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The Impact of COVID-19 on Distribution Company in Korea

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Abstract

As the COVID-19 outbreak has prolonged, social distancing movements are encouraged and non-face-to-face lifestyle trends are spreading. As a result, it is necessary for general restaurants and small marts to provide delivery services like large-scale distribution companies. Large distribution companies have also suffered significant economic losses from COVID-19 because epidemiological investigations were conducted after the distribution center was closed due to the outbreak of COVID-19 in several large domestic distribution companies. In this thesis, in order to examine whether COVID-19 actually affects distribution companies, we attempt to understand the relationship between the number of confirmed cases per month and the sales share and growth rate by categories of distribution companies.

Keywords : correlation analysis, COVID-19, distribution company, linear regression analysis.

1. Introduction

In the 21st century, we have been fighting various viruses. SARS is a typical example of the viruses and was first discovered in China in 2002. It was prevalent from November 2002 to July 2003, and the mortality rate was 10%. In 2009, the first swine flu was discovered in the United States, and the World Health Organization (WHO) declared a pandemic. The mortality rate of the novel swine-origin influenza A (H1N1) was 1%. In 2012, MERS was first discovered in Saudi Arabia and the mortality rate was 41%. In 2019, COVID-19 was first discovered in China, and the mortality rate is estimated to be around 4.6%. The WHO declared COVID-19 as a pandemic on March 11, 2020 (Switzerland local time).

COVID-19 has had a lot of influence on our daily life, and active research is being conducted on this. Pham[1] proposed a model to estimate the cumulative number of deaths in the United States due to COVID-19. Pal *et al*.[2] proposed a neural network applying the Bayesian optimization framework to predict the long-term occurrence of infectious diseases. Jenelius *et al*.[3] analyzed daily public transportation use in three populated areas of Sweden and announced that it was hit harder than other means of transportation. Watanabe *et al*.[4] investigated consumption behavior following the outbreak of COVID-19 and reported that consumption was suppressed in areas such as eating out, entertainment, travel and lodging. Katz *et al*.[5] mentioned that developing countries have a greater digital gap compared to developed countries, and argued that digitalization of offline services would help prevent confusion of infectious diseases and lower the unemployment rate in the long run. Ivanov[6] predicted the long-term impact of the outbreak of infectious diseases on the global supply chain through simulations using COVID-19 as an example. Butu *et al*.[7] claimed that the pandemic of COVID-19 caused a change in the way consumers buy fresh food ingredients, and proved that offline purchases have turned online.

As the COVID-19 outbreak prolongs, social distancing is being encouraged, and the trend of non-face-to-face life is spreading. As a result, it is needed delivery services by general restaurants and small marts for consumers like large-scale distribution companies. In particular, mass infections occurred in February and March 2020. Epidemiological investigations were conducted after the distribution center was closed due to the outbreak of COVID-19 in several large domestic distribution companies. While the social distancing is continued, consumers refrained from visiting large retailers to prevent infection. Jung *et al*.[8] investigated the effect of

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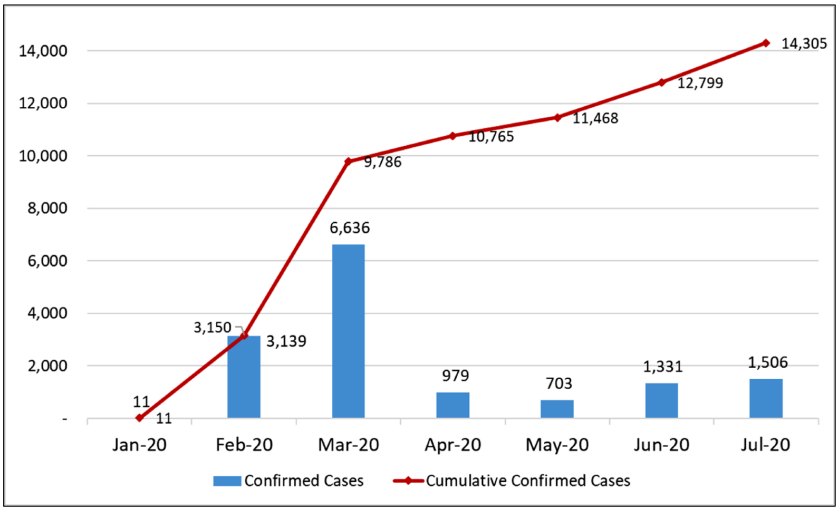

Fig. 1. Monthly and cumulative number of confirmed cases.

fear of MERS outbreak on Korean consumer spending and reported that during the MERS outbreak period, consumer spending on traditional stores decreased and spending on e-commerce increased. Jung *et al.*[9] applied a time series to understand the relationship between the MERS outbreak and online and offline retail sales in Korea, and argued that as the offline sales decreased, the online sales shifted. Kim[10] argued that the growth of the e-commerce market accelerated as more people stayed at home to prevent COVID-19 infection, and that digitalization must be done to survive in the market economy. Goddard[11] investigated the impact of COVID-19 on food retailers in Canada, and reported that about 30% of food consumption was transferred to retail stores.

Herin, we deal with the relationship between COVID-19 confirmed cases and the growth rate of distribution companies by category. We estimate that the number of confirmed cases negatively affect the growth rate of hypermarkets and department stores by category. In addition, convenience stores and super supermarkets[1](SSMs) with small floating populations due to their small size are estimated to be positively affected. We try to verify this using correlation analysis and simple linear regression analysis.

In Section 2, we show COVID-19 cases in Korea. Data set is described in Section 3. In Section 4, we discuss the analysis and results. Finally, Section 5 concludes the paper.

2. COVID-19 Cases in Korea

The first domestic COVID-19 confirmed case in Korea was a woman from Wuhan, China on January 19, 2020. She had fever and pneumonia symptoms and was treated for 18 days in Korea. After that, a total of 11 confirmed cases occurred in January, and COVID-19 confirmed cases sporadically occurred in February and March through collective infection. As a result, confirmed cases gradually decreased, such as telecommuting and social distancing, and showed stability from April to July. Figure 1 shows monthly and cumulative number of confirmed cases from January to July in Korea.

The number of confirmed cases in March was the highest at 6,636. The number of confirmed cases in July was 1,506, and the total cumulative number of confirmed cases in July was 14,305.

3. Data

In this paper, we use two data sets provided by the Korean public data portal and one data set of COVID-19. The first data set is “Small and Medium Business Distribution Center Support Project (Small and Medium Business Exclusive Sales Office, Home Shopping Broadcasting Sales Agency) Sales Proportion by Category” provided by the Small & Medium Business Distribution Center (SBDC). The data set deals with the

cumulative data by categories from December 2019 to July 2020.

The second data set is "26 major distributors online and offline group year-on-year growth rate" provided by the Ministry of Trade, Industry and Energy (MOTIE). Data from January to June 2019 and 2020 are used to understand the sales relationship before and after the COVID-19 outbreak. The data set includes the year on year (YoY) growth of hypermarkets, department stores, convenience stores, and SSMs.

The third data set for the number of COVID-19 confirmed cases was organized by recording the number of confirmed cases per day released by the government every day starting in January when the first confirmed case occurred. The COVID-19 data set used in this study was aggregated and reconstructed monthly.

4. Analysis and Results

4.1. The Relationship Between the Proportion of Sales by Category of SMEs and the Number of Confirmed Cases

Table A.1 of the appendix shows the results of the correlation analysis between the percentage of sales by category of SMEs and the number of confirmed cases. As a result, since the p-value is very small, Clothes / Underwear (-0.820*) is significant. Also, the correlation coefficient is negative, it shows a negative correlation between Clothes / Underwear and the number of confirmed cases.

A simple regression analysis is performed to determine the effect of the number of COVID-19 confirmed cases per month on the proportion of sales by category of small and medium retailers. We consider a total of 10 models by designating the number of confirmed cases per month as an independent variable and setting the proportion of sales for the 10 categories as dependent variables.

Table 1 shows the results of simple linear regression for SMEs. The p-value of the model with Clothes / Underware as the dependent variable is 0.013, which is shown to be significant. In other words, the number of confirmed cases per month affects proportion of sales for Clothes / Underware, and the standardization coefficient beta is -0.820, which appears to have a negative relationship. This means that as the number of confirmed cases per month increases, proportion of sales for Clothes / Underwear decrease.

4.2. The Relationship between YoY Growth Rate by Categories of Major Distributors Online and Offline Group and the Number of Confirmed Cases

Table 2 shows monthly YoY growth rate by type of major distributors group in 2020. As a result, the growth rate of hypermarkets and department stores sharply

Table 2. Monthly growth rate (YoY) of distributors

Months	Hypermarkets	Department stores	Convenience stores	SSMs
Jan	6.2	2.5	6	-6.7
Feb	-10.6	-21.4	7.8	8.2
Mar	-13.8	-40.3	-2.7	5.5
Apr	-1	-14.8	-1.9	-2.6
May	-9.7	-7.4	0.8	-12.4
Jun	-18.8	-3.4	2.4	-14.7

Table 1. Results of simple linear regression for SMEs

Independent variable	Dependent variable	Standardized coefficients	t	p-value
Monthly number of confirmed cases	1. Digital ElectricalAppliances	0.235	1.389	0.174
	2. Living/Kitchen/Bath	0.070	0.404	0.689
	3. Beauty	0.134	0.779	0.442
	4. Food	0.051	0.291	0.773
	5. Fashion Accessories	-0.129	-0.749	0.459
	6. Clothes/Underware	-0.820	-3.514	0.013*
	7. Sports	-0.153	-0.380	0.717
	8. BedroomFurniture	0.135	0.333	0.750
	9. Furniture	0.045	0.110	0.916
	10. Child Education	-0.380	-1.007	0.353

declined in February and March, when the outbreak of mass infection occurred, but the growth rate of SSMs increased. The growth rate of convenience stores increased in February, but the growth rate of convenience stores decreased slightly in March.

4.2.1. Analysis for Hypermarkets

Table A.2 of the appendix shows the results of the correlation analysis between YoY growth rate by categories of hypermarkets and the number of confirmed cases. As a result, the p-values for categories excluding Food and Total are very small. So, the categories are significant. In addition, since all correlation coefficient are negative, the number of confirmed cases and categories excluding Food are negative correlation.

A simple regression analysis is performed to determine the effect of the number of COVID-19 confirmed cases per month on the YoY growth rate by categories of hypermarkets. We consider a total of 6 models by designating the number of confirmed cases per month as an independent variable and setting the growth rates of the 6 categories as dependent variables.

Table 3 shows the results of simple linear regression for hypermarkets. All models except Food have very small p-values, so they are significant. In other words, the number of confirmed cases per month affects growth rates of all categories except Food. Also, values of standardization coefficient beta for the categories are negative, which appears to have a negative effect. This means that as the number of confirmed cases per month increases, the growth rates of Digital Electrical Appliances, Clothes, Living, Sports and Miscellaneous Goods decrease.

4.2.2. Analysis for Department stores

Table A.3 of the appendix shows the results of the correlation analysis between YoY growth rate by categories of department stores and the number of confirmed cases. As a result, all p-values are significant. The values of the correlation coefficient are negative, so the relationship between growth rates of all categories and the confirmed cases is negative.

A simple regression analysis is performed to determine the effect of the number of COVID-19 confirmed cases per month on the YoY growth rate by category of department stores. We consider a total of 8 models by designating the number of confirmed cases per month as an independent variable and setting the growth rates of the 8 categories as dependent variables.

Table 4 shows the results of simple linear regression for department stores. All models have very small p-values, so they are significant. In other words, the num-

Table 3. Results of simple linear regression for hypermarkets

Independent variable	Dependent variable	Standardized coefficients	t	p-value
Monthly number of confirmed cases	1. Digital Electrical Appliances	-0.656	-2.748	0.021*
	2. Clothes	-0.847	-5.031	0.001**
	3. Living	-0.643	-2.652	0.024*
	4. Sports	-0.887	-6.081	0.000**
	5. Miscellaneous Goods	-0.868	-5.517	0.000**
	6. Food	-0.138	-0.441	0.669

Table 4. Results of simple linear regression for department stores

Independent variable	Dependent variable	Standardized coefficients	t	p-value
Monthly number of confirmed cases	1. Miscellaneous Goods	-0.887	-6.061	0.000**
	2. Women Suits Set	-0.905	-6.742	0.000**
	3. Women Casual	-0.878	-5.801	0.000**
	4. Men Clothes	-0.942	-8.841	0.000**
	5. Kid Sports	-0.953	-9.899	0.000**
	6. Living	-0.760	-3.694	0.004**
	7. Luxury Goods	-0.908	-6.860	0.000**
	8. Food	-0.604	-2.398	0.037*

ber of confirmed cases per month affects growth rates of all categories. Also, values of standardization coefficient beta for all categories are negative, which appears to have a negative effect. This means that as the number of confirmed cases per month increases, the growth rates of all categories decrease.

4.2.3. Analysis for Convenience stores

Table A.4 of the appendix shows the results of the correlation analysis between YoY growth rate by categories of convenience stores and the number of confirmed cases. As a result, since the p-value is very small, Miscellaneous Goods (-0.710**) is significant. The correlation coefficients is negative, it shows a negative correlation between Miscellaneous Goods and the number of confirmed cases. Also, the correlation coefficients of Instant Food / Fresh Food is -0.558, so it is negative correlation between Instant Food / Fresh Food and the number of confirmed cases.

A simple regression analysis is performed to determine the effect of the number of COVID-19 confirmed cases per month on the YoY growth rate by category of convenience stores. We consider a total of 5 models by designating the number of confirmed cases per month as an independent variable and setting the growth rates of the 5 categories as dependent variables.

Table 5 shows the results of simple linear regression for convenience stores. The p-value of the second model is very small, so it is significant. The p-value of Instant Food / Fresh Food is slightly larger than 0.05, but it is meaningful. In other words, the number of confirmed cases per month affects growth rate of Miscellaneous Goods and Instant Food / Fresh Food. Also, values of standardization coefficient beta for Miscellaneous Goods and Instant Food / Fresh Food are negative. This means that as the number of confirmed cases per month increases, the growth rates of Miscellaneous Goods and Instant Food / Fresh Food decrease.

4.2.4. Analysis for SSMs

Table A.5 of the appendix shows the results of the correlation analysis between YoY growth rate by categories of SSMs and the number of confirmed cases. As a result, since the p-value is very small, Fresh-cut / Prepared Food (0.629*) is significant. Also, the correlation coefficient is positive, it shows a positive correlation between Fresh-cut / Prepared Food and the number of confirmed cases.

A simple regression analysis is performed to determine the effect of the number of COVID-19 confirmed cases per month on the YoY growth rates by category of SSMs. We consider a total of 5 models by designating the number of confirmed cases per month as an independent variable and setting the growth rates of the 5 categories as a dependent variables.

Table 5 shows the results of simple linear regression for SSMs. The p-value of the fourth model is very small, so it is significant. In other words, the number of confirmed cases per month affects growth rate of Fresh-cut / Prepared Food.

Table 5. Results of simple linear regression for convenience stores

Independent variable	Dependent variable	Standardized Coefficients	t	p-value
Monthly number of confirmed cases	1. Living	-0.249	-0.813	0.435
	2. Miscellaneous Goods	-0.710	-3.189	0.010*
	3. Cigarettes, etc	0.200	0.647	0.532
	4. Beverages/Processed Food	-0.481	-1.735	0.113
	5. Instant Food/Fresh Food	-0.558	-2.124	0.060

Table 6. Results of simple linear regression for SSMs

Independent variable	Dependent variable	Standardized Coefficients	t	p-value
Monthly number of confirmed cases	1. Living	0.142	0.455	0.659
	2. Miscellaneous Goods	0.038	0.120	0.907
	3. Agriculture/Fisheries/Livestock	0.186	0.599	0.562
	4. Fresh-cut/Prepared Food	0.629	2.559	0.028*
	5. Processed Food	0.338	1.137	0.282

Also, value of standardization coefficient beta for Fresh-cut / Prepared Food is positive, which appears to have a positive effect. This means that as the number of confirmed cases per month increases, the growth rate of Fresh-cut / Prepared Food increases.

5. Conclusions

In this paper, it was hypothesized that the outbreak of COVID-19 would have reduced sales of large supermarkets and department stores with a large floating population, and increased sales of relatively small convenience stores and corporate supermarkets. To verify this statistically, correlation analysis and simple regression analysis for each model was conducted according to the type of distribution companies.

As a result, as the number of COVID-19 confirmed cases increased by month, the growth rates of hypermarkets, department stores, and convenience stores by categories overall decreased year-on-year. On the other hand, the growth rate of freshly cooked products in corporate supermarkets has increased. In order to prevent infection, we estimate that consumers who did social distancing prefer SSMs, which are smaller than hypermarkets or department stores, and sell a variety of products rather than convenience stores. The SSMs, which suffered a deficit due to the ambiguous location between convenience stores and hypermarkets, was rather positive amid the bad news of COVID-19. According to the announcement of the Ministry of Trade, Industry and Energy, from February to March, when the COVID-19 group infection began, sales of SSMs increased compared to the same month last year [12,13]. In particular, the proportion of sales for fresh food increased. In addition, since the Ministry of the Interior and Safety has designated SSMs as a subsidy user, sales of SSMs are expected to be positive in July and August when the subsidy by COVID-19 was paid.

In recent August to September, mass infection resumed, and high-intensity social distancing has been continued. In this situation, only places using non-face-to-face services by the Internet can survive. In addition to providing temporary subsidies, the government must actively build an infrastructure with large companies that allows access to non-face-to-face services for self-employed and SMEs in economic difficulties. This allows the companies to collect large amounts of customer data and implement aggressive marketing policies in the future. Therefore, the companies need to continue working with the government to bridge the digital divide for SMEs.

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Appendix

Table A.1. Results of correlation analysis between the percentage of sales by categories of SMEs and the number of confirmed cases

Variable	Confirmed Cases	Digital Electrical Appliances	Living/ Kitchen/ Bath	Beauty	Food	Fashion Accessories	Clothes/ Underware	Sports	Bedroom Furniture	Furniture
Digital Electrical Appliances	0.235									
Living/ Kitchen /Bath	0.07	0.356*								
Beauty	0.134	-0.303	0.189							
Food	0.051	-0.428*	0.331	0.824**						
Fashion Accessories	-0.129	0.104	-0.345*	-0.186	-.390*					
Clothes/ Underware	-0.820*	-0.402	-0.837**	-0.178	-0.637	0.03				
Sports	-0.153	-0.613	-0.331	-0.193	-0.447	0.428	0.451			
Bedroom Furniture	0.135	-0.464	0.102	-0.211	-0.709*	-0.074	0.111	0.348		
Furniture	0.045	0.744*	-0.099	0.587	0.597	0.05	-0.329	-0.488	-0.574	
Child Education	-0.38	-0.043	-0.485	-0.575	0.018	0.44	0.459	0.436	-0.35	-0.133

Table A.2. Results of correlation analysis between YoY growth rate of categories for hypermarkets and the number of confirmed cases

Variable	Confirmed Cases	Digital Electrical Appliances	Clothes	Living	Sports	Miscellaneous Goods	Non-food Subtotal	Food
Digital Electrical Appliances	-0.656*							
Clothes	-0.847**	0.629*						
Living	-0.643*	0.753**	0.703*					
Sports	-0.887**	0.852**	0.885**	0.733**				
Miscellaneous Goods	-0.868**	0.722**	0.950**	0.768**	0.914**			
Non-food Subtotal	-0.809**	0.892**	0.869**	0.911**	0.932**	0.924**		
Food	-0.138	0.239	0.127	0.662*	0.071	0.124	0.350	
Total	-0.474	0.376	0.375	0.715**	0.364	0.379	0.528	0.860**

Table A.3. Results of correlation analysis between YoY growth rate of categories for department stores and the number of confirmed cases

Variable	Confirmed Cases	Miscellaneous Goods	Women Suits Set	Women Casual	Men Clothes	Kid Sports	Living	Luxury Goods	Non-food Subtotal	Food
Miscellaneous Goods	-0.887**									
Women Suits Set	-0.905**	0.953**								
Women Casual	-0.878**	0.976**	0.977**							
Men Clothes	-0.942**	0.962**	0.981**	0.963**						
Kid Sports	-0.953**	0.945**	0.956**	0.941**	0.975**					
Living	-0.760**	0.543	0.656*	0.564	0.728**	0.725**				
Luxury Goods	-0.908**	0.807**	0.842**	0.765**	0.880**	0.893**	0.807**			
Non-food Subtotal	-0.955**	0.940**	0.965**	0.934**	0.988**	0.983**	0.778**	0.935**		
Food	-0.604*	0.739**	0.642*	0.683*	0.681*	0.667*	0.395	0.48	0.645*	
Total	-0.926**	0.940**	0.934**	0.909**	0.966**	0.964**	0.736**	0.895**	0.972**	0.793**

Table A.4. Results of correlation analysis between YoY growth rate of categories for convenience stores and the number of confirmed cases

Variable	Confirmed Cases	Living	Miscellaneous Goods	Cigarettes, etc	Non-food Subtotal	Beverages/ Processed Food	Instant Food/ Fresh Food	Food Subtotal
Living	-0.249							
Miscellaneous Goods	-0.710**	0.623*						
Cigarettes, etc	0.200	0.565	-0.061					
Non-food Subtotal	-0.016	0.827**	0.272	0.928**				
Beverages/ Processed Food	-0.481	0.535	0.697*	-0.065	0.205			
Instant Food/ Fresh Food	-0.558	0.415	0.574	-0.174	0.072	0.843**		
Food Subtotal	-0.522	0.518	0.681*	-0.102	0.171	0.982**	0.929**	
Total	-0.445	0.769**	0.685*	0.279	0.540	0.920**	0.821**	0.921**

Table A.5. Results of correlation analysis between YoY growth rate of categories for SSMs and the number of confirmed cases

Variable	Confirmed Cases	Living	Miscellaneous Goods	Non-food Subtotal	Agriculture/ Fisheries/ Livestock	Fresh-cut/ Prepared Food	Processed Food	Food Subtotal
Living	0.142							
Miscellaneous Goods	0.038	0.961**						
Non-food Subtotal	0.099	0.992**	0.988**					
Agriculture/ Fisheries/ Livestock	0.186	0.744**	0.759**	0.752**				
Fresh-cut/ Prepared Food	0.629*	0.502	0.454	0.481	0.836**			
Processed Food	0.338	0.806**	0.780**	0.800**	0.958**	0.849**		
Food Subtotal	0.355	0.732**	0.719**	0.729**	0.982**	0.911**	0.981**	
Total	0.339	0.780**	0.768**	0.778**	0.983**	0.889**	0.987**	0.997**