Master’s Thesis of Landscape Architecture

Effects of greenbelt cancellation on land value: The case of Wirye New Town, South Korea

개발제한구역 해제가 지가에 미치는 영향: 위례 신도시를 중심지로

February, 2019

Graduate School of Seoul National University

Department of Landscape Architecture and Rural Systems Engineering, Landscape Architecture Major

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Abstract

This study aims to examine the time−varying effects of greenbelt cancellation on surrounding land values, using random−coefficient multilevel modeling. The study site is Wirye New Town in Seoul, South Korea, an example of a government−driven urban development project on a repealed greenbelt, and the study period is from 1996 to 2015. The results suggest that the greenbelt cancellation has generated positive externalities on the remaining nearby greenbelt within a 500 m range, peaking at the groundbreaking for construction of the project, up to a price increment of 11.2% for each 100 m closer to the site. For non−greenbelt land parcels, a similar pattern was observed: externalities peaked at the announcement of the development plan with a relatively lower magnitude—up to 2.1%. These positive externalities might be due to increased expectation for a continued cancellation of greenbelts and heightened investment potential. In the rest of the study site beyond the 500 m range, the greenbelt cancellation and subsequent urban development seemingly yielded negative effects on both the greenbelt and non−greenbelt land parcels. Or, alternatively, the greenbelt effects might possibly be negligible due to remoteness, being masked by the effects of proximity to the urban center. The findings of this study will provide urban planners with better understanding of the economic impact of greenbelt cancellation on land markets.

Keyword : Externalities of greenbelts, Greenbelt development, Land value, Random−coefficient multilevel model

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Chapter 1. Introduction

Greenbelts are open spaces surrounding urban areas, set aside for the purposes of controlling excessive urban growth and preserving environmental and recreational resources (Nelson, 1985; Bengston and Youn, 2006; Amati, 2007; Lafortezza et al., 2013). Since the first designation in London in the 1930s, cities around the world have adopted greenbelts as a common urban containment policy. Asian mega-cities such as Tokyo, Seoul, and Bangkok, Sydney in Australia, and many European cities, including Berlin and Vienna, are examples (Bengston and Youn, 2006). City administrators, however, often feel pressure to release greenbelt land to development, since urban populations have grown exponentially and demands for land for housing and fundamental infrastructure have consequently increased (Gilbert, 2007; Yang and Jinxing, 2007; Jun, 2012;). The land scarcity within the cities and the barrier-like presence of greenbelts have caused exurban "leapfrog" developments beyond the growth limits (Fung and Conway, 2007), requiring citizens to make longer commutes and tightening the transportation capacity around the city (Jun and Bae, 2000; Kong, 2012).

In response to this circumstance, many countries have released greenbelt land. Greenbelt sites are in close proximity to densely developed urban areas, and the administrative process of taking them is relatively easy (Amati, 2007; Morrison, 2010; MOLIT, 2011; McWilliam et al., 2014; Papworth, 2015; Campaign to Protect Rural England, 2016). Examples include the UK, in that the government there planned to develop 275,000 housing units on a repealed greenbelt in 2015 (Campaign to Protect Rural England, 2016). The government of Australia, in the new development plan for Sydney in 2005, suggested easing 20,350 hectares of greenbelt to provide 160,000 housing units over the next 25–30 years (Gilbert, 2007). Seoul is no exception. Since 1998, its greenbelt has been gradually released to meet an appropriate level of housing supply, providing land for more than 10 million people wanting to live in the Seoul metropolitan area (Choi and Cho, 2012).

Such changes to greenbelts have exerted substantial externality effects on real estate markets. A large proportion of research has investigated those effects using cross-sectional analysis. One of the widely known and proven hypotheses is that the presence of a greenbelt causes land scarcity and drives up the price of both land and properties within and near its boundary (Lee and Linneman, 1998; Nicholls and Crompton, 2005; Herath et al., 2015; Jun and Kim, 2017). Relatively fewer empirical studies have revealed a greenbelt effect when it is cancelled; some argue that such changes decrease housing prices due to the fear of potential housing oversupply on the repealed land (Jun, 2012), while others argue that such changes increase the land values within and around the greenbelt, reflecting speculators' hopes that major developments on the repealed land might raise the visibility of the neighborhood (Lee, 2008; Lee and Heo, 2011; Byun et al., 2013).

However, the effect of greenbelt cancellation is more complex than what can be explained by a before-and-after comparison. Adjusting greenbelts requires a long and multi-pronged administrative process, to which the real estate markets in the vicinity react rather sensitively (MOLIT, 2011; Byun et al., 2013).

In some cases, when land speculation becomes excessive in the property market, governments constrain real estate transactions in and around the subject site (MOLIT, 2011; Chen and Heath, 2017); in other cases, when the property market is down, governments do the opposite, such as offering tax exemption on the acquisition and transfer of properties (White and Allmendinger, 2003; Park, 2012). Depending on the real estate market conditions, governments decide to impose regulation or deregulation to alter the effect of greenbelt cancellation on property values. The effects of greenbelt cancellation may differ according to the effects of regulatory changes.

While this anecdotal evidence is obvious from real life practices, the empirical research conducted has been insufficient to decipher the continuous and non-linear effects of greenbelt cancellation. Most of the research analyzed the effect of greenbelt cancellation on properties value only through cross-sectional or before-and-after comparison approaches (Jun and Bae, 2000; Cheshire and Sheppard, 2002; Byun et al., 2013; Jun and Kim, 2017). The uniqueness of this study is that I addressed the externalities of greenbelt cancellation throughout the entire process, from before the announcement of greenbelt cancellation to the residential development on it, with an innovative statistical approach - random-coefficient multilevel modeling structured by time. Against this backdrop, I aim to analyze the time-varying externality effect of greenbelts on land price during the process of the cancellation, in the case of a government-driven housing development project on a repealed greenbelt called Wirye New Town in Seoul, South Korea. Unlike extant studies, ours employs random-coefficient multilevel modeling structured by time to reveal the continuously changing effects in response to milestones of the implementation, from 1996 when the debate for greenbelt cancellation began to 2015 when the housing development project was partially complete and people started to move in.

Chapter 2. Background

2.1 Greenbelts in Korea

In 1971, the South Korean government began designating greenbelts around major cities to control the urban sprawl spurred by the rapid industrialization and urbanization of the 1960s. Beginning with the establishment of 454.21 km^2 in the Seoul metropolitan area, the government designated greenbelts for 14 other major and medium-sized cities up to 1977, totaling 5,397 km^2 or 5.4% of the land area of the country (Kim et al., 2015). In the early days after the designation, it was believed that the greenbelt functioned well, since it prevented the disorderly spread of the cities, preserved natural environments, and provided green amenities to citizens (Lee and Linneman, 1998).

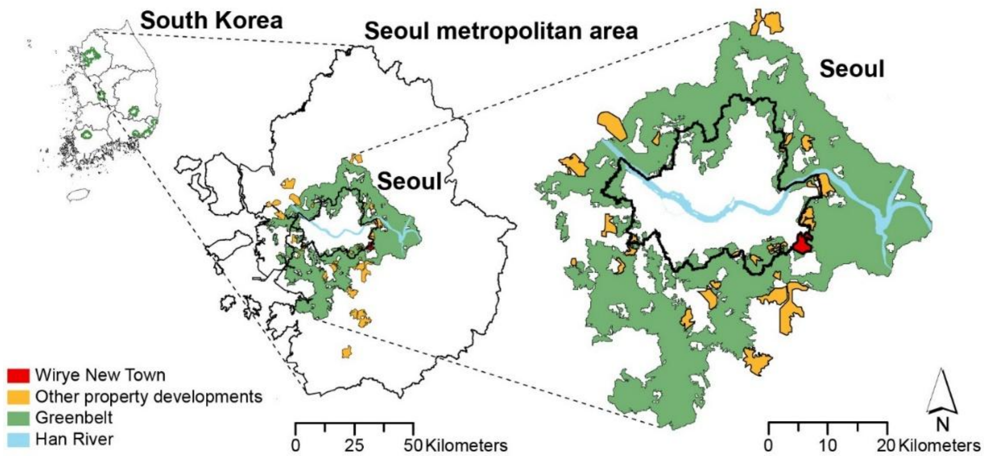

Figure 1. The location of the greenbelt in the Seoul metropolitan area, Wirye New Town, and other property developments

However, as Seoul developed, the real estate property development pressure within the city also grew. Land prices around the greenbelt boundary increased in response to the land scarcity, and the "leapfrog" development over the greenbelt led to the sprawl of the Seoul metropolitan area, resulting in inefficient land use and increased commuting costs (Jun and Bae, 2000; MOLIT, 2011). In the late 1980s, additional designations of greenbelt land and congestion in the urban core spurred unauthorized land developments near the greenbelt boundary; a phenomenon that quadrupled from 1987 to 1989 (Donga Newspaper, 1989).

Deregulation from the 1980s to the early 1990s mainly focused on market adjustment of land prices, which had increased two-fold on average, and on legalizing formerly banned activities, such as change of land use, expansion of existing facilities, and construction of new facilities for public use (MOLIT, 2011). The first greenbelt repeal plan, enacted in 1998, further enabled cancellation of greenbelt status when property development was needed and the subject greenbelt land had low ecological value. Consequently, 1,543 km^2 (28.6% of the original greenbelt) were released, and 343 k^2 were designated as semi-developable land to be developed when municipalities were ready (Kim et al., 2015). In 2008, the central government endowed local municipalities with the authority to cancel greenbelt status when they have convincing reasons. Additionally, 188.7 km^2 of greenbelt land were released as semi-developable land, mostly for the purposes of stabilizing real estate markets, creating jobs, revitalizing the local economy, and improving the citizens' welfare (MOLIT, 2011).

2.2 Wirye New Town

Wirye is one of the New Town projects planned to meet the great housing demand of the southern part of Seoul (Choi et al., 2011). New Town projects are one type of large-scale comprehensive development on repealed greenbelt area, purposed to create self-sustainable urban sub-centers; thus the project embraces not only the residential development but also procuring supplementary infrastructures such as commercial and industrial complexes, transportation facilities, and utility facilities (Kim, 2007). The site area is 6.8 km^2, containing new subway lines, transit malls, and 42,947 housing units. The development plan was announced in 2005, the construction began in 2008, and the expected completion date is 2021 (Choi et al., 2011; Kim, 2017). People have lived in the city since 2015, and some of the housing units, tram lines, and subway stations are currently under construction (Kim, 2017). Fig. 2 depicts the milestones of the greenbelt cancellation and the Wirye New Town development process.

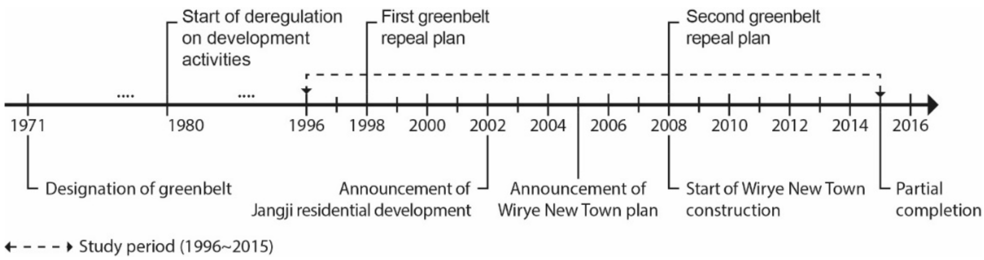

Figure 2. Milestones of the Wirye New Town development

Before 2002, the land within and around Wirye New Town was not attractive to developers, because it had long been part of a greenbelt and no imminent cancellation plan was foreseeable. The first greenbelt repeal plan in 1998 was not applicable to the Wirye New Town site. In 2002, a new housing development project—called Jangji residential development, 0.65 km^2 for 5,677 housing units—was announced for nearby land (Seoul Housing & Communities Corporation, 2015). The Wirye New Town site received positive externalities generated by the expectation of further developments after 2002. In 2005, the greenbelt status of the Wirye New Town site was cancelled and the New Town development plan was announced. Compared to other New Towns, the Wirye New Town site has increasingly gained popularity for its locational advantage; it was located near one of the main downtowns of Seoul – Gangnam and Jamsil, while the land value was relatively inexpensive due to its former history as greenbelt (Yoon, 2012). From anecdotal sources, it is reported that the original landowners and speculators began to react, driving up the price of land (Choi et al., 2011; Kim et al., 2015). Individual investors and construction companies were eager to buy land for property developments within Wirye New Town, generating premiums over the original value (Kim, 2013).

Dynamic externalities have continued throughout the development process. After the announcement in 2005, the asking price of housing units bordering the Wirye New Town rose when the then-current owners withdrew their properties from the market, further reducing the supply (Cho and Yoon, 2005). However, soon after, the government intervened with policies to constrain real estate transactions around and within Wirye New Town, prohibiting reselling for 10 years after any transaction and establishing a price ceiling for properties in Wirye New Town (Lee, 2005; Lim, 2006). With the beginning of construction in 2008, the property market seemed to have stabilized (Park, 2008a); however, the newly built housing units have attracted substantial attention from home-buyers since 2012, and simultaneously the price of existing housing units in the vicinity has declined (Ha, 2003; Jung, 2013; Mun, 2013).

Chapter 3. Literature review

The designation and cancellation of greenbelts affect surrounding property markets in diversified ways. In theory, the designation of a growth boundary should increase the land values within, while decreasing those beyond the boundary (Nelson, 1985; Knaap and Nelson, 1988; Bengston and Youn, 2006; Jaeger, 2006; Kim et al., 2007). This difference is mainly due to changes in the equilibrium of supply and demand for land (Knaap and Nelson, 1988; Dawkins and Nelson, 2002; Jaeger, 2006). With a greenbelt in place, the land within the boundary becomes scarce, causing the increase of land values (Jaeger, 2006). Meanwhile, the desirability of land within the boundary increases, because greenbelts improve the quality of urban environments by preserving natural resources and providing enjoyable amenities (Nelson, 1985; Jaeger, 2006; Yoon, 2017a). The land beyond the boundary, however, becomes devalued due to inconveniences such as long commuter distance (Jun and Bae, 2000) and disconnection from the urban center (Kuhn, 2003; Papworth, 2015).

The cancellation of a greenbelt restores the price equilibrium (Jun, 2012; Jun and Bae, 2000). For example, Byun et al. (2013) compared the price of remaining greenbelt land in Gyunggi-do, South Korea, before, during, and after the partial cancellation of the greenbelt, and revealed that the partial cancellation had led to a rapid increase in the price of the remaining greenbelt land in the short term. Kim (2011) conducted a panel analysis with land and housing data from 1995 to 2007 in South Korea, suggesting that a 1% increase of the greenbelt area ratio in a city is associated with 2.15%

and 2.95% land price increments at the national level and the Seoul metropolitan level, respectively.

A considerable body of hedonic research explains the amenity value of greenbelts and its proximity effects on nearby properties; the results diverge. Cheshire and Sheppard (2002), using 433 housing sales data from the UK in 1984, examined the net costs of a greenbelt cancellation by calculating the reduced amenity values. The findings suggest that each household would experience a welfare loss of £210.94 or £407.44, depending on the degree of the cancellation. Nicholls and Crompton (2005), by analyzing 700 property transactions in the three neighborhoods around Barton Creek Greenbelt, Lost Creek, and Wilderness Park in Austin, Texas, suggested a positive externality. Prices of properties directly adjacent to the greenbelt within Barton Creek rose by $44,332 (12.2%) on average, and the prices of properties within Lost Creek increased $3.97 for each foot closer to the nearest greenbelt entrance.

Herath et al. (2015) conducted a spatial hedonic analysis to examine the effect of a greenbelt on housing price in Vienna, Austria. The findings indicated that distance from the greenbelt was an important factor in housing prices, as prices declined by 0.13–0.26% with every 1% increase in the distance from the greenbelt. On the other hand, Jun and Kim (2017), also using spatial hedonic analysis, found a negative effect of greenbelt proximity on apartment rent in Seoul, in that the rent decreased by 3.83–3.85% for each 500 m closer to the nearest greenbelt. Deaton and Vyn (2015) showed, by analyzing the effect of Ontario's greenbelt around the Greater Toronto Area, that the greenbelt negatively influenced vacant farmland values located within a 10 km distance from urban areas.

Chapter 4. Analytical design

4.1 Research question

In this study, I aim to investigate the changes in the land values around the Wirye New Town in response to the greenbelt relaxation from 1996 to 2015. The research question addressed here is whether—and, if so, to what extent—the process of greenbelt cancellation has affected the land value of the surrounding area. To answer this question, I conduct a set of random-coefficient multilevel regression analyses for two different areas surrounding the repealed greenbelt (or Wirye New Town).

4.2 Study site and period

The study site is the area surrounding the repealed greenbelt site for Wirye New Town, including all parcels within 1.5 km from the boundary. The repealed greenbelt itself is not the subject of the analysis. The study site is stratified into two zones, because the effect of the greenbelt cancellation is expected to differ in two types of areas: 1) the greenbelt zone that has remained greenbelt since its first designation in 1971, and 2) the non-greenbelt zone that was never designated as greenbelt. To estimate the varying distance effect, each zone is further stratified into three groups by its distance from the site: 0-500 m, 500-1,000 m, and 1,000-1,500 m (that is, 5-, 10-, and 20-minute walking distances). Fig. 3 depicts the location of the repealed greenbelt (Wirye New Town), the two zones, and the three distance rings.

The study period is from 1996 to 2015. This period includes milestone changes in the greenbelt policies from the late 1990s and the early 2000s and the period embracing the Wirye New Town development process from the first announcement of the development plan in 2005 to the beginning of occupation in 2015.

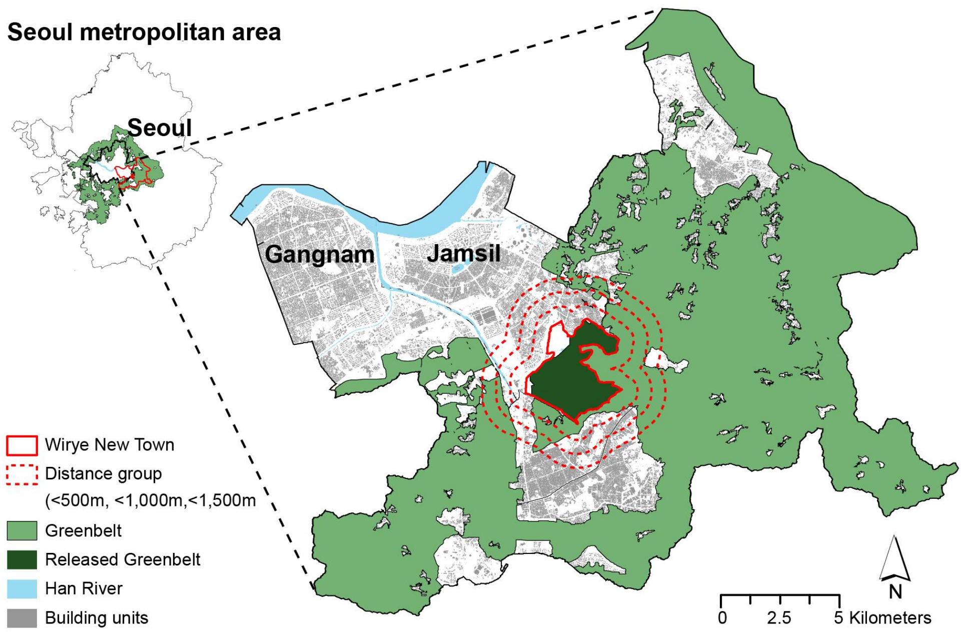

Figure 3. The location of Wirye New Town, the boundary of the study site, and the three distance groups

4.3 Data

The primary dataset is officially assessed individual land price from the Korea Appraisal Board (KAB) from 1996 to 2015. The Ministry of Land Infrastructure and Transport (MOLIT) annually assesses land values for taxation purposes. The assessed land value reflects about 70% of the real transaction values (Kim and Kim, 2006; Koo, 2006). For our analysis, 345,808 parcels are used. Among those, 5,028 parcels, or 1.45% of the total sample, are in the greenbelt zone, and 340,780 parcels, or 98.55% of the total sample, are in the non-greenbelt zone. All the prices from multiple years are adjusted to the value of 2015, using the Consumer Price Index (CPI) provided by the Korean Statistical Information Service (KSIS). Information on building factors were sourced from a building register database provided by the Electronic Architectural Administration Information System of MOLIT. Locational factors were sourced from the National Transport Information Center of MOLIT, and from the Korea Appraisal Board.

4.4 Measures

The dependent variable is log of assessed land price per square meter: ln (Land_price). The question variable is Dist_Wirye, the Euclidean distance to the boundary of Wirye New Town from the center point of each land parcel, measured in 100-m increments.

To deduce the effect of the question variable, I control the three groups of explanatory variables: land, building, and location factors of the land parcel (Min, 2006; Herath et al., 2015, among many). Land factors include land classification by its purpose (Land_Category), land use (Land_Use), zoning (Land_Zoning), elevation (Elevation), and level of road accessibility (Road-access). Building factors describe construction activities allowed in the subject parcel, such as area of parcel, ground floor area of main buildings, ground floor area of supplementary buildings, gross floor area of entire building, net floor area for calculating floor area ratio, parking area (Area_Parcel, Area_Main_building, Area_Sub_building, Area_Total_floor, Area_Ratio_floor, Area_Parking_lot), total unit of detached house, apartment house, congregate house (Number_Detached_house, Number_Apartment, Number_Congregate_house), number of supplementary buildings, elevator, emergency elevator, parking lot, ground floor, underground floor (Number_Sub_building, Number_Elevator, Number_Emergency_elevator, Number_Parking_lot, Number_Ground_floor, Number_Underground_floor), and height of tallest building (Height_Building). Locational factors indicate the distance to important urban features considered to generate externalities on land price; examples are the distance to elementary schools, middle schools, high schools, special schools and universities (Dist_Elementary_school, Dist_Middle_school, Dist_High_school, Dist_Special_school, Dist_University), arterial roads, highways (Dist_Arterial_road, Dist_Highway), and hazard facilities (Dist_Hazard_facility). I exclude variables with variance inflation factor (VIF) exceeding 5 from the models. I also include wards fixed-effect to control unobserved location characteristics. Detailed description of variables is presented in the Table 1.

Table 1. Descriptive statistics for variables used in the analytical model

Variables	Description	Mean	Std. Dev	Min	Max
Ln(Parcel price per square	Log of the officially assessed	14.430	0.582	7.974	16.697

meters	individual land price per square meters				
Dist_Wirye	Distance to the boundary of Wirye New Town (in 100m)	8.462	4.014	0.016	15
Land variables					
Land_Category	Dummy variable of land category (field, paddy, forestland, others, and reference : building)				
Land_Use	Dummy variable of land use (commercial use, residential-commercial use, paddy use, forestland use, public use, other uses, and reference : residential use)				
Land_Zoning	Dummy variable of land zoning (commercial zoning, green-land zoning, , other zoning, and reference : residential zoning)				
Elevation	Dummy variable of elevation (gentle slope, other slopes, and reference : flat land)				
Road-access	Dummy variable of accessibility with road (road 8m and 12m, between 12m and 25m, more than 25m, no available road and reference : road less than 8m)				
Building variables					
Area_Parcel	Area of individual parcel (in $1m^2$)	447.982	11,936.4	0	1,001,545
Area_Main_Building	Ground floor area of main building (in $1m^2$)	167.545	6,579.991	0	830,110
Area_Sub_building	Ground floor area of substantial building (in $1m^2$)	7.500	310.590	0	27,394.080
Area_Total_floor	Total floor area of entire building (in $1m^2$)	459.599	4,172.721	0	426,635.600
Area_Ratio_floor	Validate total floor area for calculating floor area ratio, and parking area (in $1m^2$)	337.931	3,414.306	0	260,534.200
Area_Parki	Area of Parking	62.98	3,277.3	0	418,554

ng lot	lot (in $1m^2$)	1	98		
Number_Detached	Total unit of detached house	1.674	1.960	0	49
Numer_Apartment	Total unit of apartment house	3.744	42.255	0	5,366
Number_Congregate	Total unit of congregate house	0.292	7.523	0	1,570
Number_Sub_building	Number of supplementary building	0.067	0.467	0	30
Number_Elevator	Number of elevator	0.068	0.578	0	43
Number_Emergency elevator	Number of emergency elevator	0.011	0.541	0	47
Number_Parking lot	Number of parking lot	5.145	279.353	0	36,396
Number_Ground floor	Number of ground floor	2.959	1.584	0	29
Number_Underground floor	Number of Underground floor	0.795	0.444	0	6
Height_Building	Height of tallest building (in 1m)	5.042	6.993	0	85
Location variables					
Dist_Elementary	Distance to the nearest elementary school (1unit : 100m)	2.792	1.645	0.000	19.050
Dist_Middle	Distance to the nearest middle school (1unit : 100m)	6.675	4.457	0.006	28.620
Dist_High	Distance to the nearest high school (1unit : 100m)	9.508	4.458	0.000	30.495
Dist_Special	Distance to the nearest special school (1unit :	8.806	4.328	0.004	29.868

	100m)				
Dist_University	Distance to the nearest university (1unit : 100m)	18.268	11.633	0.014	39.694
Dist_Arterial road	Distance to the nearest arterial road (1unit : 100m)	12.608	8.873	0.024	35.789
Dist_Highway	Distance to the nearest highway (1unit : 100m)	15.418	10.113	0.137	41.243
Dist_Hazard	Distance to the nearest hazard facility (1unit : 100m)	24.799	9.646	0.000	50.533
Ward fixed-effects					
W_GN(Gangnam-gu)	Dummy variable of fixed-effect of Gangnam ward				
W_SP(Songpa-gu)	Dummy variable of fixed-effect of Songpa ward				
W_SJ(Sujung_gu)	Dummy variable of fixed-effect of Sujung ward				
W_JW(Jungwon-gu)	Dummy variable of fixed-effect of Jungwon ward				
W_HN(Hanam-si)	Dummy variable of fixed-effect of Hanam ward				

4.5 Analytical plan

I adopt random-coefficient multilevel regression modeling. Multilevel specification provides unbiasedness and efficiency in estimating parameters when the data have a hierarchical or cluster structure (Hox, 1998). When observations in the sample have strong autocorrelations within groups such as neighborhood or region or time, the independence assumption required for ordinary least square (OLS) strategy is violated (Wooldridge, 2015). Multilevel structuring decomposes the variance by hierarchy (level) —groups and individuals—and estimates group-specific effects as a group-specific intercept and/or coefficient of a question variable (Orford, 2002; Rabe-Hesketh and Skrondal, 2008).

Unlike multilevel hedonic studies in cross-sectional approach, whereby the group-level was specified as a spatial unit, such as district or neighborhood (Orford, 2002; Kang and Cervero, 2009; Feng and Jones, 2015), I specify it as a time period —the year—to assess the time-varying effect of greenbelt cancellation on the land value of surrounding parcels along the planning phase (Jung et al., 2016; Yoon, 2017b). According to the intra-class correlation test, 44.7% of land price variation is explained by the group level, validating the definition of the year as the group level.

Consequently, in the two-level structure of the model, the level-1 unit is land parcel and the level-2 unit is a year, in which I analyze land price of 345,808 parcels, grouped into 20 years from 1996 to 2015. As mentioned above, I stratified the sample and analyzed separately: 1) the greenbelt zone, that has always been greenbelt since its first designation in 1971, and 2) the non-greenbelt zone, that has never been greenbelt. Also, to discern the magnitude of the greenbelt cancellation, I stratified the sample by distance to the Wirye New Town: 0-500 m, 500-1,000 m, 1,000-1,500 m.

The models were specified as below: for ith parcel and jth period, Level−1 :

$$
\begin{aligned}
ln(Land\_price_{ij}) \\
&= \pi_{0j} + \pi_{1j}Dist\_Wirye_{ij} + \beta_2\boldsymbol{S_{ij}} + \beta_3\boldsymbol{B_{ij}} + \beta_4\boldsymbol{L_{ij}} \\
&+ \beta_5 W\_GN_{ij} + \beta_6 W\_SP_{ij} + \beta_7 W\_SJ_{ij} + \beta_8 W\_JW_{ij} + \beta_9 W\_HN_{ij} \\
&+ \varepsilon_{ij}
\end{aligned}
$$

Level−2 :

$$\pi_{0j} = \theta_0 + v_{0j}$$

$$\pi_{1j} = \theta_1 + v_{1j}$$

Composite model:

$$
\begin{aligned}
ln(Land\_price_{ij}) \\
&= \theta_0 + (\theta_1 + v_{1j})Dist\_Wirye_{ij} + \beta_2\boldsymbol{S_{ij}} + \beta_3\boldsymbol{B_{ij}} + \beta_4\boldsymbol{L_{ij}} \\
&+ \beta_5 W\_GN_{ij} + \beta_6 W\_SP_{ij} + \beta_7 W\_SJ_{ij} + \beta_8 W\_JW_{ij} + \beta_9 W\_HN_{ij} \\
&+ \varepsilon_{ij} + v_{0j}
\end{aligned}
$$

$Land\_price_{ij}$: the officially assessed individual land price per square meter

$Dist\_Wirye_{ij}$: the distance to the boundary of Wirye New Town

S_{ij} : a vector of land factors

B_{ij} : a vector of building factors

L_{ij} : a vector of locational factors

$W\_GN_{ij}, W\_SP_{ij}, W\_SJ_{ij}, W\_JW_{ij}, W\_HN_{ij}$: wards fixed−effect

ε_{ij} : Level − 1 residual

v_{0j} : Level − 2 residual for the intercept

v_{1j} : Level − 2 residual for the coefficient

Chapter 5. Analytical results

(1) Result for population-mean coefficient

The analytical result of this part reveals that Wirye New Town produced significant externalities to parcels in both greenbelt and non-greenbelt zones. Table 1 presents the population-mean coefficients of the parameters from multilevel regression, describing the mean value of the effect of greenbelt cancellation on land price for the entire study period, controlling for land, building, and locational factors.

In the greenbelt zone, Wirye New Town generated positive externalities up to 1,000 m distance from its boundary. The coefficients of the variable Dist_Wirye were −0.087 in the 0−500 m group, −0.057 in the 500−1,000 m group, suggesting that the price premium of being 100 m closer to the Wirye New Town is 8.7% and 5.7% in each distance group, respectively. On the other hand, the coefficient of the variable Dist_Wirye for the 1,000−1,500 m group is 0.123, meaning that the land price decreased −12.3% per 100−m distance closer to the Wirye New Town. In the non-greenbelt zone, I could observe the positive externality within 0−500 m with a 10% significance level, and negative externality within 500−1,000 m and 1,000−1,500 m groups. The magnitudes are, in the aforementioned order, 0.7%, −0.7%, and −1.1% price premium for being 100 m closer to the boundary, on average.

Table 2. Results of random−coefficient multilevel model on greenbelt and non−greenbelt zones

Variables	Greenbelt			Non−greenbelt		
Distance to Wirye New Town	<500m	<1,000m	<1,500m	<500m	<1,000m	<1,500m
Dist_Wirye	−0.0868*** (0.0085)	−0.0572** (0.0265)	0.1229*** (0.0187)	−0.0074* (0.0039)	0.0070*** (0.0008)	0.0109*** (0.0011)
Land_Category (Reference group: building)						
Category_Field	−0.3147*** (0.0313)	−0.3162*** (0.0804)	−0.4837*** (0.0382)	−0.0125 (0.008)	−0.0266** (0.0135)	−0.2339*** (0.0193)
Category_Paddy	−0.3676*** (0.0370)	−0.5656*** (0.1288)	−0.9712*** (0.0494)	−0.1507*** (0.0169)	−0.1540*** (0.0266)	−0.0507 (0.0324)
Category_Road	−	−	−	−0.6395*** (0.0905)	−0.4815*** (0.0875)	−0.6278*** (0.0696)
Category_Forestland	−0.7419*** (0.0523)	−0.7094*** (0.1268)	−1.8086*** (0.0647)	−0.3265*** (0.0155)	−0.1872*** (0.0166)	−0.8326*** (0.0432)
Category_Others	0.0562* (0.0325)	−0.0694 (0.0803)	−	−0.1549*** (0.0067)	−0.1000*** (0.0067)	−0.1040*** (0.0058)
Land_Use (Reference group: residential)						
Use_Commercial	0.4327***	−	0.5524***	0.4974***	0.5164***	0.4160***

	(0.0285)		(0.1541)	(0.0030)	(0.0023)	(0.0020)
Use_Residential−commercial	0.2295*** (0.0331)	−	0.2734** (0.1179)	0.2231*** (0.0016)	0.1772*** (0.0013)	0.1606*** (0.0010)
Use_Paddy	−1.0590*** (0.0309)	−	−0.4356*** (0.0324)	−0.5358*** (0.0176)	−0.4744*** (0.0154)	−0.2182*** (0.0117)
Use_Forestland	−2.0335*** (0.0565)	−	−	−1.6468*** (0.0366)	−1.5802*** (0.0256)	−0.4755*** (0.0419)
Use_Public	−2.5964*** (0.0813)	−	−	−0.6632*** (0.0132)	−0.3772*** (0.0123)	−0.6164*** (0.0080)
Use_Others	−1.336*** (0.0487)	−	−	−0.4477*** (0.0352)	−0.2562*** (0.0163)	−0.2576*** (0.0282)
Land_Zoning (Reference group: residential)						
Zoning_Commercial	−	−	−	−1.0726*** (0.1222)	−0.2978*** (0.0066)	−0.0702*** (0.0077)
Zoning_Green	−	−	−	−0.2622*** (0.0072)	−0.9293*** (0.0148)	−1.4084*** (0.0095)
Zoning_Others	−	−	−	−	−	0.2768*** (0.0396)
Elevation (Reference group: flat)						
Eleva_Gentle	−0.1613*** (0.0177)	0.2080*** (0.0721)	−0.3670*** (0.0420)	−0.3127*** (0.0020)	−0.2685*** (0.0014)	−0.1592*** (0.0011)

Eleva_Others	0.0935** (0.0377)	−	1.1599*** (0.2770)	0.0154 (0.0181)	−0.3292*** (0.0081)	−0.3370*** (0.0044)
Road−access (Reference group: road<8m)						
Access_8m<width<12m	0.0950** (0.0475)	0.6749*** (0.1091)	−0.5325*** (0.0862)	0.1151*** (0.0017)	0.1038*** (0.0013)	0.0764*** (0.0011)
Access_12m<width<25m	−0.4091* (0.2451)	1.7660*** (0.2640)	−	0.2645*** (0.0031)	0.1859*** (0.0024)	0.2481*** (0.0017)
Access_width>25m	0.2612*** (0.0234)	3.4649*** (0.1861)	−0.2700*** (0.0902)	0.2985*** (0.0035)	0.2165*** (0.0030)	0.4369*** (0.0023)
Access_No−road	−0.0742** (0.0327)	−0.7354*** (0.0816)	−0.2136*** (0.0387)	−0.0825*** (0.0206)	0.1143*** (0.0165)	−0.6275*** (0.0135)
Building variables						
Area_Parcel	0.0000** (0.0000)	0.0001*** (0.0000)	−	−0.0000*** (0.0000)	0.0000*** (0.0000)	−0.0000*** (0.0000)
Area_Main_building	0.0003*** (0.0000)	0.0010*** (0.0001)	−0.0003*** (0.0000)	−0.0000*** (0.0000)	−	−
Area_Sub_building	0.0025*** (0.0003)	−0.0012 (0.0013)	−0.0002 (0.0008)	0.0000*** (0.0000)	0.0000*** (0.0000)	−0.0000*** (0.0000)
Area_Total_floor	−	−	−		−	0.0000*** (0.0000)
Area_Ratio_floor	−	−	−		−	−0.0000*** (0.0000)
Area_Parking lot	−0.0002	0.0024	−	0.0000***	−0.0000**	−

	(0.0004)	(0.0036)		(0.0000)	(0.0000)	
Number_Detached_house	0.0228* (0.0123)	0.2832*** (0.0303)	0.0662*** (0.0219)	−0.0038*** (0.0003)	−0.0039*** (0.0002)	−0.0012*** (0.0002)
Number_Apartment	−0.0847* (0.0497)	0.5941*** (0.2056)	−	0.0002*** (0.0000)	0.0001*** (0.0000)	−
Number_Congregate_house	−	−	−	−0.0000 (0.0001)	0.0005*** (0.0000)	0.0026*** (0.0001)
Numer_Sub_bulding	−0.2238*** (0.0251)	−0.0712 (0.0791)	0.3254*** (0.0419)	−0.0114*** (0.0018)	−0.0001 (0.0015)	0.0082*** (0.0006)
Number_Elevator	−0.1438*** (0.0440)	0.8643*** (0.1739)	−	0.0260*** (0.0017)	−0.0010 (0.0014)	−
Number_Emergency_elevator	−	−	−	0.0150*** (0.0030)	0.0056*** (0.0008)	−
Number_Parking_lot	−	−	−		0.0000 (0.0000)	−
Number_Ground floor	0.0049 (0.0171)	−0.2301*** (0.0703)	0.1408*** (0.0198)	0.0168*** (0.0007)	0.0103*** (0.0005)	0.0109*** (0.0004)
Number_Underground floor	0.0623*** (0.0213)	−0.2264*** (0.0649)	0.0452 (0.0470)	0.0253*** (0.0014)	0.0071*** (0.0011)	0.0007 (0.0008)
Height_Building	−0.0093*** (0.0032)	−0.0103 (0.0082)	−	−0.0023*** (0.0001)	−0.0004*** (0.0001)	−0.0003*** (0.0001)
Location variables						
Dist_Elementary_school	0.0832*** (0.0037)	−0.1119*** (0.0120)	−	−0.0210*** (0.0004)	−0.0041*** (0.0004)	−0.0067*** (0.0003)
Dist_Middle_school	−0.0338***	−	−	−0.0224***	−0.0100***	−0.0061***

	(0.0300)			(0.0002)	(0.0002)	(0.0002)
Dist_High_school	0.0104*** (0.0022)	0.0011 (0.0091)	0.0032 (0.0042)	−0.0012*** (0.0002)	−0.0081*** (0.0002)	−0.0152*** (0.0001)
Dist_Special_school	−	−	−	0.0023*** (0.0003)	−0.0058*** (0.0002)	−0.0072*** (0.0001)
Dist_University	−	−	−	−	−	0.0116*** (0.0001)
Dist_Arterial_road	0.0509*** (0.0016)	0.0662*** (0.0031)	−	−	0.0052*** (0.0001)	−0.0044*** (0.0001)
Dist_Highway	−0.0762*** (0.0021)	−	−	−	−	−
Dist_Hazard_facility	−0.0028*** (0.0010)	−0.0106*** (0.0024)	0.0102*** (0.0018)	0.0045*** (0.0001)	−0.0006*** (0.0001)	0.0029*** (0.0001)
Ward fixed effects						
W_GN(Gangnam−gu)	−	−	0.8982*** (0.0743)	−	0.5286*** (0.0179)	0.1808*** (0.0138)
W_SP(Songpa−gu)	−0.0383 (0.0867)	−	1.2256*** (0.0580)	−	−	−
W_SJ(Sujung_gu)	−	−	−1.2290*** (0.0862)	−	−	−
W_JW(Jungwon−gu)	−	−	−3.0442*** (0.1408)	−	−0.1649*** (0.0023)	−0.0473*** (0.0015)
W_HN(Hanam−si)	−	−	−	−		−0.4307*** (0.0067)
Constant	14.2411***	12.3877***	11.3034***	14.6122***	14.5315***	14.2994***

	(0.1505)	(0.2301)	(0.2300)	(0.0100)	(0.0802)	(0.0861)
Random effects						
$\Sigma\ \mu$			0.3880(0.061)			
$\Sigma\ \varepsilon$			0.4317(0.0005)			
ρ			0.4468(0.0782)			
Observations	2,530	931	1,567	76,600	123,371	140,806
Number of groups	20	20	20	20	20	20

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

(2) Result for group-specific coefficients

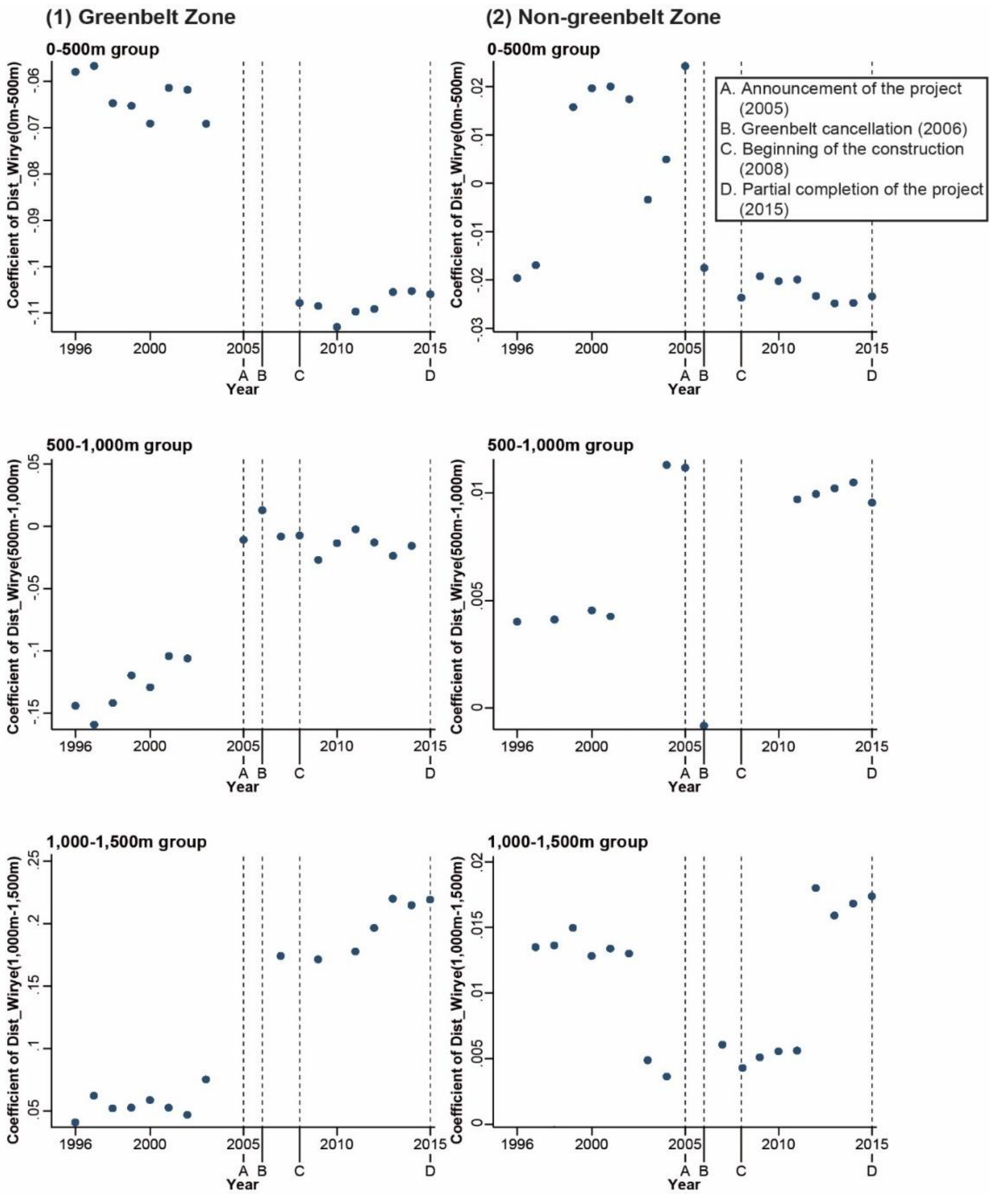

Figure 4. The proximity effect of Wirye New Town by level-2 group (by year from 1996 to 2015)

The result from this part shows that the externalities of the greenbelt cancellation and the Wirye New Town construction have changed throughout the study period from 1996 to 2015. Fig. 4 presents the group-specific coefficients of Dist_Wirye from the random-coefficient multilevel regression.

Fig. 4-(1) illustrates the change of the coefficient Dist_Wirye in the greenbelt zone during the study period. In the 0-500 m range, coefficients at all times are negative, representing positive externalities during the entire study period. When the greenbelt repeal plan was announced, the externality generated by the proximity to the greenbelt was approximately 6-7% land value increment per 100 m closer to the boundary. Then the magnitude drastically increased up to 10.8% when the construction of the Wirye New Town development plan was started in 2008 and peaked at 11.2%. This higher and positive externality continued thereafter until 2015, through enactment of a second greenbelt repeal plan and the partial completion of the project. This result suggests that the nearby land of the repealed greenbelt and the subsequent development on it was viewed as promising by land buyers.

Unlike the 0-500 m range, the coefficients of Dist_Wirye in the 500-1,000 m and 1,000-1,500 m range changed in the opposite direction after the announcement of Wirye New Town project in 2005. In the 500-1,000 m range, the average coefficient before 2005 was less than -0.118, meaning 11.8% higher land value per 100 m closer to the site. However, that positive externality was reduced from 11.8% to 1.3% as the greenbelt was repealed in 2005. In the 1,000-1,500 m range, the externality of the greenbelt was negative from the beginning (approx. -4.1%) and has become more so since the beginning of the Wirye New Town project in 2005 (approx. −17.4%), stabilizing in 2015 at −21.9%.

Fig. 4−(2) shows the change of the coefficient Dist_Wirye in the non−greenbelt zone during the study period. The trajectory of the coefficients is similar to that of the greenbelt zone but with different magnitudes. In the 0−500 m range, from 1999 to 2005, the proximity to the greenbelt did not generate positive premiums (coeff. Dist_Wirye: from 0.016 to 0.024), since the site was not in the scope of the first greenbelt repeal plan in 1998. After the announcement of the Wirye New Town development plan in 2005, the premium is observed at about 2.1% (coeff. Dist_Wirye: −0.021), suggesting that the positive effect of the development plan on the repealed greenbelt extended to the nearby non−greenbelt land.

In the non−greenbelt zone beyond 500 m, neither the presence or the cancellation of greenbelt was an attractive factor for land value. The coefficients remain positive throughout the study period, meaning the greenbelt generated negative externality to the vicinity. The magnitude, however, changes along the process. In the 500−1,000 m range, the greenbelt generated a price premium of about −0.4%, which peaked at −1.1% around 2005 and stayed at a similar level until the end of the period. In the 1,000−1,500 m range, the negative price premium of −1.4% during 1997 to 2002 decreased to −0.5% around 2005 and stayed until 2011, then it soared to −1.7% in 2012 until the end of the period. This result corresponds to previous studies, presented by Deaton and Vyn (2015) and Jun and Kim (2017), in that greenbelt generates negative externalities, simply because getting closer to a greenbelt means getting farther from the city core. In the range beyond 500 m, the amenity value of a greenbelt might be offset by the remoteness from the nearby city center.

Comparison of the mean land value in the six different zones also supports the argument. Fig. 5 presents the change of mean land value per square meter by year in greenbelt and non-greenbelt zones of the study site. The mean land values in both greenbelt and non-greenbelt zones have increased with a higher rate from 2002 to 2008 than in other periods, which coincides with the project development process. In the greenbelt zone, the land value continued increasing even after 2008, while that in the non-greenbelt zone plateaued thereafter. In particular, the land value of the greenbelt within a 500 m distance from the cancelled greenbelt has accelerated more rapidly than other zones, reflecting the higher demand and investment value. It should also be noted that land in the 500 m range had not been the most valuable land before 2002 but has gained added popularity, exceeding the values of the other two parts of the greenbelt in the end by a large margin. Considering that the actual use-value of the greenbelt is quite limited in general, such a high demand could be due to speculation.

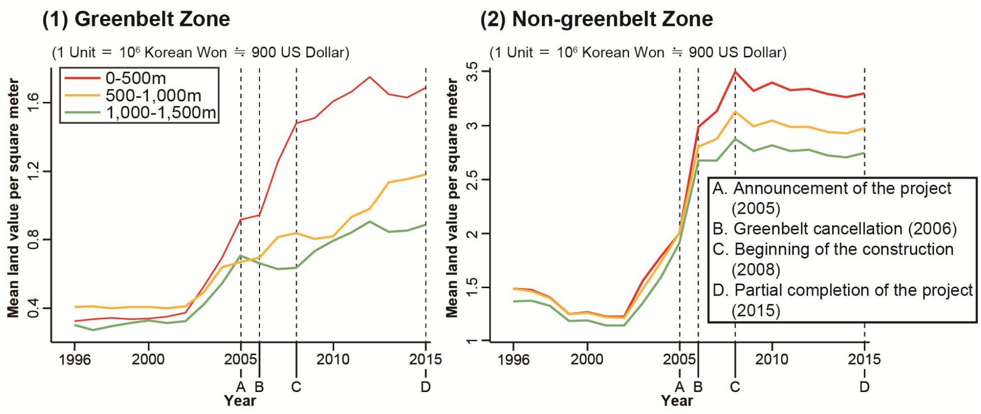

Figure 5. Mean land value per square meter by year in three distance groups (0–500 m, 500–1,000 m, 1,000–1,500 m)

Chapter 6. Conclusion and discusssion

In this study, I investigated the trajectory of the greenbelt effect on the value of surrounding land after the cancellation process from 1996 to 2015, focusing on the Wirye New Town area. Unlike other studies analyzed the effect of greenbelt on land value based on before–and–after comparison (Jun and Bae, 2000; Cheshire and Sheppard, 2002; Byun et al., 2013; Jun and Kim, 2017), I assessed the changes of externalities of greenbelt development on land price throughout the entire process, from the greenbelt cancellation and to the development process, using a unique approach – a random–coefficient multilevel modeling structured by time. I expect that the same analytical technique could be applied to other cities where greenbelt was released and large–scale property developments occurred. Developments of greenbelt usually takes long period of time, accompanied with diverse conflicts during the process (Paine, 2007; MOLIT, 2011). For example, in the United Kingdom, the government planned Harlow North regeneration project including 10,000 new housings in greenbelt land over 20 years, accompanying with the conflicts between support and opposition (Paine, 2007; Harlow Council, 2014). Shawfair development, after its first sales of 170 housings in the year of 2016, aimed to supply 6,000 housing for next 20 years on the periphery of Edinburgh and greenbelt (Deakin, 2002; Shawfair LLP, 2018). It showed that our analytical model could be useful method to measure the empirical impact of development projects to nearby properties and greenbelt, following its development process.

Primary findings are as follows: the externalities of the repealed greenbelt are heterogeneous by geographic locations and by the implementation process, from the cancellation to the property development. In the greenbelt zone, such changes generated positive externalities, possibly due to the investment potential. The result suggests that as one piece of greenbelt is repealed, expectations for further cancellation of nearby greenbelt lands increase and consequently activate the land market, as revealed in the aforementioned extant studies (Byun et al., 2013; Choi et al., 2011). This condition is observed mainly within 500 m from the site. In the non-greenbelt zone, a similar pattern has been observed, in that such changes of greenbelt exerted a positive externality to a lesser extent in the vicinity within the 500 m range. From this result, it is evident that externalities generated from the greenbelt cancellation exceed the amenity value attributable to the presence of the greenbelt.

Through our research, I suggested the development expectation as the primary reason for the positive externalities on nearby properties, in case of the greenbelt cancellation. For both groups, the land values within 500m groups showed the largest increase rate, and the positive price effects for the accessibility to Wirye New Town area were also observed. Especially, on non-greenbelt zone, it was clearly presented through the decreasing of externalities after the first greenbelt repeal plan when the development expectation was gone as this plan did not include Wirye New Town site, and the increasing of externalities after the announcement of Wirye New Town development plan.

The finding of this study provides policy implications. As described above, cancellation of a greenbelt positively influences the land market in the vicinity; however, it may also induce land speculation. This result corresponds to previous researches such as Byun et al., 2013, and Lee, 2008. To control such undesirable effects, governments often intervene with regulations on the subject sub-market by designating a real estate transaction constraint zone (MOLIT, 2011). In this zone, local government examines each case to verify whether the transaction is for the purpose of real use, not speculation. Also, the transacted land is monitored for 5 years to ensure it keeps its original use, and resale is prohibited for up to 10 years (Cheong, 2011; Lee et al., 2017). However, as the analytical results revealed, the land value of the nearby greenbelt soared at the announcement of the development plan despite such policy intervention, suggesting that this type of intervention was not successful in preventing speculative investments. A better way to stabilize the market should be exercised.

Especially, many researches showed the increase of land value after the announcement of the development plans, including our analytical results. Changing of land use, increasing of investment value are mainly suggested for the reasons (Lee, 2008; Byun et al., 2013), but Kim and Kim (2012) suggested the leakage of development plan as one of main reasons for soaring land price and real estate speculation, and presented the increase of land value before the development plan as the sign of the information leakage. Since there was an increase of land value even before the announcement of plan in our analytical results, there was a suspicion for the leakage of development plan and entering the speculative trade in Wirye New Town, as well. However, the government's interventions were limited for the investments before the announcement of development plan, since the regulations only worked after its implementation and it was hard to discern the speculative investments using information leakage from normal investments. To prevent the speculative investment and stabilize housing market, governments are needed to secure the development plan, and to include the specific period for pre-development plan in their regulations.

Although, the current study concludes that the greenbelt has been highly valued as potential developable land by the owners in the vicinity, the foregone amenity value should not be neglected. The development costs the permanent loss of beautiful scenery, environment resource, and open spaces, which have belonged to all citizens within and beyond the original greenbelt (Cheshire and Sheppard, 2002; Pacione, 2012). Currently, in many countries, governments attempt to address this issue by imposing development impact fees to compensate local residents who will be directly affected by the development (Park, 2008b; Ross, 2012). This, however, could be extended to include compensation to a wider public, by providing an equal level of ecosystem services in other locations, rather than mitigating the inconvenience made by the development per se.

Way to charge the development fee is also important topic to be considered. Mostly, governments, by imposing an exaction fee for development profits, requested the developers to construct infrastructures for the local community as a compensation for permitting the development plans on the regions (Ihlanfeldt and Shaughnessy, 2004; Mathur, 2007; Jeong, 2014). However, while the land value of nearby the repealed greenbelt, as our analytical results revealed, was also increased after the development on greenbelt, imposing the impact fee on them is relatively hard. In South Korea, property tax and transfer income tax are only sources, but those taxes are not only changed depends on the real estate market conditions, but became revenue sources for local and central governments, not for the residents (Jeong, 2014; Sim, 2017). To clarify the development profit from existing properties to be used for the regions affected by the developments, current policies should be revised to announce the exact amount of the revenue, and to present the exaction plan for local community using the announced revenue.

Urban sprawl also needs to be addressed in government policy. While the development of repealed greenbelt land generates a price premium on surrounding lands, no plan or guideline had imposed to address this issue. As argued in previous studies, the cancellation of the greenbelt may bring about intensified negative effects due to the threat of potential haphazard development of the land (Choi et al., 2011), deterioration of neighborhood environment, and devaluation of the existing properties (Nguyen, 2005; Kim and Choi, 2009; Gu et al., 2009). To prevent such uncontrolled urban development, governments should provide a guideline to comprehensively connect the new and existing developments. Shared infrastructure and transit connections could be examples (Kim, 2007; Park and Kim, 2009).

In South Korea, greenbelt land has been released since the first designation of greenbelt in 1971 (Kim et al., 2015). Before the Wirye New Town plan, most of development plans on greenbelt are for small-scale rental housing for low-income families (MOLIT, 2011). The large scale developments such as other New Towns were located outside of Seoul, due to the presence of greenbelt. However, after the construction of Wirye New Town, the government policy to provide developable land is changed; they announced 4 more New Town plan recently, and most of the planned area are not only designated on greenbelt, but located in inside of Seoul similar to Wirye New Town (Lee, 2018). Although the greenbelt developments could contribute to solving urban problems such as housing shortages, the impact of the cancellations on surrounding areas is substantial and often neglected.

Without proper understanding of existing and disappearing greenbelts, greenbelt relaxation could cause the loss of natural resources, imbalanced development between cities, and decrease of welfare (Cheshire and Sheppard, 2002; Kong, 2012). Consequently, the greenbelt cancellation caused conflicts between the private sectors for profit and public sectors for welfare value (MOLIT, 2011; Pacione, 2012). To resolve the conflicts, the governments need to control the impact of greenbelt cancellation. The findings of this research, that the effects differ by distance from a greenbelt, for different stakeholders, and by time dimension throughout the process, would provide useful information for future greenbelt planning.

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Abstract (Korean)

개발제한구역 해제가 지가에 미치는 영향: 위례 신도시를 중심으로

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본 연구는 다층 무작위 계수 모형(Random-coefficient multilevel model)을 이용하여 개발제한구역 해제가 주변 지역의 지가에 미치는 영향을 시간에 따라 분석하였다. 연구 대상지는 정부 주도로 발생한 개발제한구역 해제지역 개발 사례 중 하나인 위례 신도시이며, 연구 기간은 1996년부터 2015년까지이다. 연구 결과, 개발제한구역 해제는 해제 지역으로부터 500m 내 위치한 잔존 개발제한구역 필지에 긍정적인 외부효과를 발생시키는 것으로 확인되었다. 외부 효과는 위례 신도시 건설이 시작한 직후 최대치를 기록하여, 대상지에 100m 가까워질수록 11.2%의 지가 상승을 초래하는 것으로 관측되었다. 대상지에서 500m 내 위치한 비개발제한구역 필지에서도 위례 신도시 발표 직후 100m 근접할 때마다 지가가 2.1% 증가하는 양상이 관측되어, 잔존 개발제한구역 필지의 상승폭보다는 작았지만 유사한 경향을 확인할 수 있었다. 위와 같은 긍정적 가격 효과는 추가적인 개발제한구역 해제에 대한 기대감과 투자 가치 상승이 결합되어 나타난 것으로 추정된다. 대상지로부터 500m

이상 거리에 위치한 필지들은 개발제한구역 해제와 수반되는 개발 계획에 부정적인 영향을 받는 것으로 관측되었다. 이는 개발제한구역과의 거리가 멀어 개발제한구역의 영향력이 작아지며, 반면 도심(잠실, 강남)과의 접근성이 높아져 도심의 영향력이 커진 결과로 추정된다. 본 연구 결과는 도시 계획가들에게 개발제한구역 해제가 토지 시장에 미치는 경제적 영향에 대한 정보를 제공할 것으로 기대된다.

주요어: 개발제한구역의 외부효과, 개발제한구역 개발, 지가, 다층 무작위 계수 모형
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