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Pandemic and employment: Evidence from COVID-19 in South Korea

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\textbf{ABSTRACT}

Using two complementary approaches, this study examines the deterioration of the Korean labor market during the first 10 months of the global COVID-19 pandemic. Applying the synthetic control method, we first find that the COVID-19 outbreak has eliminated 1.1 million jobs (4.2\% of nonfarm employment) nationwide in April 2020. However, a difference-in-differences approach shows that local variation in COVID-19 intensity, which captures the “regional” effect of the pandemic, explains only 9\% of the national shock. The portion of the regional effect remains low until December. This is mainly because the nationwide fear and policies such as social distancing measures also have a “common” effect on local economies. Our findings suggest that the COVID-19 shock may last long in the labor market due to this common effect unless the risk of infection is completely eliminated.

\section{1. Introduction}

The relationship between public health and economic activity has long been of interest to researchers and policy makers. In general, health status affects labor market outcomes including employment and wages (for example, see Strauss & Thomas, 1998; García Gómez & López Nicolás, 2006; García-Gómez, Van Kippersluis, O’Donnell, & Van Doorslaer, 2013; Lenhart, 2019). In particular, a pandemic may have broader impacts on the labor market since infectious diseases such as the flu are easily spread across a large region affecting a substantial number of people.

In this paper, we examine the causal impact of the recent COVID-19 crisis on the labor market in South Korea using two different approaches that complement each other. In the first approach, we compare the year-on-year changes in employment with the counterfactuals constructed from the synthetic control method. This approach, by providing a synthetic counterfactual, allows us to accurately estimate the overall effect of the pandemic on the Korean labor market even without a valid control group for Korea. In the second approach, we exploit regional variation in intensity of COVID-19, which is measured by the number of confirmed cases relative to total local population in 2019 to understand changes in employment across 17 regions in response to the COVID-19 outbreak. By doing so, we measure the “regional” effect of COVID-19 on the local labor markets. The regional effect comes from local factors which capture the influence of confirmed cases in a certain region. In other words, the regional effect is associated with the direct risk of infections due to the number of confirmed patients in one’s residential area.

Our causal estimate of the overall employment loss between April 2019 and April 2020 in Korea using the first approach is
approximately 1.1 million workers (4.2% of nonfarm employment), and this employment loss is persistent until December 2020. In addition, temporarily laid-off employees have increased by 1.1 million (additional 4.2% of nonfarm employment) although this number has decreased significantly in December. However, the regional effects of COVID-19 estimated from the second approach for the same period correspond to only a decrease of 95,000 in the overall employment and an increase of 60,000 in the number of temporary layoffs. This suggests that the regional variation in the number of confirmed cases explains only 5–9% of the overall effect of COVID-19 during the pandemic’s early months. The portion of the regional effect remains low throughout the sample period.

Then, what would be the remaining portion out of the total employment loss? We argue that it arises from the “common” effect of the outbreak. This common effect represents the overall domestic and global factors that are likely to affect most regions. For example, the excessive number of confirmed cases in a specific region not only affects that region, but also other regions because of the movement of people and spread of fear into those regions. Moreover, nationwide policies such as social distancing measures are more likely to affect all regions of a country rather than a specific region. Lastly, the collapse of international trade also influences most areas, in particular regions with local manufacturing business. Therefore, it is possible that regional variation explains only a small portion of the negative effects of the pandemic. The traditional approach to evaluate the economic damages of an outbreak uses local information on deaths and illness to estimate its effect. In our view, however, this approach might underestimate the true effect. Thus, both the regional and the common factors should be considered together in understanding the overall impact of the global pandemic.

From the two approaches, we also find an important lesson regarding the effect of the pandemic on the labor market. The size of the regional effect is proportional to intensity of the virus. For example, when the pandemic peaked in March 2020 in Korea, the regional effect shows that approximately 13.7 employed persons lost jobs for every confirmed patient. However, this number decreased to 3 in August 2020 as the number of patients decreased significantly after mid-March. However, as the common effect explains most of the decrease in employment, the deterioration of the labor market has continued even in December. These findings suggest that the negative impact of COVID-19 will last for a long time unless the risk of infection completely disappears.

We also find significant heterogeneities in the impact of the outbreak across different groups of workers, although most groups have been affected. Among the 1.1 million job decrease in total nonfarm employment in April, almost 1 million job losses occurred in the service sector. In particular, wholesale, retail, food and lodging businesses or educational services were affected the strongest. In addition, job losses were heavily concentrated in temporary workers, female, and less educated workers. While the employment loss of these groups has been relieved over time, there is still significant job loss even in December 2020. For instance, in the service sector, 890,000 workers lost their jobs in December. Another noticeable phenomenon is the growing negative effect on the tradable sector. The negative impact on the manufacturing sector gets larger and resulted in 214,000 job loss in December.

Since the outbreak of COVID-19, there has been a fast-growing literature on the labor market impact of the pandemic. Coibion et al. (2020a) use a large-scale survey to measure how unemployment was affected and find that around 20 million people lost jobs in the U.S. by early April 2020. Using unemployment insurance data, Kahn, Lange, and Wiczer (2020) examine the deterioration in the labor market across industries and occupations. They find that the spike in unemployment insurance claims and contraction in job vacancies occurred nationwide regardless of the characteristics of industries and occupations. Béland, Brodeur, and Wright (2020) discuss the short-term impacts of COVID-19 on unemployment rates and wages at both the national and state level. They show that COVID-19 certainly increased the unemployment rate but had no significant effect on wages. Using weekly administrative payroll data, Cajner et al. (2020) find that U.S. private-sector employment declined by about 22% during the first two months of the COVID-19 pandemic.

Another branch of literature explores the impact of previous epidemics on the labor market. For example, Correia, Luck, and Verner (2020) exploit geographic variation across U.S. states to explore how the 1918 flu pandemic negatively affected economic activities. Karlsson, Nilsson, and Pichler (2014) also exploit variation in incidence rates across Swedish regions and find a significant increase in poorhouse rates but no discernible effect on earnings. Prior to the recent COVID-19 outbreak, Duarte, Kadiyala, Masters, and Powell (2017) estimate the effect of the 2009 influenza pandemic on missed days of work in Chile. On the other hand, Lee and Cho (2016) study the effect of the Middle East Respiratory Syndrome epidemic on the labor market in Korea and uncover that older workers have a higher probability of being unemployed in the face of an unprecedented disaster. However, the coronavirus crisis in 2020 cannot be simply compared with previous epidemics since it is declared as a global pandemic and is generating larger spillover effects within and across regions (Fernandes, 2020).

This paper contributes to the literature on the labor market consequences of the pandemic in the following ways. To our knowledge, this is the first study to analyze the national causal impact of the coronavirus crisis on the labor market in Korea using two complementary approaches. By applying the synthetic control method with historical data, we estimate counterfactuals of the Korean labor market. This approach could be used in analyzing the effect of the COVID-19 crisis in other countries in a timely manner. Additionally, unlike the previous literature that mostly documents the partial effect of the virus on labor market outcomes, this paper focuses on decomposing the overall effect into “regional” and “common” factors. Breaking down the channels through which COVID-19 affects the labor market will help predict further changes in employment amidst the crisis.

The rest of the paper is organized as follows. Section 2 explains the COVID-19 outbreak in Korea. Section 3 details data and identification strategies. Section 4 presents empirical results and Section 5 concludes.

2. COVID-19 outbreak in South Korea

Ever since the COVID-19 outbreak has started from Wuhan, China in December 2019, the virus continues to spread across the world. On March 11 2020, the World Health Organization declared COVID-19 as a global pandemic. Compared to other countries that have been severely infected by coronavirus, Korea is recognized to have swiftly taken actions in “flattening the infection curve.” To
contain the infection rate, Korea has carried out efficient contact tracing via credit card transactions, CCTV, GPS phone tracking, and most particularly, aggressive infection testing in the early stage. Due to early isolation and the free treatment of infected patients combined with widespread testing and digital technologies, Korea has managed the risk of the virus, without taking “lockdown” measures (Lee, Heo, & Seo, 2020). The containment strategy resulted in a very low cumulative infection rate of 140.3 per 100,000 population compared to other countries (France 4359.8; Germany 2426.6; Italy 3915.3; Japan 254.8; Mexico 1248.8; U.K. 4944.6; U.S. 7052.7) as of January 18 2021. Due to free prompt treatment of positive cases, the number of deaths per 100,000 population in Korea is 2.4 and is also far lower than other countries (France 106.8; Germany 55.4; Italy 135.2; Japan 3.5; Mexico 107.9; U.K. 130.5; U.S. 117.6). Currently more than 90% of all confirmed cases have fully recovered in Korea (Korea Disease Control and Prevention Agency).

Fig. 1 shows the cumulative COVID-19 infections over time in Korea. There were signs of an active phase of the pandemic, including an increase in the number of new cases and the spread of the disease across the country. During the early months, the cumulative number of confirmed cases peaked in March and has since decreased as the Korean government delayed the start of the school year on March 2 and implemented social distancing measures on March 22. Other peaks of confirmed cases were in late August and December, but those spikes were suppressed after two to four weeks of stronger social distancing. Policies targeted at coronavirus mitigation such as strict social distancing and aggressive mass testing seem to be successful in quickly controlling outbreaks. In contrast to the U.S. or other European countries, the Korean government does not impose significant restrictions on the movement of citizens. However, despite the timely interventions and relatively low infection rates, Korea is not immune to the negative labor market consequences of the pandemic. During the early stage of the COVID-19 outbreak, the economically active population decreased by 550,000 (1.9% year-on-year), and the number of employed persons went down by 476,000 (1.8% year-on-year) (Statistics Korea).

In response to the deterioration of the labor market, in mid-May, the Korean government initiated a stimulus payment program that provides up to KRW 1000,000 (USD 818 as of June 1) per household in order to stimulate consumption spending and catalyze the recovery of sales losses. This financial aid policy was unique in the sense that the government required the payment to be used only in the province of residence and in pre-specified sectors. For example, the payment was not to be used in online transactions or large-scale department stores and retailers. In addition, the stimulus payment must be used by the end of August 2020 (Kim, Koh, & Lyou, 2020).

Table 1 shows that the spread of COVID-19 as well as changes in employment has not been uniform across the country. Daegu, a metropolitan city in the Gyeongbuk province, had a significant number of infections in March due to a religious gathering of “Shincheonji,” a group the government describes as a cult. The number of confirmed cases in that area was 6684 in March and 6852 in April, and 68% and 64% of the total cases, respectively.

One noticeable finding from Table 1 is that the job losses are not necessarily higher in regions with the larger COVID-19 shock. In March, while the job loss in Daegu is certainly the largest, regions such as Incheon or Jeju show relatively large decreases in employment, compared to the small numbers of confirmed cases in those regions. Moreover, Sejong which ranked third in the size of the COVID-19 shock actually shows an increase in employment. This suggests that regional variation may not fully capture the total effect of the pandemic. Regions that largely depend on industries such as tourism may suffer more despite the relatively low risk of infections. Hence, we can suspect that the labor market effects of COVID-19 may be comprised of more complicated factors other than local factors. We will discuss this issue more in the following sections.

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1. The cumulative COVID-19 testing rates for Korea, Italy, Japan, Mexico, and United States for May are as follows: As of May 1 2020, Korea tested 12, Italy tested 23, Japan tested 1.2, Mexico tested 0.9, and the U.S. tested 22 people per thousand people. Sources: Our World in Data (https://ourworldindata.org/coronavirus-testing#testing-for-covid-19-background-the-our-world-in-data-covid-19-testing-dataset) and Korea Disease Control and Prevention Agency (http://ncov.mohw.go.kr/en/).
2. Every confirmed patient, even those with mild symptoms, gets isolated at hospitals or dormitories operated by the government without any treatment fee.
3. Source: Korea Disease Control and Prevention Agency.
4. The Ministry of Education in Korea delayed the spring semester for elementary, middle, and high school students, which usually starts at the beginning of March, to April 9. Universities were also postponed to March 23 to prevent crowding in campuses. Despite the postponing of on-site classes, 75% of all private, public and national four-year universities decided to continue with online lessons until the end of fall semester.
5. Korea has reported its largest daily increase in coronavirus infections with 1214 new cases late December and the country expanded its mass testing programs with stricter social distancing rules to slow the rate of transmissions.
6. Under this social distancing scheme, the second-highest in the nation’s five-tier system, gatherings with 50 or more people are prohibited, including a ban on private meetings of more than four people in the nation’s capital area, which covers Seoul, Incheon, and Gyeonggi Province. Restaurants must stop dine-in services after 9 p.m. while cafes are only allowed to serve takeout at all hours.
7. There are several studies investigating the impact of stimulus packages on consumption. For instance, Baker, Farrokhnia, Meyer, Pagel, and Yannelis (2020) and Coblin, Gorodnichenko, & Weber (2020b) estimate the effect of the U.S. CARES Act on households’ spending responses. They find that households, especially with lower incomes, respond rapidly to the receipt of stimulus payments, but the marginal propensity to consume is lower compared to 2001 and 2008 experiences in the U.S. Chetty, Friedman, Hendren, and Stepner (2020) show that the stimulus payments increased consumer spending, particularly among low-income households, but had modest impacts on employment in the short run.
8. There is no policy variation across regions in Korea. All policies including social distancing measures and school closures are nationwide.
Fig. 1. Size of COVID-19 outbreak. Note: The data are obtained from the Korea Centers for Disease Control and Prevention (KCDC).

Table 1
Regional distribution of employment loss and COVID-19 intensity.

| City         | Mar 2019 – Mar 2020 Employment (%Δ) | Aug 2019 – Aug 2020 COVID-19 intensity | Dec 2019 – Dec 2020 COVID-19 intensity |
|--------------|-------------------------------------|----------------------------------------|----------------------------------------|
| Daegu        | -7.4%                               | -2.2%                                  | -0.7%                                  |
| Gyeongbuk    | -1.6%                               | 0.247                                  | 0.303                                  |
| Sejong       | 6.6%                                | 0.043                                  | 0.070                                  |
| Chungnam     | -3.8%                               | 0.011                                  | 0.054                                  |
| Busan        | -1.0%                               | 0.003                                  | 0.038                                  |
| Seoul        | 0.7%                                | 0.003                                  | 0.130                                  |
| Gyeongnam    | -1.7%                               | 0.003                                  | 0.026                                  |
| Ulsan        | -1.1%                               | 0.002                                  | 0.042                                  |
| Chungbuk     | 1.7%                                | 0.002                                  | 0.036                                  |
| Gangwon      | -0.3%                               | 0.002                                  | 0.054                                  |
| Gyeonggi     | 0.0%                                | 0.002                                  | 0.077                                  |
| Daejeon      | 0.9%                                | 0.001                                  | 0.045                                  |
| Gwangju      | -1.2%                               | 0.001                                  | 0.057                                  |
| Incheon      | -1.9%                               | 0.001                                  | 0.065                                  |
| Jeju         | -1.3%                               | 0.001                                  | 0.019                                  |
| Jeonbuk      | -0.4%                               | 0.000                                  | 0.029                                  |
| Jeonnam      | -0.7%                               | 0.000                                  | 0.026                                  |

Note: COVID-19 intensity is the number of confirmed cases per 100,000 population. The data are obtained from the EAPS.
3. Data and empirical framework

3.1. Historical series as potential controls

To estimate the overall labor market effects of the COVID-19 pandemic, we mainly use the Economically Active Population Survey (EAPS) data, a monthly survey of 35,000 households from Statistics Korea, and measure the labor market conditions of Korea before and after the outbreak. This household-level survey is comparable to the Current Population Survey in the U.S. Specifically, the EAPS provides detailed information on the Korean labor market such as employment by industry, worker status, characteristics, and region. For every month, its reference period is one week (seven days, Sunday to Saturday) which includes the 15th of the month.

Using the EAPS data, we employ the synthetic control method to analyze how the COVID-19 pandemic has affected the labor market in Korea. The synthetic control method was first developed by Abadie and Gardeazabal (2003) and is widely used in analyzing a case where only one unit is affected by an event or policy intervention. For example, Abadie, Diamond, and Hainmueller (2010) study the effects of Proposition 99, a large-scale tobacco control program that California implemented in 1988. In our context, the method essentially reproduces the counterfactual of the Korean labor market in the absence of the COVID-19 outbreak.

To construct counterfactuals of the labor market in Korea, we combine multiple historical series of the year-on-year changes in employment with the goal of matching trends similar to the actual pre-trends right before the COVID-19 outbreak. Specifically, we include the historical series of the year-on-year changes in employment during 2005–2019 in the donor pool. Then, the method provides a synthetic counterfactual that is a weighted average of the historical series, where the weights are selected to ensure that the “synthetic” year-on-year changes closely follow the “actual” year-on-year changes. As the first confirmed case in Korea appeared on January 20, 2020, we use data until January 2020 in matching the pre-trends of the outcome variable. For the matching variables, we use the year-on-year changes in employment by industry, educational attainment, and worker status (i.e., whether they are self-employed or temporary workers). Finally, we compare the actual year-on-year changes with the counterfactuals, and the differences between them for the post period are the difference-in-differences (DID) estimates of the COVID-19 pandemic.

The synthetic control method using historical data as a potential counterfactual is particularly helpful in estimating the nationwide effect of the pandemic. In the standard DID framework, other countries or regions are usually used as a control group. However, countries rarely share consistent definitions of labor market characteristics, and information from survey data is not directly comparable. More importantly, the COVID-19 pandemic has affected almost all countries, and thus any country cannot be used as a control group. On the contrary, by using variation in historical employment trends, our synthetic counterfactual framework allows us to reasonably estimate the effects of the COVID-19 outbreak, even without valid control regions.

3.2. Exploiting regional variation

To better understand how the pandemic affects the labor market in Korea, we also exploit the regional variation of the confirmed cases (relative to pre-period population). The data on the number of cases across 17 regions in Korea are obtained from the Korea Centers for Disease Control and Prevention (KCDC). Specifically, we estimate the following equation:

$$\frac{\Delta \text{Emp}_r}{\text{Pop}_r, 2019} = \alpha + \beta \frac{\text{COVID19}_r}{\text{Pop}_r, 2019} + \gamma X_r + \epsilon_r, \quad (1)$$

where $\Delta \text{Emp}_r/\text{Pop}_r, 2019$ is the change in employment of region $r$ during 2019–2020 relative to the population in 2019, and $\text{COVID19}_r/\text{Pop}_r, 2019$ is the (cumulative) number of confirmed cases relative to the population in 2019. The term $X_r$ is the predetermined control variables including the log of population, Seoul capital area dummy, and the share of manufacturing workers by region. Finally, $\epsilon_r$ is the mean-zero error term. Regressions are weighted by population and standard errors are heteroscedasticity-robust. This equation can be viewed as a DID regression with the term $\text{COVID19}_r/\text{Pop}_r, 2019$ being treatment intensity.

The assumption of this regression is that the occurrence of confirmed cases is random across regions. In other words, the intensity of
the COVID-19 pandemic should not be correlated with unobservable characteristics of regions. Although this assumption is certainly strong, it would not introduce a significant bias because the occurrence of COVID-19 across regions in Korea for the first six months is fairly random, especially due to the outbreak in Daegu. To support this, in Appendix Table A2, we document that the number of confirmed cases is not significantly correlated with other important regional characteristics such as population size or in-migration rate. Under this assumption, the coefficient $\beta$ in Eq. (1) measures the number of jobs lost in a region as a result of one more confirmed case in that region. We estimate Eq. (1) for every month and compare how the estimates vary over time.

However, this approach might underestimate the true effect since exploiting regional variation may only capture the direct effect of the COVID-19 shock. The implicit assumption of Eq. (1) is that the confirmed cases in a region only affect employment in that region. However, this assumption may not hold. For example, the rapid COVID-19 infections in Daegu due to a religious group could increase the fear of people in other regions, and thus negatively affect the labor market on a national scale. Moreover, the effect of the nationwide social distancing and self-quarantine of the confirmed infected may not be fully captured by the regional variation. While the effect is certainly larger in strongly-hit areas, there will likely be spillovers to other regions, particularly within a country. For this reason, we call the estimates from Eq. (1) as the “regional” effect and the difference between the overall effect and the regional effect as the “common” effect.

4. Results

4.1. Overall effect of COVID-19

Before we show results using the synthetic control method, we present a simple event study result using the year-on-year changes in nonfarm employment for 2019 and 2020. We set January 2020 as a reference month. Fig. 2 clearly shows that overall nonfarm employment has decreased significantly since the outbreak of COVID-19, although the estimates are not close to zero for some pre-periods. Specifically, after 3 months of January 2020, about 1.3 million jobs were lost, and the job loss reached to almost 1.8 million after 11 months. We will compare these numbers with those using the synthetic control method.

Fig. 3 describes the year-on-year changes in employment and other labor market outcomes since the COVID-19 outbreak by plotting the actual series (solid line) and the counterfactuals (dashed line) for the period between January 2019 and December 2020. The dashed vertical line represents the outbreak month, which is February 2020. For most cases, the constructed counterfactuals using the synthetic control method reasonably follow the actual series of the outcome variables until the outbreak month, although small deviations are found in some outcomes. As the trends show similar patterns for the pre-period, we examine whether large differences in outcomes suddenly arise after the outbreak.

The overall results in Fig. 3 suggest that the COVID-19 outbreak negatively affects Korean labor market. In the absence of an employment shock generated by COVID-19, the number of employed persons in March is estimated to have increased by about 538,000 year-on-year based on the synthetic control method. However, in contrast to this counterfactual scenario, the number of employed persons decreased by 330,000. Therefore, the causal estimate of overall employment loss is 868,000, which corresponds to 3.2% of the entire number of employed persons in March. This number is slightly smaller than that of Fig. 2. This suggests that the results from the simple event study is upward biased. This is possibly because the labor market in Korea in 2019 did not perform well due to other reasons. In April, this negative effect on overall employment seems to have worsened: the number of employed persons decreased by 1.1 million. After April, the negative employment effect gradually decreased, although overall employment has not recovered yet in December. There was another sharp drop in December as the daily number of infections rose to more than one thousand. The increase in employment after June might be due to the stimulus payment program initiated by the Korean government. However, the effect of the program on overall employment might be limited as the government restricted the use of stimulus payments (Kim et al., 2020). In particular, payments should be spent in the province of residence and in the pre-specified sectors excluding online transactions, department stores, and large retailers.

Fig. 3 also presents a salient decrease in weekly hours worked: during March and April hours worked decreased by 2.3 and 5.7 hours, respectively. However, hours worked have recovered relatively quickly and reached its counterfactual level in July, although they have decreased by around two hours per week since then. This result suggests that labor market adjustments occur at both the extensive and intensive margin, but the effect on the extensive margin is greater and persistent longer. In addition, the number of temporarily laid-off employees increased by 1.26 million in March, but it has gradually decreased until August as the number of newly-confirmed cases significantly decreased. The number of temporarily laid-off employees has increased again due to the explosive surge in infections in December. On the other hand, economically inactive population rapidly increased during the first two months of the pandemic and remain high until December.

In one sense, the spike of temporarily laid-off employees in March can be explained by Korea’s unique “Employment Retention Subsidy” policy. The Ministry of Employment and Labor provides support subsidy to employers who find it inevitable to adjust employment and thus implement employment retention measures such as paid leave or suspension. Such government subsidy aims to

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15 After a COVID-19 infected member attended a religious gathering of “Shincheonji” sect in Daegu, the number of cases in Korea had exploded.

16 The Korean government implemented a nationwide stimulus payment program in mid-May 2020. A single household received the payment of KRW 400,000 and the amount increased by KRW 200,000 with additional household member, up to maximum KRW 1000,000 (USD 818) per household.

17 Chetty et al. (2020) also show that loans to small businesses have little impact on employment rates.
reduce the management burden of employers and prevents workers from losing their jobs. Unlike the U.S., Korea puts more priority on maintaining employment in times of crisis rather than paying unemployment benefits after job dismissals. Such differences could possibly explain the sharp increase of workers on temporary leave.

All sectors have been affected by the outbreak. However, the consequences of COVID-19 are not equally distributed throughout the economy as well as over time. In the beginning, employment declines were larger in the service industry than in the manufacturing industry. Specifically, in April, around 990,000 job losses occurred in the service sector while the manufacturing sector observed the decline of 78,000. However, the impact of the COVID-19 outbreak shows different patterns for the two industries throughout the period. While the negative effect in the service industry has gradually decreased until November, that in the manufacturing industry gets larger or remains. This could reflect a decrease in the global demand for manufacturing products. We will discuss this difference between industries in more detail in the next section.

Among the service industry, wholesale, retail, hotels, and restaurants particularly have experienced the biggest shock, followed by educational services: the numbers of decreased employed persons in wholesale, retail, food and lodging businesses were 375,000 and in educational services 147,000, respectively, in April as shown in Fig. 4. Those sectors have not recovered to the counterfactual levels. Wholesale, retail, hotels, and restaurants disproportionately employ lower-wage workers, and thus the shock is likely to disproportionately affect the most vulnerable workers. The employment declines in these sectors seem to be mostly due to the social distancing measures and school closures by the government.

By employment type, job losses were heavily concentrated among temporary workers compared to regular workers. Fig. 4 shows that if the situation were normal, there would have been decreases of 43,000 and 93,000 for temporary and daily workers in April, respectively. In reality, they decreased sharply by about 587,000 and 195,000 although the number of daily workers quickly went back to its normal level in June. The numbers of both temporary and daily workers seem to have recovered by November, but they sharply declined again with the coronavirus resurgence.

Fig. 4 also shows that employment patterns are different by gender and age. The declines in employment were slightly larger for women when compared to men: 293,000 for women (4.5%) and 183,000 for men (2.5%) in April. This finding is possibly due to the fact that women, relative to men, are more likely to be employed in the service sector and potentially more involved in child care, although other explanations are also possible. Furthermore, younger people aged 15–29 seem to have suffered more from the pandemic than older counterparts aged over 50. Younger workers saw an employment decline of 246,000 (7.5%) while older workers experienced a smaller decline of 131,000 (3.1%) in April. Moreover, the negative effect on younger workers seems to persist throughout the period, compared to that on older workers: older workers’ employment has almost recovered to the normal level in August, although it declined again in December. Younger workers are concentrated in industries that were hit severely by the pandemic such as leisure and hospitality activities, and as a result, they are more likely to remain unemployed. These findings are consistent with the idea that the coronavirus is virulent enough to affect not only industries but also individuals that otherwise would not have been sick.

We also examine the robustness of the significant employment effects of COVID-19 by running a placebo test of setting the treatment month as December 2019 (instead of February 2020) in applying the synthetic control method. If the estimated effects in Figs. 3 and 4 are indeed from the COVID-19 outbreak, the deviation of the actual series from the counterfactual series should occur after February 2020. Fig. 5 shows the results from this placebo test. Each figure corresponds to one in Fig. 3. Reassuringly, the negative

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18 In December employment in the service sector sharply decreased again due to the surge in new cases.

19 Because of school and daycare center closure, school-aged or younger children have to stay at home; all elementary, middle, and high schools have transited to online classes since April 2020.
Fig. 3. Overall labor market effects of COVID-19. Note: The counterfactuals are obtained using the synthetic control method by including the historical series of the year-on-year changes in the donor pool. The dashed vertical line represents the treatment month. The outcomes are expressed in 1,000 persons except for working hours which are in hours. The data are obtained from the Economically Active Population Survey (EAPS).
effects are found months after February 2020. Thus, we confirm that our estimated effects are not spuriously driven by other confounding shocks.

Finally, we investigate the channels of the decrease in employed persons after COVID-19, using the unique information on self-reported reasons of job loss. The Regional Employment Survey of Korea (2015–2020) provides information on reasons of job changing. For people who lost jobs during February and April for each year, we gather this information and standardize each category’s number to 100 in 2015. Fig. 6 clearly shows that the number of not-employed (unemployed and not in the labor force) people increased in 2020. In particular, the number increased mainly due to layoffs and business slowdown. Although somewhat smaller than those two main reasons, business closure also plays a significant role. Since this finding is based on the relatively early period of COVID-19 (April 2020), we expect that job loss due to business closure would increase more. These results suggest that the employment loss could last longer, as the significant portion of the loss is from business closure.

4.2. Regional effect of COVID-19

In this section, we use regional distribution of confirmed cases to estimate the direct causal effect of COVID-19 on local employment, given the exogenous nature of the variation in confirmed infections by region. As shown in Eq. (1), \( \beta \) represents the change in the number of employed persons per confirmed patient. Column (1) in Panel A of Table 2 shows that in March, an additional confirmed case in a region decreased nonfarm employment by 13.68 in that region. In other words, the analysis on the local level shows that one confirmed case of the coronavirus infection reduces about 13.7 local jobs. On March 15th, the total number of confirmed cases was 8162 and multiplying this by the estimated \( \beta \) we get 111,656. Thus, approximately 111,660 jobs were lost due to the local factor in March, accounting for 12.9% of the total job loss of 868,000. The negative effect decreased gradually over time as the number of new confirmed cases decreased significantly. For example, while the estimate is –9.30 in April, it becomes –1.832 and insignificant in December. Regional variation also negatively affects working hours (column (2)) with a decreasing trend over time. In August, the effect on working hours becomes insignificant.

This analysis also shows that regional factors have a relatively larger impact on service sector workers compared to those in the manufacturing sector in the short run, which is in line with the finding in the previous section: the effect on service employment is more than double that on manufacturing employment during the pandemic’s early months (columns (3) and (4) of Table 2). For example, an additional confirmed case in a region reduced about 9.9 local jobs in the service sector while it decreased 3.5 jobs in the manufacturing sector in March. However, the estimates on the two sectors show very different patterns over time. While the negative effect on the service sector has gradually decreased, that on the manufacturing sector seems to be proportional to the national number of isolated patients in Fig. 1. As a result, in August, the negative impact on manufacturing employment gets larger than that on service employment. Jobs in the manufacturing sector do not recover easily once they disappear. For example, an additional confirmed patient in a region reduced almost 3 local jobs until November.

Relatively low-skilled workers such as high school graduates and daily or temporary workers have suffered more from the pandemic than high-skilled workers such as college graduates and regular workers (columns (5) and (6) of Table 2). Not surprisingly, the less educated and temporary workers are likely to be hired at accommodations and food service industries which have been hit hardest, as people avoided contact-intensive services. The self-employed also seem to suffer from the epidemic and their employment has not recovered yet in December as shown in column (8). In December, an additional confirmed patient in a region reduced 6.9 self-employed workers.

4.3. Common effect of COVID-19

We next decompose the cause of the employment contraction into two effects: the regional effect and the common effect. The regional effect is mainly driven by local factors while the common effect is channeled through general factors that affect all regions. These general factors may include an overall decrease in social gathering resulting from social distancing measures by the government or fear of infection as the contagious disease travels between geographical regions in the midst of the pandemic. The regional effect captures the impact of a sharp increase of confirmed COVID-19 cases in specific regions as shown in the previous section. For example, a sudden surge of confirmed infections in Daegu, which was mostly due to members of a mega church, brought a sharp contraction in the labor market. Hence, the regional effect of COVID-19 can be traced back to factors attributed to local channels.

Complementing this effect, the common effect captures the rest of the overall spillover of COVID-19 on labor market outcomes. In response to the global pandemic, the Korean government has recommended social distancing and urged citizens to restrict their social gathering including religious gathering in all regions. Such policies were not restricted to a specific region and have thus affected overall labor supply and demand. In addition, it is hard to imagine that the nationwide fear of infection hits only specific regions. For example, the mass infection in Daegu has affected other regions of the country, and the fear of infection itself has restrained many citizens from going outside altogether. The common effect also includes the decline in international trade due to the global pandemic, which could bring significant negative effects on employment in the manufacturing sector.

\footnote{The government’s call for strict social distancing has made religious groups suspend all services and gatherings in Korea. The government announced that it would take legal actions against several Protestant churches for violating the government’s guidelines for preventing the massive spread of the coronavirus.}

\footnote{In this study, we do not separate regional fear from the overall fear of infection.}
Fig. 4. Overall effects of COVID-19 on sub-groups. Note: The counterfactuals are obtained using the synthetic control method by including the historical series of the year-on-year changes in the donor pool. The dashed vertical line represents the treatment month. The outcomes are expressed in 1000 persons. The data are obtained from the Economically Active Population Survey (EAPS).
Our estimates of the causal effects in Table 2 allow us to calculate how many jobs were destroyed solely due to the common effect as shown in Fig. 7. For example, in April, the decrease in the number of employed people due to the common factors is about 987,000, which is 91% of the total decrease. This portion of the common effect increases to 94% in December. Although those portions fluctuate over time, the common effect is far greater than the regional effect. The common effect ranges from 87% to 95% during the sample period. In particular, in the service industry, the common effect of COVID-19 on employment is 93.4%, while in the manufacturing...
Fig. 6. Reasons for not employed. Note: This figure describes the trends in not-employed (unemployed and not in the labor force) people by reason for the period 2015–2020. The samples are restricted to those who lost jobs during February and April for each year. The numbers in each category are standardized to 100 in 2015. The data are obtained from the Regional Employment Survey 2015–2020.

Table 2
Regional effects of COVID-19 (selected months).

|                  | (1) Nonfarm employment | (2) Working hours | (3) Service employment | (4) Manufacturing employment | (5) High school graduates | (6) Daily/Temporary workers | (7) Youth (Age 15–29) | (8) Self-employed |
|------------------|------------------------|-------------------|------------------------|------------------------------|--------------------------|----------------------------|----------------------|------------------|
| **Panel A: March 2020** |                        |                   |                        |                              |                          |                            |                      |                  |
| COVID19, \( r_{Pop, 2019} \) | -13.681 ***          | -0.739 ***        | -9.924 ***             | -3.489 **                    | -16.192 ***              | -9.530 **                 | -2.479 **            | -6.737 ***       |
| \( r_{Pop, 2019} \)     | (1.970)                | (0.085)            | (1.761)                | (1.563)                      | (2.183)                  | (1.485)                   | (0.960)              | (1.911)          |
| **Panel B: April 2020**  |                        |                   |                        |                              |                          |                            |                      |                  |
| COVID19, \( r_{Pop, 2019} \) | -9.303 ***            | -0.332 **         | -6.362 ***             | -2.983 *                     | -13.279 ***              | -7.328 ***                | -1.889 **            | -6.811 ***       |
| \( r_{Pop, 2019} \)     | (1.644)                | (0.132)            | (1.164)                | (1.533)                      | (1.890)                  | (1.286)                   | (0.670)              | (2.068)          |
| **Panel C: May 2020**    |                        |                   |                        |                              |                          |                            |                      |                  |
| COVID19, \( r_{Pop, 2019} \) | -5.574 **             | -0.303 **         | -2.842 **              | -2.877 **                    | -12.489 ***              | -4.468 ***                | -0.497               | -7.542 ***       |
| \( r_{Pop, 2019} \)     | (1.836)                | (0.120)            | (1.236)                | (1.274)                      | (2.061)                  | (1.461)                   | (0.756)              | (2.295)          |
| **Panel D: August 2020** |                        |                   |                        |                              |                          |                            |                      |                  |
| COVID19, \( r_{Pop, 2019} \) | -2.982 **             | -0.115            | -0.401                 | -2.979 *                     | -10.687 ***              | -3.527 **                 | 0.836                | -9.193 ***       |
| \( r_{Pop, 2019} \)     | (1.228)                | (0.108)            | (1.275)                | (1.505)                      | (1.873)                  | (1.239)                   | (0.609)              | (2.251)          |
| **Panel E: September 2020**|                        |                   |                        |                              |                          |                            |                      |                  |
| COVID19, \( r_{Pop, 2019} \) | -2.448                | -0.158            | 0.352                  | -2.929 *                     | -10.961 ***              | -3.799 *                  | 0.132                | -8.491 ***       |
| \( r_{Pop, 2019} \)     | (1.418)                | (0.103)            | (1.633)                | (1.477)                      | (1.962)                  | (1.829)                   | (0.658)              | (2.191)          |
| **Panel F: December 2020**|                        |                   |                        |                              |                          |                            |                      |                  |
| COVID19, \( r_{Pop, 2019} \) | -1.832                | 0.085             | 0.457                  | -2.300                       | -8.964 ***               | -4.466 *                  | -0.289               | -6.900 ***       |
| \( r_{Pop, 2019} \)     | (2.406)                | (0.062)            | (2.172)                | (1.400)                      | (2.486)                  | (2.484)                   | (0.884)              | (2.670)          |
| N                 | 17                     | 17                | 17                     | 17                           | 17                       | 17                        | 17                   | 17               |

Note: The estimates are from Eq. (1). The coefficients can be interpreted as the number of jobs lost in a region as a result of one more (cumulative) confirmed case. The data are obtained from the EAPS.

*** p < 0.01.
** p < 0.05.
* p < 0.1.
sector it is 61% in April. The two industries show different patterns in the composition of the regional and common effects over time. The total decrease of the service sector is almost entirely explained by the common effect in the pandemic’s later months. On the other hand, in the manufacturing sector, both the regional and common effects play significant roles throughout the period, although the common effect is greater. This could reflect the collapse of international trade during the COVID-19 pandemic.

For younger people aged 15–29, the common effect of COVID-19 is around 93% in April and it has gradually increased over time as their employment loss has not recovered until December. As most of the decrease in the number of employed people is due to the common channel, there is limited capacity to restore employment through policies targeting specific regions. Those policies may not be effective when economic activity is constrained by fear of infection in the midst of the pandemic. Thus, the impact of COVID-19 is expected to continue for a while even if confirmed cases decrease, unless health concerns are fundamentally eliminated.

5. Conclusion

The COVID-19 pandemic has presented unprecedented shocks devastating both national and household economies. The resulting income losses from layoffs have reduced the demand for many goods and services nationwide. Policy makers need more accurate information to draw policy-relevant lessons from the COVID-19 crisis. Exploiting the fact that the virus arrived unexpectedly, this study regards the COVID-19 outbreak as a natural experiment for investigating the effect of the pandemic on labor market outcomes in Korea.

Fig. 7. Regional and common effects of COVID-19. Note: The regional effects are estimated using the Eq. (1). The total effects indicate the difference between the actual data and the counterfactuals in Fig. 2. The dashed vertical line represents the placebo treatment month. The outcomes are expressed in 1000 persons. The data are obtained from the EAPS.
All sectors have been affected by the COVID-19 outbreak. However, the consequences of COVID-19 are not equally distributed throughout the economy. In the early stage of COVID-19, employment declines were larger in the service industry than the manufacturing industry. In particular, losses are concentrated in the wholesale, retail, accommodation, food, and education industries. Employment in the manufacturing industry has also gradually declined throughout the sample period. The pandemic affected younger people to a greater degree and less educated workers lost disproportionately more jobs. After the outbreak, there have been noticeable increases in temporarily laid-off employees and economically inactive population when compared to a counterfactual scenario assuming the absence of the pandemic. The negative effects of the COVID-19 is still ongoing even though Korea has successfully managed the coronavirus.

This study can be used to design more optimal policies to combat economic stresses. Our work complements previous and on-going research by analyzing the impact of COVID-19 on the labor market in the context of Korea by decomposing the overall impact into regional and common effects. The regional effect of the pandemic is mainly due to exogenous local variation in COVID-19 exposure, while the common effect mainly comes from social distancing imposed by the government or fear of infection beyond regions. As the common effect is far greater than the regional effect, policies targeting specific regions with lots of confirmed patients, such as providing subsidies to those regions, might not be effective in relieving the negative labor market effect of COVID-19. Those policies may be blunted when economic activity is constrained by health concerns. Rather, reducing the overall fear of infection by taking nationwide preventive measures against the infectious disease or rapidly supplying COVID-19 vaccines could be more effective in the long run. That is, long-term solutions lie in addressing virus itself and promoting public health efforts.

**Data availability**

Data will be made available on request.

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**Appendix**

See Appendix Tables A1 and A2.

### Table A1

| Outcome variables     | Years used in making the synthetic control (%) |
|-----------------------|-----------------------------------------------|
| **Nonfarm employment**| 2009–2010: 33.5                              |
|                       | 2010–2011: 42.2                               |
|                       | 2013–2014: 24.3                               |
| **Working hours**     | 2005–2006: 2.2                                |
|                       | 2006–2007: 14.0                               |
|                       | 2008–2009: 12.8                               |
|                       | 2010–2011: 17.0                               |
|                       | 2016–2017: 54.0                               |
| **Service employment**| 2010–2011: 32.9                               |
|                       | 2011–2012: 39.6                               |
|                       | 2013–2014: 9.5                                |
|                       | 2016–2017: 18.0                               |
| **Manufacturing employment**| 2006–2007: 27.4                           |
|                        | 2009–2010: 40.2                               |
|                        | 2016–2017: 11.7                               |
|                        | 2017–2018: 20.7                               |

Note: This table describes what years are used in constructing synthetic controls for selected outcomes.
Table A2
Correlation between number of confirmed cases and regional characteristics.

|                      | COVID19, Pop, 2019 | COVID19, Pop, 2019 | COVID19, Pop, 2019 | COVID19, Pop, 2019 | COVID19, Pop, 2019 | COVID19, Pop, 2019 |
|----------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Log Population       | -0.0001 (0.0001)   |                    |                    |                    |                    | 0.0001 (0.0001)    |
| In-migration rate    |                    | -0.0068 (0.0057)   |                    |                    |                    | -0.0038 (0.0047)   |
| Greater Seoul Area   |                    |                    | -0.0003 (0.0002)   |                    |                    | -0.0004 (0.0005)   |
| Share of Manufacturing|                    |                    |                    | 0.0001 (0.0005)    |                    | 0.0000 (0.0006)    |
| Share of College Graduates |              |                    |                    |                    | 0.0002 (0.0005)    | 0.0013 (0.0014)    |
| R²                   | 0.0319             | 0.0367             | 0.0703             | 0.0003             | 0.0020             | 0.1235             |
| N                    | 17                 | 17                 | 17                 | 17                 | 17                 | 17                 |

Note: The data for average number of cases are obtained from the KCDC. ***p < 0.01, **p < 0.05, *p < 0.1.

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