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The Positive Aspects of the Sharing Economy
: The Relationship between Airbnb and Commercial Sales Volume through the Lens of Spatial Regression Models

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Abstract

Recently, the concept of sharing economy has gained increasing popularity in the accommodation industry. However, relatively less research has been conducted on this subject. In this study, the likelihood of Airbnb, a shared accommodation platform, to have a positive effect on the commercial sales volumes in the city of Seoul was examined. The spatial regression model was used to process detailed Airbnb data and sales volume in the commercial districts of Seoul. Particularly, the Airbnb data from Dr. Tom Slee and the sales volume data from the Seoul data plaza were collected. To account for the spatial autocorrelation between the sales volumes, spatial error models were used with the queen spatial weight matrix. The results showed that the listings of Airbnb had a positive relationship with the commercial sales volume in Seoul. Specifically, all else considered equal, one unit increase in the Airbnb listing lead to a 1.4% increase in commercial sales volume. This effect was significantly larger in the alley commercial districts. One unit increase in the Airbnb listing in alley commercial districts was associated with a 1.8% increase in the commercial sales volume. These findings indicate important policy implications that encouraging Airbnb businesses would aid in revitalizing the declining commercial districts. However, Airbnb can also have a negative influence on the residential areas owing to noise, crime, and littering from tourists. Therefore, careful consideration on the policies for the Airbnb business is required.

Keywords Sharing Economy, Airbnb, Commercial Sales Volume, Spatial Regression Model
주제어 공유경제, 에어비앤비, 상권매출, 공간회귀모형

Ⅰ. Introduction

1. Research Background and Purposes

Discussions on the sharing economy have become an issue worldwide in recent years, and diverse forms of sharing economy models have already been realized in diverse spheres. Though definitions of it vary, the sharing economy generally refers to services that link suppliers and users so that diverse forms of underutilized resources such as spaces, homes, tools, clothes, and vehicles may be used more efficiently. As such, the sharing economy has expanded swiftly with the development of platform services, which use as their medium the Internet, easily usable by users. In particular, corporations with head offices in the Silicon Valley such as Airbnb, Inc. and Uber Technologies, Inc. form the backbone (Miller, 2016).

Airbnb is a representative sharing economy corporation that has quickly expanded across the globe by providing travelers with a short-term accommodation service.

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Launched in 2008 in San Francisco, it is a representative customer-to-customer (C2C) platform linking hosts who lease available residential spaces not in use and consumers who use such available spaces after paying rents. Airbnb has grown quickly by forming an economic structure where, based on such a platform, hosts obtain additional income by using available residential spaces and consumers obtain utility by using a lodging facility service at relatively low prices. In addition, because Airbnb has generally expanded from residential areas, there is also the advantage that travelers and visitors making use of the corporation can experience the locals' exotic lifestyles in the bases of the latter's lives (Lagonigro, et al., 2020).

As can be confirmed also from statistical data, the Airbnb market has dramatically increased in South Korea as well, and the types of Airbnb users have not been restricted to outbound tourists, either, with the number of inbound travelers increasing gradually (Huh J.J. and Noh S.C., 2018). Furthermore, Airbnb's service is not limited to single rooms but is provided in diverse forms such as entire homes and room sharing, and the scope of the service has gradually expanded to transcend the level of mainly providing residential spaces whose owners are traveling or that are vacant for extended periods and to encompass owners living and having meals together with users or leasing their homes for the Airbnb business. According to Tom Slee's data, the number of domestic Airbnb users amounted to 2.94 million in 2018, and the resulting economic impact was estimated to be 1 trillion 370 billion won.

Thus expanding through diverse accommodation sharing services, Airbnb has greatly led the accommodation market. However, the corporation can contribute to the growth not only of the accommodation industry itself but also of the local economy. This is because Airbnb has deeply infiltrated not only major tourist attractions but also the sphere of the locals' daily lives and also because the corporation's economic impact positively affects the commercial sales volumes of both major tourist attractions and local communities at the same time (Guttentag, 2015). Consequently, while estimates of Airbnb's economic impact must be based on the Airbnb market, the corporation's influence over the commercial sales volumes of surrounding areas, too, need to be taken into consideration.

In the case of South Korea, out of diverse accommodation services, lodging facilities whose utilization rates have continued to increase since 2016 are linked to Airbnb, which is based on a sharing economy platform (Huh J.J. and Noh S.C., 2018). The utilization rate of Airbnb in Seoul has increased because Airbnb is distributed throughout the city so that accessibility to representative tourist attractions in the capital is high and customers can stay at quality lodging facilities for prolonged periods at comparatively low prices. Because of such characteristics and advantages, Airbnb's effects on diverse fields are evaluated abroad to estimate its economic value (Horn and Merante, 2017). In the case of South Korea, however, despite the expansion of the Airbnb market and increase in its utilization rate, studies elucidating the economic value of Airbnb have failed to be conducted, and, in particular, research on the influence of Airbnb on various fields including the housing market, commercial sales volumes, residential environments, and local economy is insufficient (Hong S.J. and Lee C.M., 2020).

From such a perspective, the purpose of this study lies in empirically analyzing the positive effects of Airbnb. In particular, this study seeks to elucidate empirically the effect of Airbnb on the local economy by grasping the relationship between Airbnb and local commercial sales volumes. In general, spatial influence is expected to exist between Airbnb and commercial sales volumes. Consequently, this study will proceed by using spatial modeling in order to consider the spatial influence between Airbnb and commercial sales volumes. In the future, it will be possible to use the empirical results of this study in order to provide implications for strategies on the development of the local economy through the sharing economy.

II. Literature Review

1. Sharing Economy

With the recent and global spread of the influence of the sharing economy, a concept where individuals rent their assets to others, social interest in it has increased as well. Sharing economy platforms, which include Airbnb and Uber, cited as representative sharing economy corporations, and have spread to various fields such as WeWork Companies, Inc. and Closet Share, have made astonishing accomplishments and come to be accepted as an undeniable trend

of the age now. While there are expectations that the sharing economy will create additional economic effects by either improving insufficient services within existing industries or creating new value, however, there also exist in some quarters concerns about its side effect of seriously harming existing industries by replacing them with new industries. For example, because Uber and Airbnb have grown by seriously damaging the existing taxi and hotel industries and transcended the legal framework in many cases, there exist legal problems as well. In addition, the sharing economy causes grave inequality between groups that are familiar with the Internet and those that are not (Martin, 2016).

With increasing interest in the sharing economy, research on it has been actively conducted in South Korea in recent years as well. Oh S.H. et al. (2018) have analyzed cases of the use of the sharing economy in major countries and regions such as North America, China, and Europe to present plans for application to South Korea. In particular, they have proposed a sharing economy model that can be introduced into South Korea based on examples of the concrete revitalization of the local economy through the use of the sharing economy such as job creation effects, local resource exchange and sharing platforms, and construction of local development networks. Lee H.N. et al. (2018) have analyzed the effect on the tourism industry in South Korea, with a focus on accommodation sharing out of the sharing economy, and, based on this, presented plans on how the domestic tourism industry is to accommodate the sharing economy and respond in terms of policies. Also under way are diverse other studies on policy and institutional measures regarding the introduction of the sharing economy based on macroscopic expected effects of the sharing economy as well as analyses of points of contention regarding the sharing economy.

2. Empirical Research on Airbnb

Out of discussions on the sharing economy, studies on Airbnb, an accommodation sharing service provider, have been actively conducted abroad and largely consists of two currents in research. First, research empirically analyzing the spatial distribution and locational characteristics of Airbnb has been conducted. This is to examine the areas in which Airbnb, which has proliferated indiscriminately, has increased and, based on the results, to grasp the characteristics of Airbnb. Eugenio-Martin, et al. (2019) have conducted an empirical analysis of the spatial distribution of Airbnb and the influencing factors of diverse geographical and socioeconomic factors in Barcelona, Spain by using spatial models. According to the results of the analysis, the distribution of Airbnb is related to the concentration of urban tourists but is largely unrelated to beaches or tourist attractions with good natural landscapes. There exist several studies in South Korea as well. Huh J.J. and Noh S.C. (2018) have analyzed patterns in the spatial distribution of Airbnb in Seoul by using the nearest neighbor hierarchical clustering method. The results of the analysis confirm that, though Airbnb is distributed in concentration in the city center, Gangnam Station (subway) area, and Hongik University area, unlike other lodging facilities, it is widely spread throughout Seoul.

The second current of research on Airbnb in the academia consists of studies on the effects of Airbnb on the housing market. Research on the academia's perspectives on the relationship between Airbnb and the housing market tends to be strongly negative. This is due to the structural problem where a dramatic increase in Airbnb leads to a decrease in general rental housing and a decrease in the supply of rental housing results in a rise in rents. Consequently, studies empirically analyzing such phenomena have been actively conducted, mainly abroad. Horn and Merante (2017) have empirically verified that an increase in Airbnb has decreased the supply of rental housing in the housing market in Boston, thus causing a rise in rents. Conducting research on Sydney, Gurran and Phibbs (2017) have shown that an increase in Airbnb has decreased the supply in the housing rental market. Because an increase in Airbnb is linked to noise, traffic congestion, and parking problems in residential areas, however, they have stressed the important of urban planners' roles. In South Korea, Hong S.J. and Lee C.M. (2020) have conducted empirical research on Gangnam-gu and Mapo-gu in Seoul and demonstrated that the number of Airbnb listings has negatively affected apartment prices in Seoul. According to their explanation, this is because the influx of tourists into existing residential areas has generated problems such as noise, litter, and parking violations, thus having negative effects and destroying existing residential environments.

3. Airbnb and Commercial Sales Volumes

Earlier research on Airbnb has consisted largely of academic studies exploring the spatial characteristics of Airbnb itself, and, as for Airbnb's relationship to the housing market, mainly in progress is research on the negative effects of the former on the latter. However, comparatively limited has been research empirically elucidating the economic value of sharing economy platforms in relation to value creation, the original goal of the sharing economy. In other words, Airbnb increases consumers' utility by providing accommodation sharing services at low prices and has a positive effect on the local economy by inducing the influx of a greater number of tourists through the provision of diverse accommodation sharing services as well. In fact, many studies claim that while an increase in Airbnb occurs together with an increase in the number of tourists, from the perspective of local communities, an increase in Airbnb can revitalize local commercial districts. However, empirical research on this has been all too insufficient.

In South Korea, actively conducted in recent years has been research on commercial sales volumes in small areas in relation to local communities or alley commercial districts. In particular, earlier studies on commercial sales volumes have consisted mainly of those searching for factors that affect commercial sales volumes. As for factors influencing commercial sales volumes, it is possible largely to cite the characteristics of commercial districts, urban spatial structures, and hinterlands (Kim H.C. and Lee S.I., 2019). In addition, the patterns of de jure population, floating population, workplace population, and consumers directly affecting commercial sales volumes likewise have been verified through previous research (Oh H.R. et al., 2017), and consumers' genders and ages, too, have been shown to be important variables (Kang H.M. and Lee S.K., 2018). In addition, there also exist differences according to commercial district types (Kang H.M. and Lee S.K., 2018), and accessibility has been stressed as an important variable as well (Jung E.A. and Sung H.G., 2018). Because contiguous areas affect one another in terms of commercial districts, spatial interactions can arise among commercial sales volumes, and the need to control them in grasping the influencing factors of commercial sales volumes has been raised as well (Lee M.H., et al., 2019; Jung E.A. and Sung H.G., 2018).

Despite such research on commercial sales volumes using diverse variables, studies on the effect of the distribution of accommodation sharing facilities such as Airbnb on commercial sales volumes regrettably have yet to be conducted. As has been mentioned before, Airbnb exhibits a pattern of being distributed much in urban areas and a tendency to increase dramatically around so-called "hip" places. In addition, Airbnb, which has infiltrated residential areas around "hip" places and increased, has a negative effect on residential areas as well but is also expected to affect surrounding commercial districts positively. Consequently, verification of this through empirical analysis is necessary, and, through this, urban planning implications stemming from an increase in accommodation sharing facilities need to be derived. In addition, examining the influence of Airbnb on commercial sales volumes is expected to be useful also for empirically grasping Airbnb's positive aspects and deriving policy implications for the sharing economy.

Ⅲ. Research Methods and Data

1. Analytical Data

The object of this study is Seoul, and the data necessary for the analysis are those on commercial sales volumes, Airbnb data, and those necessary for constructing spatial variables affecting commercial sales volumes. As for data on the spatial distribution of Airbnb, the most important data for this study, listing data for April-June, or data on the second quarter (Q2) of 2017, obtained from Tom Slee (http://tomslee.net/airbnb-data) were used. Data on commercial districts in Seoul were obtained from the Seoul Open Data Plaza portal, and those for Q2 2017 were used. Commercial districts in Seoul as of 2017 were distinguished into 1,318 out of 1,497 through data work among the variables and were classified into the four types of alley commercial districts, major commercial districts, traditional retail markets, and special tourism districts, as in 〈Table 1〉. In order to construct variables on factors affecting commercial sales volumes, data on floating population, economically active population, and household type included in data on commercial districts were used. In addition, Statistics Korea's data on employees on the level of census output areas were used, and data on subway station and bus stop spaces in Seoul (shp files)

Table 1. Commercial district type and definition

Type	Count	Definition
Alley commercial district	1,010	A commercial district with a high concentration of stores among the alley business districts and a residential area including 30 or more stores
Major commercial district	253	A densely populated area of commercial businesses within walking distance without considering the hinterland
Traditional retail market	227	Permanent market or regular market formed naturally in a certain area over a long period of time
Special tourism district	6	A commercial area located in a regional space where tourism activities are mainly conducted

provided by the Seoul Open Data Plaza portal were used in order to construct accessibility variables.

2. Analytical Models

In order to verify the effect of Airbnb on commercial sales volumes, this study constructed an empirical analytical model based on regression model equations. In particular, in reference to earlier research, the characteristics, accessibility, and types of commercial districts were included as variables affecting commercial districts in addition to Airbnb. The empirical analytical model is as follows:

$$Y=\alpha+\beta A+\gamma X+\delta D+\theta T+\epsilon \quad (1)$$

Y is the commercial sales volume, a dependent variable, A is the number of Airbnb listings, X is the commercial district characteristics, D is accessibility, T is the dummy variable of a commercial district type, and is the error term. As for the commercial district characteristic variables, a variety of them capable of affecting commercial sales volume were constructed in accordance with earlier research, and they include the number of employees per commercial district type, floating population, and number of households per housing type. Accessibility variables are variables importantly affecting commercial sales volume and include transportation accessibility variables and the distance to the central business district (CBD) in this study. Finally, because there exist differences in commercial sales volumes according to the commercial district type, dummy variables according to the commercial district type were included.

As has been mentioned above, spatial autocorrelation is highly likely to exist among commercial sales volumes. Because consumers perceive similar, contiguous commercial districts as identical, spatial autocorrelation arises in the commercial sales volumes of contiguous commercial districts. In other words, this signifies a phenomenon where, in case diverse commercial districts are geographically contiguous, the high sales of a particular commercial district simultaneously raise the sales of the surrounding commercial districts. This is because consumers generally tend to consume while moving instead of remaining in single locations so that the more consumers there are, the larger commercial districts become. In order to consider such spatial autocorrelation, this study constructed the empirical model above in the form of a spatial model.

Spatial regression models signify analytical models that take spatial autocorrelation into consideration in accordance with Tobler's (1970) first law of geography ("everything is related to everything else, but near things are more related than distant things")(Lee H.Y. and Noh S.C., 2013). In other words, this can be explained as a research method where, based on a hypothesis regarding the impact of spatial contiguity, the degree of dispersion or concentration on a space is analyzed statistically. Spatial regression models are representatively divided into spatial lag models and spatial error models. Spatial lag models are spatial regression models that are used as alternatives to OLS in case spatial dependence arises to dependent variables due to aggregation errors in the data. They are models that, in order to control spatial dependence, variabilize the influence of surrounding areas on dependent variables and construct them as spatial weight matrices. In other words, spatial lag models are useful models when seeking to control interactions among contiguous areas as particular phenomena out of the main causes of spatial autocorrelation. The basic equation of spatial lag models is as follows:

$$Y = \rho WX + X\beta + \epsilon \quad (2)$$

With spatial error models, which are among alternative models to OLS regression models, in order to control spatial dependence existing among errors, error covariance is created for each, and the influence of spatial interactions within regression models is taken into consideration. They are research models appropriate to cases where, out of the main causes of spatial autocorrelation, variables regarding discrepancies on the spatial level and spatial autocorrelation cannot be observed. The basic equation of spatial error models is as follows:

$$\begin{aligned} Y &= X\beta + \epsilon \\ \epsilon &= \lambda W\mu + \mu \end{aligned} \quad (3)$$

Here, W is spatial weight matrices, and representative are methods that consider spatial contiguity and those that consider spatial distance. In this study, because of the characteristics of the formation of commercial districts, spatial weight matrices that take spatial contiguity into consideration are used. In other words, the basic assumption is that spatial influence among commercial districts will arise among contiguous commercial districts but be largely unrelated to distant commercial districts. This is because contiguous commercial districts generally share floating population in many cases so that relations of spatial influence presumably will arise in commercial sales volumes as well.

3. Spatial Weight Matrix Calculation and Spatial Autocorrelation Measurement Methods

This study used GeoDa 1.14 in order to calculate spatial weight matrices and, out of spatial contiguity methods, used the Queen method. Queen's spatial contiguity is calculated based on the form shown in 〈Figure 1〉, and this method presumes the contiguity of the sides and edges of two areas as spatial contiguity. In order to measure spatial autocorrelation based on the spatial weight matrices constructed, Moran's I index was used. An index for verifying spatial autocorrelation devised by Moran (1950), Moran's I can be seen as an index showing a spatial clustering tendency among similar values for the entire objects of study and is expressed as in the following equation (Lee H.Y. and Noh S.C., 2013).

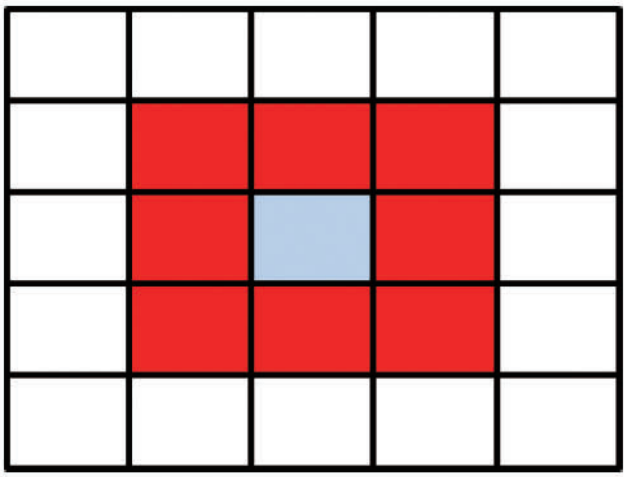

Figure 1. Queen adjacency matrix calculation method

$$\begin{aligned} I &= \frac{N\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(Y_i - \overline{Y})(Y_j - \overline{Y})}{\left(\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}\right)\sum_{i=1}^{n}(Y - \overline{Y})^2} \\ Z &= \frac{I = E(I)}{S_\epsilon(I)} \\ E(I) &= -1/(n-1) \end{aligned} \quad (4)$$

Though spatial clustering generally occurs throughout the area in question, as presumed by Moran, it can occur locally as well. This is because, for example, while there exists the CBD in the entire region in question, small commercial districts locally form spatial clustering around station influence areas (SIAs). However, Moran's I has the disadvantage of being unable to take this into consideration. In order to supplement this, it is necessary also to examine the local indicator of spatial association (LISA), which is a local index devised by Anselin (1995), and to grasp the degree of spatial clustering(Lee H.Y. and Noh S.C., 2013). The LISA is an index that makes it possible to observe the occurrence of the phenomenon of spatially similar values clustering in a particular area and is expressed as in the following equation:

$$I_i = \left[\frac{n^2}{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}}\right]\frac{(y_i - \overline{Y})\sum_{j=1}^{n} w_{ij}(y_j - \overline{Y})}{\sum_{i=1}^{n}(y_i - \overline{Y})^2} \quad (5)$$

This study sought to grasp the degree of commercial sales volumes' spatial clustering by using the LISA index together with Moran's I and then to determine the need to apply a spatial econometric model.

Ⅳ. Research Results

1. Basic Statistics Analysis

Descriptive statistics on the variables used in this study is as in (Table 2). The mean commercial sales volume of Seoul during Q2 2017 amounted to 11.4 billion won, and commercial sales volumes were high in the city center and the Gangnam area, as shown in (Figure 2). The mean number of Airbnb listings was 15 per commercial district, and it was possible to confirm that there also existed a commercial district encompassing a maximum of 1,367 listings. As in 〈Figure 3〉, it was possible to confirm that Airbnb was distributed throughout Seoul but concentrated in Gangnam-gu, city center, and Mapo-gu. The mean floating population using commercial districts in Seoul per quarter amounted to 252,707, and employees in the electrical and construction industry, those in the wholesale and retail industry, those in the service industry, and those in the FIRE industry were

Table 2. Variables and descriptive statistics

		Variable	Mean	STD	Min	Max
Dependent		Sales volume (100,000 won)	11,400	25,300	37	424,000
Independent		Number of Airbnb listing	15	61	0	1367
Control	Commercial district characteristics	Floating population	252,707	420,876	1331	6,693,667
		Employees in electrical and construction industry	161	598	0	8357
		Employees in the wholesaler and retail industry	671	2047	0	37337
		Employees in service industry	500	1673	0	29453
		Employees in FIRE industry	199	1072	0	29388
		Number of households living in APT	87	187	0	3286
		Number of households living in non-APT	1003	662	0	4811
	Accessibility	Distance to subway station (m)	550	350	23	3337
		Distance to bus station (m)	125	83	2	531
		Distance to CBD (m)	8229	3674	58	17214
	Commercial district type	Alley commercial district	0.74	0.43	0	1
		Major commercial district	0.15	0.35	0	1
		Traditional retail market	0.10	0.30	0	1
		Special tourism district	0.01	0.06	0	1

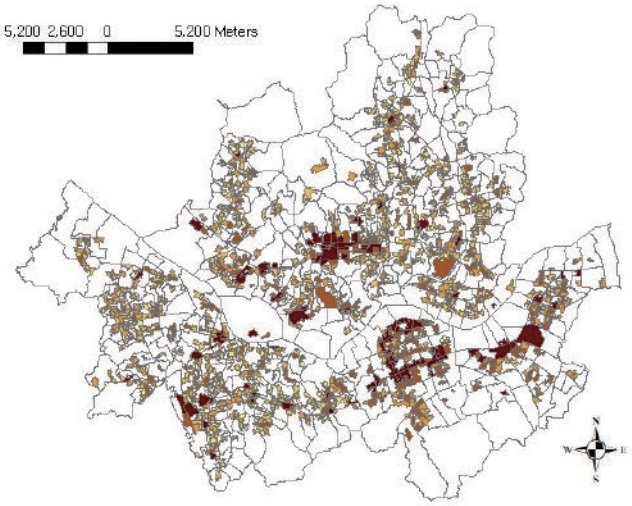

Figure 2. Spatial distribution of sales volume

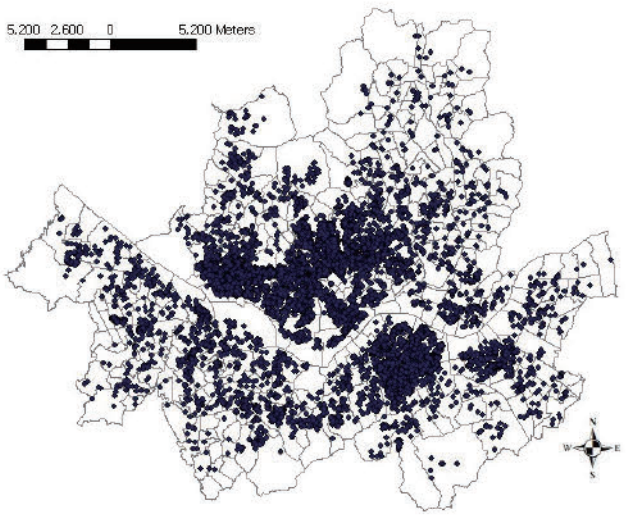

Figure 3. Spatial distribution of Airbnb

161, 671, 500, and 199, respectively. While the mean number of households living in apartments was 87, the number of households living in non-apartments amounted to 1,003, thus demonstrating that more of the households existing in commercial districts lived in general housing instead of apartments. The distance to a subway station, distance to a bus stop, and distance to the CBD were 550 m, 125 m, and 8,229 m, respectively, per commercial district. Finally, as for commercial districts in Seoul, alley commercial districts amounted to 74%, major commercial districts amounted to 15%, traditional retail markets amounted to 10%, and special tourism districts amounted to approximately 1%, respectively. Through this, it was possible to confirm that most commercial districts in Seoul were alley commercial districts, and spatial distribution was confirmed through ⟨Figure 4⟩ as well.

2. Verification of the Appropriateness of the Spatial Regression Model

Moran's I for the commercial sales volumes of Seoul was 0.348, as in ⟨Figure 5⟩, and this was a statistically significant value. ⟨Figure 6⟩ shows a LISA map and that, in Seoul, areas with high commercial sales volumes are distributed in clusters. In other words, this can be explained as: when a particular area with a high commercial sales volume exists in the city, this significantly affects commercial districts in contiguous areas, thus generating a phenomenon of similar commercial sales volumes. Global and local autocorrelation verification in ⟨Figure 5⟩ and ⟨Figure 6⟩ imply the need to consider spatial autocorrelation before empirically analyzing commercial districts in Seoul.

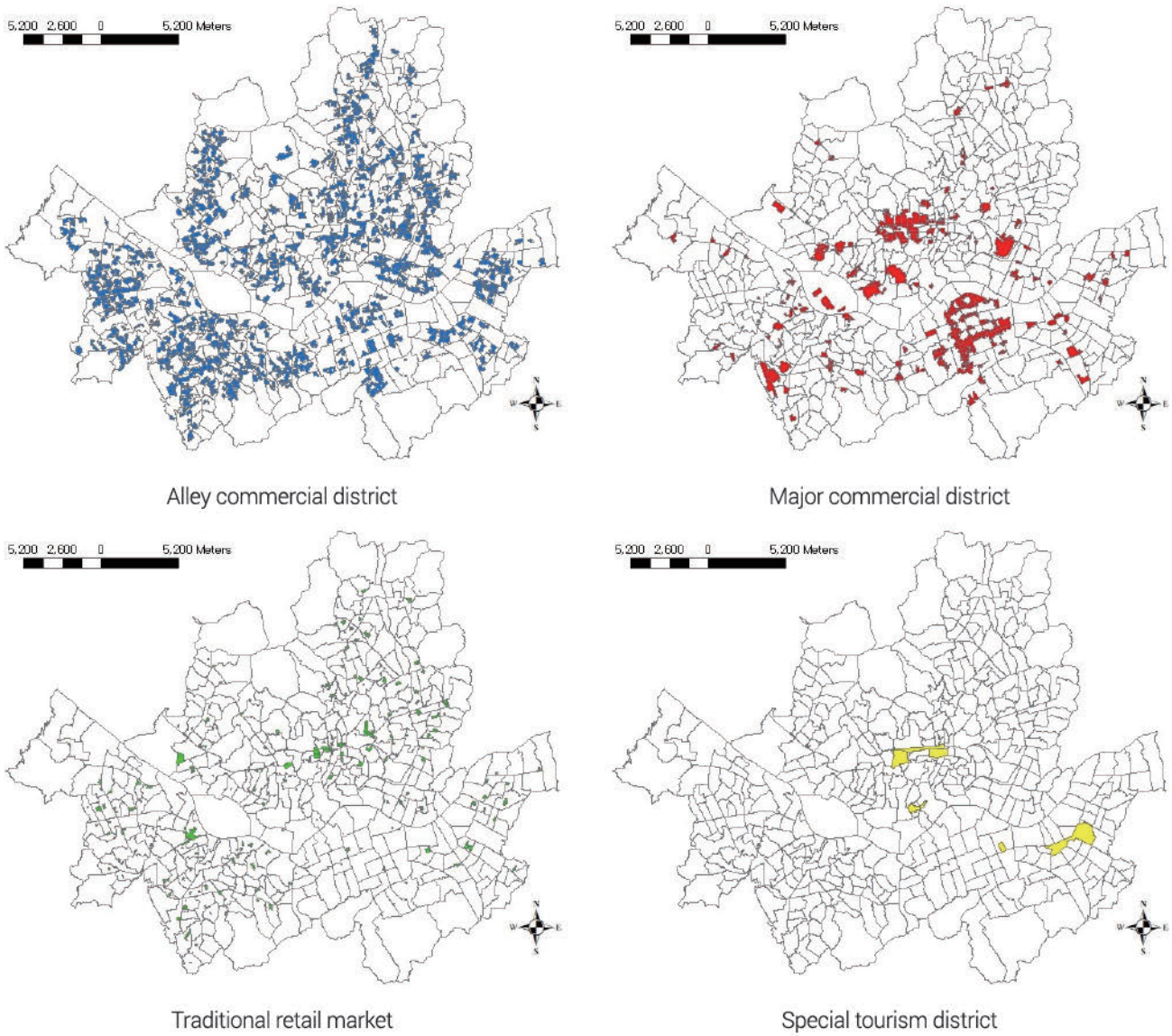

Figure 4. Dispersion of 4 types of commercial district in Seoul

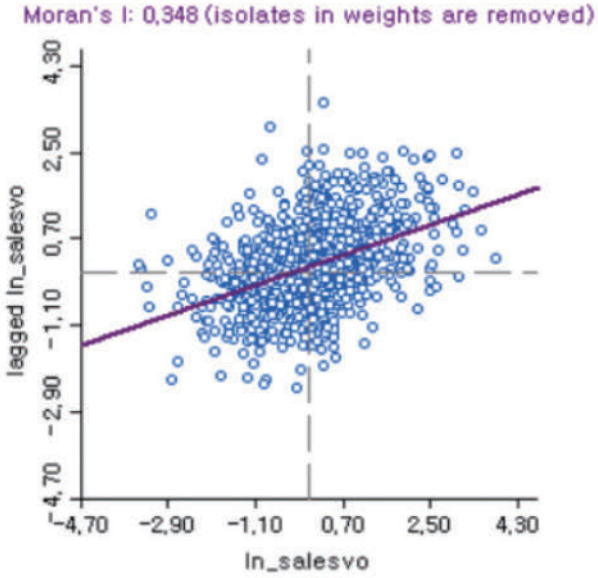

Figure 5. Moran's I (sales volume)

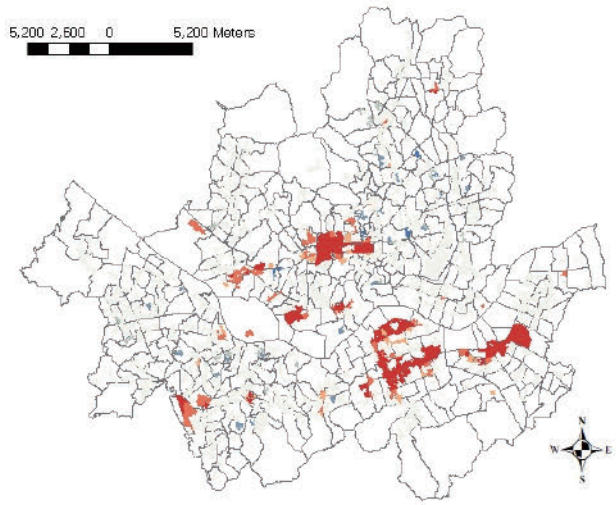

Figure 6. LISA Map

With Moran's I or the LISA alone, however, it is impossible to know which model, out of the spatial lag and spatial error models, to apply when applying a regression model for grasping factors that affect commercial sales volumes. Because it was necessary to verify this through a Lagrange multiplier (LM) test, an LM was conducted. As a result, as shown in 〈Table 3〉, spatial error models were determined to be more appropriate to this study than were spatial lag models. In other words, while spatial error models were statistically significant, spatial lag models were shown to be inappropriate. Consequently, this study used a spatial error model to verify the effects of Airbnb on commercial sales volumes.

3. Results of Estimates of Multiple Regression Models and Spatial Regression Models

〈Table 4〉 shows the results of this study. According to the results of a comparative analysis of the regression model (OLS) and the spatial error model (SEM), the R-squared values and the log likelihood values all increased in reliability and validity in terms of the relationship between Airbnb and commercial sales volumes the more spatial error models were used. In addition, diagnosis of the normality of error terms, model fit comparison statistics, verification of the significance of spatial error models, and values for influence on contiguous areas all satisfied the significance level of 0.1%, and spatial models increased in explanatory power in comparison with regression models. In addition, judging from the fact that the lambda value amounted to 0.1829 and was significant, spatial influence seemed to be appearing in the positive direction. In other words, diverse variables not observed in contiguous areas seemed to be affecting commercial sales volumes of the areas in question.

Table 3. Largrange multiplier test

TEST	MI/DF	Value	Prob
Moran's I (error)	0.1431	5.7188	0.000
Lagrange multiplier (lag)	1	0.2999	0.583
Robust LM (lag)	1	0.0008	0.977
Lagrange multiplier (error)	1	31.2830	0.000
Robust LM (error)	1	30.9839	0.000

When Airbnb variables, the foremost variables of interest, were examined, an increase in Airbnb listings in Seoul positively affected commercial sales volumes in the city. In order to interpret the coefficient values, it is necessary first to discuss the characteristics of the data. The data on commercial sales volumes used in this study constitute the total sum for Q2 2017. In contrast, as for Airbnb data, data on the listings for one day each month were used. In other words, if the data on commercial sales volumes constitute the total sum for 90 days (Q2 2017), then Airbnb data are data for three days. Consequently, if the total number of Airbnb listings in a quarter is presumed to be 450(15×30 (total: 3 months 90 days/3 days)) on an average and if the Airbnb market in Seoul grows by 50% in the future, there is the possibility that

Table 4. Empirical results

	OLS	SEM
Number of Airbnb listing	0.00096** (0.00041)	0.00089** (0.00041)
ln (floating population)	0.47859*** (0.02822)	0.48984*** (0.02837)
Employees in electrical and construction Industry	0.00010** (0.00004)	0.00008** (0.00004)
Employees in the wholesaler and retail industry	0.00010*** (0.00002)	0.00010*** (0.00002)
Employees in service industry	0.00005*** (0.00002)	0.00005** (0.00002)
Employees in FIRE industry	-0.00010*** (0.00003)	-0.00010*** (0.00003)
Number of households living in APT	0.00026** (0.00011)	0.00023** (0.00011)
Number of households living in non-APT	-0.00010*** (0.00004)	-0.00011*** (0.00004)
Distance to subway station (m)	-0.00009 (0.00006)	-0.00009 (0.00006)
Distance to bus station (m)	0.00039 (0.00024)	0.00036 (0.00024)
ln (distance to CBD) (m)	0.11655*** (0.03436)	0.11347*** (0.03908)
Alley commercial district	-0.56282*** (0.07254)	-0.58630*** (0.07034)
Special tourism district	0.13776 (0.42450)	0.21627 (0.41560)
Major commercial district	0.53255*** (0.42450)	0.47261*** (0.08955)
Constant	15.98260*** (0.46288)	15.91910*** (0.49363)
Lambda		0.17899*** (0.02818)
R-squared	0.55	0.58
Log likelihood	-1438.2	-1420.97
AIC	2906.4	2871.95
SC	2984.16	2949.71
Observation	1318	1318

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

the quarterly commercial sales volume of Seoul will increase by 0.675% (0.003%×450/2(50%)), or approximately 0.7%. In other words, the growth of the Airbnb market by 100% signifies an increase in the city's quarterly commercial sales volume by 1.4%. Providing quality facilities at comparatively low costs, Airbnb seems to affect commercial sales volumes positively by raising users' utilization rates of surrounding commercial districts.

When other variables were examined, as expected, an increase in floating population positively affected commercial sales volumes. When the coefficient values were examined, an increase in floating population by 1% increased commercial sales volumes in Seoul by 0.49%. As has been shown in earlier research as well, because floating population increases the number of people directly consuming in commercial districts, it can be seen as one of the most important factors of commercial sales volumes (Oh H.R. et al., 2017; Kim H.C. and Lee S.I., 2019). When the influence of individual industries' characteristics per commercial district was examined, an increase in the number of employees in the electrical and construction, wholesale and retail, and service industries positively affected commercial sales volumes. Such results empirically show that, as has been explained in previous studies, service customer attraction facilities inducing floating population are important for revitalizing commercial districts (Park Y.S., 2006; Shin Y.C., 2018). In addition, the expansion of the service industry including the wholesale and retail industry, which can increase convenience and attraction for consumers, seemed to affect commercial sales volumes positively.

When the influence of households living in apartments and those living in non-apartments were examined, the former exhibited a positive relationship with commercial sales volumes while the latter exhibited a negative relationship with commercial sales volumes. As for interpretation of this, apartments and non-apartments can be estimated with housing characteristics, which are representative of household income levels. Because households living in apartments generally have high average incomes, they consume much, too, thus being able to affect commercial sales volumes positively as well. In other words, an increase in the number of households living in apartments, which have high income levels, is likely to promote the utilization rates of and consumption in either the areas in question or contiguous commercial districts, thus capable of positively affecting commercial sales volumes (Kim J.H., 2014; Oh H.R. et al., 2017). Finally, when accessibility variables were examined, the shorter the distance to a subway station was, the more the commercial sales volumes of Seoul increased, but bus stops yielded insignificant results. While this shows that the development of public transportation has the possibility of inducing and promoting consumption in commercial districts by increasing access convenience ensuing from the

use of the commercial districts in question (Jeong D.G. and Yoon H.Y., 2017), in Seoul, accessibility to the subway rather than to buses can be seen as a factor importantly affecting the development of commercial districts.

4. Effects of Airbnb on Commercial Sales Volumes per Commercial District Type

Because the effects of Airbnb on commercial sales volumes can differ according to the type of commercial districts, this study analyzed the influence of Airbnb per commercial district type. In order to verify which of the spatial models were appropriate for the analysis, as in the previous analysis, spatial autocorrelation was verified through LM tests. As shown in 〈Table 5〉, alley commercial districts and major commercial districts yielded significant Moran's I values, and, according to the results of LM test, spatial error models were the suitable models. However, as for the traditional retail market model, Moran's I values did not exhibit spatial autocorrelation, and, in the end, spatial models were inappropriate according to the results of LM tests. In other words, when constructing models of commercial sales volumes, spatial error models were appropriate for alley commercial districts and major commercial districts while general regression models were suitable to traditional retail markets.

Based on such results, as in 〈Table 6〉, the influence of Airbnb was estimated by applying spatial error models to alley commercial districts and major commercial districts and general regression models to traditional retail markets. According to the results of the models' estimates, the lambda values were all significant, and, in the end, as for alley commercial districts and major commercial districts, spatial influence emerged in the relationship between the unobserved variables of contiguous commercial districts and commercial sales volumes. The explanatory power of the models, too, amounted to 0.34 and 0.59, thus being similarly favorable to the traditional retail market model, which was a general regression model.

When the results of estimates of Airbnb's influence were interpreted, Airbnb's effects were significant only in alley commercial districts but were insignificant in the major commercial districts and traditional retail market models. While diverse interpretations are possible, the reasons for this can be summarized into approximately two. First, because the trend is for the spatial distribution of Airbnb to expand gradually to residential areas, sales in alley commercial districts contiguous to residential areas seem to relatively closely related to an increase in Airbnb. In other words, users staying at Airbnb can be seen as exhibiting patterns of engaging in diverse forms of consumption in alley commercial districts near their lodging. In addition, this can be seen as the same context as the pattern of an increase in Airbnb near so-called "emerging" alley commercial districts. Second, because major commercial districts encompass central commercial districts of Seoul such as the city center and the Gangnam Station area, the influence of Airbnb on sales in these commercial districts seems to be relatively low. This seems to be because traditional retail markets constitute a type of commercial districts that does not appeal much to Airbnb users.

When the coefficient values are interpreted in a manner identical to that of the results in 〈Table 6〉, it is possible to say that, if the number of Airbnb listings for three days increases by one, alley commercial districts' quarterly sales are likely to increase by 0.25%. Considering that the mean number of Airbnb within alley commercial districts amounts to 8.25, the total number of Airbnb listings in alley commercial districts in a single quarter can be presumed to be 247.5 (8.25×30) on an average. Consequently, if the Airbnb market in alley

Table 5. Spatial autocorrelation test (LM Test)

	Alley commercial district			Major commercial district			Traditional retail market		
	MI/DF	Value	Prob	MI/DF	Value	Prob	MI/DF	Value	Prob
Moran's I (error)	0.131	4.168	0.000	0.134	2.368	0.017	0.011	0.336	0.737
Lagrange multiplier (lag)	1	0.062	0.803	1	2.218	0.136	1	0.010	0.921
Robust LM (lag)	1	0.007	0.929	1	2.571	0.108	1	0.013	0.911
Lagrange multiplier (error)	1	16.340	0.000	1	4.421	0.035	1	0.053	0.818
Robust LM (error)	1	16.286	0.000	1	4.773	0.028	1	0.056	0.814

Table 6. Empirical results by commercial district types

	Alley commercial district	Major commercial district	Traditional retail market
	SEM	SEM	OLS
Number of Airbnb listing	0.00250*** (0.00087)	0.00020 (0.00044)	-0.00693 (0.01159)
ln (floating population)	0.40194*** (0.03589)	0.39677*** (0.04758)	0.53745*** (0.08658)
Employees in electrical and construction industry	0.00002 (0.00010)	0.00000 (0.00004)	-0.00033 (0.00043)
Employees in the wholesaler and retail industry	0.00077*** (0.00010)	0.00010*** (0.00002)	0.00005 (0.00010)
Employees in service industry	0.00022** (0.00010)	0.00003 (0.00002)	0.00065 (0.00047)
Employees in FIRE industry	-0.00014 (0.00017)	0.00000 (0.00004)	0.00053 (0.00066)
Number of households living in APT	0.00021* (0.00012)	0.00055** (0.00021)	0.00071 (0.00117)
Number of households living in non-APT	-0.00013*** (0.00004)	0.00016** (0.00008)	0.00047* (0.00025)
Distance to subway station (m)	0.00002 (0.00007)	-0.00021 (0.00023)	-0.00543 (0.11174)
Distance to bus station (m)	0.00021 (0.00026)	0.00084* (0.00049)	0.03247 (0.10014)
ln (distance to CBD) (m)	0.15472*** (0.04445)	0.08607 (0.06254)	-0.03118 (0.14483)
Lambda	15.77110*** (0.59333)	17.67060** (0.85641)	
Constant	0.13478*** (0.03062)	0.15580*** (0.07416)	16.18930*** (1.79046)
R-squared	0.34	0.59	0.47
Likelihood ratio	17.52***	4.28**	
VIF			2.08
Observation	976	201	135

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

commercial districts grows in the future by 50% in comparison with the present, there is the possibility that quarterly sales in alley commercial districts will increase by approximately 1% (0.008%×247.5/2 (50%)), and if the market grows by 100%, there is the possibility that sales in alley commercial districts will grow by a maximum of 2%. The fact that Airbnb is in an effect relationship especially with sales volumes in alley commercial districts is closely linked to its spatial distribution. Because Airbnb is generally a structure that is operated by ordinary citizens with surplus residential spaces who become hosts, numerous services are provided in residential areas (Huh J.J. and Noh S.C., 2018; Gurran and Phibbs, 2017; Ju D., 2016; Cho S.Y., 2013). Consequently, alley commercial districts and Airbnb, both of which are generally distributed near residential areas, come to form a spatially close relationship so that, in comparison with other commercial district types, alley commercial districts seem to be strongly influenced by Airbnb in commercial sales volumes.

Finally, when the control variables were interpreted, floating population was a factor important to sales even per commercial district type, as expected. It was possible to make the interpretation that when floating population increased by 1%, sales increased by 0.40% in alley commercial districts, 0.39% in major commercial districts, and 0.54% in traditional retail markets. Such results reemphasize the importance of floating population to commercial sales volumes, as with the results in 〈Table 4〉 above, and signify the

necessity of policies that can induce and attract consumers in order to revitalize the economy of commercial districts. In particular, judging from the fact that, in the case of traditional retail markets, an increase in floating population had the greatest effect on commercial sales volumes in comparison with other commercial districts, policies attracting people must be prioritized in order to revitalize traditional retail markets.

V. Conclusion and Discussion

With an emphasis on the praxis of the sharing economy worldwide, the academic likewise has proceeded with research on the impact of the sharing economy in a multifaceted manner. In the case of South Korea, however, comparatively limited are studies empirically elucidating the impact of the sharing economy. Consequently, this study sought to analyze the impact of Airbnb, an accommodation-sharing service and a representative example of the sharing economy, through the corporation's influence on commercial sales volumes, In particular, in order to consider spatial influence between commercial sales volumes and Airbnb, it sought to estimate the effect of the corporation on commercial sales volumes of Seoul through the use of a spatial econometric model capable of taking spatial autocorrelation into consideration.

When the results of this study are summarized, they are as follows. First, as for the relationship between Airbnb and commercial sales volumes of Seoul, it had a positive correlation. Specifically, if the Airbnb market grew twofold, the overall commercial sales volumes of Seoul were likely to increase by 1.4%, and, out of commercial district types, alley commercial districts were likely to increase in sales by 1.8%. Such results show that the expansion of Airbnb, which is an accommodation sharing service actively increasing in Seoul, can be said to have a positive effect on the revitalization of alley commercial districts to a certain extent. Consequently, policies inducing the expansion of the Airbnb market are expected to have a positive effect on the revitalization of alley commercial districts. However, it will be possible to minimize the negative effects of Airbnb and to maximize the positive aspects only when accompanied by plans for resolving problems such as noise and litter generated with Airbnb's illegalization and expansion into residential areas.

Second, floating population was a variable greatly contributing to commercial sales volumes in Seoul. When floating population increased by 1%, the overall commercial sales volumes of Seoul increased by 0.48, and, in particular, commercial sales volumes were likely to increase by 0.4% in the case of alley commercial districts, 0.39% in the case of major commercial districts, and 0.54% in the case of traditional retail markets, respectively. In other words, as for traditional retail markets, which have been declining due to the expansion of large distribution companies, strategies that can attract floating population are among the greatest countermeasures capable of revitalizing these commercial districts. Recent policies to block the entry of large distribution companies as countermeasures to prevent the decline of traditional retail markets can decrease floating population in the local communities instead, thus serving as a factor capable of further deteriorating traditional retail markets. Of course, while this aspect requires more detailed analysis, in order to revitalize traditional retail markets, indispensable are policies for increasing floating population, for which it is necessary to establish policies based on changes to consumers' needs and consumption patterns. In addition, rather than policies that categorically block the entry of large distribution companies, necessary are measures whereby these companies and traditional retail markets can benefit mutually.

This study is significant for conducting an empirical analysis of commercial sales volumes with respect to the economic impact of Airbnb, an accommodation sharing company, and meaningful, in particular, for empirically examining factors that significantly affect commercial sales volumes of Seoul in consideration of spatial autocorrelation. However, it has the following limitations and points to be supplemented as well. First, this study has the limitation that the temporal scope is narrow, amounting to a single quarter, because of limitations in the process of obtaining Airbnb data and data on commercial districts in Seoul. In the future, it will be necessary to obtain data on the spatial expansion of Airbnb, which has increased in recent years, and then to conduct research in connection with data on long-term commercial sales volumes. In addition, while this study used the Queen matrix in order to control the spatial autocorrelation of commercial sales volumes, in order to verify the spatial impact in greater detail, it is necessary to analyze comparatively the influence of Airbnb by using

diverse types of spatial weight matrices. This study failed to consider the causality between Airbnb and commercial sales volumes. That is, while Airbnb increased commercial sales volumes as well, it may also be located in places with considerable commercial sales volumes. The aspect of causality needs to be studied in future research. In addition, if, based on this, the specific types of commercial districts that are strongly affected by Airbnb are grasped, it will be possible to derive policy implications in a variety of ways. Finally, in the future, it will be necessary to analyze Airbnb's economic impact by linking it to various fields instead of being restricted to commercial sales volumes and, based on such results, to derive policy implications for sharing economy services in the future. In addition, because expectations for the sharing economy have continued to rise, it will be necessary to engage in concrete research and discussions on the desirable direction for sharing economy services in the future through research on the effects of sharing economy services on customer satisfaction.

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