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Industry Structure of Commercial Districts and the Impact of COVID-19

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Abstract: This paper aims to empirically analyze the difference in the closure rate of the commercial district according to the industry structure of the commercial district. Theoretically, the larger the number of stores in a commercial district, the greater the positive externality caused by the agglomeration economies in consumption, namely, the external economies of scale. However, the agglomeration economies could occur from comparison shopping or one-stop shopping, depending on the business structure of the commercial district. According to the empirical results of the regression analysis of all 1164 commercial districts in Korea, the more specialized a commercial district is by stores in a specific industry, the lower the closure rate of that commercial district. This means that the agglomeration economies in consumption are driven by comparison shopping rather than by one-stop shopping and implies that it is necessary to introduce incentives that allow stores in the same industry to cluster together in terms of policy. Meanwhile, if the closure is limited to a specific industry, it will cause an endogeneity problem since it affects the industry structure of the commercial district. Considering this, as a result of additional estimation by 2SLS and GMM using instrumental variables, the error in estimation due to the endogeneity problem was not large, confirming that COVID-19 corresponds to an overall external shock that is not limited to a specific industry. In addition, this paper presents diagnostic indicators for commercial districts to measure the impact of COVID-19. Through this, it will be possible to alleviate conflicts between social classes over compensation or subsidies for sanctions for quarantine. To the best of our knowledge, it is the first time to use all commercial districts in Korea for a research in evaluating the impact of COVID-19, and empirical results on agglomeration economies focusing on the consumption side are limited.

Keywords: COVID-19; agglomeration economies; comparison shopping; one-stop shopping; diagnostic index for commercial district

Citation: Hong, S.H.; Im, J.; Lee, G. Industry Structure of Commercial Districts and the Impact of COVID-19. *Sustainability* **2023**, *15*, 8905. https://doi.org/10.3390/su15118905

Academic Editor: Afees A. Salisu

Received: 11 April 2023
Revised: 27 May 2023
Accepted: 30 May 2023
Published: 31 May 2023

1. Introduction

Due to its strong transmission power, COVID-19 has caused greater economic damage throughout society than previous infectious diseases, such as SARS and MERS. Although there are differences between countries and time periods, strict executive orders, such as quarantining affected individuals and their contacts. In addition, temporary closures of facilities were issued in the early stages of the outbreak. As a result, damage was caused not only to the store, but also to the entire commercial district where the store was located.

COVID-19 may have acted as a negative shock throughout the whole economy, increasing the closure of stores in commercial districts, but the extent of the shock may vary depending on the industry structure of individual commercial districts. In particular, different impacts may appear between cases where a commercial district is specialized in a specific industry and diversified by several industries. Therefore, the difference in damage caused by COVID-19 according to the industry structure of the commercial district should

be empirically analyzed. This paper attempts to empirically analyze the factors that affect the closure rate of stores in 1164 commercial districts in Korea. In particular, the role of industry structure of commercial districts is investigated given the same circumstances with respect to distributions of firms and residents in the neighborhood of the commercial districts. According to the analysis results, the more specialized a commercial district is by stores in a specific industry, the lower the rate of business closure in that commercial district. This means that the agglomeration economies in consumption are due to comparison shopping rather than one-stop shopping, and implies that the introduction of incentives that allow stores in the same industry to be clustered is necessary from a policy point of view.

Recently, the authors of [1] set up a model of interdependent retail demand based on multi-stop shopping and found the existence of shopping externalities from retail stores agglomeration by estimating a 5–6% average decline in nearby store foot traffic after a grocery closure. In ref. [2], the authors argue that retail firms benefit from shopping externalities. Moreover, they estimate an elasticity of store owners' rental income with respect to footfall (namely, the number of pedestrians that pass by) as well as the number of shops in the vicinity of (at least) 0.25. This implies that the shopping externalities are unlikely to be internalized.

Empirical studies on the agglomeration economies have been conducted with a focus on the production side. For example, an increase in labor productivity [3], growth in local employment, location decision of newly established firms, and exporting of domestic businesses in the region [4] have been studied. However, this paper is differentiated in that it empirically analyzes the existence of the agglomeration economies in terms of consumption. Even though the existence of shopping externalities has been shown by some previous studies, the sources, namely, comparison shopping vs. one-stop shopping have not been proven yet. This paper aims to empirically show what type of shopping externalities would work in Korea between the two conflicting forces. In addition, since endogeneity issues are considered through analysis using instrumental variables, and the effects of external shocks, such as COVID-19 are analyzed, this paper includes, in some sense, natural experimental analysis results. The results of this paper would give some clues on how the commercial districts need to be organized in terms of industry structure and where to be located for the better performance of the stores in a given district against an external shock, such as COVID-19.

The structure of this paper is as follows: The next section presents the theoretical background, literature review, and a regression model for hypothesis testing in this paper. Section 3 describes the summary statistics of the data and variables used in the empirical analysis, and the results of the empirical analysis are discussed in Section 4. Section 5 discusses policy implications, and the last section summarizes the key findings of this paper along with future tasks.

2. Theoretical Backgrounds and Analytical Model

2.1. Theoretical Backgrounds and Previous Studies

The geographical concentration of economic activities arises from external economies of scale through knowledge spillover, labor market pooling and matching, and sharing of intermediate input suppliers [5,6]. Despite the development of communication technology and the expansion of transportation infrastructure, the proportion of the population residing in cities continues to increase worldwide due to these external economies of scale. As firms are geographically clustered, opportunities for informal face-to-face contact between workers in the cluster increase, facilitating the dissemination of tacit knowledge [7]. In larger local labor markets, changes in employment due to individual firm-specific shocks that are not cyclical are easier, and better matching between firms and workers is possible [8,9]. Clusters of firms in the same industry provide incentives for firms to buy intermediate inputs from nearby suppliers rather than producing them themselves. This allows suppliers to realize economies of scale and supply intermediate inputs at lower prices [10,11].

The agglomeration economies are not limited to the production side. For example, if a commercial district specializes in a specific industry, it may be relatively less sensitive to business fluctuations since it enables comparison shopping for consumers. However, even when diversified by several industries, external economies of scale can appear since they enable consumers to perform one-stop shopping. In Ref. [12], the authors argue that stores perform better when they are surrounded by other stores of diverse complementary products since diverse stores attract consumers with love-of-variety preferences. In their empirical study on the Tokyo Tsukiji Fish Market, they found that the diversity of the types of neighboring wholesalers positively affects the performance of small-sized and specialized retailers. However, the authors of [13] through a study using approximately fourteen thousand buildings on the street network of Cambridge and Somerville, Massachusetts found that consumers enjoy comparison shopping across proximal similar-type stores, leading to clustering of similar-type stores.

However, similar to the production activities, the geographical concentration of stores in a given commercial district would bring forth agglomeration economies. At the same time, stores would co-locate in order to obtain the external benefits from large commercial districts. Therefore, this possible endogeneity should be tackled.

This paper empirically analyzes how the closure rate differs between commercial districts in 2022 due to the impact of COVID-19 according to the industry structure of individual commercial districts in 2019, before the outbreak of COVID-19, using data on all 1164 commercial districts in Korea.

2.2. Analytical Models and Regression Equation

The regression equation to test the main hypotheses of this paper is as follows:

$$y_j = \alpha + \beta_1 HI_j + \gamma \, Density_j + \beta_2 \, NE_k + X_k \, \zeta + \varepsilon_j \quad (1)$$

The dependent variable, y_j is the rate of stores that closed in the third quarter of 2022 compared to those that were open for business in the third quarter of 2019 in a given commercial district. Therefore, it reflects the impact of COVID-19.

The degree of specialization by a specific industry in each commercial district is defined by the Herfindahl index, which is measured as follows: $HI_j = \sum_{i \in j} s_{ij}$, where $s_{ij} = \left(\frac{active_{ij,2019}}{\sum_{i \in j} active_{ij,2019}} \right)^2$. This index is greater than 0 and has a range corresponding to a maximum value of 1. The higher the number, the more specialized the commercial district is for a specific industry. The coefficient is negative when comparison shopping exists, whereas it is positive when one-stop shopping appears.

$Density_j$ represents the density of a commercial district, measured by dividing the number of stores in the commercial district by the area (1000 square meters) of the commercial district. As stores are concentrated within a unit area, the risk of COVID-19 infection or anxiety increases, resulting in the sluggish business performance of the stores. This may lead to an increase in store closures, and thus the coefficient is expected to be positive.

NE_k is a proxy variable representing the agglomeration economies in terms of production, and is measured as the number of establishments with one or more employees belonging to wholesale and retail trades or accommodations and restaurants within the municipality where the commercial district is located. Therefore, the larger this variable, the larger the local labor market. Local labor markets are determined by the geographical extent of workers' commutes. Although the possible commuting distance is expanding due to the development of transportation, the short-term local labor market, which assumes that migration is impossible, generally coincides with the boundary of a city or county. In larger local labor markets, idiosyncratic store-specific shocks on employment that are not related to business cycles are more likely to cancel out between stores. After all, individual stores are easier to hire new workers (if the store is facing a boom) or fire current employees (if the store is facing a recession); therefore, the expected profit is relatively large, which

reduces the likelihood of going out of business [9]. Therefore, the coefficient is negative, at least theoretically.

X_k includes the population and the share of population by age group of the city or county, along with dummy variables for metropolitan cities or provinces where the commercial district is located. Population and the share of population by age group are based on the initial analysis period, namely, 2019. Therefore, the larger the population size in the region to which the commercial district belongs, the greater the decrease in consumption due to COVID-19, which would have a greater negative impact on the sales of stores in the commercial district, increasing the closure rate. In addition, since it would be relatively easier for the younger generation to switch to online purchases, the rate of store closures would be higher in commercial districts with a higher proportion of them.

3. Data and Variables

There are 1164 commercial districts nationwide, and the boundaries of individual commercial districts were extracted from information on major commercial districts nationwide (data.go.kr/data/15029180/standard.do, accessed on 13 March 2023) provided by the Small Business Corporation. On the other hand, the information on individual stores in the commercial district was extracted from the shopping district (commercial district) information of the Small Enterprise Market Promotion Agency (data.go.kr/data/15083033/fileData.do, accessed on 13 March 2023). However, this dataset only provides information on currently operating commercial businesses and does not provide information on closures. However, regular updates are made on a quarterly basis, allowing for the construction of closure data using past data. For example, if there was store information in the third quarter of 2019 but no data available in the third quarter of 2022, it was considered as a closed store. Using this method, the number of operating stores and closed stores was aggregated.

In addition to data related to commercial districts, in order to measure the degree of agglomeration economies in terms of production (i.e., the scale of the local labor market), the number of establishments in a city or county where the commercial district is located is extracted from the 2019 data of the National Business Survey conducted by the National Statistical Office. As of 31 December 2019 or the survey date, this dataset covers all establishments located in all areas under the administrative jurisdiction of the Republic of Korea. Prior to the outbreak of COVID-19, the total size of potential consumers by commercial district and the proportion by age group are extracted from the 2019 Census data as of 1 November 2019.

Table 1 presents the summary statistics of the variables included in the empirical analysis. As of 2022, approximately 55.4% of the stores that were open in 2019 appear to have closed. In contrast, during the period of 2016–2019 which was unrelated to COVID-19, the ratio was 23.7%, less than half the current rate, indicating the significant economic impact of COVID-19.

The Herfindahl index is measured at three different levels, where stores are classified into 9, 94, or 737 industries, respectively. As the number of industry categories increases, the index becomes smaller. When stores are grouped into 94 categories, the mean value of the Herfindahl index is 0.08.

The average number of stores per unit area (1000 square meters) in each commercial district is 5.46, with the highest density being 34.25, which is a significant difference from the lowest density of 0.05. The average number of establishments with at least one employee in the wholesale and retail trade or lodging and restaurant industries in the municipality where the commercial district is located is 4723, with the smallest area containing only 111 establishments, while the largest area includes 20,350 establishments. The average population size of cities or counties to which commercial districts belong is 295,573, exhibiting a large gap between the smallest and largest regions. The proportion of the population in the region belonging to the age group of 51 to 65 is highest, with an average of 24.3%.

Table 1. Summary statistics.

Variables	Mean	Std. Dev.	Min	Max
Rate of stores closed in 2022 to stores in 2019	55.4	16.7	0.0	100.0
Rate of stores closed in 2019 to stores in 2016	23.7	10.9	0.0	100.0
Herfindahl index				
9 industry categories	0.343	0.094	0.212	0.969
94 industry categories	0.080	0.044	0.033	0.490
737 industry categories	0.039	0.030	0.015	0.489
Density	5.46	4.19	0.05	34.25
NE (number of establishments)	4723	3755	111	20,350
Population	295,573	162,780	15,257	815,805
Share of population who are:				
at most 19 years old	16.5	3.2	7.0	25.4
20 to 35 years old	20.1	3.9	8.5	33.8
36 to 50 years old	23.6	3.0	12.9	30.2
51 to 65 years old	24.3	2.9	17.1	33.8
66 to 80 years old	12.3	4.1	5.4	29.0
at least 81 years old	3.1	1.7	1.0	11.6

4. Empirical Results

Table 2 presents the estimation results for Equation (1). Column (1) includes the past value of the dependent variable, i.e., the closure rate by commercial district in 2019, as an explanatory variable to test a (type of) hysteresis hypothesis. The coefficient of this variable shows a statistically significant negative value, indicating that the lower the store closure rate before the COVID-19 outbreak, the higher the closure rate after the outbreak. Therefore, the impact of COVID-19 was not limited to stagnant commercial districts, but also affected active commercial districts, implying that the latter suffered greater damage.

Column (2) corresponds to the estimated results of the factors affecting the closure of stores in the commercial district. The Herfindahl index has a statistically significant negative value, indicating that the probability of store closure decreases as a commercial district is concentrated by stores belonging to the same industry. In particular, the positive externality caused by the geographical concentration of stores, i.e., external economies of scale, is mainly due to comparison shopping rather than one-stop shopping. Despite the negative shocks caused by COVID-19 across all sectors, these shocks are partially mitigated as commercial districts specialized in certain sectors offer the benefit of agglomeration by enabling consumers to compare goods between stores in the commercial district and make the best choice.

Density is significant as a positive factor, meaning that the closure rate is higher in commercial districts where stores are more densely concentrated. This coincides with the observation that COVID-19 has become a significant issue in society as a whole due to its high transmission power even though it may not cause fatal symptoms compared to previously prevalent infectious diseases. The more densely populated the stores are, the easier it is for COVID-19 to spread in a commercial district, leading to a decrease in sales and an increase in closures due to reduced sales.

The larger the number of wholesale and retail establishments or restaurants in the area where the commercial district is located, the lower the closure rate of stores in that district. This empirical observation supports [9] the theoretical assertion regarding the existence of external benefits from local labor market pooling. Firms' employment is influenced not only by cyclical factors, but also by firm-specific idiosyncratic factors. When there are enough firms in the local labor market, workers can easily move from recession-hit firms to those that are experiencing a boom in the local labor market. Therefore, larger local labor markets provide relatively greater employment flexibility to firms, enabling them to choose to reduce employment rather than shutting down entirely during firm-specific recessions.

Table 2. Empirical results on the rate of stores closed in 2022 to stores open for business in 2019.

	Dependent Variable: The Rate of Stores Closed in 2022 to Stores Open for Business in 2019		
	(1)	**(2)**	**(3)**
The rate of stores closed in 2019 to stores open for business in 2016	−0.1170 ** (−2.74)		−0.0328 (−0.70)
Herfindahl index (94 categories)		−56.9345 ** (−3.99)	−57.1330 ** (−3.99)
Density		1.2715 ** (9.50)	1.2374 ** (9.10)
NE (number of establishments)		−0.0004 ** (−2.61)	−0.0004 ** (−2.55)
Population (in 1000s)		0.0103 ** (2.78)	0.0106 ** (2.83)
Share of population who are:			
20 to 35 years old		1.1473 ** (2.85)	1.2052 ** (2.98)
36 to 50 years old		2.4701 * (2.58)	2.5580 ** (2.67)
51 to 65 years old		1.3176 ** (2.62)	1.3666 ** (2.70)
66 to 80 years old		0.5114 (1.00)	0.5278 (1.02)
at least 81 years old		0.2189 (0.26)	0.2952 (0.35)
Constant	58.2262 ** (49.06)	−66.1903 (−1.37)	−70.2660 (−1.46)
Fixed effects			
Metropolitan areas or provinces	yes	yes	yes
Number of observations	1161	1164	1161
Adj. R-squared	0.0050	0.3207	0.3225

Note: Huber−White's t-values are in parentheses. ** and * indicate statistical significance at 1% and 5%, respectively.

The greater the population of the area in which a commercial district is located, the higher the sales of the stores in that district. However, since these regions have a higher likelihood of COVID-19 occurrence or resulting decrease in consumption, the possibility of a decrease in sales and an increase in store closures in the local commercial district may be higher. In fact, empirical results show that if the population in a region increases by its standard deviation (162.78 thousand people) as of 2019, the closure rate of commercial districts in that region increases by 1.7 percentage points in 2022. On the other hand, the influence of the proportion of the population by age group in the total population appears to differ among age groups. The higher the proportion of people aged 20 to 65 in 2019, the higher the rate of store closure in that commercial district in 2022. Among these groups, the greatest damage in terms of store closure due to COVID-19 occurred in commercial districts where the proportion of people aged 36 to 50 was high.

The last column includes all explanatory variables in Columns (1) and (2), and unlike Column (1), the closure rate as of 2019 does not have a significant effect on the closure rate in 2022. In particular, the closure rate of a commercial district is not determined by unobserved commercial district-specific trends, but is rather influenced by the industrial structure or density of the commercial district and the characteristics of the city where the district is located.

In Equation (1), it is assumed that the closure rate of stores in an individual commercial district is affected by the industry structure (Herfindahl index) of that commercial district. However, if the closure rate of stores in a commercial district differs between industries, and thus the industrial structure of the commercial district changes, an endogeneity problem may arise due to an inverse causal relationship in which the dependent variable affects the explanatory variable. In particular, if more closures occur in a specialized industry and the

number of stores in this industry decreases more, the Herfindahl index falls. In this case, the estimation results in Table 2 may be biased, i.e., overestimated.

Table 3 presents the estimation results using two-step least squares estimation and GMM, taking into account the possibility of the endogeneity problem. The past figures of the Herfindahl index, specifically the values for 2016, are used as instrumental variables for the industrial structure of commercial districts. The estimation results of the first stage are shown in Table A1 in Appendix A, where it can be seen that the 2016 value of the Herfindahl index used as an instrumental variable is statistically significant in relation to the 2019 value. The results in Table 3 indicate that even after considering this endogeneity problem, external economies of scale in consumption are attributed to comparison shopping. In particular, Column (2) of Table 2, which did not account for endogeneity, may have slightly overestimated the role of comparison shopping as a cause of agglomeration economies in consumption.

Table 3. Empirical results of two-stage least square estimation and two-step GMM, where the endogeneity issue of the Herfindahl index is tackled by its past value as an instrumental variable.

	Dependent Variable: The Rate of Stores Closed in 2022 to Stores Open for Business in 2019	
	2SLS	**GMM**
Herfindahl index (94 categories)	−56.0251 **	−56.1317 **
	(−2.92)	(−2.93)
Density	1.2706 **	1.2711 **
	(9.61)	(9.62)
NE (number of establishments)	−0.0004 **	−0.0004 **
	(−2.64)	(−2.67)
Population (in 1000s)	0.0104 **	0.0103 **
	(2.84)	(2.82)
Share of population who are:		
20 to 35 years old	1.1461 **	1.1217 **
	(2.86)	(2.85)
36 to 50 years old	2.4697 **	2.4277 **
	(2.61)	(2.59)
51 to 65 years old	1.3164 **	1.2924 **
	(2.64)	(2.62)
66 to 80 years old	0.5122	0.4853
	(1.01)	(0.97)
at least 81 years old	0.2187	0.1999
	(0.26)	(0.24)
Constant	−66.2190	−63.6166
	(−1.39)	(−1.36)
Fixed effects		
Metropolitan areas or provinces	yes	yes
Adj. R-squared	0.3207	0.3206

Note: Huber−White's t-values are in parentheses. ** indicates statistical significance at 1%. The number of observations is 1164 commercial districts.

Table 4 shows the analysis results for nine industry categories and seven hundred and thirty-seven industry categories in defining the Herfindahl index. Since the industry classification was based on ninety-four industry categories in the previous tables, the estimated coefficients are different, but both cases show statistically significant negative values. In particular, regardless of industry classification, if a commercial district specializes in certain industries, it enables consumers to do comparison shopping, and increases the attractiveness of the commercial district. This is interpreted as relatively lowering the possibility of store closures in the commercial district during the era of recession due to COVID-19 for the whole society.

Table 4. Empirical results where the Herfindahl index is defined at different levels.

	Herfindahl Index is Defined at the Level of Following Categories:	
	9 Industry Categories	**737 Industry Categories**
Herfindahl index	−30.3769 **	−85.7422 **
	(−5.17)	(−4.36)
Density	1.3100 **	1.2298 **
	(10.10)	(9.11)
NE (number of establishments)	−0.0004 *	−0.0003 *
	(−2.55)	(−2.30)
Population (in 1000s)	0.0091 *	0.0101 **
	(2.43)	(2.70)
Share of population who are:		
20 to 35 years old	1.2975 **	0.9703 *
	(3.24)	(2.37)
36 to 50 years old	2.6161 **	2.2323 *
	(2.76)	(2.30)
51 to 65 years old	1.3557 **	1.1758 *
	(2.71)	(2.32)
66 to 80 years old	0.7038	0.3701
	(1.40)	(0.71)
at least 81 years old	0.2930	0.1605
	(0.34)	(0.19)
Constant	−70.6365	−51.7740
	(−1.48)	(−1.06)
Fixed effects		
Metropolitan areas or provinces	yes	yes
Adj. R-squared	0.3261	0.3225

Note: Huber−White's t-values are in parentheses. ** and * indicate statistical significance at 1% and 5%, respectively.

In summary, the empirical results of this paper find the existence of shopping externalities in Korea. However, they arise from comparison shopping among stores competing against each other, not from complementarity among stores dealing with similar products. In addition, results from 2SLS and GMM show that these shopping externalities are unlikely to be biased potentially from self-selection.

5. Discussion

This paper empirically analyzes the effect of the industrial structure of stores in commercial districts on the possibility of closure. The dependent variable is defined as the share of stores that have closed during the COVID-19 outbreak out of the total number of stores in the commercial district before the outbreak, indirectly reflecting the impact of COVID-19. The closure of stores in a commercial district is expected to be consistent to some extent over time as it is influenced by the characteristics of the commercial district. However, COVID-19 is interpreted as having a ripple effect that challenges this historical hypothesis by having an influence throughout society. In particular, due to the rapid infectivity of COVID-19, when an infection case occurred in a commercial district, strong administrative measures were taken to force stores within the travel route of the infected person to suspend business for a certain period of time, further exacerbating the business losses of stores.

Moreover, by mandating that those who come into contact with confirmed cases self-isolate for a certain period, their economic activities are also restricted. The government has provided subsidies to compensate for the business losses of stores and economic activity restrictions of those in contact with confirmed cases. Therefore, there is a need for a plan to make it relatively easy to distinguish whether store closures in a commercial district are due to a certain trend or due to the influence of COVID-19. For example, the following indicators for diagnosing the degree of activation of commercial districts could be introduced.

$Z_j = \sqrt{O_i} + \sqrt{O_i + 1} - \sqrt{4E_i + 1}$, where $O_j = closed_{j,2022}$ and $E_j = \frac{closed_{j,2019}}{active_{j,2016}} * active_{j,2019}$. O_j and E_j present observed values and expected values, respectively. This is a z-value using the Freeman−Tukey method [14]. The higher this value, the more store closures occur in 2022 compared to 2019. As a result of the estimation of $y_j = \alpha + \beta \cdot Z_j$, β shows an estimated value of 1.0024, which is statistically significant. In particular, R^2 is 0.4192, which means that 41.9% of the changes in the closure rate of stores in the commercial district are explained by the diagnostic index in the commercial district, which implies that at least half of all store closures fall under the influence of COVID-19.

6. Conclusions

6.1. Summary of Key Findings

COVID-19 has caused great damage throughout society due to its rapid spread. This paper empirically analyzes store closures in commercial districts and reveals how this damage differs depending on the industrial structure of the district. According to the analysis of 1164 commercial districts in Korea, the rate of store closures is relatively low in districts specialized in certain industries, indicating that the agglomeration economies in consumption are represented by comparison shopping rather than one-stop shopping. Additional analyses suggest that these results are relatively robust against endogeneity or industry classification.

6.2. Practical Implications

The emergence of an infectious disease, such as COVID-19 requires the government to take several quarantine measures to prevent its spread. However, by restricting economic activities, these measures can cause conflicts and confrontations between various classes in society with conflicting interests. Therefore, it is necessary to first clarify the differences in damage between classes according to quarantine measures, along with the scale of pure damage caused by infectious diseases.

The resilience of commercial districts is a big issue academically as well as from a policy point of view. Therefore, it would be worthy of analyzing under what circumstances the commercial districts recover quickly from COVID-19. Then, the government could use a subsidy as a policy tool to attract a specific-type of store to a commercial district and allow for comparison shopping to customers.

It is suggested that the local labor market where a commercial district is located contributes to mitigation of external shocks, such as COVID-19 to some extent. If there is more ease in job transfer between stores in a given commercial district from the reinforced link between the commercial district and local labor markets, store-specific idiosyncratic shocks which are unrelated with a business cycle would be more easily absorbed due to the employment flexibility in the local labor market. In addition, it would be vulnerable to infectious disease or fire when the stores in a commercial district are located very close to each other. Therefore, the physical and spatial structure of a commercial district is also important.

6.3. Limitations and Future Research Avenues

This paper analyzes big data by using data on the closure of individual stores at each point in time throughout Korea. However, due to data limitations, sales could not be analyzed. Since a decrease in sales would appear before the decision to close a business is made, more diverse analysis results and policy implications could be derived if sales data are included in future analyses.

COVID-19 has increased the use of online orders with delivery service. However, these changes would decrease the consumers' visit to stores in person, and thus agglomeration economies in consumption, such as comparison shopping and one-stop shopping would be less likely to occur. Consequently, it would be a next mission to measure the share of online orders with delivery service by industry, to calculate the ratio of stores in an industry to

those in the commercial district, and to estimate the negative effect of online orders with delivery service.

Author Contributions: Conceptualization, S.H.H.; methodology, S.H.H. and G.L.; formal analysis, S.H.H. and G.L.; investigation, G.L. and J.I.; resources, G.L.; data curation, S.H.H. and G.L.; writing—original draft preparation, S.H.H.; writing—review and editing, J.I. and G.L.; project administration, J.I. and G.L.; funding acquisition, G.L. All authors have read and agreed to the published version of the manuscript.

Funding: This work is supported by the Korea Agency for Infrastructure Technology Advancement (KAIA) grant funded by the Ministry of Land, Infrastructure and Transport (Grant RS-2022-00143336).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this paper are available upon request from the authors.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. First stage regression result of 2SLS and GMM.

	Dependent Variable: Herfindahl Index in 2019
Herfindahl index in 2016	0.4873 **
	(3.48)
Density	0.0006 *
	(2.03)
NE (number of establishments)	2.48×10^{-7}
	(0.69)
Population (in 1000s)	-9.28×10^{-6}
	(−0.98)
Share of population who are:	
20 to 35 years old	0.0013
	(1.22)
36 to 50 years old	0.0009
	(0.47)
51 to 65 years old	0.0016
	(1.29)
66 to 80 years old	0.0005
	(0.48)
at least 81 years old	−0.0002
	(−0.14)
Constant	−0.0545
	(−0.48)
Fixed effects	
Metropolitan areas or provinces	yes
Adj. R-squared	0.5019

Note: Huber−White's t-values are in parentheses. ** and * indicate statistical significance at 1% and 5%, respectively. The number of observations is 1164 commercial districts

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