | − |
| *Number of bedrooms* | − | − | − | − |
| **Neighborhood Variables** (in 10m increment) | | | | |
| *Distance to subway station* | −5.18e−05<br>(0.000688) | −0.000637*<br>(0.000374) | −0.00277***<br>(0.000181) | −0.00116***<br>(9.22e−05) |
| *Distance to bus station* | 0.00135<br>(0.000983) | 0.00233***<br>(0.000702) | 0.000419<br>(0.000524) | −0.00295***<br>(0.000285) |
| *Distance to kindergarten* | 0.00462***<br>(0.000869) | 0.00314***<br>(0.000685) | −0.000819*<br>(0.000447) | −0.00406***<br>(0.000301) |
| *Distance to school* | −0.00128**<br>(0.000615) | −0.000706*<br>(0.000420) | 0.000233<br>(0.000260) | 0.00138***<br>(0.000163) |
| *Distance to university* | 0.000766<br>(0.000614) | 0.00185***<br>(0.000365) | 6.96e−06<br>(0.000162) | −0.000627***<br>(9.77e−05) |
| *Distance to other parks* | −0.000259**<br>(0.000117) | −0.000175**<br>(8.25e−05) | −0.000114**<br>(5.49e−05) | −0.000130***<br>(3.55e−05) |
| *Distance to cultural asset(s)* | −0.000823<br>(0.000701) | 0.000378<br>(0.000334) | −0.00110***<br>(0.000137) | 0.000254***<br>(8.14e−05) |
| *Distance to public institution* | −0.00102**<br>(0.000494) | −0.000653**<br>(0.000270) | −0.000300**<br>(0.000120) | −0.000551***<br>(9.63e−05) |
| *Distance to police & fire station* | −0.00111*<br>(0.000571) | −0.000973***<br>(0.000343) | 0.000134<br>(0.000165) | −0.000213**<br>(9.60e−05) |
| *Distance to Han River* | −0.000453***<br>(0.000105) | −0.000350***<br>(4.96e−05) | −0.000195***<br>(2.57e−05) | 0.000150***<br>(1.91e−05) |
| *Distance to factory* | 4.79e−05<br>(0.000509) | −9.51e−05<br>(0.000222) | −0.000340***<br>(9.71e−05) | −3.78e−05<br>(5.29e−05) |
| *Distance to shopping center* | 0.000273<br>(0.000393) | −4.64e−05<br>(0.000302) | 0.00184***<br>(0.000154) | 0.00118***<br>(6.23e−05) |
| *Distance to sport facility* | 0.00128***<br>(0.000432) | 0.00179***<br>(0.000225) | 0.000492***<br>(0.000114) | 0.000896***<br>(9.62e−05) |

| | | | | |
|---|---|---|---|---|
| *Distance to hotel* | 0.00127** | 0.000202 | 0.00101*** | 0.00137*** |
| | (0.000494) | (0.000261) | (0.000122) | (8.71e−05) |
| *Distance to main roads* | −0.00298*** | −0.00485*** | −0.00162*** | 0.000992*** |
| | (0.00116) | (0.000774) | (0.000494) | (0.000284) |
| Demographic Variables | | | | |
| *Percentage with high education* | −0.0475 | 0.0402 | 0.0671** | −0.154*** |
| | (0.0859) | (0.0555) | (0.0315) | (0.0200) |
| *Percentage more than 65 years old* | 0.391 | 0.931*** | 1.026*** | 0.496*** |
| | (0.263) | (0.172) | (0.108) | (0.0713) |
| *Percentage less than 15 years old* | −0.181 | −0.316*** | −0.301*** | −0.259*** |
| | (0.181) | (0.120) | (0.0695) | (0.0556) |
| *Population density* | −1.45e−06** | −8.53e−07** | −1.69e−07 | 2.04e−07 |
| | (5.64e−07) | (4.08e−07) | (2.44e−07) | (1.42e−07) |
| Constant | −13.79*** | −10.37*** | −13.39*** | −9.388*** |
| | (1.725) | (1.352) | (0.836) | (0.551) |
| Random effects | | | | |
| $\Sigma\ \mu$ | 0.259 (0.0103) | | | |
| $\Sigma\ \varepsilon$ | 0.456 (0.00185) | | | |
| $\rho$ | 0.244 (0.147) | | | |
| Observations | 2,818 | 4,256 | 10,566 | 20,134 |
| Number of groups | 335 | 344 | 345 | 345 |

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

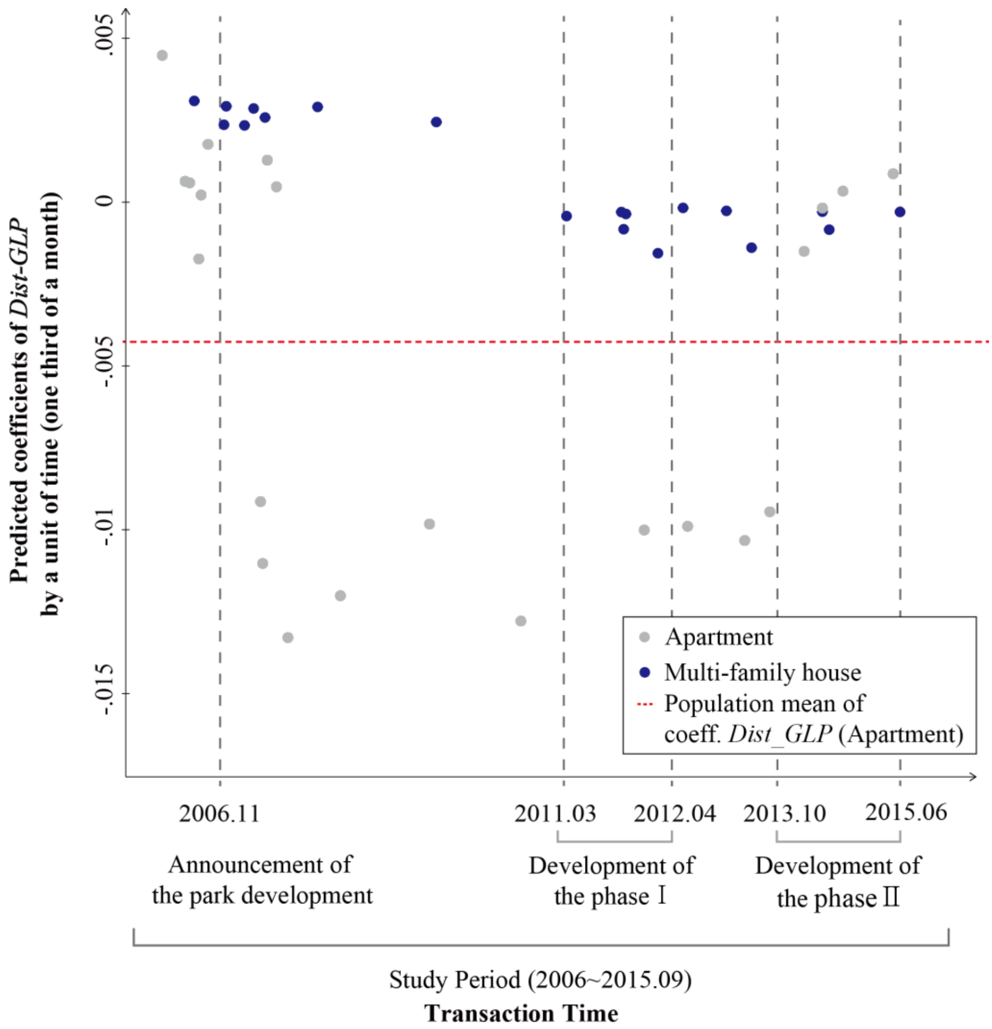


Figure 4. The coefficients of the "distance to the Gyeongui Line Park (within 500 meters)" by Level−2 group (one third of a month) from random−coefficient multilevel regression

# 6. Discussion

This study investigated how the Gyeongui Line Park project has influenced the surrounding neighborhoods' real estate market values over the project's development phases—announcement, planning, public opening, and beyond—by using market transaction records of both apartments and multi−family housing. As discussed above, urban amenity projects tend to exert heterogeneous effects over time, and therefore time−scale should be incorporated into impact analyses to fill gaps left by cross−sectional studies, and to draw productive policy implications accordingly.

As hypothesized, the project has generated differing price effects throughout the development period. Apartment units saw the largest premiums after the public announcement of the procurement plan and sustained large premiums before Phase II construction began. During and after Phase II, however, the size of the premium declined and did not return to the level observed during Phase I of the project. Multi−family housing units did not see park−related premiums before the beginning of Phase I construction. Following construction, the park appears to be associated with premiums for multi−family housing units, but in a lesser order of magnitude than those of apartments.

The analytical results of this study support the idea that parks can be used as a means to revitalize real estate markets in neighboring communities. Increased residential property values indicate a larger amount of property tax revenue, which could benefit the neighborhood in the form of improved public services. This virtuous cycle could eventually bring forth an overall enhancement of a neighborhood.

That said, the negative effects of this project should not be overlooked. While the neighborhood has been moving upwardly, small businesses have suffered as a result of fiscal burdens from increased rents and operational costs, and some have had to leave the area involuntarily (B.M. Kim, 2015). Some argue for the necessity of government-driven programs to protect existing tenants, while others claim that gentrification is a positive outcome of urban revitalization. Considering that relatively large public resources are committed to such influential projects (Shin et al., 2006), balanced guidelines should be established to benefit wider groups of people and businesses fairly (Yoon & Currid-Halkett, 2015). Promoting the local economy should be linked closely with compensating members of the community who are negatively affected by revitalization projects. As such, collaborative governance systems should be developed, and opinions from existing inhabitants should be respected (Mo, 2015).

Urban revitalization practices generally take 10 to 30 years (Shin, 2015a); throughout this long process, a variety of small projects are announced and completed, creating fluctuations within neighboring housing markets due to homebuyers' expectations of neighborhood improvement as well as speculative investments. From a short-term perspective, increased property values in formerly derelict neighborhoods may seem a desirable outcome; however, this should not be misunderstood as fulfilling the purpose of urban revitalization. The early, positive price effects on building stock would eventually disappear if projects such as Gyeongui Line Park do not satisfy original expectations, or if they cause negative externalities.

For long-term and balanced benefits, governments should select projects that correspond with the current demand from the original inhabitants, as well as future demand of incoming residents and visitors, by developing a governance structure with locals and assessing current neighborhood issues. While this additional step may delay the process, it may reduce the risk of shortened or negative project impacts (Shin, 2015b).

In South Korea, approximately 820 kilometers of railway have been deaccessioned; roughly 24% have been redeveloped as open spaces (Y.S. Jeong, 2015). The remaining portion has the potential to become a great local amenity and popular tourism attraction, such as in the case of Gyeongui Line Park. If the South Korean government and others are to maximize the positive effects of urban revitalization, findings from this study and its methodology may be valuable in determining the course of future planning efforts.

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# Abstract (Korean)

경의선 공원 프로젝트는 서울시 도시 공원 프로젝트의 일환으로, 낙후된 근린 환경의 재활성화를 목적으로 실시되었다. 본 연구는 경의선 공원 프로젝트가 주택 가격에 미치는 영향을 분석하는 데 목적을 두고 있다. 기존의 헤도닉 연구들과는 달리, 본 연구에서는 프로젝트의 시작부터 완료 단계까지 공원 개발 과정에 따른 가격 영향의 변화를 분석하는데 초점을 두고, 경의선 공원 프로젝트가 인근 지역의 주택 가격에 언제, 그리고 어느 정도의 범위까지 영향을 미치는지를 분석하였다. 분석 결과에 따르면 경의선 공원 프로젝트는 아파트와 다세대/연립 주택 모두에 긍정적인 외부효과를 발생시켰으며, 가격 영향의 정도는 프로젝트 개발 단계 및 주택 유형 별 상대 위치에 따라 다르게 나타났다. 먼저 아파트 시장에서는 2006년 경의선 공원 개발이 공시되며 공원에 100m 접근당 약 15%의 가격 프리미엄이 형성되었다. 이러한 프리미엄은 1단계 개발이 완료될 때까지 지속되다가, 2단계 공사가 시작되며 0-3%로 감소하였다. 다세대 주택 시장에서도 경의선 공원 프로젝트가 주택 가격에 긍정적인 영향을 미쳤으나, 아파트에 비하여 가격 영향의 정도가 상대적으로 작게 나타났다. 2012년에 1단계 개발이 시작되며 경의선 공원에 100m 접근 당 약 2%의 가격 프리미엄이 형성되었으며, 이는 2015년 6월까지 1-2%로 지속되었다. 본 연구의 결과와 방법론은 향후 도시 재활성화 프로젝트의 긍정적인 효과를 극대화하기 위한 도시계획 의사결정 과정에 활용될 수 있을 것으로 기대된다.

키워드: 경의선 공원, 도시 재활성화, rail-to-trail, 임의계수모델

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