

Analysis on the Change of Online and Offline Sales in Commercial Districts amid the Growth of E-commerce: Focusing on Major Commercial Districts in Seoul

전자상거래 성장에 따른 상권의 온·오프라인 매출변화 분석: 서울의 발달상권을 중심으로

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< Abstract >

With the growth of the e-commerce market, the retail market changes in the direction of online shopping replacing offline shopping. However, some commercial areas witness gradual increase of sales from offline stores and some commercial areas experience a new growth pattern where both online and offline sales increase together. The purpose of this study is to investigate the characteristics of commercial areas with growing sales in the era of e-commerce by analyzing the changes in online and offline sales focusing on 253 major commercial districts in Seoul. To this end, clustering analysis is presented to classify commercial districts with different pattern of online and offline sales, and multinomial logistic regression is suggested to identify the characteristics of commercial districts which experience sales growth. The results show that it is necessary to have a strategy to grow both online and offline sales by supporting ICT industry, or explore ways to increase the competitiveness of the commercial districts. On the contrary, it is necessary to establish exit strategies to induce transition to new growth engines by providing incentives for changing the use to office, logistics or residential areas for commercial areas with low competitiveness.

Keyword : Major Commercial District, E-Commerce, Types of Change by Commercial Areas, Relative-Diversity Index (RDI), ICT Infrastructure

I. Introduction

Commercial areas, where products and services are exchanged, are playing a very important role in a community's economy as they create jobs and provides social place. With

the dramatic growth of e-commerce in the 2010s, commercial districts, which have grown together with the advancement of cities and transportation, face serious crisis. The rapid growth of e-commerce have reduced the visit to offline stores and accelerated the shift to

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online shopping, promoting the changes in the retail market environment.

In particular, the changes in offline markets are more evident in Korea where the share of e-commerce is increasing rapidly. According to KOSIS Retail Sales Index by Retail Business Type, the constant index¹⁾, which was 100 as of 2015 when e-commerce began expanding with the mobile simple payment in 2015, increased to 231.0 for online shopping while the index decreased for hypermarkets (95.2), supermarkets (93.4) and specialty stores (97.8) in 2019. In Korea, the share of the self-employed in the total industry is very high. Wholesale, retail, accommodation and restaurant businesses account for 43.4% of total industry and 25.0% of the total employment, accounting for a significant share of the national employment (KOSIS, 2020). Therefore, if offline commercial areas stagnate as a whole, it will lead to mass unemployment and the unemployment of those who are in relatively low-income bracket²⁾ could exacerbate social polarization. In addition, most commercial areas play an important role in the local community as a center for business, commerce and social networking. If the vacancy rate increases due to the closure of stores in commercial districts, economic activities in a community will be reduced and real estate market will stagnate. Therefore, it is very important to explore ways for commercial areas to adapt to the growth of e-commerce.

In general, the change is made in the direction of offline shopping being replaced by online shopping but there are certain commercial areas which experience offline sales gradually increase. In addition, a new growth pattern, where online and offline sales grow together

with the increasing number of e-commerce businesses within commercial areas, is observed. This study is intended to investigate the characteristics of commercial areas with growing sales in the era of e-commerce by looking at the online and offline sales change between 2014 and 2018, and identifying characteristics of commercial areas with growing sales, targeting 253 major commercial districts in Seoul. In chapter 2, the formation and changes of commercial areas and emergence of e-commerce are examined through literature review. In chapter 3, explanation on major commercial districts in Seoul, which are the scope of this study, and relevant data is presented. In chapter 4, clustering analysis and multinomial logistic regression are presented for comparing different commercial districts and the changes in commercial districts in Seoul. In chapter 5, summary of the results and implications from the implication of urban planning are presented.

II. Literature review

1. Formation and changes of commercial areas

Commercial areas are formed when stores are concentrated at central locations or places with good accessibility to transportation in a city. The Classical Retail Competition Theory models, which laid the theoretical foundation for the location of stores, explains that trade area and density of retail stores are determined by purchase frequency, cost of mobility and

1) It is an index that removes price fluctuations to analyze actual growth. It is calculated by dividing the current index by inflation deflator.

2) In 2019, the average income by business was the lowest for accommodation and restaurant business at USD 1,217(1.44 million Won). The average income for wholesale and retail businesses was USD 2,256(2.67 million Won), which was lower than overall average of USD 2,611(3.09 million Won) (KOSIS, 2021).

retail cost related to the consumption of goods (DiPasquale & Wheaton, 1996, pp.195-200). Those studies provide insights on the pattern of retail store distribution, but do not provide a clear explanation on the clustering of stores in one place like commercial areas. Later, the Neoclassical Retail Theory emerged to focus on shopping behavior and inter-store externalities. It explains that profit can be generated by reducing the cost of exploration and transportation for shopping through comparison shopping and multi-purpose shopping when stores are clustered in one place (Stahl, 1982; Weisbrod et al., 1984; Brueckner, 1993; Eppli & Benjamin, 1994).

Comparison shopping is one of the shopping behaviors of consumers, who want to compare many products and make a better purchasing decision to increase the benefits of shopping in case, where they handle imperfect substitutes with different price and quality among homogeneous merchandise. Such shopping behavior promotes the formation of homogeneous merchandise markets with low variety of businesses and specialization in certain industries (Nelson, 1970; Eaton & Lipsey, 1979; Wolinsky, 1983). On the contrary, multi-purpose shopping is related to the sales of goods and services in complements relationship. On the assumption that consumers are on a joint purchase trip where they purchase various kinds of goods and services at once during a one shopping trip, heterogeneous merchandise markets where various kinds of stores are clustered can reduce shopping time and transportation cost significantly (Hanson, 1980; O'Kelly, 1981; Dellaert et al., 1998). The commercial areas based on multi-purpose shopping are likely to be formed in locations with relatively high consumer demand or good accessibility. It is shown that an environment where various commercial activities such as office facilities, food and beverage facilities, and leisure facilities can be

conducted contributes to attracting consumers (Popkowski Leszczyc et al., 2004; Arentze et al., 2005). Such precedent studies support the reason why stores are concentrated spatially to form commercial areas and explain why the commercial areas with different industrial composition are formed.

In case of major commercial districts in Seoul, they grew based on homogeneous merchandise market where wholesale and retail stores were clustered in the past. Central Business District (CBD), which served as a center of Seoul for a long time, has still active commercial areas with wholesale and retail businesses that have been in existence in the form of traditional market from pre-modern times such as Dongdaemun Market. After the 1980s, stores handling a specific kind of product such as Garak Farm and Fish Products Market, Dongdaemun Fashion Town and Yongsan were established all over Seoul and specialized commercial areas were formed, led by those stores (Park, 2007, pp.349-392). On the contrary, heterogeneous merchandise market where stores of various businesses are clustered, began to be developed in the 1980s when the Korean economy grew rapidly and purchasing power increased. The dining and leisure businesses grew explosively as the expansion of Korean food restaurants and introduction of western food restaurants after holding international sports games such as Asian Games and Olympic Games. And quality of food and beverage as well as services were improved with increased national income level (Chong, 2011). The consumer behavior, which focused on purchasing groceries and daily necessities, has been changed to multi-purpose shopping. Purchasing of products and spending time for dining out or leisure activities are pursued together. Looking at emerging commercial areas after the 1980s such as Gangnam Business

District (GBD), Sinchon and Hongdae, the share of service facilities such as food and beverage, beauty, education and medicine as well as leisure facilities such as theater and club is relatively high. The commercial areas with high variety of industry were developed in places where demand for consumption is high such as business districts, residential districts, and areas around universities, and good accessibility with well-established transportation network such as subway (Lee, 2017).

Nowadays major commercial districts are under threat due to explosive growth of e-commerce and changing shopping pattern of consumers. People can purchase products they need anywhere using their computers or mobile devices, so consumers who visit offline commercial areas value fun and experience of shopping more than purchasing products itself (Schmitt, 1999; Brown & Lubelczyk, 2018). If existing commercial areas cannot provide various shopping experience anymore, consumers will opt for newly formed small commercial areas which are created for fresh experience, or online shopping. The spread of information via SNS channels accelerate this phenomenon, resulting in the shift of commercial functions which were concentrated in major commercial districts, to the commercial areas near residential areas (Heo et al., 2014). And large-scale retail stores such as shopping malls are also preferred by consumers for diverse shopping and leisure experience (Shim et al., 2013). The pressure for such change is expected to be higher with the advancement of ICT. Growth or collapse of commercial districts will depend on their adaptation to new shopping environment.

2. Growth of e-commerce and changes in commercial areas

Starting from the 2010s, the increased

penetration rate of internet and mobile device with the advancement of information and communication technologies (ICT) has contributed to the advancement of e-commerce. OECD (2011) defines that an e-commerce transaction is the sale or purchase of goods or services, conducted over computer networks by methods specifically designed for the purpose of receiving or placing of orders. The global e-commerce market grew to 2 trillion-dollar market in 2019, indicating 21.0% annual growth on average for 5 years. The growth rate is very high compared with 4.9% annual growth on average of the retail distribution market for the same period. In case of Korea, which is the ICT powerhouse, boasts the world's top 5 e-commerce size and has the highest share of e-commerce at 28.2% in the retail distribution market (Kim, 2020). The Korean government established the Ministry of Science, ICT and Future Planning in 2013, which consistently carried out policies for SMEs and startups (Han, 2017). Because of launching 5G smartphone services and lowering cost for mobile communication in 2019 (MSIT, 2019), mobile based e-commerce is growing a lot.

Business areas in e-commerce include Management Information Systems, Finance and Accounting, Production and Operation and Marketing and Computer Science plays an important role (Shahjee, 2016). In particular, skilled and professional programmers are necessary to implement stable service on the website and intuitive user experience, as business is run based on online. Precedent studies found a strong positive interaction effect between ICT infrastructure and e-commerce capability. This suggests that their complementarity positively contributes to firm performance (Zhu, 2004; Yadiati & Meiryani, 2019). Along with the advancement of ICT industry in Korea, many companies provide high level of salary and welfare benefits to

<Table 1> Status of Major Commercial Districts in Seoul

classification	2014				2018				
	Avg.	S.D.	Min.	Max.	Avg.	S.D.	Min.	Max.	
major commercial district	area (㎡)	116,421	130,119	4,972	1,142,740	116,421	130,119	4,972	1,142,740
	the number of stores	419	424	18	3,452	401	405	16	3,432
	share of retail business (%)	39.6%	18.3%	6.6%	95.6%	39.1%	18.3%	7.3%	94.5%
	the number of large-scale retail stores	0.5	0.9	0	6	0.5	0.9	0	6
region	the number of residents (per dong)	22,855	10,471	1,207	51,143	22,581	10,367	1,104	46,821
	the number of employees (per dong)	35,206	37,403	2,313	148,392	38,084	40,304	2,166	164,278
	the number of ICT service companies (per dong)	224	349	1	2,027	3,595	5,955	7	36,857
	subway station	yes	185 (73.1%)	no	68 (26.9%)	yes	185 (73.1%)	no	68 (26.9%)

secure talents in artificial intelligence and software sectors. Such environment lays the foundation for the growth of large companies as well as small and medium sized e-commerce companies by enlarging the size of programmer pool, driving the growth of e-commerce in Korea.

The opinion that the growth of e-commerce will lead to the decline of the existing commercial areas is dominant, (Burt & Sparks, 2003; Lee & Kim, 2019) but some studies predict that the advancement of ICT will give a new vitality to the retail market, which is searching for new growth engine after it enters mature stage. Such studies argue that existing retail stores based on offline sales will be required to establish e-commerce operating system. They can create new consumption through omni-channel where seamless experience is provided by utilizing all channels such as offline store, mobile app and web shop (Bonet, 2016). If an online sales channel establishes, based on existing retail infrastructure, it will have a positive impact on the survival of offline stores, resulting in the growth of both online and offline sales in the commercial areas. In addition to, areas where ICT companies are clustered, can be utilized as a testbed for new

service of stores, and ICT employees can increase the offline store sales as a consumer. However, precedent studies focused on the impact of ICT advancement on overall retail market, and no studies focused on the changes at the local commercial area level. There is a case of “danawa.com” that the service started with comparing the price of electronics goods while located near Yongsan Electronics market (Kim, 2021). This shows the offline stores can grow more when ICT employees work near the offline market and the exchange of information becomes more transparent than traditional ways by creating database. This study assumes that there is a difference in terms of access to technology between areas with ICT infrastructure clustered and areas without such cluster, and looks at the impact of the number of ICT companies in hinterland on the changes in online and offline sales.

III. Analysis scope and data

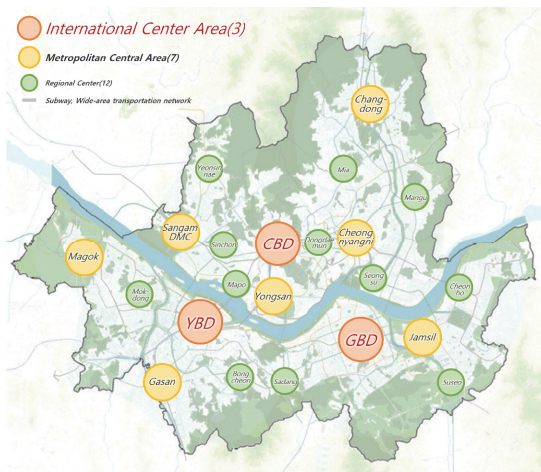
1. Major commercial districts in Seoul

Seoul is the capital of Korea and a large city with 10 million population. There are various

commercial districts formed in Seoul and it is possible to observe rapid changes in commercial areas due to the rapid growth of e-commerce in Korea. According to My Neighbor Commercial Area Analysis Service of Seoul City, commercial areas in Seoul are mainly divided into major commercial district, alley commercial district, traditional market and tourism-specific commercial area. Among them, major commercial districts are located in central areas in Seoul, and maximize the benefits of comparison shopping or multi-purpose shopping as many stores are clustered. However, with the emergence of e-commerce, consumers tend to visit the commercial areas more for fun and experience of shopping than for the benefits of reducing cost of product search and transportation. As the commercial function of existing major commercial districts have shifted to online shopping or alley commercial districts near residential area, they face significant crisis. This study targets major commercial districts in Seoul for analysis and Table 1 shows the status of 253 major commercial districts in Seoul as of 2014 and 2018. The data with big difference between standard deviation, minimum and maximum value, indicates that there are diverse major commercial districts.

It is necessary to look at the spatial structure of Seoul to understand major commercial districts in Seoul better. Figure 1 and 2 show that there are 3 International Center Areas, 7 Metropolitan Central Areas and 12 Regional Centers in Seoul. 3 International Center Areas are representative business and commercial districts in Seoul where large commercial areas are concentrated and distributed across the whole Seoul area as a hinterland. CBD has commercial areas where store with special kinds of products are clustered, such as Dongdaemun Market, Fashion Town, Jongno Jewelry Street focusing on the purchase of goods, while GBD has high ratio of food and beverage as well as service business with various kinds of businesses around Gangnam Station, Nonhyeon Station, Apgujeong Rodeo Street and Sinsa-dong Garosu Street. 7 Metropolitan Central Areas are major commercial areas with some part of Seoul as hinterland. In general, they have two to four major commercial districts located adjacent to each other. Those commercial areas include areas with special kinds of products such as Yongsan Electronics Market and Gasan Fashion Town, and areas formed mainly by large department stores and shopping malls such as Jamsil and Cheongnyangni. 12 Regional Centers are formed around subway

<Figure 1> Spatial Structure of Seoul (a)



<Figure 2> Spatial Structure of Seoul (b)



stations, composed mainly of sales facilities and restaurants for nearby residents.

2. Data on commercial areas

This study utilizes data from My Neighbor Commercial Area Analysis Service of Seoul City, Seoul Open Data Service and National Spatial Data Infrastructure Portal. My Neighbor Commercial Area Analysis Service of Seoul City defines commercial areas and discloses information on the number of stores and estimated sales per commercial area. The business is mainly divided into food, service and retail and specifically, it is divided into 45 businesses³⁾. Estimated sales data are calculated by applying compensation ratio of each credit card based on sales data provided from credit card companies. The study period is set between 2014 when commercial area data began to be provided and 2018 when the data structure was not changed.

E-commerce defined in this study data refers to retail sale via mail, phone, tv, and electronic media, which is one type of retail sale not in stores according to the 9th Korean Standard Industrial Classification (KSIC). Among them, electronic commerce via internet refers to industrial activities by retailing various kinds of products through online network, targeting the general public⁴⁾. In some cases, such companies have their business place in commercial areas, even though benefits from clustering do not have to be considered unlike offline stores. It can be assumed that they do not register their office within commercial areas, and expand their business to e-commerce based on their

existing distribution and sales infrastructure of offline stores. The good examples are e-commerce stores handling computers and electronic devices with the registered business place in Yongsan Electronics Market, or fashion cloth online shopping malls with their registered office in Dongdaemun Fashion Town. This study looks at the changes in online and offline sales in major commercial districts of Seoul simultaneously by defining e-commerce sales as online sales and sales from other business as offline sales from sales data.

3. Relative-Diversity Index (RDI) of business type

In the earlier part, the differences in business type composition depending on the background of the formation of major commercial districts in Seoul are explained. This study sets the measurement unit of business type as the subcategory of business type, which is composed of 45 business types covering food, service and retail. The RDI is measured using formula (1) to identify differences of business type composition. RDI compares the share (S_{ij}) of certain business type (j) in a certain commercial area (i) with the share (S_j) of certain business type (j) in major commercial districts and alley commercial districts in Seoul. If there

<Formula 1> RDI calculation process

$$RDI_i = 1 / \sum_j |s_{ij} - s_j|$$

s_{ij} : Ratio of business type j in commercial area i

s_j : Ratio of business type j in the whole main streets and alley commercial areas in Seoul

3) Of 45 businesses, food refers to 10 business types such as Korean food, snack, fast food, bakery, and cafe. Service refers to 18 business types such as academy, clinic, karaoke, laundry room and hair shop. Retail includes 17 business types such as convenience store, computer and accessories, clothing shop, medicine and medical devices, stationery and books, furniture and home appliances.

4) Provided that the classification of e-commerce by Korean Standard Statistical Classification does not include the whole e-commerce related to manufacturing business, businesses involved in wholesale and retail businesses and food industry.

are more business types with S_{ij} higher than S_j , it means that there are many business types with S_{ij} smaller than S_j , indicating relatively high bias of business types (Duranton & Puga, 2000). The lower RDI value means a commercial area is closer to homogeneous merchandise market focusing on a specific business type compared with overall commercial areas in Seoul, while higher RDI value means a commercial area is closer to heterogeneous merchandise market with a variety of business types. This study calculates RDI of 253 major commercial districts in Seoul, based on the business type composition in 2014. The average RDI for all major commercial districts in Seoul is 1.49, with standard deviation of 0.44. The commercial district with the lowest RDI is Yangjaedong Flower Market (0.56) while the commercial district with the highest RDI is Nonhyeong Station (3.48).

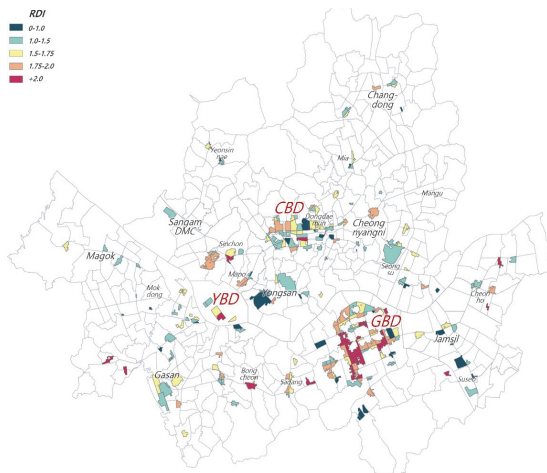
Figure 3 shows the significant difference in RDI among commercial areas in CBD and GBD. CBD shows the higher share of homogeneous merchandise market with low RDI as it focuses on selling specific products such as Dongdaemun

market for fashion and Jongno for drug and jewelry stores. On the other hand, GBD has the characteristics of heterogeneous merchandise market with high RDI as various food and service stores are developed along the streets where large office buildings are located such as Nonhyeong Station and Gangnam Station. Commercial buildings with specialty (Yongsan Electronics Market, Yangjaedong Flower Market, Garak-dong Farm and Fish Product Market, etc.), large-scale retail stores such as department stores, hypermarkets and shopping malls (Express Terminal, Jamsil Lotte World, COEX, etc.) shows low RDI. In addition, most of the small commercial areas near residential area show an RDI ranging from 1.0 to 2.0.

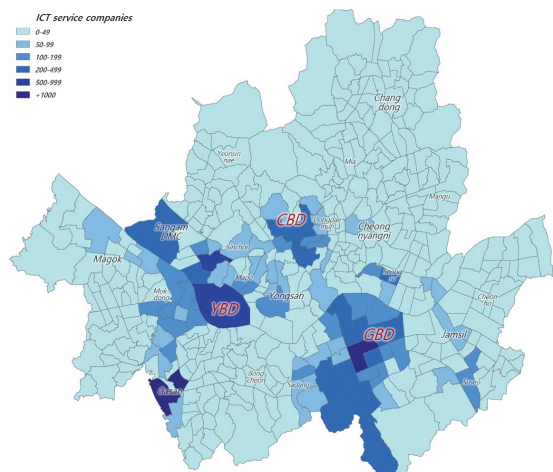
4. The number of ICT service companies

This study intends to identify the impact of the local ICT advancement on the growth of e-commerce in the commercial areas. Standards for how to measure the level of ICT development of the area are necessary for analysis. The 9th

<Figure 3> RDI Distribution of Major Commercial Districts



<Figure 4> Distribution of ICT Service Companies by Administrative Neighborhood(dong)



Korea Standard for Industrial Classification (KSIC) incorporates service businesses related to information and communication technologies which are scattered across various business types into the large category 'Publication, Video, Broadcasting and Telecommunication and Information Service Business' (Jung et al., 2016). This study utilizes the number of companies that belong to the category of 'Publication, Video, Broadcasting and Telecommunication and Information Service Business' in the commercial areas (hereinafter referred to as the number of ICT service companies) as the indicator for ICT industry advancement. The reason why this study utilizes the number of companies, not the number of employees is that a structure where many small and medium sized companies form ICT talent pool is more favorable for starting e-commerce business than a structure where a few large companies hire many employees. In addition, the number of ICT service companies is counted as of 2014 when the commercial data starts to be collected. The investigation finds that administrative neighborhoods(dong) where major commercial districts in Seoul are located have 224 ICT service companies on average with standard deviation of 349. Changsin-dong in Dongdaemun commercial area has the least number of ICT service companies (1) and Gasan-dong in Gasan Digital Complex Station commercial area has the largest number of ICT service companies (2027).

Figure 4 indicates that ICT service companies are clustered and concentrated in some areas of Seoul. In particular, there are many ICT service companies located in CBD and GBD, which are representative business district, but the density of such companies differs between CBD and GBD. Financial, insurance, legal and accounting service companies and conventional large companies as well as public organizations

are located CBD, while IT venture companies were clustered in GBD in the 1990s, forming office street and attracting headquarters of large companies based on IT manufacturing business. It is found that ICT service companies are densely located in Yongsan, Gasan and Sangam in Metropolitan Central Areas. Even though Yongsan Electronics Market has declined recently due to the recent growth of e-commerce but it is still the largest shopping mall for electronic devices in Korea. Seoul Digital National Industrial Complex located in Gasan was formed with growing number of IT and knowledge service ventures built in former Guro Industrial Complex. Sangam Digital Media City is an advanced IT and media industry cluster completed in the 2010s where many broadcasting, media and IT companies are located. As such, ICT industry in Seoul is distributed in central business districts and industrial clusters, indicating that there are differences in accessibility to ICT talent pool and infrastructure depending on areas. Even though e-commerce is conducted based on online, it is necessary to secure ICT engineers to establish a website and provide service. Therefore, regional difference in ICT industry is expected to have an impact on the distribution of e-commerce business.

IV. Analysis and results

1. Changes in sales of commercial areas

This study utilizes the changes in estimated sales of major commercial districts in Seoul as an indicator of measuring the changes in commercial areas. Sales are compiled for offline and online categories, and e-commerce business is classified as online and other businesses are classified as offline. The study

period is set between 2014 when commercial area data began to be provided, and 2018 when the data structure was not changed. Table 2 shows that the number of offline stores in the whole major commercial districts in Seoul decreases by 4.8%, and during the same period their estimated sales increase by only 4.0%. On the contrary, the number of online stores increases by 13.2% and estimated sales increase by 57.2%, indicating the qualitative and quantitative growth of e-commerce business in major commercial districts, even though their share in the major commercial districts is still small.

Table 3 shows the data on major commercial districts in Seoul with classification of commercial districts with increased sales and commercial districts with decreased sales. 64.4% of commercial districts show increased sales while 35.6% of commercial districts show decreased sales out of 253 major commercial districts in Seoul. It shows that the number of commercial districts with growing sales is higher than the number of major commercial districts with decreasing sales by 1.8 times. Among them, only 143 commercial districts or 56.5% of commercial districts show sales from

e-commerce, indicating that e-commerce business is concentrated on only some of commercial areas. Despite rapid growth of e-commerce market, only 58.0% of commercial districts show increased online sales. It implies that e-commerce is not grown in a balanced manner without regional deviation, it is developed in a way of clustering in some commercial areas such as ICT industry clusters.

2. Classification of types of commercial area change

As shown in chapter 4, online and offline sales increase or decrease do not show a certain direction so it is necessary to look at the characteristics of commercial areas by dividing them based on similar pattern in sales change. To classify the commercial area, cluster analysis is conducted using variables such as ratio of retail stores(2014) and whether online and offline sales increase or not (2014-2018). 143 major commercial districts are scope of this analysis after excluding commercial districts without any online sales. The ratio of retail stores is used as a variable in clustering analysis, because there is difference between

<Table 2> The Number of Stores and Estimated Sales of Major Commercial Districts in Seoul

year	the number of stores			estimated sales (per month)		
	total	offline	online	total	offline	online
2014	105,971	103,010	2,961	27,799 million USD (32,900 billion Won)	27,493 million USD (32,538 billion Won)	306 million USD (362 billion Won)
2018	101,423	98,070	3,353	29,061 million USD (34,394 billion Won)	28,581 million USD (33,826 billion Won)	480 million USD (568 billion Won)
change	-4.3%	-4.8%	13.2%	4.5%	4.0%	57.2%

<Table 3> Increase and Decrease of Estimated Sales of Major Commercial Districts in Seoul

classification	total commercial districts	commercial districts with sales from e-commerce	
		offline	online
sales increase	163 (64.4%)	94 (65.7%)	83 (58.0%)
sales decrease	90 (35.6%)	49 (34.3%)	60 (42.0%)
total	253 (100%)	143 (100%)	143 (100%)

commercial districts with high ratio of retail stores and commercial districts with high ratio of food and service business. In addition, increase or decrease, not the change rate of sales is used as the criteria for classifying commercial districts, to prevent the distortion considering relatively small online sales volume and differences in the size of each commercial district.

There are various methods for clustering analysis, but in this study, Gower’s method, which can use continuous and categorical variables at the same time, is used⁵⁾. Gower uses a method for categorical variables, calculating distances by normalizing the minimum value to 0 and the maximum value to 1 for each continuous variable. Variables are made to have an even influence on distance calculation (Han & Cho, 2018).

Table 4 shows the classification of 143 major commercial districts into 8 groups using Gower method. It is mainly divided into food and service commercial districts and retail streets. The numbers are given with the rule that 1 is given for commercial districts with increase in both online and offline sales, 2 for commercial districts with increase in only offline sales, 3 for commercial districts with increase in only online

sales and 4 for commercial districts with decrease in both online and offline sales.

3. Analysis on the characteristics by type of change in commercial area

In this section, multinomial logistic regression analysis is utilized to analyze the characteristics by type of change in commercial districts classified through clustering analysis. Reference group which experienced decrease in both online and offline sales from 2014 to 2018 are used for analysis to identify the characteristics of other groups. Characteristic variables of commercial districts (the number of stores, RDI, the number of large-scale retail store) and characteristics variables of the regions where commercial districts are located (the number of residents, employees, ICT service companies in administrative neighborhoods (dong), existence of subway stations) are selected as independent variables based on precedent studies and all variables are based on 2014, the period that caused all of these changes.

Table 5 shows the results of multinomial logistic regression analysis. In case of food and service major commercial districts, the possibility of offline or online sales increase is high if RDI

<Table 4> Results of Clustering Analysis

classification	food and service commercial districts				retail commercial districts				chi-square /F	
	1	2	3	4	1	2	3	4		
	(N=31)	(N=39)	(N=8)	(N=24)	(N=6)	(N=18)	(N=7)	(N=10)		
offline	increase	31	39	0	0	6	18	0	0	143
	decrease	0	0	8	24	0	0	7	10	***
online	increase	31	0	8	0	6	0	7	0	143
	decrease	0	39	0	24	0	18	0	10	***
retail share (mean)		0.357	0.302	0.324	0.309	0.806	0.630	0.618	0.712	71.03 ***

5) Cluster analysis is mainly used for continuous variables. However, in this study, some informations are treated as categorical variables to focus on whether the sales of commercial districts are increasing of decreasing, rather than dealing with the amount of changes in detail. Therefore, Gower method is used to include both categorical and continuous variables that can show increase and decrease of the online and offline sales and retail share.

<Table 5> Results of Multinomial Logistic Regression Analysis

group		coefficients	estimate	S.D.	error	z-value	pr (> z)
food, service 1 offline+ online+	com- mercial district	the number of stores (1,000)	-0.62	0.63	-0.99	0.32	
		relative diverse index (RDI)	2.58	0.94	2.74	0.01	***
		the number of large-scale retail stores	0.17	0.39	0.44	0.66	
	region	the number of residents (1,000)	-0.05	0.03	-1.66	0.10	*
		the number of employees (1,000)	-0.03	0.02	-2.24	0.03	**
		the number of ICT service companies (1,000)	5.22	1.94	2.69	0.01	***
		existence of subway stations	2.07	0.88	2.34	0.02	**
	intercept	-4.73	1.82	-2.60	0.01		
food, service 2 offline- online-	com- mercial district	the number of stores (1,000)	-1.14	0.74	-1.55	0.12	
		relative diverse index (RDI)	2.53	0.89	2.85	0.00	***
		the number of large-scale retail stores	-0.34	0.43	-0.8	0.43	
	region	the number of residents (1,000)	-0.01	0.03	-0.55	0.58	
		the number of employees (1,000)	-0.01	0.01	-0.82	0.42	
		the number of ICT service companies (1,000)	1.82	1.91	0.95	0.34	
		existence of subway stations	1.09	0.64	1.69	0.09	*
	intercept	-3.71	1.62	-2.28	0.02		
food, service 3 offline- online+	com- mercial district	the number of stores (1,000)	-4.07	2.11	-1.93	0.05	**
		relative diverse index (RDI)	4.56	1.71	2.67	0.01	***
		the number of large-scale retail stores	-0.24	0.72	-0.34	0.73	
	region	the number of residents (1,000)	0.05	0.05	0.91	0.36	
		the number of employees (1,000)	0.03	0.02	1.27	0.20	
		the number of ICT service companies (1,000)	-2.22	3.13	-0.71	0.48	
		existence of subway stations	0.40	0.96	0.41	0.68	
	intercept	-9.73	3.53	-2.76	0.01		
retail 1 offline+ online+	com- mercial district	the number of stores (1,000)	-2.58	2.36	-1.09	0.27	
		relative diverse index (RDI)	-12.66	5.49	-2.31	0.02	**
		the number of large-scale retail stores	0.39	0.81	0.48	0.63	
	region	the number of residents (1,000)	-0.10	0.07	-1.44	0.15	
		the number of employees (1,000)	-0.10	0.05	-1.82	0.07	*
		the number of ICT service companies (1,000)	9.88	4.98	1.98	0.05	**
		existence of subway stations	1.03	1.99	0.52	0.61	
	intercept	15.31	5.85	2.62	0.01		
retail 2 offline+ online-	com- mercial district	the number of stores (1,000)	-1.74	1.09	-1.60	0.11	
		relative diverse index (RDI)	-1.24	1.04	-1.19	0.23	
		the number of large-scale retail stores	0.77	0.36	2.15	0.03	**
	region	the number of residents (1,000)	-0.02	0.03	-0.56	0.57	
		the number of employees (1,000)	0.00	0.03	-0.05	0.96	
		the number of ICT service companies (1,000)	-5.75	6.31	-0.91	0.36	
		existence of subway stations	0.12	0.76	0.15	0.88	
	intercept	2.32	1.81	1.28	0.20		
retail 3 offline- online+	com- mercial district	the number of stores (1,000)	0.28	1.05	0.27	0.79	
		relative diverse index (RDI)	-2.85	1.55	-1.84	0.07	*
		the number of large-scale retail stores	0.24	0.46	0.53	0.60	
	region	the number of residents (1,000)	-0.03	0.05	-0.60	0.55	
		the number of employees (1,000)	-0.01	0.02	-0.59	0.55	
		the number of ICT service companies (1,000)	4.37	2.12	2.06	0.04	**
		existence of subway stations	-0.31	1.10	-0.28	0.78	
	intercept	1.79	2.27	0.79	0.43		
Loglikelihood / LRχ ²			-182.88 / 129.08***				
McFadden R ²			0.26084				

Signif. codes: *** 1%, ** 5%, * 10%

is high. For the type of changes in commercial districts, commercial districts with both online and offline sales increase have a smaller number of residents and employees in hinterland, high number of ICT service companies and nearby subway stations. On the contrary, commercial districts with increase in only offline sales have characteristics of the existence of nearby subway stations, and commercial districts with increase in only online sales show the characteristics of small size of commercial districts, which are statistically significant. For retail commercial districts, the opposite pattern is shown. The lower the RDI, the higher the possibility of online or offline sales increase. For the type of changes in commercial districts, commercial districts with increase in both online and offline sales show the characteristics of a smaller number of employees and higher number of ICT service companies. On the country, commercial districts with increase in only offline sales show the characteristics of the number of large sales facility, and commercial districts with increase only in online sales show higher number of ICT service companies, which are statistically significant.

The conclusion can be drawn in four points as follows. First, food and service commercial districts are likely to benefit from densely populated stores with various business types and retail commercial districts are likely to enjoy benefit from specialized commercial districts with homogenous merchandise stores. This is because the driving force behind the formation of each commercial district is different as one is for multi-purpose shopping and the other one is comparison shopping. Consumers visiting food and service commercial districts enjoy various foods and services and buy diverse goods, while consumers visiting retail commercial districts try to make best decision for specific goods by comparing different shops

and products. Second, formation of ICT infrastructure in the hinterland is important to achieve sales increase in both online and offline. Table 5 shows that the variable of the number of ICT service companies is higher for group 1 which shows increase in both online and offline sales than group 3 with increase in only online sales for both food and service and retail commercial districts. These results indicate that ICT infrastructure play a bigger role in increasing both online and offline sales rather than increasing only offline sales. Third, the large-scale retail stores would be considered for the growth of offline sales in retail commercial districts. The large-scale retail stores are designed to use various facilities within one building. This composition enhances the competitiveness of offline commercial areas compared to e-commerce by providing consumers with a convenient and colorful shopping experience. Fourth, transportation accessibility is an important factor for continuous sales growth of offline stores, especially in food and service commercial districts.

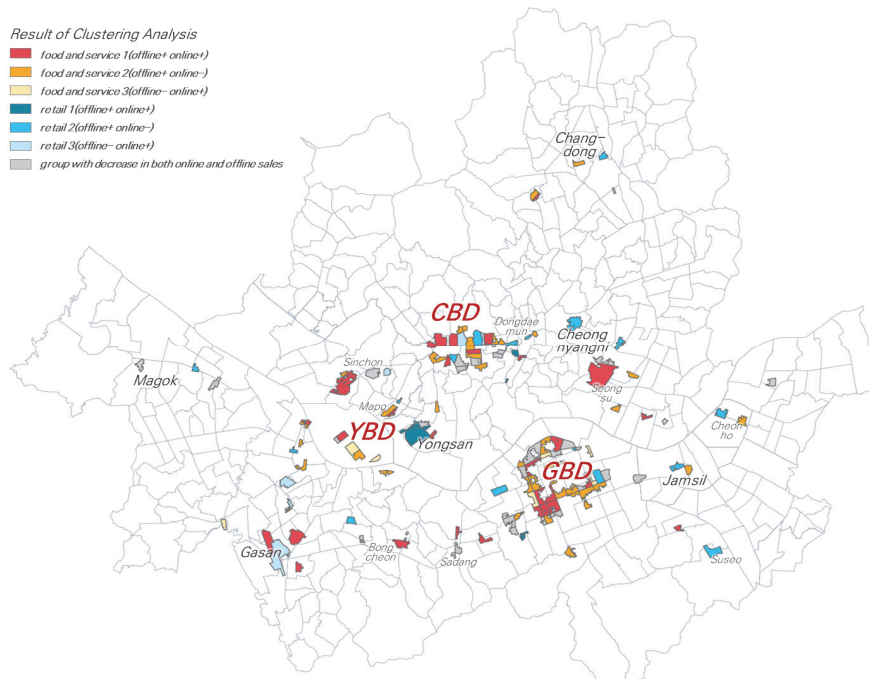
Figure 5 is the map for the type of change by commercial districts in Seoul based on clustering analysis results. GBD shows higher ratio of food and service group 1 and 2. Because GBD is the place where ICT industry is clustered, with high RDI and many nearby subway stations. As such, online and offline sales for the major commercial districts record high volume. On the contrary, CBD shows various types of change in the commercial districts. This is because location where traditional retail commercial districts and business districts are located together. Due to this regional characteristics, the commercial districts with growing sales are as follows. The commercial districts in developed office area are food service group 1 and 2, and areas with low RDI and densely populated large-scale retail

stores such as Dongdaemun market, department stores and shopping malls are classified as retail group 1 and 2. However, commercial districts where old and small retail stores are densely populated with a smaller number of ICT service companies and large-scale retail stores, both online and offline sales have been decreased.

The other commercial districts can be divided into three groups based on the type of change. First, supply of ICT manpower is important for commercial districts with increase in both online and offline sales based on their existing distribution and sales infrastructure. ICT industrial infrastructure is concentrated in some parts of Seoul such as 3 International Center Areas, Yongsan, Gasan, Sangam, Sincheon and Hongdae. Therefore, commercial districts in Gasan Digital Industrial Complex, Sincheon and Hongdae are classified as food and service group 1. Commercial districts in Yongsan Electronics Market and some commercial markets with specialty are classified as retail

group 1. Groups that show growth in only offline sales are as follows. In case of commercial districts where diversity of business types and transportation accessibility are important, commercial districts located near subway stations with a variety of food restaurants are classified as food and service group 2. On the contrary, commercial districts with large-scale retail stores which can provide various shopping experiences are expected to experience offline sales increase. Lastly, there are some commercial districts which are expected to experience decline, with decreasing online and offline sales. Commercial districts without many things to enjoy, and low transportation accessibility are not attractive as a food and service commercial district. If there are no stores that sell special products or provide special shopping experience like large-scale retail stores in the retail commercial district, there is no attractive point compared with e-commerce.

<Figure 5> Types of Change by Major Commercial Districts in Seoul(2014-2018)



V. Conclusion and discussion

The purpose of this study is to investigate the characteristics of commercial areas with growing sales amid to the growth of e-commerce by analyzing the changes in sales of major commercial districts in Seoul. The changes in the sales of major commercial districts in Seoul indicate that changes in overall retail market are made in the direction where e-commerce replaces offline commercial areas. However, not all commercial areas experience declining sales. Sales of commercial areas can be divided into online and offline sales and this study intends to pay attention to commercial districts with new change pattern where online and offline sales are growing together or offline sales that still account for most of the sales of commercial district, are growing. This study classifies commercial districts based on different online and offline sales pattern based on clustering analysis. Then multinomial logistic regression analysis is conducted to identify the characteristics of commercial district groups with growing sales. Based on the analysis results, this chapter summarizes the measures that need to be taken by existing major commercial districts in the era of e-commerce.

First, online and offline sales of commercial districts can be growth by utilizing ICT infrastructure fully. This means that it is necessary to pay attention to the fact that advancement of ICT can grow both online and offline sales by combining ICT with existing distribution and sales infrastructure of traditional retailers rather than focusing on negative impact of ICT that could lead to the decline of commercial districts. The clustering of ICT service companies can contribute to the launching of new services and expansion of sales network in case of food and service

commercial districts. In addition, they can contribute to offline sales as the ICT employees can be a consumer. In this study, stores involved in wholesale and retail business in parallel according to e-commerce classification are excluded. But the sales from online parallel sales might be received as offline sales. This implies that the distribution of omni-channel in the future could provide a new opportunity to traditional commercial districts. This result shows that it is necessary to explore ways for the shared growth of e-commerce and offline stores by utilizing ICT infrastructure. However, the problem is that ICT service companies are concentrated in some parts of Seoul and accessibility of small business owners without much capital to ICT infrastructure is low. Various ways are tried to increase the accessibility to ICT and provide online shopping platform such as online training conducted by Korea Small Enterprise and Market Service and web service of Traditional Market at Naver Shopping. Such attempts will help all stores establish online sales channel without discrimination based on location and size and have a positive impact on the sales growth of offline stores ultimately.

Second, offline stores account for most of the sales generated in major commercial districts, and they should attract consumers by shopping benefits which cannot be replaced by online shopping. Food and service business are hard to be replaced by e-commerce. Therefore, it is possible to attract consumers by providing opportunities to choose from many stores in case of major commercial districts located with good transportation accessibility and various food and service stores. On the contrary, it is shown that offline sales increase in retail commercial districts where large-scale retail stores are located. This is because consumers can conduct various activities such as checking

products, eating, enjoying and taking a rest in one place. Retailers who understand this trend are designing their stores to be more experience-oriented and making an effort to expand food, service and leisure space in addition to space for sales. Large-scale retail stores are competitive compared with e-commerce, so it is necessary to lead them to achieve shared growth with nearby small stores in the commercial districts.

Third, it is necessary to consider exit strategies to prepare for the decline of less competitive commercial districts. The analysis results show that there are 34 (23.8%) commercial districts which experience decrease in both online and offline sales. Most of the commercial districts expected to decline are located in regional centers, and government provides significant amount of budget to vitalize local commercial areas with no significant effect. It is necessary to have an active strategy to drive a new growth engine such as giving incentive to declining commercial areas if they change the use to business, logistics or residence as there are convenient transportation network and commercial real estate. Already, some projects are underway to convert hypermarkets into residential complex and attempts are being made to remodel the hypermarkets into logistics center dedicated to online sales.

Such analysis results have an implication for the potential for sales growth of major commercial districts in the region where there is a concern over the decline of existing commercial districts. However, the study period is before COVID-19 pandemic outbreak and analyzes trend of overall changes in commercial districts with the growth of e-commerce. As the speed of growth of e-commerce market has been accelerated due to COVID-19 pandemic, while sales of offline stores have decreased further. This study has a limitation in terms of study data as the e-commerce business data classified according to

KSIC do not cover all e-commerce related to manufacturing, companies involved in wholesale and retail businesses and food industry. In addition, the number of residents, employees and the number of ICT service companies based on administrative neighborhood(dong) where a major commercial district is located, and the commercial districts in My Neighbor Commercial Area Analysis Service of Seoul City were used. It has a limitation as interaction with nearby regions and connection from broader perspective are not reflected, and it could not limit the ICT service companies to e-commerce related ones. The limitations mentioned above should be considered upon utilizing the results of this study and follow-up studies need to be conducted based on improved statistical classification and data covering the whole Seoul area. Also follow-up studies shall consider the impact of growth in online and offline sales to business profit and corresponding to the change of business environment. This would lead to the surviving strategy of commercial districts by systematic analysis. Lastly, this study is conducted on the premise of industrial growth according to the spatial interaction between ICT and the distribution industry. However, the ICT business has less locational influence than other industries, so additional theoretical support for geographic interaction is needed. Therefore, it is necessary to interpret it carefully and supplement it in the later studies.

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<국문요약>

전자상거래 성장에 따른 상권의 온·오프라인 매출변화 분석: 서울의 발달상권을 중심으로

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이 정 란 (Lee, Jeong-Ran)

전자상거래 시장이 성장함에 따라 소매 시장의 변화 양상은 온라인 쇼핑이 오프라인 상권을 대체하는 방향으로 이뤄지고 있다. 그러나 지역별로 오프라인 매출이 증가하고 있는 상권들도 있으며, 온·오프라인 매출이 동시에 성장하고 있는 새로운 성장패턴이 관찰되기도 한다. 본 연구의 목적은 서울 253개 발달상권의 온·오프라인 매출 변화 분석을 통해 전자상거래 시대에 매출 증가 상권의 특성을 알아보는 것이다. 이를 위해 군집분석을 실시하여 온·오프라인 매출 변화 양상이 다른 상권들을 분류하고, 다항 로지스틱 회귀분석을 활용하여 매출이 증가하고 있는 상권의 특징을 밝히고자 하였다. 분석 결과는 ICT 산업 지원을 통하여 상권의 온·오프라인 매출이 동시에 성장하는 전략을 취하거나, 상권 경쟁력을 높이는 방안이 필요함을 보여주고 있다. 반면 경쟁력이 낮은 상권의 경우, 업무, 물류, 주거 등으로 용도변경에 대한 인센티브를 통해 지역의 새로운 성장동력으로 전환을 유도하는 출구전략이 필요할 것이다.

주 제 어 : 발달상권, 전자상거래, 상권 변화 양상, 상대적 다양성 지수(RDI), ICT 인프라