Master's Thesis

Spatially varying effects of Gyeongui Line Forest Park on Retail Types and Location

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Seongbo Yoon

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Advisor
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Abstract

The importance and interest about green space continue to grow as people's interest in the quality of life increases with global environmental issues in recent years. Accordingly, various studies have been conducted on the direct and indirect benefits provided by the green space in the urban. And the benefits have impact on surrounding area. These effects of parks are not only positive but also negative. the park constructed in the city plays a role in raising the property value in the surrounding area, and various studies about this effect have been steadily conducted in many countries. In particular, research on the effects of parks using hedonic models has been actively conducted. These results show that the closer the distance from the park, the greater the impact on property value and many studies show similar results. Many studies show the effect of an urban park on neighborhoods, but the effect of urban park on the specific commercial environment of the neighborhood is relatively less studied.

The Gyeongui Line Forest Park is a good study area to understand the diverse pattern of commercialization according to the characteristics of the neighborhood and also it has worth doing research. Therefore, this study carried out research with two purposes. First, we suggest the sustainable management plan through empirically exploring the mechanism of commercialization triggered by the Gyeongui Line forest park. Especially, we classify the retail services into six types to identify the characteristics of retail location decision. Second, after clustering neighborhoods through statistical method, we aim to derive the academic implications that need for effective urban management planning by identifying the characteristics of retail opening according to classified neighborhoods.

As a result, the construction of the Gyeongui Line Forest park led to the commercialization of adjacent neighborhoods. In particular, it was confirmed that the total retail increased 1.6 to 1.8 times in the neighborhood nearest to the park(0-100m). In addition, the increase of the occupation of all retail type in the residential area increased, and the effect was larger the closer to the park. Therefore, commercialization due to the formation of the Gyeongui Line Forest Park has been triggered, and it has been confirmed that it occurs intensively in the residential area.

The patterns of retail opening induced by parks construction are as follows. In the case of restaurant, the number of entrepreneurs increased more than twice in the area adjacent to the park. Among the retail services classified in this study, the restaurant is highly productive, which is a result of empirically revealing the self-destruction of diversity as claimed by Jane Jacobs(1961). On the other hand, in the case of the neighbor retail, the result was significantly decreased only in the section(100-200m).

However, it can be said that the crowding low productivity retail out has occurred. In the case of bar, it is expected that the high productivity of bar pushed off the low productivity of the neighboring retail when considering that the section between the decrease of the neighbor retail and the increase of the bar is same. In case of café, it decreased in the neighborhoods adjacent to the park, while it increased

in the residential neighborhoods adjacent to the park. This result suggests that the café sector has moved to a low rent residential area due to the park construction

As a result of the above-mentioned results, commercialization was induced by the park construction, and it was confirmed that the industries with high productivity in the residential area increased in particular. These results indicate that eco-gentrification phenomenon, similar to highline parks, is needed a concern. Therefore, policy instruments for sustainable neighborhood management are needed.

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1. Introduction

1.1 Background

The importance and interest of green space continue to grow as people's interest in the quality of life increases with global environmental issues in recent years (Green Gentrification, 2017). Accordingly, various studies have been conducted on the direct and indirect benefits provided by the green space in the urban (Konijnendijk, Annerstedt, Nielsen, & Maruthaveeran, 2013). Especially, the green space created in the city center has attracted a relatively large number of people due to its high proximity. Thus, for people who lived in urban, these advantages lead to increased physical activity (Cohen et al., 2007), reduced stress (Annerstedt et al., 2012), and make indirect benefits such as social integration through the place attachment (Beckley, 1995).

These effects of parks are not only positive but also negative. In New York city, Highline Park which has a green space of about 2.33km in length, 10m above the ground generates 8 million visitors a year by 2016, resulted in enormous economic impact and has become one of New York's most popular destinations (Cho, 2017). As a result of the increased visitors, the area surrounding the High Line Park naturally became an activated business streets and housing prices began to rise (Levere, 2014).

In this way, the park constructed in the city plays a role in raising the property value in the surrounding area, and various studies about this effect have been steadily conducted in many countries. In particular, research on the effects of parks using hedonic models has been actively conducted. These results show that the closer the distance from the park, the greater the impact on property value and many studies show similar results (Konijnendijk et al., 2013). Many studies show the effect of an urban park on neighborhoods, but the effect of urban park on the specific commercial environment of the neighborhood is relatively less studied.

Since neighborhoods provide not only function of resident but also play a role in vitalizing the local economy and generating commercial transactions and investments, drastic changes in neighborhood retailing can threaten neighborhood sustainability. Therefore, studies on change of commercial environment are important as much as studies of the residential environment (Meltzer & Capperis, 2016). Various factors change the retail services that constitute the commercial environment of neighborhood. In general, the location of the retail services is most influenced by the floating population and visitors. Therefore, the urban park constructed in the neighborhood attracts many people by serving a variety of benefits, furthermore plays a role in changing the characteristics of neighborhoods. Through the case of High Line Park, we can see the effects of urban parks that affect the residential environment as well as the commercial environment of neighborhoods.

Recently, the Gyeongui Line Forest Park, which was constructed in the center of Seoul, Korea, is regarded as a very similar case to the High line park, and several studies of its effect are identified (Won, 2016) (S.-Y. Yang & Yoo, 2016) (Yun, 2017). Gyeongui Line Forestry Park is completed in Phase 1, Phase 2 and Phase 3 in 2012, 2015 and 2016 respectively and it is a large-scale linear park with a length of 6.3 km and a width of 10 to 60 meters, is connecting from the Hongjea stream to the Yongsan cultural and physical education center.

Because of the nature of linear parks located in the city center, Gyeongui Line Forest Park has a variety of neighborhoods such as low-rise residential districts (Yeonnam-dong, Sinchon, Seogangdong, etc.), commercial districts (Sinchon, Sogang, Hongik), business districts (Gongdeok, Yongsan) (Cho, 2017). In particular, in the case of a densely populated area, these region is relatively low property value due to isolated from the wave of development. These areas usually correspond to a space that meets the 'fundamental distinction' in which production-aspect of gentrification phenomena proposed by Smith (1979). Therefore, from the view of the founder, these areas have conditions for maximizing the profit through minimizing the initial investment cost. Actually, the construction of the Gyeongui line forest has increased the price of real estate in neighborhoods and the voice of concern about the phenomenon of gentrification has been increasing through various media (Jung, 2016; Kwon, Joo, Han, & Park, 2017).

1.2 Purpose of the study

In short, the Gyeongui Line forest park is likely to induce commercialization of adjacent neighborhoods. Thus, it is a good study area to understand the diverse pattern of commercialization according to the characteristics of the neighborhood and also it has worth doing research. Therefore, this study carried out research with two purposes. First, we suggest the sustainable management plan through empirically exploring the mechanism of commercialization triggered by the Gyeongui Line forest park. Especially, we classify the retail services into six types to identify the characteristics of retail location decision. Second, after clustering neighborhoods through statistical method, we aim to derive the academic implications that need for effective urban management planning by identifying the characteristics of retail opening according to classified neighborhoods.

2. Literature Review

2.1 The relationship between urban park and neighborhood environment

As mentioned above, the impact of parks on neighborhoods has been studied in various ways around the world. In the case of High Line Park, it is considered as an example of Green Gentrification, and much research has been conducted on the change of the neighborhood caused by the park.

Levere (2014) used housing transaction data from 2004 to 2011 to investigate the impact of high line parks on housing prices according to the distance from park center. The result shows that the effect of park construction was positively influenced to housing price and the increased price affected by the park is bigger when the housing is close to the park than a distant one. Also, he examined the effect of park construction on the establishment by dividing into five categories. As a result, the number of cultures and arts-related establishment, restaurant and accommodation establishment has increased significantly after the creation of the park.

According to Haffner (2015), High line parks are an example of perfect environmental gentrification due to increased property prices. The greening project which has brought more than 5 million visitors every year has completely changed the socio-economic characteristics of the neighborhood and has been suffering from this successful project. Therefore, the authors said that small business and low- and middle-income groups located near the park are forced to relocate due to the increase in land value, and even those who can afford it are threatened with the quality of life by tourists.

In addition to high line parks case, impacts of green space on the neighborhood have been studied around the world. Czembrowski and Kronenberg (2016) divided the types of parks and found that their impacts vary according to the characteristics of each park types. They used the Lodz region of Poland as a case study area and classified the park into nine categories according to the size and kind of the park. According to the results of the study, it was found that the bigger and more distinct parks had a positive effect on the house price. They explained that a large and distinctive park is well known and easily recognized by people. Conversely, the other result shows that cemetery park decreases the price of adjacent houses, which is consistent with the existing literature.

Panduro and Veie (2013) also examined the impact of the park on the price of surrounding homes in a way similar to the study described above. Using Aalborg as a case study area in Denmark, they found that eight types of green spaces, including parks, have a positive effect on housing prices. Also, it was found that the influence of the green space on the housing price increase is significant only in the apartments. They mentioned that the reason why people living in single-family homes had no influenced by the outside green space is that they had private gardens.

In this way, we have been able to realize the effects of parks in various countries through various methods. Next, we will explore literature related to Gyeongui Lake Forest Park, which is used as a case study area in this study.

It was found that various studies on the externality of parks were conducted in many countries including High Line Park. Next, we will look at the literature on the effects of Gyeongui Line Forest Park. Gyeongui Line Forest Park as case study area of this study, this park is regarded as case study area where continuous monitoring is required according to the concern about gentrification phenomenon becomes bigger,

Kwon et al. (2017). Used the housing price data from 2010 to 2015 to find out the influence boundary of the Gyeongui Line forest construction on the price of the surrounding houses. The housing transactions occurred from 2011 to 2014 show a linear relationship between the count of transactions and the distance from the park, and the number of housing transactions occurred from 2014 to 2015 increased up to 400m. These results show that there is a relationship between park opening time and housing transactions, but it is difficult to identify the effect of park opening because the research period is short to grasp the influence of the park.

Jung (2016) examined the effect of park-related events on the price of neighboring houses since 2006 when the construction of the Gyeongui Line Forest Park has been decided to 2015 when the second phase of park constructed. In the case of apartments, the price was increased by the park when they were within 800m from the park. The prices of apartments within 100m from the park increased by 4.26% and those within 500m increased by 0.77%. However, as pointed out in the limitations of the study, it is difficult to grasp the influence of the pure effect of park because there is a dense area in the study area and the influence of these concentrated apartments cannot be controlled.

Won (2016) analyzed using card sales data as a dependent variable to investigate the effect of the third stage of the Gyeongui Line forest park by utilizing the DID(difference in difference) model. The opening of restaurant establishment showed a slight decrease after the opening of the park, and the retail services showed a 1.5-fold increase in sales. In conclusion, the effect of park construction on sales growth was not significant. Therefore, the authors concluded that the contribution of park did not have a significant effect on the sales of individual stores but contributed only to the activation of the market. However, due to the limitations of data, it is limited to fully understand the effect of park construction by using card transaction data that occurred for a very short period(6 months).

Yun (2017) examined the change patterns of adjacent exterior buildings in Yeonnam-dong part of Gyeongui line forest park. The factors affecting the change in the structure and appearance of buildings were summarized as seven factors. The effect of parks on the physical changes of the buildings was

classified as the buildings and parks were disconnected, the visual appearance was improved, and the park users were encouraged to use the buildings together. However, since it has only partial sections of the Gyeongui Line forest park and there is a limitation that the empirical analysis is a shortage.

In addition to the studies described in detail above, there have been many studies. However, most of the empirical studies have concentrated on revealing the increase in housing prices due to the park construction. Therefore, it is considered that the study on the commercial environment changed due to the park construction is still needed.

2.2 The nature of retail churn from production-based perspective

Jacobs (1961) said that neighborhoods perform not only residence functions but also commercial functions that provide services and jobs at the same time due to the retail business located in the neighborhood. Therefore, research on the commercial environment is as important as research on the neighborhood residential environment. To understand the commercial environment of the neighborhood, firstly, the understanding of the retail change is needed. We checked the literature that where and when the retails are located in the neighborhood.

According to Meltzer and Capperis (2016), the research on the location of neighborhood retailing can be divided into production- and the consumption-perspective, and the viewpoint of consumer perspective is highly related with the socio-demographic change of neighborhood. He analyzed the distribution of retail business in New York according to the socio-demographic characteristics of the neighborhood. In addition, the retail types are divided into two parts as Necessity establishments and Discretionary establishments. However, to explain the theoretical background of this study, we think it is more appropriate to follow the production- rather than the consumption perspective. Because the construction of Gyeongui Line Forest Park is a physical environment and the factors that drive retail location are not due to socio-economic indicators but are due to physical environmental improvements

The rent gap theory suggested by Smith (1979) provides a theoretical background to understand the location decision of retail from the production-aspect. In the rent gap theory, the value of land and buildings in urban areas continues to decrease as time passes by, thus reduce investment in maintenance of facilities. In the end, the capital of the city escapes to the suburban area, and the city center forms a slum area. And the rise of rent price around the slums generate the large capital inflows when the potential rent price of the slums increases. Therefore, the time and place where the potential rent reaches the maximum take the fundamental distinction for the occurrence of the gentrification

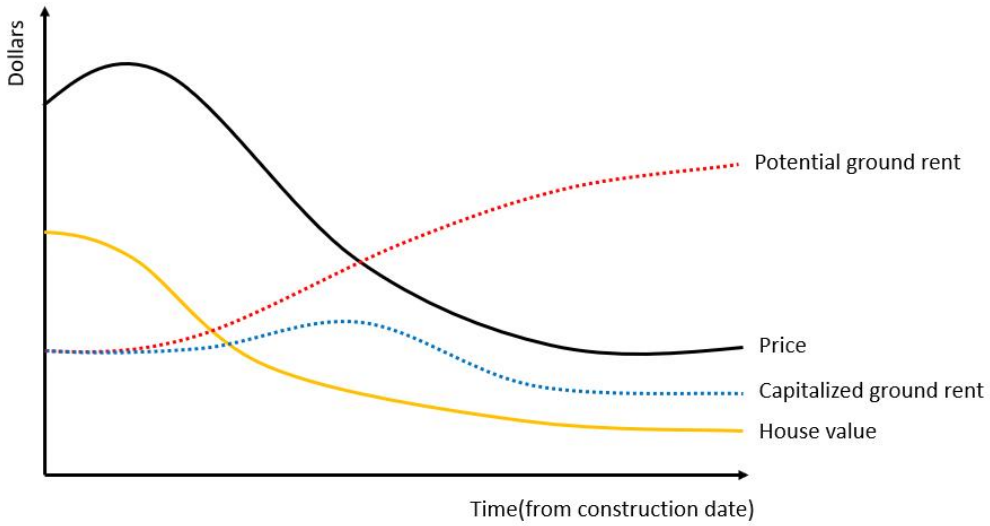

Figure 1. Rent gap theory suggested by Smith(1979)

According to rent gap theory(Smith, 1987), the slum is the area where gentrification occurs in the United States. However, in Korea, since the high-density development has been progressing steadily, it is difficult to form a slum area, and thus, a relatively low rent region where is excluded from the wave of development can be regarded as a slum area (Heo, 2015). The various types of neighborhoods are located near the Gyeongui Line Forest Park, and the low-rise residential districts that form a relatively low area are likely to cause gentrification phenomenon due to their high potential value. The Gyeongui Line Forest Park has been used as a railroad track in the past to serve as a negative factor in the neighborhood, thereby reducing the value of the surrounding residential area. However, through the underground project of the railroad, the grounds that are left are converted into parks. So, the characteristics of the space have completely changed from negative to positive space. The lands built as urban park provide space for rest, leisure, and exercise and attract many people. Therefore, there are two important changes in the surrounding neighborhoods due to the formation of the Gyeongui Line Forest Park. First, the transformation from negative to positive facility result in change neighborhood environment. Secondly, due to the changed neighborhood environment, the preference for residence and the increased visitors resulted in a rise of potential rent value. Especially, when the visitor increases in the low rent region, it becomes the target of the founders because these regions can minimize the initial investment cost. Therefore, this study will empirically investigate the impact of the Gyeongui Line Forest Park construction on nearby neighborhood based on the rent gap theory.

It is necessary to explore the changes which are different according to the retail types as well as the changes in the neighborhood retail environment which are different according to the characteristics of

the neighborhood. According to Jacobs (1961), 'the self-destruction of diversity' has arisen due to the dominance of certain service type, and the retail services that have operated for existing residents are crowded out by retails with high productivity. Therefore, it is expected that the retail services with high productivity will come into the neighborhood with the greatest potential value due to the formation of the Gyeongui Line Forest Park.

2. 3 Research hypothesis

When we summarize the studies so far, we can get some implications. First, people 's preference for green space was found to be a positive globally. Especially, it was found that the park built in the city influenced both the residential and commercial environment of the neighborhood. Second, the retail location decision is expected to show different pattern depending on the productivity of the retail type, and is active in places where the current price is low and the value of the potential rent is high at the same time. Through literature review, we conducted research to establish and identify the following hypothesis.

Hypothesis 1*: Gyeongui Line forest park promoted the commercialization of neighboring neighborhoods.*

Hypothesis 2*: The location pattern of the retail services induced by the park is different according to the productivity of the retail types, and the opening of high productivity retail types increase. On the contrary, the opening of low productivity retail types decreases.*

Hypothesis 3*: There are neighborhoods with different characteristics in the area around the Gyeongui Line forest park. Thus the influence of the park will be different according to the characteristics of the neighborhood.*

In this study, the three hypotheses mentioned above were established through literature review and the research was conducted to verify hypotheses through appropriate research design.

3. Methodology

3.1 Spatially scope

The Gyeongui Line Forest Park is located in Mapo-gu and Yongsan-gu, and some sections are connected to the southern boundary of Seodaemun-gu. Gyeongui Line Forest Park has five universities, four subway lines and a metro station within the 1km radius of its center. Also, various major commercial areas such as Hongdae, Shinchon and Gongdeok are located nearby.

Therefore, to differentiate the effects of the Gyeongui Line Forest Park opening on the commercialization of nearby neighborhoods, the block within 1km from the park center was set as the study area, so that some parts of Mapo-gu, Yongsan-gu and Seodaemun-gu were included. This spatial range setting is intended to identify only the pure effects of the park by excluding the other factors 1km away from the target area that can cause the retail location. Although some blocks in the north and south-east are included in the study area, if it recognized as distinctive spaces due to the physical disconnection by the ground railway (Gyeongui-Jungang Line), they were excluded from the study area. *Figure 2* shows the study area

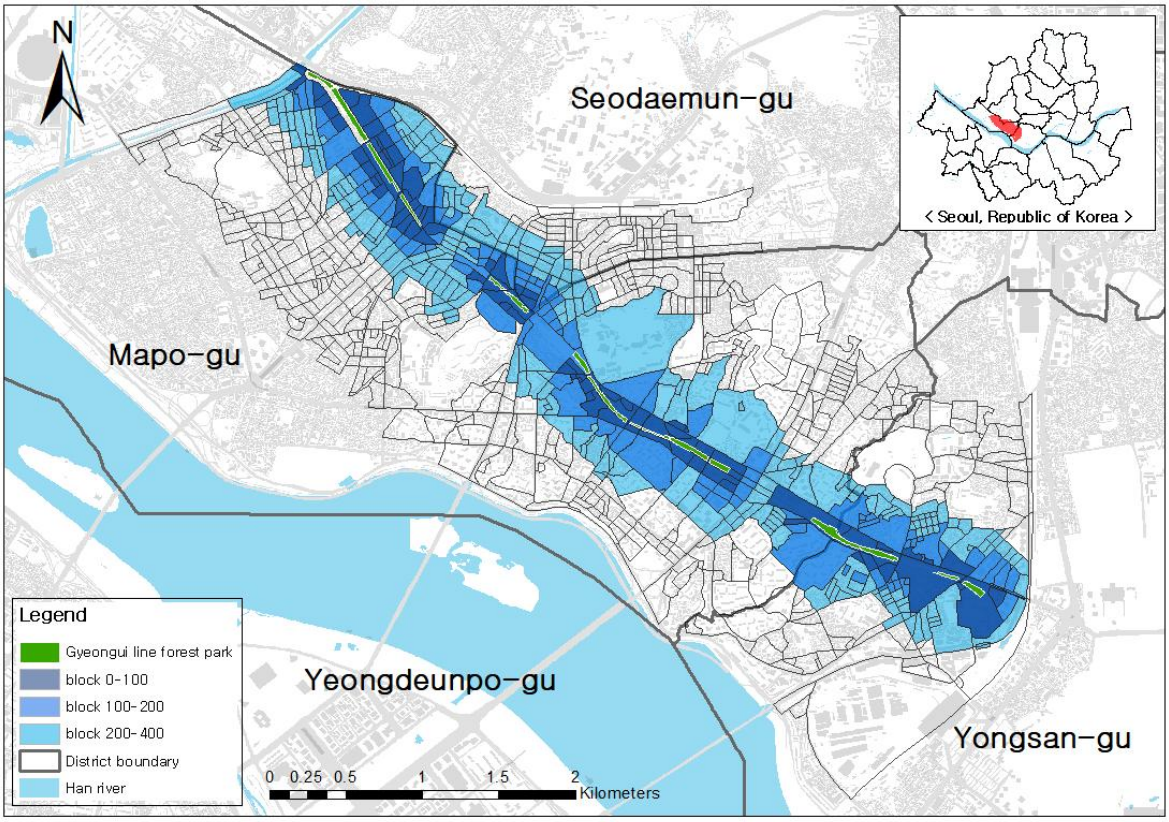

Figure 2. Spatial scope of the study

3.2 Temporal scope

Gyeongui Line Forest Park is opened in 2012, 2015 and 2016 with the time gap between each phase. Thus, the temporal range was divided by the park opening time to identify the effect of each park opening on the nearby neighborhoods. In here, a year before the 1st park opening and after the 3rd park opening was added to the temporal range to figure out the influence between the before and after the park opening. As a result, the temporal range of this study included the four phases from April 2011 to June 2017; a year before the 1st park opening, from the 1st park opening to the 2nd park opening, from the 2nd park opening to the 3rd park opening and a year after the 3rd park opening (*Figure 3*).

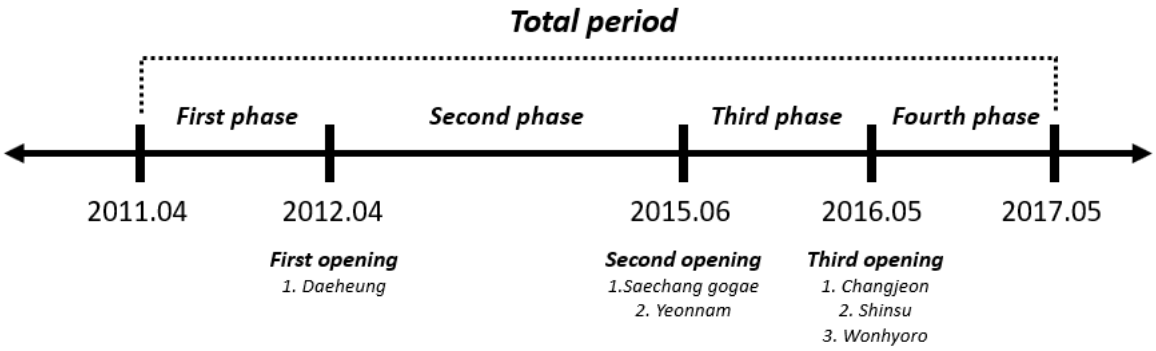

Figure 3. Temporal scope of the study

3.3. Unit of analysis

To determine that the influence of the park opening is different according to the neighborhood characteristics, each neighborhood should be classified by its neighborhood characteristics. In general, many studies use administrative boundaries to distinguish the neighborhood boundaries. However, considering the scope of this study, it is expected that the neighborhood classification using administrative boundaries will not properly reflect the neighborhood characteristics. Therefore, this study classified the neighborhoods by using the roads over the 6m width. As a linear and physical infrastructure in a city, the road plays a role in dividing the boundaries of land. This suggests that the land divided by roads may have a similar environment. Therefore, in this study, the neighborhood boundaries were classified using the minimum road width (= 6m) capable of two-way traffic, so the study area includes the 919 blocks in total (*Figure 2*).

3.4 Neighborhood classification

Neighborhood classification(LCA) This study used the LCA (Latent Class Analysis) method for classifying the neighborhood types. The LCA method finds out the individual potential groups with similar characteristics and calculates the probability of belonging to the potential groups by various statistical fit indicators (Kim at el, 2010). Among the clustering methods, when compared with the K-means clustering method using the Euclidean distance, the LCA method has two major advantages. First, it doesn't need to standardize the variables included in the analysis. This makes it possible to interpret the clustering result as a unit of non-standardized variables and allows two or more variables to be included in the clustering analysis. Second, it uses the statistical methods such as the AIC (Akaike`s Information Criterion) or BIC (Bayesian Information Criterion) values to derive the cluster coefficients, so that the objective estimation can be made in determining the number of the clusters.

Despite these advantages, few studies have used the LCA methods for neighborhood classification in the field of geography. Recently, however, the study that conducted by C. D. Higgins and Kanaroglou (2016) suggested the possibility of neighborhood classification using the LCA method in the field of geography. He used the LCA method including the land use, population, and the transportation access as the variables, to classify the ten neighborhoods around the TOD (Transit Oriented Development) area. Then, by including the neighborhood classification in the regression analysis, he identified the different influences depending on the classified neighborhoods. After using LCA, he found that the effects of TOD were different depending on the neighborhood characteristics (C. Higgins & Kanaroglou, 2017). C. Higgins and Kanaroglou (2017) showed the possibility of the neighborhood classification using the LCA method, so this study also uses the same method to classify the neighborhoods. The LCA used in this study included the six variables and the explanations for them are summarized in *Table 1*. In the LCA method, BIC is used most often with AIC (M. Yang, Lee, & Son, 2010) when determining the number of clusters. However, because the AIC does not directly consider the number of samples in the calculation process, it is difficult to provide consistent results according to the number of samples (Little, 2013). For this reason, the number of clusters was determined by using BIC, the most widely used LCA method. R package was used for LCA processing, and six variables related to neighborhood characteristics were included in the analysis.

Table 1. Variable description for Latent Class Analysis

Name	Variable	Description
Land use	Residential	The land use with the highest proportion in the block is 1,2,3 general residential area
	Mixed-use	The land use with the highest proportion in the block is a semi-residential area
	Commercial	The land use with the highest proportion in the block is a general, neighbor commercial area
Block main use	single family	The building use with the highest proportion in the block is single family housing,
	multi family	The building use with the highest proportion in the block is multi-family housing
	neighbor living	The building use with the highest proportion in the block is neighbor living facility
	commercial	The building use with the highest proportion in the block is sales and business and commercial building
	rest	The building use with the highest proportion in the block is medical and educational and sports facility, etc
	empty	If there is no building within the block
Block average story	0-5 story	0 =< the average building story < 5
	5-8 story	5 =< the average building story < 8
	8-14 story	8 =< the average building story < 14
	14- story	14 =< the average building story
Land price	0-20 percentile	0 =< the average land price within each block < 20 percentile
	20-40 percentile	20 =< the average land price within each block < 40 percentile
	40-60 percentile	40 =< the average land price within each block < 60 percentile
	60-80 percentile	60 =< the average land price within each block < 80 percentile
	80-100 percentile	80 =< the average land price within each block < 100 percentile
Block density	0-20 percentile	0 =< building total area divided by block net area < 20 percentile
	20-40 percentile	20 =< building total area divided by block net area < 40 percentile
	40-60 percentile	40 =< building total area divided by block net area < 60 percentile
	60-80 percentile	60 =< building total area divided by block net area < 80 percentile
	80-100 percentile	80 =< building total area divided by block net area < 100 percentile
Subway area	0 or 1	The block is within 400m from each subway stations

3.5 Data

Dependent This study used the 'Approval/Permission Open Data by Industry' to capture the commercialization caused by the park opening. The open data collects and aggregates the retail approval/permission data, which are renewed every day, from 226 si/gun/gu districts throughout the nation. Then, the data are divided into 440 categories in 11 fields and are open to the public, including the information on the business location, the opening/closing day, and the store size. This study used the data extracted from 72 categories in restaurant, culture & sports, and small business fields, and then the data were reclassified into six categories. The criteria for reclassification were based on the literature studies. As a result, the six categories were classified as restaurant, bar, boutique, neighborhood retail, cafe, and culture. The restaurant business is mainly for providing meals to people, including the restaurant and beverage related services. Excluding the restaurant business, the bar business is mainly for providing liquors to people. The boutique business provides the beauty-related services to people, the cafe is a business that sells the coffee or dessert, and the culture business is one that provides entertainment and recreational services. This study reclassified the categories with those criteria, and *Table 2* shows the industry types by each category.

Table 2. Classified retail types

Retail type	Items
Restaurant	16 types including Korean, Japanese, China, family restaurant
Bar	16 types including a pub, public house, bar
Boutique	15 types including nail beauty, toenail beauty, make-up
Neighbor	18 types including public bath, butcher′s shop, convenience store, clinic, optical store, pharmacy
Cafe	7 types including live café, kids café, teahouse, rice cake cafe, coffee shop
Culture	7 types including a movie theater, museum, billiard hall

Independent The independent variables used for the analysis consist of location characteristics, block characteristics, building characteristics, sociodemographic characteristics, park effect variables, and the time trend variables. First, the location characteristics are related to the block's geographical factors like subway station area, land use, or major commercial areas. The block characteristics correspond to the characteristic of the block itself, which is the block area. The building characteristics refer to the characteristics of the buildings within the block, including the average of building age, the average of building floors, and the average of building floor area. The sociodemographic characteristics are about the population living in the block, and the number of apartment buildings, average population age, the

ratio of rent household are the examples. Then, the park effect variables were included in the analysis to identify the influence of the park opening. Blocks within the pedestrian zone (400m), regarded as the influential area, were divided into three sections by the distance from the park center and each section was included in the analysis as a dummy variable (Perry, 1929) (Lee, Kim, & Jun, 2015). Blocks outside the pedestrian zone (400-1000m), as the non-influential area, was also included in the analysis as a reference variable for the dummy variables. Additionally, the time trend variables were added to identify the different impact by each periods, divided into the four stages based on the date of park opening. The description of each variable is summarized in *Table 3*.

Table 3. Variables description for regression model

Features	variable	Description	Data
Dependent	Opening all	The number of retail opening within each block during research periods	Local data
Park effect	bk0-100	The block between 0 and 100m from Gyeongui line forest park	SGIS
	bk100-200	The block between 100 and 200m from Gyeongui line forest park	
	bk200-400	The block between 200 and 400m from Gyeongui line forest park	
	bk400-1000	The block between 400 and 1000m from Gyeongui line forest park	
	Park opening	2011.04-2012.04: First phase, 2012.05-2015.06: Second phase, 2015.07-2016.05: Third phase, 2016.06-2017.06: Fourth phase	Author
Location	School area	The area that used as school within the each block	SGIS
	Space area	The area that used as space facility(such as park) within each block	SGIS
	Land price	The average land price per meter square within each block	SGIS
	Land use	Types of land use that occupy the largest portion of block	SGIS
	Main building use	Types of buildings that occupy the largest percentage of blocks	EAIS
	road	When there are small, middle, large, and great road in a block	SGIS
	Main_com	Blocks included in the seven major commercial areas	SGIS
	subway	Blocks are included in the station area(=400) corresponding to each line	Seoul statistics
Demographic	Apart_num	The number of apartment building within the each block	
	avg_age2010	The average age of block based on the 2010 years	KOSIS

	rent_ratio2010	The ratio of rent household per owned household based on 2010 years	KOSIS
	total_pop2010	The total population based on 2010 years	KOSIS
Building	total_area	The average of building floor area	EAIS
	Building avg_story	The average of building story	EAIS
	Building avg_age	The average of building age based on 2017	EAIS
Block	net_area	The area except for school and space area	Author
Time trend	date	75 months from 2011.04 to 2017.06	Author

3.6 Analytical Methods

In this study, the multiple regression analysis applying DID (Difference in Difference) method was used to identify the effects of park opening. DID method is a widely used methodology to analyze the effect of the policy implementation on a specific region. DID distinguishes the treatment group that is affected by the policy from the control group that does not, and identifies the influence of the policy implementation (J. Kim, Park, Yoon, & Cho, 2016). In this study, the blocks within the 400m from the park are set as the treatment group, and the blocks located outside the park are set as the control group so that the effects of each park opening on the retail business were identified.

Negative binomial regression

Regression models suitable for analyzing the count data, same as the one used in this analysis, are the Poisson regression model and the negatively biased regression model (Cheong & Park, 2015). However, the Poisson regression model has a restriction in its model definition that the conditional mean and conditional variance should be the same, and there is a problem of overexploitation where the variance increases with the mean increases (Chun & Ahn, 2012). Thus, the negative binomial regression model can be the most suitable alternative model to this problem. The negative binomial regression model is expressed by the following equation.

$$Y_i = \exp(\beta_0 X_0 + \cdots + \beta_m X_m + \varepsilon_i$$

$$Y_i : Dependent\ variable(number\ of\ opening)$$

$$\beta_0, \ldots, \beta_m : Coefficients\ estimated\ by\ using\ maximum\ likelihood$$

$$X_0, \ldots, X_m : \text{Independent variables}$$

$$\varepsilon_i : Error\ assuming\ that\ mean\ is\ 1\ and\ following\ gamma\ distribution$$

The negative binomial regression model is a generalized model of Poisson distribution and can be applied to the cases where the mean and variance are largely different. The negative binomial model assumes that the observed values are not fully explained by the observed explanatory variables but by the other randomness (Chun & Ahn, 2012) because it includes the errors between the actual values and the fitted values as in the above equation. Therefore, the analysis was conducted by the negative binomial regression model, and the number of retail opening that occurred for 75 months within 919 blocks, constructed as a panel data, was included in the analysis as a dependent variable. Furthermore, to ensure the model accuracy and validity of the result interpretations, the correlation between the explanatory variables was examined by VIF (Variant Inflation Factors) test so that the variables with multiple collinearity were removed from the analysis.

4. Results

4.1 Descriptive statistics

In the case of the statistic value of Opening_all as the dependent variable, the maximum value of all types retail opening is 26 per block. Blocks with the largest number of opening in a month during the study period are included in the main commercial areas and are mainly included in Shinchon, Hongdae and Yongsan commercial areas. The blocks within 400m are 47%, and 53% blocks are outside of 400m. The higher land price, the more likely it is located in the main commercial area. In the case of land use, the second general residential area composed the highest ratio, followed by the third general residential area. In the case of main building use in block, residential building was the highest ratio, followed by neighborhood living facility. The average population in the block is about 525, with the maximum value is 1569 and minimum value is 12. In the case of the period variable, it took longer than 50% of the total period at second_phase.

Table 4. Descriptive Statistics

Features	variable	specific	Min	Mean	Max	S.D	unit
Dependent	Opening_all		0.00	0.11	26.00	0.49	count
Park effect	BK_0-100		-	0.10	-	0.29	dummy
	BK_100-200		-	0.12	-	0.32	dummy
	BK_200-400		-	0.27	-	0.44	dummy
	BK_400-1000		-	0.53	-		dummy
Location	School_area		0.00	898.50	173329	7922	m2
	Space_area		0.00	886.70	126027	6512	m2
	Land_price		0.00	4833859	22270000	2885145	won/m2
	Land_use	The first gen.resi	-	0.03	-		dummy
		The second gen.resi	-	0.61	-		dummy
		The third gen.resi	-	0.20	-		dummy
		Semi resi	-	0.05	-		dummy
		Gen.com	-	0.10	-		dummy
		Neig.com	-	0.02	-		dummy
	Main_b_use	single_house	-	0.50	-		dummy
		multi_house	-	0.14	-		dummy
		neighborhood living	-	0.25	-		dummy
		commercial	-	0.05	-		dummy
		rest	-	0.02	-		dummy
		empty	-	0.03	-		dummy
	Road	small_road	-	0.30	-		Dummy
		middle_road	-	0.30	-		Dummy
		large_road	-	0.25	-		dummy
		great_road	-	0.13	-		dummy
	Main_com	Ewha Univ	-	0.02	-		dummy
		Gongduck	-	0.01	-		dummy
		Hongik Univ Sta	-	0.03	-		dummy
		Mapo	-	0.03	-		dummy
		ShinChon Sta	-	0.08	-		dummy
		Yongsan Elect	-	0.03	-		dummy
		None	-	0.73	-		dummy
	Subway	sub2	-	0.28	-	0.45	dummy

		sub5	-	0.11	-	0.31	dummy
		sub6	-	0.27	-	0.45	dummy
		subgu	-	0.29	-	0.45	dummy
	Apart_num		0.00	0.50	19.00	2.24	count
Demographic	Avg_age2010		1.11	37.16	47.92	4.07	year
	Rent_ratio2010		0.03	0.70	0.98	0.15	%
	Total_pop2010		12.56	525.75	1569.00	182.55	person
Building	Total_area		0.00	1945.3	76825.9	6028.5	m2
	Avg_story		0.00	3.95	25.00	2.91	m2
	Avg_age		0.00	29.11	81.89	10.29	year
Block	Net_area		0.00	10834	568481	22709	m2
Time trend	Park opening	first_phase	-	0.16	-	0.37	dummy
		second_phase	-	0.51	-	0.5	dummy
		third_phase	-	0.15	-	0.35	dummy
		fourth_phase	-	0.17	-	0.17	dummy
	Date		2011-04-01	2014-05-01	2017-06-01	-	month

4.2 LCA(Latent Class Analysis) result

The results of the LCA analysis determine the most appropriate number of class through the BIC(Bayesian Information Criteria) value (Koo & Lee, 2011) (S. Kim, Kim, Chang, & Moon, 2017), and thus the distribution of the variables included in the analysis is given. First, the LCA is conducted with increasing the number of class from 2 to 8. As a result, it can be seen that the BIC value is the smallest when the number of class is 4, as shown in *figure 4*. Therefore, in this study, the number of the potential class was set to 4. Also, the results of the LCA analysis provide the probability that each block is included in which group and the results are attached in Appendix 2.

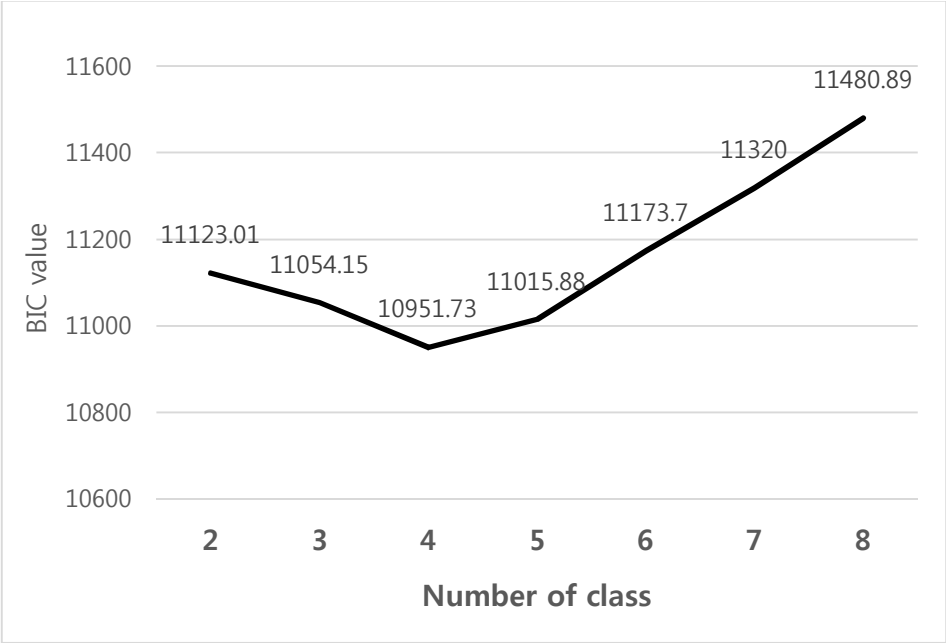

Figure 4. BIC(Bayesian Information Criteria) value of each number of class

Based on the results of the LCA analysis, potential class types were given to each block included in the

study area, and the statistics of the classified classes is shown in *Table 5*.

Four types of neighborhoods classified by LCA were largely named according to the building use and number of stories. The four kinds of neighborhoods type are low-rise and residential neighborhood, middle-rise and residential neighborhood, high-rise and commercial neighborhood, low-rise and commercial neighborhood.

In the case of the residential type neighborhood, the land price was lower by half than the commercial type. In the case of the main building use in the block, the single-family house was higher and there are no commercial buildings in the low-rise and residential. On the contrary, commercial buildings were the most dominant in the high-rise and commercial neighborhood and neighborhood commercial facilities were the most dominant in the low-rise and commercial neighborhood.

In the case of subway station area, it has a higher ratio in the commercial neighborhood when compared with the residential neighborhood. In particular, about 90% or more of high-rise and the commercial neighborhood is included in the station area. In the case of building density ratio, only high-rise and commercial neighborhood have a value more than 1, which means that the total area of the building included in the block is higher than the block area. For the other neighborhood types, middle-rise and residential neighborhood, low-rise and commercial neighborhood, and low-rise and residential neighborhood were a higher value in the order. The reason why middle-rise and residential neighborhood was higher than low-rise and the commercial neighborhood is that high-rise apartment. For the average number of stories in the block, high-rise and commercial neighborhood were the highest with an average of 10 stories or more.

Most of the large-scale commercial facilities are located in high-rise and commercial neighborhood. In the case of middle-rise and residential neighborhood, the average number of buildings is 4.8, which is the second highest. The average number of buildings in the low-rise and commercial neighborhood is 3.5, which is the result of a large number of neighborhood living facility that can perform residential and commercial functions at the same time. Lastly, since the low-rise single-family housing is distributed in low-rise and residential neighborhood, it appears to be the lowest stories among the four neighborhood types.

In summary, the number and types of neighborhoods are classified by statistical methods using the LCA method to find out that the types of retail services are differently located depending on the type of neighborhood. According to the characteristics of the classified latent class, they are named by using statistical values. Four types of neighborhoods in the study area are represented *Figure5*.

Table 5. Descriptive statistics of LCA(Latent Class Analysis)

		Low story and Residential neighborhood	Middle story and Residential neighborhood	High story and commercial neighborhood	Low story and commercial neighborhood	unit
Land price		3438998.7	3388052.0	8270102.4	7125427.0	won/m2
Main building use	single family	344	52	3	57	count
	multi family	3	117	12	1	count
	neighbor living	13	18	19	179	count
	commercial	0	1	38	9	count
	rest	2	15	2	1	count
	empty	33	0	0	0	count
subway	0	168	96	7	47	count
	1	227	107	67	200	count
Building density		0.04	0.27	1.76	0.15	count/m2
Land use	residential	379	199	22	167	count
	Mixed-use	3	1	11	34	count
	Commercial	13	3	41	46	count
Building average story		2.75	4.82	10.32	3.55	story

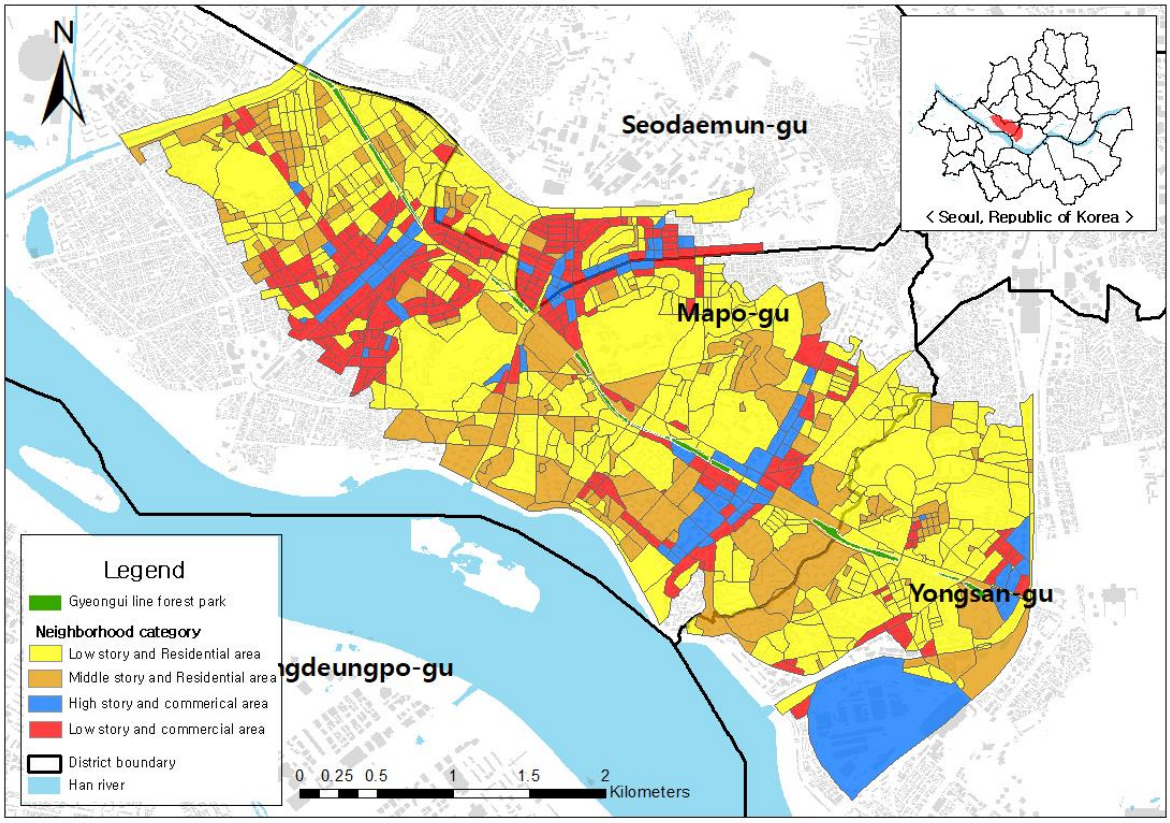

Figure 5. Mapping of the LCA result to the study area

4.3 NB regression model results

4.3.1 NB regression result with all types of retail

The negative binomial regression analysis represented in *Table 6* shows the factors influencing all of the retail services from 2011.04 to 2017.06. The monthly dummy variable was included in the analysis but omitted due to lack of space on the table. The influence of each variable was applied to the exponential function and then the coefficient values can be interpreted as a multiple.

Except for line 6, all of the other subway lines were found to have more retail opening in the subway station area than non- subway station areas. It is considered that the 2 line has a positive relationship with the opening in the subway station area where major commercial areas such as Hongdae-dong area and Sinchon station are located.

It can be seen that all variables of land use are more active than the first general residential area as a reference, and that the most active retail opening occurs in general commercial areas. Furthermore, it is noteworthy that in the second and third general residential areas designated for residential purposes, the

retail opening is similar to or more than the commercial area.

In the case of main commercial area variables, Hongdae commercial area induces 4.5 times more retail opening than non-commercial area. Hongdae commercial area has high proximity to public transportation because it is close to the lines 2, 6 and Kyeongui Line, and has an attractive space like Hongik University commercial area and has a higher retail opening rate than other regions and diversity of retail type is also very high. Other main commercial areas except Yongsan Electronic commercial area showed 1.5 ~ 1.9 times more retail opening. It was found that the number of openings was higher in an area with dominant single-family housing than in an area with dominant multi-family housing.

On the other hand, it was found that a block with a dominant use for commercial purposes or other purposes is less retail opening. This result can be interpreted that the retail opening is active in the residential area where the single-family housing is concentrated, and it can be said that the commercialization of the residential area is expected. In addition, the more households rented in the block, the more active the retail opening as much as 3.5 times.

The impact of the park construction is that the blocks between 0-100m from the park are 1.3 times more active than the blocks between 400-1000m from the park. The interaction variables of Park 0-100 and each period showed that the retail openings were significantly increased after the opening of the second and third stage park as much as 1.6 times and 1.9 times respectively.

Therefore, it was found that the park construction had a significant positive effect on the retail opening, and the effect was limited only to the opening of the second and third stage park, not the entire section of the Gyeongui Line forest park.

By using the interaction variable which is a combination of the distance from park, each phase, and the second general residential area, we can find that retail openings actively occur only in blocks located between 0-100m from the park compared with the reference group. These results suggest that the first opening of Gyeongui Line Forest Park has caused the opening of retail services in the residential area adjacent to the park. The retail opening of blocks located between 100-200m from the park was increased to 1.8 times and 1.6 times in the second general residential areas after the second and third park opening respectively. These results show that the entry of retail services into the residential area adjacent to the park has been triggered by the formation of the Gyeongui Line forest park.

Table 6. Negative binomial Regression result by using all types of retail

variables	Odds ratio	Std. Error	t value
(Intercept)	0.016 ***	0.24	-16.94
bk100	1.371 ***	0.12	2.58
bk200	1.323 **	0.11	2.55
bk400	1.159 *	0.08	1.75
second phase	0.874	0.17	-0.80
third phase	1.073	0.16	0.43
fourth phase	1.099	0.16	0.59
2 line	1.273 ***	0.05	5.16
5 line	1.490 ***	0.06	6.44
6 line	0.884 ***	0.04	-3.15
Gyeongui line	1.097 **	0.04	2.25
Gen.2 residential	2.136 ***	0.13	5.95
Gen.3 residential	2.091 ***	0.13	5.56
Semi residential	2.050 ***	0.14	4.96
Gen.commercial	2.465 ***	0.14	6.34
Neig.commercial	1.667 ***	0.17	3.02
Ewha Univ	1.896 ***	0.11	5.97
Gongduck	1.519 ***	0.12	3.59
Hongik Univ	4.559 ***	0.06	25.90
Mapo	1.616 ***	0.09	5.27
ShinChon Sta	1.731 ***	0.07	7.90
Yongsan Elect	0.743 ***	0.10	-2.83
Space facility	1.000 *	0.00	1.89
Schoole area	1.000 ***	0.00	2.59
land price	1.000	0.00	0.72
Apart num	1.068 ***	0.01	10.19
single	1.164 ***	0.06	2.66
neighbor living	1.126 *	0.06	1.90
commercial	0.640 ***	0.08	-5.43
rest	0.445 ***	0.14	-5.65
empty	0.046 ***	0.31	-10.04
Mid.road	1.803 ***	0.04	13.28
Larg.road	2.708 ***	0.05	21.25
Gret.road	1.943 ***	0.06	11.20
net area	1.000 ***	0.00	22.59
building avg_age	0.996 **	0.00	-2.02
building avg_floor	0.954 ***	0.01	-4.77
building total area	1.000 ***	0.00	16.11
total pop	1.000 ***	0.00	-5.51
avg_age	0.985 ***	0.00	-3.90
rent_ratio	3.544 ***	0.15	8.58
bk100*second phase	0.877	0.16	-0.81
bk100*third phase	1.623 **	0.20	2.42
bk100*fourth phase	1.878 ***	0.18	3.47
bk200*second phase	0.824	0.13	-1.44
bk200*third phase	0.732 *	0.19	-1.66
bk200*fourth phase	0.865	0.17	-0.86
bk400*second phase	0.827 *	0.11	-1.80
bk400*third phase	0.892	0.14	-0.81

bk400*fourth phase	1.005	0.13	0.04
bk100*second phase*Gen.2 residential	1.394 **	0.14	2.42
bk100*third phase*Gen.2 residential	1.236	0.19	1.09
bk100*fourth phase*Gen.2 residential	0.959	0.17	-0.24
bk200*second phase*Gen.2 residential	1.031	0.13	0.24
bk200*third phase*Gen.2 residential	1.819 ***	0.21	2.91
bk200*fourth phase*Gen.2 residential	1.568 **	0.18	2.55
bk400*second phase*Gen.2 residential	1.080	0.09	0.85
bk400*third phase*Gen.2 residential	1.166	0.15	1.04
bk400*fourth phase*Gen.2 residential	1.115	0.13	0.86
		Number of obs :	68925
		Log-likelihood :	-44027.7

****: $p < 0.01$, **: $0.01 < p < 0.05$, *: $0.05 < p < 0.1$*

4.3.2 NB regression results according to the different retail types

Table 7 shows the result of applying the negative binomial regression model by applying six types classified above. Beauty and leisure & culture services were excluded from the analysis model because the number of opening these retail types is so small that the model produces unreliable results. Therefore, the analysis was carried out with four retail types (restaurant, neighbor, bar, and cafe). The interpretation of each retail types has mainly conducted the impact of the park except for variables that are considered as meaningful. And, same as the interpretation of previous results, an exponential function was applied to easily interpret the coefficient values.

For the restaurant retail, it is found that the opening within each block actively occurs when they are located in Hongdae commercial area and they have higher rent ratio. In the case of the influence of the park according to the distance, the opening within the block located between 0-100m from the park increased 2.1 times and 2.4 times after the opening of the parks in the second and third stages. No significant difference was found in the other interaction variables. The effect of the park construction on the residential area was significantly increased by 1.6 times and 1.5 times after the park opening of the first and second stage in the blocks located between 0-100m. In the blocks located 100-200m from the park, there was a significant increase of 1.8 times and 2.0 times after the park opening of the second and third stages, respectively. In the blocks located between 200-400m in the park, there was a significant increase by 1.5 times and 1.6 times after the park opening of the second and third parks, respectively. Therefore, the results show that the formation of the Gyeongui Line forest park has a significant positive effect on the opening of the restaurant retail, and the effect varies depending on the distance from the park and the time of opening the park.

In the neighbor retail, the influence of the main commercial area is relatively less when compared with the restaurant retail, and the other variables have a similar tendency. At the influence of the park according to the distance, it shows that the block located between 100-200m of the park is significantly reduced by 0.3 times after the park opening of the second stage. These results suggest that the formation of the Gyeongui Line Forest Park has had a negative impact on the opening of the neighbor retail. In the residential area, the neighbor retail opening affected by park construction was decreased 0.4 times in the block located between 0-100m from the park after the park opening in the third stage. On the contrary, the opening of neighbor retail within the blocks located between 100-200m from the park increased by 2.8 times after the park opening of the second stage. As a result, the effect of the Gyeongui Line Forest Park construction on the neighbor retail appears to be different depending on the distance from the park and the park opening time, and also it has both a positive and negative effect on the opening at the same time.

In the case of bar retail, there is a similar pattern when compared with other retail types. Especially, it can be seen that the opening of the bar retail is increased by 2.1 times and 2.8 times within the block with the single-family housing and the neighborhood living facility are dominant. Only bar retail, it was not affected by the great road. Also, it is found that the bar retail is actively started in the block where the ratio of rental households is high. In the case of the influence of the distance from the park, the result shows that the opening of bar retail is significantly increased by three times after the park opening of the second stage in the block located between 100-200m of the park. The effect of the park construction on the opening of bar retail within the residential areas was found to be a significant increase of 1.7 times after park opening in the first stage park between 200-400m. In the case of bar retails, it seems to be a little different from other retail types included in the analysis. In particular, there is no connection between the great road and the bar retail.

In the case of café retail, it seems that it does not show a big difference from the patterns of other types included in the study. However, the effect of the park was found to have a significant negative impact on all sections and periods except for the café establishment that occurred after the opening of the park second stage in a block located between 0-100m from the park.

The effect of park construction on the opening of café within residential areas positively affected all the blocks in the influence boundary after the park opening of the third stage, which led to an increase of 2.8 times and 3.5 times 1.9 times the number of opening café respectively.

Table 7. Negative binomial regression result of each retail types

	Dependent variable			
variables	restaurant	neighbor	bar	café
bk100	1.121 0	1.937 **	0.922	1.953 **
bk200	1.432 **	1.495 *	0.854	1.789 **
bk400	1.152	1.222	1.129	1.295
second phase	0.913	0.515	1.167	1.148
third phase	0.797	0.549	1.356	2.474 **
fourth phase	0.771	1.185	2.272	2.368 **
2 line	1.250 ***	1.654 ***	1.076	1.009
5 line	1.503 ***	1.748 ***	1.919 ***	1.016
6 line	0.850 ***	0.987	0.954	0.841 *
Gyeongui line	1.077	1.039	1.073	1.237 **
Gen.2 residential	2.677 ***	1.889 *	2.859 **	1.599
Gen.3 residential	2.397 ***	2.205 **	1.674	1.806 *
Semi residential	2.858 ***	1.329	1.993	2.090 **
Gen.commercial	2.649 ***	3.197 ***	1.924	1.802 *
Nei.commercial	2.201 ***	2.103 *	2.444	1.635
Ewha Univ	1.688 ***	0.858	1.328	2.570 ***
Gongduck	1.999 ***	1.482 *	2.348 **	0.816
Hongik Univ	4.695 ***	2.539 ***	4.569 ***	3.862 ***
Mapo	2.136 ***	0.750	2.598 ***	2.339 ***
ShinChon Sta	1.553 ***	1.991 ***	2.510 ***	1.394 *
Yongsan Elect	0.676 ***	0.937	0.857	0.616
Space facility	1.000 ***	1.000	1.000 ***	1.000
Schoole area	1.000	1.000	1.000	1.000 ***
land price	1.000	1.000	1.000	1.000
Apart num	1.041 ***	1.090 ***	1.056 **	1.026
empty	0.036 ***	0.082 ***	0.143 *	0.077 ***
rest	0.225 ***	0.560 **	0.160 *	0.571
neighbor living	1.527 ***	0.419 ***	2.880 ***	1.181
single	1.524 ***	0.544 ***	2.144 ***	1.610 ***
commercial	0.612 ***	0.502 ***	0.683	0.705
Mid.road	1.794 ***	2.080 ***	1.608 ***	1.766 ***
Larg.road	2.797 ***	2.971 ***	3.004 ***	2.551 ***
Gret.road	1.371 ***	4.007 ***	1.153	1.811 ***
net area	1.000 ***	1.000 ***	1.000 ***	1.000 ***
building avg_age	0.993 **	1.010 **	1.000	0.991 *
building avg_floor	0.975 *	0.932 ***	1.111 ***	0.994
building total area	1.000 ***	1.000 ***	1.000	1.000 ***
total pop	1.000 ***	0.999 ***	1.000	1.000
avg_age	0.982 ***	1.001	0.995	0.961 ***
rent_ratio	3.709 ***	2.004 **	10.464 ***	2.639 ***
bk100*second phase	0.931	0.773	1.730	0.425 **
bk100*third phase	2.136 ***	0.817	2.703	0.931
bk100*fourth phase	2.438 ***	1.716	0.548	0.311 **
bk200*second phase	0.866	0.779	1.241	0.213 ***
bk200*third phase	0.868	0.304 **	3.074 **	0.409 **
bk200*fourth phase	0.830	0.937	1.161	0.232 ***
bk400*second phase	0.875	0.847	0.739	0.576 **
bk400*third phase	0.754	0.909	1.295	0.363 **

bk400*fourth phase	0.737	0.819	0.644	0.475 **
bk100*second phase*Gen.2 residential	1.613 **	0.867	1.772	1.333
bk100*third phase*Gen.2 residential	1.547 *	0.617	1.393	0.993
bk100*fourth phase*Gen.2 residential	1.164	0.399 **	6.301	2.817 *
bk200*second phase*Gen.2 residential	0.939	1.372	1.177	1.740
bk200*third phase*Gen.2 residential	1.771 **	2.847 *	1.071	1.089
bk200*fourth phase*Gen.2 residential	2.009 ***	0.839	1.570	3.502 **
bk400*second phase*Gen.2 residential	1.015	1.050	1.662 *	1.047
bk400*third phase*Gen.2 residential	1.460 *	0.794	1.309	1.782
bk400*fourth phase*Gen.2 residential	1.606 **	1.233	1.697	1.904 *
(Intercept)	0.007 ***	0.004 ***	0.000 ***	0.005 ***
Number of obs:	68925	68925	68925	68925
Log likelihood:				

****: p < 0.01, **: 0.01 < p < 0.05, *: 0.05< p 0.1*

5. Discussion

This study was designed and carried out to investigate the structural changes of the retail in the surrounding area due to the influence of park construction. To explore the effect of the Gyeongui Line Forest Park on the neighborhoods, we examined the effect of the park by distance and tried to find out by using the retail opening. And the effect of each part of park on the retail types was examined empirically. In addition, research process was designed to identify the retail types that have entered the residential area due to the park construction. As a result of the study, two conclusions were obtained.

First, the commercialization of the neighboring areas caused by the influence of the formation of the Gyeongui Line Forest Park is different according to the type of the retail. Mostly, the number of restaurants increased and the number of bars increased only some sections of park. Among the entire sections of the Gyeongui Line Forest Park, the Yeonnam-dong section was constructed in a residential area and is located close to the Hongik university station. In addition, it is adjacent to the Hongdae commercial area, and it is likely that the commercial area will be expanded. Therefore, it is expected that the area of Yeonnam-dong section is actively founded restaurants and bars because of high transportation accessibility, cultural consumption space, and relatively low rent area. On the other hand, in the case of nearby neighbor retail and cafes, productivity is lower than that of restaurants and bars. Therefore there is a phenomenon in which the productivity is replaced by a high productivity type according to the intention of the landlord to maximize the value of the space. Therefore, it was found that the influence of park construction had a negative effect on the nearby neighbor retail and café establishment.

Second, the commercialization of the surrounding area caused by the influence of the formation of the

Gyeongui Line Forest Park shows different patterns according to the distance from the park. The nature of the linear park has a wide variety of characteristics of neighborhoods. Therefore, the same type of park would have had different influences. Therefore, sporadic start-ups have occurred in some sectors depending on the types of retail. Especially, it can be seen that the start-up of the café after the completion of the third stage of the park is greatly increased. This result is the commercialization of the neighborhood since the construction of third stage park. As a result, according to the distance from the park, the effects of park has different.

6. Conclusion

In this study, we attempt to investigate the effect of urban park construction on adjacent neighborhoods from the park. Park construction in the inner urban has a positive effect with various benefits, but there is also a negative impact such as eco-gentrification. Therefore, it is necessary to plan the management of the impact on neighborhoods due to the park construction by investing the public resources. The results of examining the effects of parks using the opening data of retail services are as follows.

The formation of the Gyeongui Line Forest park led to the commercialization of adjacent neighborhoods. In particular, it was confirmed that the total retail increased 1.6 to 1.8 times in the neighborhood nearest to the park(0-100m). In addition, the increase of the occupation of all retail type in the residential area increased, and the effect was larger the closer to the park. Therefore, commercialization due to the formation of the Gyeongui Line Forest Park has been triggered, and it has been confirmed that it occurs intensively in the residential area.

The patterns of retail opening induced by parks construction are as follows. In the case of restaurant, the number of entrepreneurs increased more than twice in the area adjacent to the park. Among the retail services classified in this study, the restaurant is highly productive, which is a result of empirically revealing the self-destruction of diversity as claimed by Jane Jacobs(1961). On the other hand, in the case of the neighbor retail, the result was significantly decreased only in this section(100-200m).

However, it can be said that the crowding low productivity retail out has occurred. In the case of bar, it is expected that the high productivity of bar pushed off the low productivity of the neighboring retail when considering that the section between the decrease of the neighbor retail and the increase of the bar are the same. In case of café, it decreased in the neighborhoods adjacent to the park, while it increased in the residential neighborhoods adjacent to the park. This result suggests that the café sector

has moved to a low rent residential area due to the park construction, therefore the rent gap theory is expected to work.

As a result of the above-mentioned results, commercialization was induced by the park construction, and it was confirmed that the industries with high productivity in the residential area increased in particular. These results indicate that eco-gentrification phenomenon, similar to highline parks, is a concern. Therefore, the results of the study show that the gentrification caused by the park is declined as fast as rise. Therefore, policy instruments for sustainable neighborhood management are needed.

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