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ABSTRACT

This study investigates the effects of a third-party certification policy for restaurants (including bars) that comply with indoor infection prevention measures on COVID-19 cases and economic activities. We focus on the case of Yamanashi Prefecture in Japan, which introduced a third-party certification policy that accredits facilities, predominantly restaurants, that comply with the designated guidelines. We employ a difference-in-differences design for each of our epidemiological and economic analyses. The estimation results show that, from July 2020 to April 2021, the certification policy reduced the total number of new infection cases by approximately 45.3% (848 cases) while increasing total sales and the number of customers per restaurant by approximately 12.8% (3.21 million Japanese yen or $30,000) and 30.3% (2,909 customers), respectively, compared to the non-intervention scenarios. The results suggest that a third-party certification policy can be an effective policy to mitigate the trade-off between economic activities and infection prevention during a pandemic, especially when effective vaccines are not widely available.

Introduction

During the COVID-19 pandemic, national and regional governments have introduced various types of non-pharmaceutical interventions to prevent its spread. A common intervention is to place operating restrictions, if not completely shut down, on restaurants as eating and drinking indoors are associated with high risks of COVID-19 transmission [1][2][3][4][5][6]. With consumers also cautious about dining out, food and beverage (F&B) has been one of the hardest hit industries [7][8][9][10].

To mitigate the sharp trade-off between infection prevention and economic activities, some governments have implemented measures to reduce the likelihood of COVID-19 transmission in physical interactions instead of eliminating interactions entirely. One example is introducing indoor infectious disease control guidelines. Through complying with guidelines on ventilation, disinfection, mask-wearing, social distancing, restaurants can continue operations while minimizing transmission risks in their premises. In Japan, prefectural governments have established third-party certification policies to recognize businesses that comply with designated COVID-19 safety measures. Prior research has demonstrated the effectiveness of relevant interventions, such as mask-wearing, regular ventilation, distancing seats sufficiently, and setting maximum occupancy load limits, in preventing infection [3][11][12][13]. It has also been shown that restaurants' economic performance can be improved through signaling their safety [14][15]. However, few studies empirically examined the effect of a third-party certification policy on the number of new cases and business revenues. We fill in this gap by assessing the impact of a third-party COVID-19 safety certification policy for restaurants on the number of new infections and restaurant revenues, taking up the case of Yamanashi Prefecture in Japan.

In May 2020, Yamanashi Prefecture introduced the Yamanashi Green Zone Certification (GZ), a third-party certification policy for infection prevention measures. The purpose of this policy is to allow consumers to patronize businesses with peace of mind by officially certifying restaurants (including bars), hotels, wineries, breweries, and other businesses that comply with infection control guidelines [16][17]. Certification is conditional on passing a rigorous on-site inspection. Once a violation is found, the certification may be revoked. Certified businesses are generally exempted from the prefectural government's requests to close or shorten hours. In the unlikely event that such a request is necessary, they are given priority in receiving financial assistance. The number of GZ-certified restaurants has increased gradually since the first approvals on July 17, 2020. As of April 30, 2021, more than 4,000 restaurants in Yamanashi were certified, and the acquisition rate was around 96% [18] (see Supplementary Information Fig. C.2).

Many prefectures introduced similar policies later, but they are not as strict as that of Yamanashi. For example, some prefectures, including Tokyo, have provided stickers to businesses that declared to comply with infection prevention guidelines, but the accreditation only required their self-reporting documents [19]. Other prefectures, such as Gunma and Tottori, introduced a certification policy with both accreditation requirements and introduction timing similar to the GZ certification policy, but their area-wide accreditation rates remain considerably low (i.e., around 20% for Gunma as of October 2021 [20]) (see Supplementary Information E.2).

We hypothesize that the GZ certification policy had positive effects on both decreasing the number of new infection cases and increasing restaurant revenues in Yamanashi Prefecture during the COVID-19 pandemic. This expectation is based on the first-hand evidence that infection cases and economic damage to restaurants in the prefecture seem to be under control compared to neighboring prefectures after the introduction of the certification policy (see Fig. 1 for the geographical location and Figs. 2, 3, and 4 for time-series graphs).

In our study, we separately evaluate the epidemiological and economic effects of the GZ certification policy by using a difference-in-differences design, exploiting the incremental introduction of the certification. The epidemiological model analyzes the effect of an increase in the number of certified restaurants on the rate of change in the number of new COVID-19 cases. Incorporating the susceptible-infectious-recovered (SIR) model [21], our model captures the number of both susceptible and infected populations in a given time period to account for the area's infection status. To evaluate the economic effect, we analyze the effect of an increase in the number of certified restaurants on the average daily restaurant POS transactions and customers in the prefecture.

Results

The GZ certification policy considerably decreased the number of new COVID-19 cases and increased restaurants' sales and the number of customers in Yamanashi. From July 2020 to April 2021, the GZ certification policy reduced the number of new infection cases by approximately 45.3% (848 new cases) as compared to the non-intervention scenario (the model in column (3) of Supplementary Information D.1) (see Fig. 5). The GZ certification policy also increased total sales and the number of customers per restaurant by approximately 12.8% (3.21 million Japanese yen or $30,000, based on the 2020 average yearly exchange rate by the U.S. Internal Revenue Service) and 30.3% (2,909 customers), respectively, compared to the non-intervention scenario (the models in columns (1) and (5) of Supplementary Information Table 4) (see Figs. 6 and 7).

The treatment effects estimated above correspond to the light-blue-shaded areas in the Figs. 5, 6, and 7. The areas are the sum of the difference between the fitted value and the non-intervention scenario value of the corresponding models, indicating the effect size in absolute value. The effect sizes on percentage bases are calculated by the sum of fitted values divided by the sum of non-intervention scenario values (both are in absolute terms).

Statistical Testing

The non-intervention scenarios are calculated through statistical analyses. For both epidemiological and economic analyses, we compare Yamanashi Prefecture, the treatment group, with its surrounding prefectures with similar external conditions for infection spread. The inclusion of two fixed effects, a time-invariant prefecture effect (e.g., population) and a prefecture-invariant time effect (e.g., infection spread period), focuses the comparison of prefectures on the degree of infection spread, not the absolute quantity of infection cases. We use the two-tailed t-test because the estimated OLS coefficients for the number of new infections, restaurants' sales, and customers are known to follow normal distributions, and when the estimated coefficient is standardized by the standard error, it follows a t-distribution. Analysis methods are further discussed in the methods section and in Supplementary Information Table 1 for the summary statistics and D. Statistical Testing.

Epidemiological Effects

Our epidemiological analyses show a consistent and significant negative coefficient when we regress the log-transformed number of new infection cases with a two-week lag on the log-transformed cumulative number of GZ-certified restaurants (see Supplementary Information Table 1). The time lag is set because previous studies have demonstrated that the time lag between the infection and the announcement of the disease is six to twelve days [22][23]. For robustness, we repeated the analyses with a one-week lag, and obtained similar results (see Supplementary Information Table 2). The regression results indicate that a 1% increase in the number of cumulative GZ-certified restaurants is accompanied by a 0.088% decrease in the number of new COVID-19 cases (column (1)). The estimated coefficient is statistically significant at the 1% level with p-value 0.002. Our analyses control for the estimated number of potentially infected people, declarations of states of emergency, the average rainfall (mm), the average temperature (Fahrenheit), school closure, bans on large assembly, and the number of COVID-19 tests. Since economic variables are not controlled for, the results imply that the drop in the number of infection cases was caused by the reduction in the probability of getting infected with COVID-19 in a given restaurant even with the higher economic performance (i.e., more contact opportunities) than in the neighboring prefectures. In fact, when we control for the number of restaurants' customers (i.e., contact opportunities), the coefficient becomes 0.105%. This difference indicates that the probability of getting infected with COVID-19 in a given restaurant decreased as considerably as to offset the increase in contact opportunities in restaurants. When we repeat the analyses using the cumulative number of GZ-certified hotels along with that of certified restaurants in the same period, the coefficient attenuates but is still statistically significant with p-value 0.008 (column (4)). We do not treat the number of certified hotels as a control variable but add it to the total number of restaurants because the guidelines for the GZ certification in hotels mainly target dining areas within their facilities. Thus, we assume that the same infection prevention mechanism works.

Economic Effects

Our economic analyses suggest that there are consistently significant positive coefficients when we regress the log-transformed restaurants' sales and the log-transformed number of customers on the log-transformed cumulative number of GZ-certified restaurants (see Supplementary Information Table 4). The regression results indicate that a 1% increase in the number of cumulative GZ-certified restaurants is accompanied by 0.018% and 0.040% increases in the restaurants' sales and the number of customers respectively (column (1) and (5)). The estimated coefficient is statistically significant at the 1% level with p-values 0.001 and 0.0001, respectively. We control for the declarations of states of emergency, the average rainfall (mm), the average temperature (Fahrenheit), school closure, and bans on large assembly. Given that we did not control for the number of new COVID-19 cases, we can interpret fewer infection cases brought by the GZ certification resulted in a smaller number of consumers refraining from going out and a smaller number of stores refraining from doing business. Even when we control for the number of infection cases, the magnitude of positive coefficients remains at 0.16% and 0.37% respectively. A plausible interpretation of these results is that GZ certification may have motivated customers to visit restaurants by lowering their risk perception to possible infection. Meanwhile, the higher elasticity of the number of customers relative to that of sales indicates that per-customer spending might have been lower than before the COVID-19 crisis due to a decrease in time spent and consumption of alcoholic beverages, which resulted from infection prevention measures. The positive coefficient of the number of cumulative GZ-certified restaurants is robust even if we replace restaurants' sales and visitors with the percentage increase in restaurant website visits (see Supplementary Information Table 5).

To investigate the mechanism of the economic effects, we ran three separate regressions for (i) human mobility by facility type, (ii) human mobility by resident type, and (iii) the stay-home rate by age against the number of cumulative GZ-certified restaurants (see Supplementary Information Tables 6–10). For (i), the analysis using Google mobility data shows a statistically significant positive effect of GZ-certified restaurants on human mobility in retail and recreation (p-value = 0.0004) and parks (p-value = 0.00001), which include target facilities of the GZ-certification, and no statistically significant effects on grocery and pharmacy (p-value = 0.235), which are not target facilities (see Supplementary Information Table 6). In terms of (ii) human mobility by resident type, the coefficient for interprefectural mobility is positive and statistically significant (p-value = 0.001 (column (7))), while the positive coefficient for intercity mobility is smaller and the coefficient for intracity is negative. It suggests that the GZ certification may have attracted more restaurant visitors from outside the prefecture than within the prefecture (see Supplementary Information Table 7). Finally, concerning (iii) the stay-home rate by age group, we consistently observe statistically significant negative coefficients at the 5% level for males in all generations, except in their 60s (p-value = 0.086); and females aged 30s or older, except in their 50s (p-value = 0.074) (see Supplementary Information Table 9). The coefficient for males aged 15–19 is positive, and the coefficient for females aged 15–19 and in their 20s is negative, but not statistically significant at the 10% level. It suggests that the GZ certification policy, which lowers the psychological hurdle for consumers to go out may have encouraged people to go out particularly among people aged 30s and above. In addition, we observe a statistically significant positive coefficient for the percentage of people going out at night. It suggests that the number of people going out for dinner increased due to the policy (see Supplementary Information Table 10).

Discussion

The GZ certification policy was introduced in an effort to cut down the probability of getting infected with COVID-19 in given facilities, primarily restaurants, while maintaining economic activities. The results of our analyses are in line with the policy objectives, as the GZ certification policy likely dropped the number of infection cases while increasing restaurants' sales and the number of customers.

The reason why Yamanashi Prefecture was able to reduce the infection probability substantially relative to neighboring prefectures is that the GZ-certification increased the percentage of restaurants that comply with the infection prevention guidelines, compared to the cases where prevention is entrusted to each restaurant. As for mechanisms, we assume multiple factors that incentivize restaurants to apply for and keep abiding by the certification guidelines. For example, subsidies on necessary equipment to certified restaurants have lowered the investment cost for the measures. Also, the certification reduced information asymmetry about infection prevention between restaurants and customers. More restaurants applied for the certification, as consumers are more likely to choose certified restaurants that take measures. Additionally, third-party inspections have lowered restaurants' incentives to deviate from compliance to the guidelines. Without a certification policy, infectious disease control in restaurants would be a collective action problem. In such a case, restaurants do not know other restaurants' compliance. If one complies while others do not, one suffers economic losses as the number of cases hikes, exposing the restaurant equally to business closure requests. Therefore, restaurants choose to deviate from compliance to avoid sales damage. Since the certification secures a clear commitment of individual restaurants' conformity, restaurants switch to abide by the rules. As a result, the commitment rate increased and the possibility of infection diminished.

We assume a third-party certification policy brought positive economic spillovers in the following two ways. First, the small numbers of infection cases supported the prefecture's decision to maintain restaurants' usual operating hours, allowing them to make sales while restaurants without proper measures faced shortened operation hours. This is evidenced by the fact that the number of business closure requests in Yamanashi Prefecture was smaller than that of the neighboring prefectures (see Supplementary Information E.3). Second, the policy made consumers feel at ease when dining out. Consequently, consumers continued to visit restaurants nearly as much as they did pre-pandemic, which helped businesses to survive.

Taken together, these two effects suggest the possibility of mitigating the trade-off between maintaining restaurant operations and preventing the spread of infection. The certification policy could help to both sustain the economy and prevent infection.

This research has two main contributions. First, it demonstrates the effectiveness of a third-party certification policy in mitigating the trade-off between infection prevention and economic sustainability. Given the uncertain prospects of the pandemic and finite administrative budget, policymakers are increasingly required to seek a balance between infection risks and economic sustainability in the long run. To this end, some countries, such as Japan and Singapore [24], have implemented third-party certification policies. However, little is known for their effectiveness. As far as we know, this paper provides the first evidence that has evaluated their policy impacts from the both epidemiological and economic points of view. Our results inform the design of a policy that achieves both infection prevention and economic sustainability, as the certification guidelines and government's screening are replicable in other regions regardless of the country or the characteristics of rural or urban areas (see Supplementary Information E.4).

The second contribution is the application of the SIR model, a classical mathematical model of epidemiology, to policy evaluation in a form that removes endogeneity. Many econometric analyses have simulated the epidemiological effects of non-pharmaceutical policies. Nonetheless, only a few examine the actual policy effect by exploiting a natural experiment. Even when they do exist, the results are likely to be biased because they often do not control for factors that can significantly affect the way infection spreads, such as population density, distance from urban areas, and the number of infected people that would have existed in an area at a given time. In this paper, we have made four efforts to overcome endogeneity. First, we include prefecture and time fixed effects to control for the heterogeneity across prefectures and time periods. Second, we limit our sample to prefectures with similar population density and distance from metropolitan areas, the epicenters of infection, to construct the control group. Third, we take into account the potential migration of infected people between prefectures by deploying the method developed by Kurahashi et al. (2021). Their model enables us to fix the number of potentially infected people, and therefore we can examine the extent to which infection spreads. Lastly, we control for other policies that could influence the outcome variables as much as possible. For example, we introduce school closure dummy variables and bans on large assembly dummy variables. We also confirm the similarity in the policies of the treatment and control prefectures except for the presence of the GZ certification by qualitatively studying restaurant-related policies.

To sum up, our study suggests the effectiveness of a third-party certification policy on infectious disease control in restaurants. The policy successfully reduced the number of infections in the targeted prefecture roughly by 45.3%. Furthermore, these measures successfully maintained restaurants' sales and the number of customers, suggesting that the economic impact is low. In this way, the policy could mitigate the trade-off between infection prevention and economic operation. We hope that the findings of this study will be used in policy planning to balance the infection prevention and economic sustainability in the current as well as future pandemics.

Methods

This section describes the main datasets, estimation equations, and treatment and control groups.

Main Datasets

In this section, data for the main explanatory and dependent variables are described. (Data for control variables are explained in the Supplementary Information.)

Green Zone Certification

The explanatory variable is the cumulative number of GZ-certified restaurants. The certification policy targets various types of facilities, such as restaurants, hotels, breweries, and wineries. In this paper, we focused on restaurants, which are deemed to be the main route of infection [1]. The dataset of individual establishments' GZ certification acquisition dates was provided by the department in charge of the certification policy at the Yamanashi Prefectural Office.

COVID-19 cases

One of the dependent variables is the number of daily new COVID-19 cases in each prefecture. The data was obtained from NHK's "Special site: New coronaviruses—Number of cases by prefecture" [25]. The dataset contains the number of publicly announced new infections and deaths since January 16, 2020, when the first cases in Japan were discovered. In order to exclude the influence of new variants and vaccination, the analysis covers the data published until April 30, 2021.

Restaurant sales and the number of customers

The other dependent variable is restaurant sales and the number of customers. They are used as proxy variables for the business conditions of restaurants (including bars). The dataset was provided by Postas Corporation, and it contains daily sales and the number of customers of restaurants that have installed the cloud POS register "Postas" provided by the corporation, which covers the period from January 1, 2019, to April 30, 2021.

Estimation Methods

The estimation model in this study is a two-way fixed effects model with prefecture as the regional unit and week as the time series unit. The dataset provided by Postas Corporation is at the prefectural level. It is also the lowest level at which data on infections can be obtained due to privacy concerns. New infection cases are calculated on a weekly basis rather than a daily basis to reflect infection dynamics more accurately by minimizing errors such as discrepancies in the number of tests and reports.

The equations for estimating the infection prevention effect and the economic effect are as follows.

First, the infection prevention effect is estimated by the following two-way fixed effects model. The derivation process of the equation (1) from the SIR model is described in B. Estimation Equation of the Supplementary Information.

$$\begin{aligned}\ln\left(New\ cases_{p,t}+1\right) = \beta_1 \ln\left(GZ_{p,t-2}+1\right) + \beta_2 \ln\left(Susceptible_{p,t-2}\right) + \beta_3 \ln\left(Infectious_{p,t-2}+1\right) \\ +\beta_4 \ln\left(Customer_{p,t-2}\right) + \sum_{i=1}^{k} \gamma^i \ln\left(Control^i_{p,t-2}\right) + c_p + \tau_t + u_{pt}\end{aligned} \quad (1)$$

$$Susceptible_{p,t-2} = Pop_p - \sum_{k=1}^{t-2} New\ cases_{p,k} \quad (2)$$

$$Infectious_{p,t-2} = \sum_{k=1}^{2} New\ cases_{p,t-k} + \sum_{i=1, i\neq p}^{47} \frac{\sum_{k=1}^{2} New\ cases_{i,t-k} * flow_{i,p,t-k}}{Pop_i} \quad (3)$$

The subscripts p and t denote prefecture and week, respectively. For logged variables, we add one to the variable to avoid the issue that log(0) cannot be defined. This process aims to follow the SIR model and to estimate the elasticity of effect. The outcome variable, $New\ cases_{pt}$ is the published number of new infections at time t in prefecture p. The variables in the right-hand side are the values at $t-2$. This is because it takes about six to twelve days from exposure to the virus, through the incubation period, to onset of symptoms, testing, and publication [22][23]. Since the lag between exposure and announcement may vary depending on the region and time of year, analyses will be conducted with a lag of one week as well as two weeks. $GZ_{p,t-2}$ is the cumulative number of restaurants that have received the GZ certification. The parameter β_1 is the treatment effect, and if this coefficient is negative and significant, it implies a high possibility of infection prevention effect. As described in equation (2), $Susceptible_{p,t-2}$ is the susceptible population that can potentially be infected, and is defined as the population in a prefecture (Pop_p) minus the total number of infection cases in p ($New\ cases_{p,k}$).

The variable $Infectious_{p,t-2}$ is the estimated total number of infectious people who can infect others in p at $t-2$. As the derivation process is described in (3), it is the sum of the total number of infected people who existed in prefecture p at $t-2$ and $t-1$ (the first term) and the total number of infected people who flowed in from other prefectures (the second term). The second term is the sum of the number of newly infected people in prefecture i ($New\ cases_{i,t-k}$) divided by the population (Pop_i) multiplied by the number of people flowing into prefecture p from prefecture i ($flow_{i,p,t-k}$) at $t-2$ and $t-1$. This is based on a previous study by Kurahashi et al. (2021), and is used to accurately measure the potential number of infected persons, who can infect others at a given point in time, in order to more strictly control for the infection situation. Since this paper assumes a trade-off in which increased economic activities come at the cost of increased infections, we also control for the number of restaurant customers, $Customer_{p,t-2}$. For control variables, we include dummy variables for the declaration of a state of emergency, school closure, bans on large assembly. We also control for the mean temperature, mean precipitation, and the

COVID-19 test cases for infections. Lastly, c_p and τ_t represent prefecture and week fixed effect, respectively, and u_{pt} is an error term.

Second, the economic effect is estimated by the following fixed-effects model.

$$Y_{pt} = \beta_1 \ln(GZ_{p,t}+1) + \beta_2 \ln(New\ cases_{p,t}+1) + \sum_{i=1}^{k} \gamma^i \ln\left(Control^i_{p,t-2}\right) + c_p + \tau_t + u_{pt} \tag{4}$$

As before, for logged variables, we add one to the variable to avoid the issue that log(0) cannot be defined. For the outcome variable, Y_{pt}, the main variable is (i) per restaurant sales and customers. For robustness and mechanism check, (ii) the rate of increase in restaurant website visits, (iii) the rate of change in human flow by facility type, (iv) the rate of change in human flow in residential areas, and (v) the stay-home rate by age group are additionally used. $GZ_{p,t}$ is the cumulative number of restaurants that have received GZ certification. The parameter β_1 is the treatment effect, and if this coefficient is positive and significant, it implies a high possibility of positive economic effects. $New\ cases_{pt}$ is the number of new infection cases in prefecture p at time t, which we added to control for the effect of people voluntarily refraining from going out due to the spread of infection. For control variables, we include a dummy variable for state of emergency declarations, a dummy variable for school closure, a dummy variable for bans on large assembly, the squared term of mean temperature, mean precipitation, and test cases for infections. Lastly, c_p and τ_t represent prefecture and week/day fixed effect, respectively, and u_{pt} is an error term.

Treatment and Control

To eliminate endogeneity as much as possible, the control group was selected from five neighboring prefectures with similar population density and distance from Tokyo, the epicenter of infection (see Supplementary Information E.1). The treatment effect of the infection prevention is to have the restaurants comply with the comprehensive infection prevention guidelines through on-site checks. The estimated effect is not a comparison with the scenario when no infection prevention or economic measures were taken at all. As shown in the table (see Supplementary Information E.2), certification and subsidy policies for restaurants existed in other prefectures, but either the programs had not been launched by April 2021 or they had lower infection prevention standards and did not require on-site checks by the government.

The infection prevention guidelines include the following five categories. The first is measures for customers, which can be divided into two cases: (i) entering the store, ordering, and paying, and (ii) dining and in-store use. For the rules concerning (i), disinfection equipment should be installed at the entrance of the store, partitions should be set up to separate clerks and customers at the cash register, and customers should be reminded to wear masks except when eating or drinking. For (ii) dining and in-store use, there should be space between each group and also between seats within a group. The space should be at least one meter wide, but the partitions at all intervals can substitute for the space. Other restrictions include limiting the length of stay and serving food to individual customers rather than on platters. The second is measures for employees. It includes wearing masks at all times, checking temperature and health conditions before starting to work, and regular hand disinfection and hand washing. The third is measures to ensure the hygiene of facilities and equipment. There should be constant ventilation through ventilation equipment or open windows, and the use of hand dryers should be prohibited. The fourth is the creation and publication of a checklist. It mandates the facility administrators to make a checklist to check the above infection prevention measures and publicize the daily checks. The last is measures in the case of infection outbreak. The guidelines stipulate that employees who are suspected of being infected should refrain from coming to work until the test results turn out to be negative. Besides, if necessary, information to prevent the spread of infection, such as business days for possible infection, should be disclosed. Further details are described in E.4 GZ Cerification criteria of the Supplementary Information.

The treatment effect on economic activity operates through both supply and demand. On the supply side, due to the low number of infected cases, restaurant operation is maintained because the government does require them to close or shorten their operation hours. In fact, except for the time of the explosive spread of the infection from December 2020 to January 2021, Yamanashi Prefecture has not declared business suspension requests unlike other prefectures (Supplementary Information Table E.3). On the demand side, customer demand is maintained because consumers do not refrain from going out due to the low number of infected people.

Data Availability

The datasets generated and analysed are available in the Github repository, https://github.com/jhirota/GZ. However, restrictions apply to the availability of the following raw datasets, which were used under license for the study, and so are not publicly available: (i) the list of restaurant names, address, and GZ certification date provided by Yamanashi Prefecture; (ii) the number of restaurants used when constructing sales and the number of customers panel data provided by Postas Corporation; and (iii) the population moving from one prefecture to another (for 47 prefectures) per day provided by Agoop Corporation. Datasets from Agoop Corporation. are publicized in the Github repository.

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Author contributions statement

Conceptualization, K.H., J.H., D.K., Y.M., and C.O.; research design, K.H., J.H., D.K., Y.M., and C.O.; data collection, K.H., J.H., and C.O.; formal analysis, K.H. and J.H.; visualization, J.H.; manuscript writing, K.H., J.H., and C.O.; editing, K.H., J.H., D.K., Y.M., and C.O.

Additional information

The authors declare no competing interests.

Figure Legends

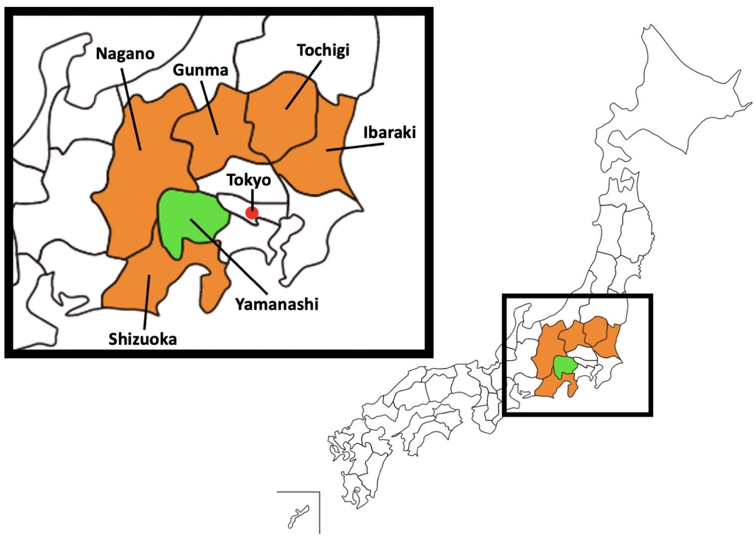

Figure 1. Location of treatment and control prefectures. Treatment (Yamanashi) and control (Shizuoka, Nagano, Gunma, Tochigi, and Ibaraki) prefectures are in green and orange colors, respectively. Control prefectures were selected because their population density and distance from Tokyo are similar to those of the treatment prefecture.

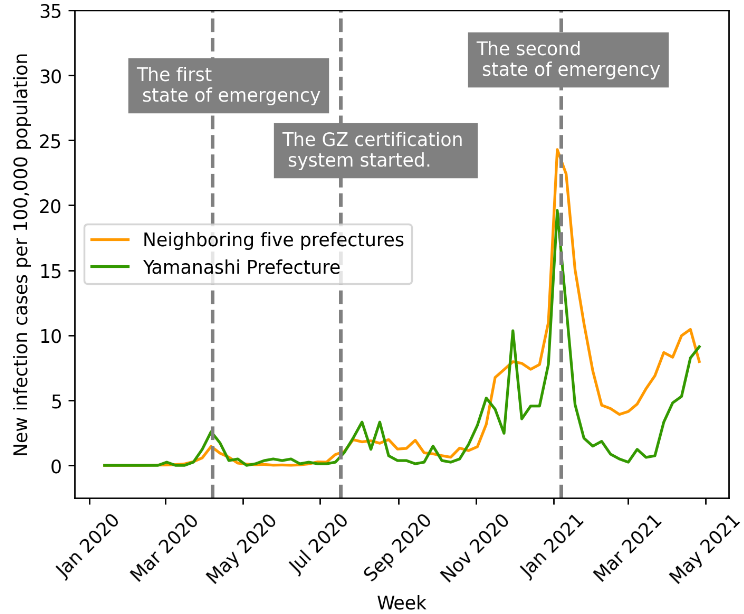

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Figure 2. Time series of new infection cases by week. The vertical axis is the new infection cases per 100,000 population per week. The green line is the trend in Yamanashi Prefecture, while the orange line is the average trend of five neighboring prefectures. The gray dotted lines signify the onset of the first and second state of emergency declaration in Tokyo.

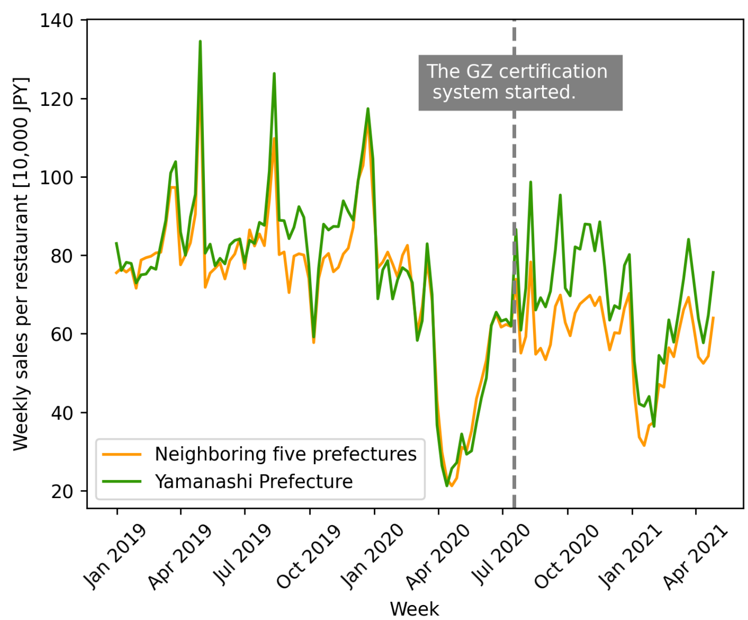

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Figure 3. Time series of weekly sales per restaurant in Yamanashi Prefecture and neighboring 5 prefectures. The vertical axis shows the weekly sales per restaurant (JPY 1 million) made through the cloud POS register "Postas" provided by Postas Corporation. The green line is the trend in Yamanashi Prefecture, while the orange line is the average trend of five neighboring prefectures. The gray dotted line signifies the week when the GZ certification policy approved the first group of restaurants.

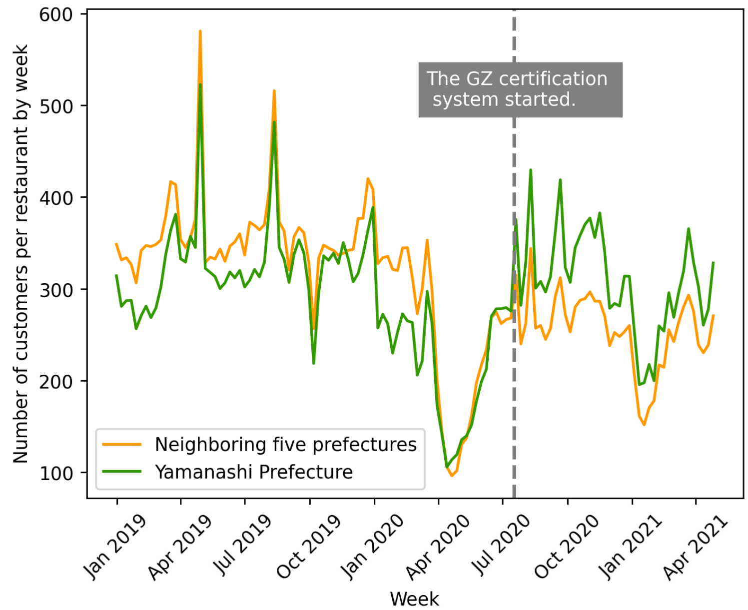

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Figure 4. Time series of the number of customers per restaurant by week in Yamanashi Prefecture and neighboring 5 prefectures. The vertical axis is the weekly number of customers per restaurant recorded through the "Postas" registration system. The green line is the trend in Yamanashi Prefecture, while the orange line is the average trend of five neighboring prefectures. The gray dotted line signifies the week when the GZ certification policy approved the first group of restaurants.

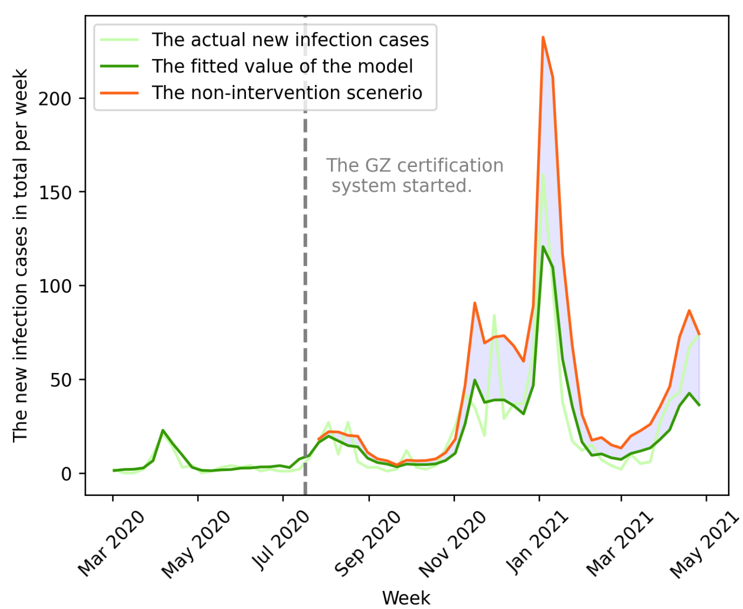

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Figure 5. GZ-certification policy effect on the number of COVID-19 new infection cases in Yamanashi Prefecture. The vertical axis is the prefecture-wide new infection cases per week. The light green, green, and orange lines show the actual, fitted, and non-intervention (counterfactual) scenarios. The green and orange lines are based on model (1) of Table 2 (see Supplementary Information). The green dotted line signifies the week when the GZ certification policy approved the first group of restaurants. The light-blue-shaded area corresponds to the treatment effect.

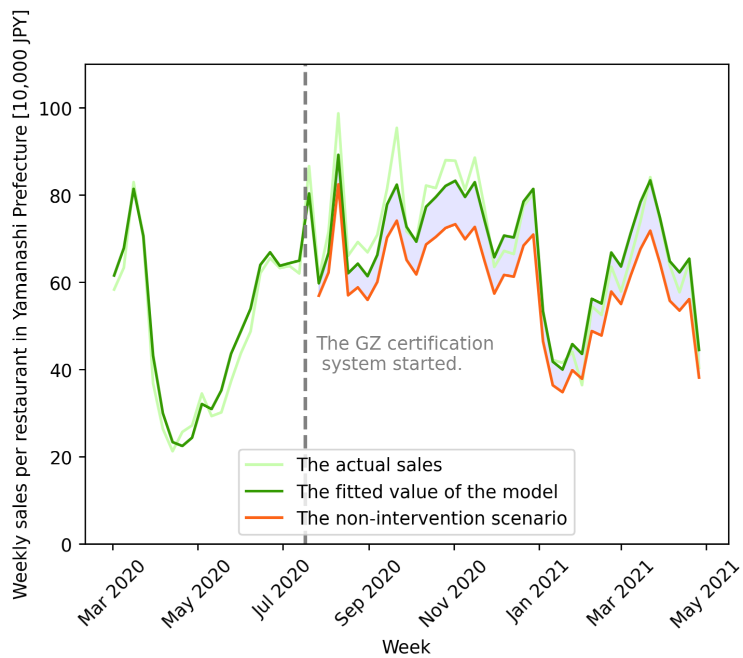

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Figure 6. GZ-certification policy effect on restaurant sales in Yamanashi Prefecture. The vertical axis is the weekly sales per restaurant in Yamanashi Prefecture (in JPY 100,000). The light green, green, and orange lines show the actual, fitted, and non-intervention (counterfactual) scenarios. The green and orange lines are based on model (1) of Table 4 (see Supplementary Information). The green dotted line signifies the week when the GZ certification policy approved the first group of restaurants. The light-blue-shaded area corresponds to the treatment effect.

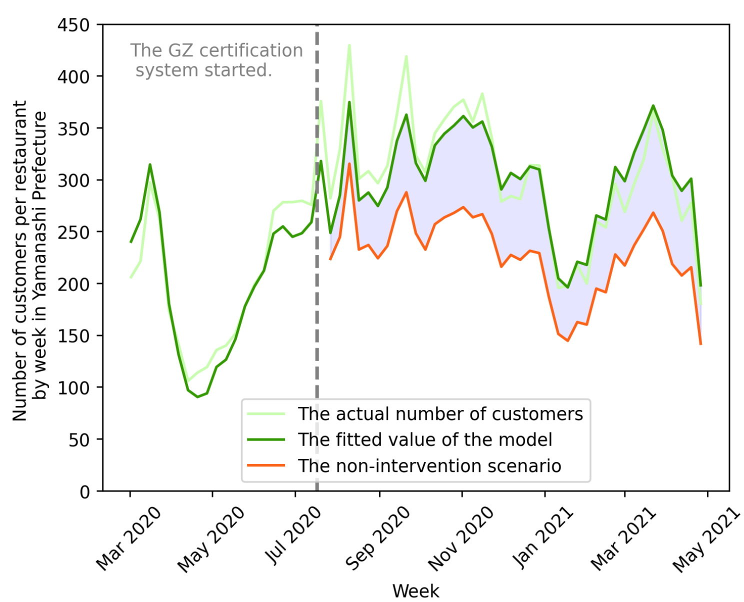

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Figure 7. GZ-certification policy effect on the number of restaurant customers in Yamanashi Prefecture. The vertical axis is the weekly number of customers per restaurant in Yamanashi Prefecture. The light green, green, and orange lines show the actual, fitted, and non-intervention (counterfactual) scenarios. The green and orange lines are based on model (5) of Table 4 (see Supplementary Information). The green dotted line signifies the week when the GZ certification policy approved the first group of restaurants. The light-blue-shaded area corresponds to the treatment effect.

Supplementary Information

Investigating the epidemiological and economic effects of a third-party certification for restaurants with COVID-19 prevention measures

Kazuya Hirokawa, Jumpei Hirota, Daiji Kawaguchi, Yusuke Masaki, Chiaki Onita

In this online appendix, we summarize the sub-evidence for the main article. First, we describe the data. Second, we derive the estimation equation. Third, we list the basic statistics for each variable. Fourth, we present our regression results. Finally, we provide supplementary information about the treatment effects.

Table of Contents

1. Comparison of Treatment and Control prefecture
2. Comparison of policies in Treatment and Control prefecture
3. List of Business suspension request
4. Yamanashi Green Zone Certification criteria

A. Data

Our data used for control variables (A.1–A.4) in the main analyses (D.1, D.3) and dependent variables (A.5–A.8) in the robustness check (D.4–D.7) come from multiple sources.

A.1 COVID-19 policy dummy variables

For the emergency declaration dummy variable, we use data on the progress of the government's response as summarized by Tottori Prefecture on its website for new COVID-19 infections. The site lists the prefectures that are subject to the issuance, change, and cancellation of emergency declarations in chronological order. Based on this information, we determined whether each prefecture was under a state of emergency declaration at a certain time. For the school closure dummy variable, we use data on information of school closures for the national government and each prefecture in the time-series news archives on NHK's special website for COVID-19. The variable was set to be 1 only when schools are closed in the entire prefecture. For municipality or school-level closure, the variable is set to be 0. The gathering restriction dummy variable is created based on the governor's press conferences and updates on COVID-19 in each prefecture. The variable takes a value of one if there is a restriction on event capacity of 5,000 people or less and a capacity ratio of 50% or less in each prefecture, and takes a value of zero if either of these criteria is not met. In cases where the prefectural criteria are based on the guidelines of the respective industry, the dummies are created based on the common guidelines of event-related industries.

A.2 COVID-19 test cases

In the analysis of the infection prevention effect, we use the data on the number of COVID-19 test cases published by each prefecture. As of 2020, the number of tests in each prefecture varies greatly in Japan, particularly because of varying capacities for conducting tests across prefectures. If the number of tests itself is small, the number of new infection cases may be underestimated.

A.3 Weather data

For the weather data of temperature and precipitation, we use the daily weather observation data of observatories in each prefecture using the "Past Weather Data Search" of the Japan Meteorological Agency. The average rainfall and the average temperature are used as the representative values. When extracting the data from the database, several municipalities with observatories are chosen from several municipalities with the top population. In detail, Yamanashi Prefecture is represented by Kofu and Kawaguchiko; Nagano Prefecture by Nagano, Matsumoto, Ueda, and Iida; Shizuoka Prefecture by Hamamatsu, Shizuoka, and Fuji; Gunma Prefecture by Maebashi and Isesaki; Ibaraki Prefecture by Tsukuba, Mito, and Hitachi; and Tochigi Prefecture by Utsunomiya and Oyama. The weather data for each prefecture is the average of the data for the municipalities belonging to each prefecture.

A.4 Human mobility inflow and outflow by prefecture

We use Agoop's paid data for the human flow within each prefecture and the human flow from outside the prefecture into each prefecture. The data is drawn from users' GPS information held by Agoop. It is the data that calculates the entire human flow from a sample of the number of people who existed at a certain coordinate at a certain time. The data provides information on not only the total number of people in a prefecture, but also the movement of people from a specific prefecture to a specific prefecture/municipality. This data is used to estimate the number of potentially infectious mobility coming from other prefectures as shown in the susceptible-infectious-recovered (SIR) model, rather than as an objective variable.

A.5 Restaurant information views online

We also use data on the rate of increase in the number of restaurant information views online per week, which is available on V-RESAS published by the Cabinet Office of Japan. The rate of increase or decrease in the restaurant information views online compared to the same week in 2019 is disclosed for each prefecture. The original data is held by Retty Inc., which operates Japan's largest word-of-mouth gourmet service. This data is used as the dependent variable in the robustness check (D.4 Restaurant information views online)

A.6 Human mobility by facility type

For the mobility data, we also use the "COVID-19: Community Mobility Report" published by Google. The data reveals the rate of increase or decrease in human flow in six types of locations ("retail and recreation," "grocery and pharmacy," "parks," "transit stations," "workplaces," and "residential") by country and region/prefecture. The median value for each day of the week for the five-week period from January 3 to February 6, 2020 is used as the baseline for the rate of change. Thus, the daily data is the rate of change from the base values for each day of the week.This data is used as the dependent variable in the robustness check (D.5 Human mobility by facility type)

A.7 Human mobility across regions

We also used human flow data on the rate of increase or decrease in the mobility by region (intracity, intercity, and interprefectural), compared to the same week in 2019 for each prefecture. This data is available on V-RESAS. This data is used as the dependent variable in the robustness check (D.6 Inter-regional Mobility) to examine the impact on human flow in and across the prefectures.

A.8 Stay-home rate

We use the data on stay-home rate, which the Mizuno Laboratory of the National Institute of Informatics and the Graduate University for Advanced Studies publish. The data is collected by age group and time, based on the population data estimated in real-time from the information of about 78 million base stations of DOCOMO, a major Japanese telecommunication company. They define the number of people going out from residential areas as

$$The\ number\ of\ people\ going\ out = daytime\ population - nighttime\ population$$

and

$$The\ Stay-home\ rate$$

$$= 1 - \frac{Number\ of\ people\ who\ go\ out\ from\ 9:00\ to\ 18:00\ on\ a\ given\ day * average\ time\ spent\ out}{Number\ of\ people\ who\ go\ out\ from\ 9:00\ to\ 18:00\ on\ a\ normal\ day * average\ time\ spent\ out}$$

This data is used in the robustness check (D.8 Stay-home rate).

B Estimation equation

The epidemiological analyses are based on the SIR-applied fixed effect model. This section shows the process of how the equation ((1) in Methods in the main article) is derived from the SIR model.

The SIR model captures the epidemic dynamics of infectious diseases that spread directly from person to person. The model estimates the infection status in three stages: Susceptible, Infectious, and Removed. Susceptible refers to the state of being susceptible to infection, Infectious refers to the state of being infected, and Removed refers to the state of having recovered or gained immunity or having died.

$$\frac{dI(t)}{dt} = \beta S(t)I(t) - \gamma I(t)$$

β denotes infectivity, and γ denotes recovery or isolation rate. In other words, the rate of change of the Infectious population is dependent on the interactions between the Susceptible and Infectious populations, the infectivity of the virus, and the rate at which the Infectious move to the Removed population. We can obtain an expression for the number of new COVID-19 cases in a given time period by rewriting the ordinary differential equation as:

$$COVID = \beta SI$$

Taking logarithms on both sides, we get:

$$ln(COVID) = ln\beta + lnS + lnI$$

A previous study has shown that the model that assumes that the proportion of susceptible people who can be infected and the proportion of infectious people who can infect others are not equal to one, but vary depending on the situation, can more accurately estimate the number of newly infected people (Law, K.B., Peariasamy, K.M., Gill, B.S. et al 2020). Therefore, we transform the model by adding coefficients to the Susceptible and Infectious variables as follows

$$ln(COVID) = ln\beta + \delta_2 lnS + \delta_3 lnI$$

In order to adapt this basic estimation equation to changes in external circumstances that affect the infection cases, we add control variables such as economic activity variables and weather conditions. In addition, the purpose of the GZ certification policy that we want to estimate is to reduce the infectivity (β) that can be transferred from one infected person to another. Therefore, we redefine the infectivity (β) as follows to derive the main estimation model.

$$ln\beta = \alpha_1 lnGZ + u$$

$$ln(COVID) = \alpha_1 lnGZ + \delta_2 lnS + \delta_3 lnI + \delta_4 lnControl + u$$

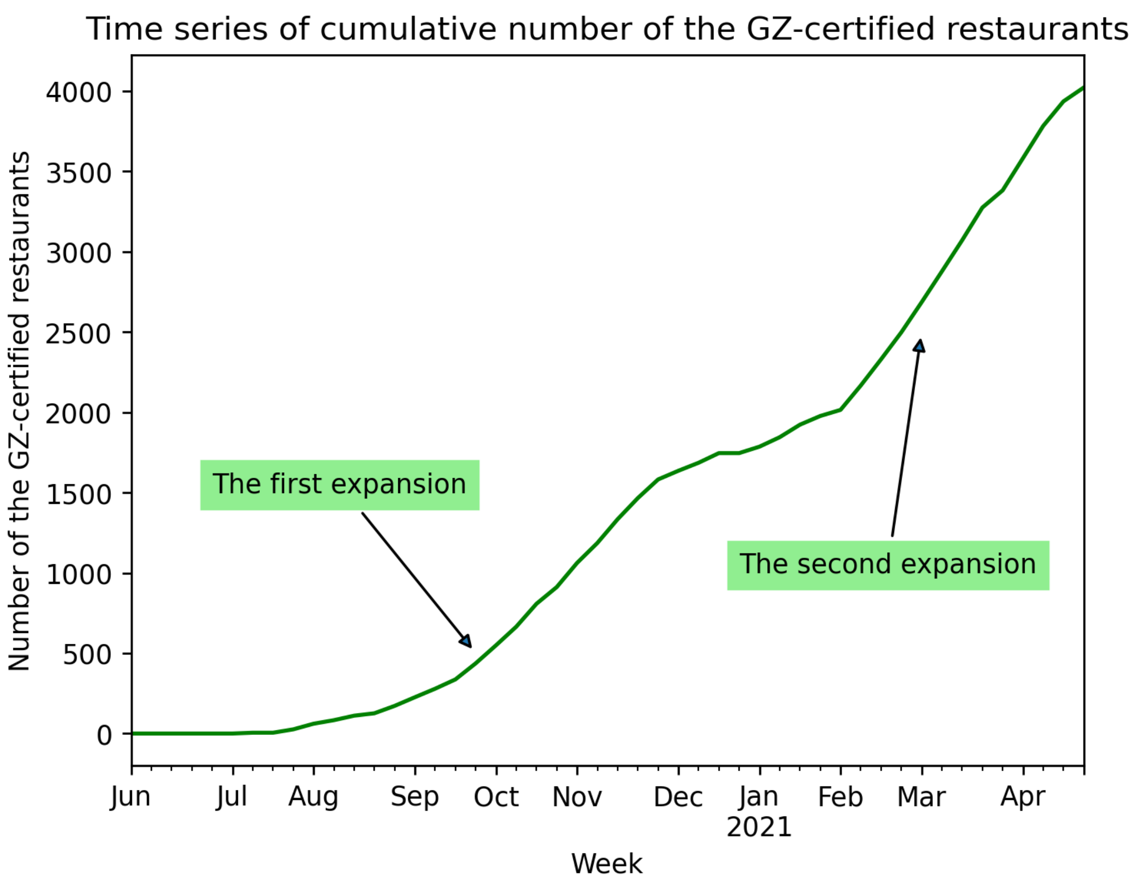
C Basic Statistics

C.1 Summary statistics of analysis

Table 1: Summary Statistics

Statistic	N	Mean	St. Dev.
New cases per day	408	76.061	122.493
Number of customers per restaurant	408	254.371	86.767
Sales per restaurant	408	585,798.500	174,182.800
Average temperature	408	56.563	14.107
Average rainfall	408	3.926	5.531
Infectious	408	172.859	260.401
Susceptible	408	2,205,422.000	877,185.900
Number of COVID-19 tests	408	1,711.466	2,655.616

C.2 Cumulative number of the GZ-certified restaurants



D Statistical Testing

D.1 Infection prevention effects (2 week lag analysis)

Table 2: The COVID-19 new infection cases (2 week lag) and the Green Zone certification

	Dependent variable:				
	New infection cases (2 week lag), log				
	(1)	(2)	(3)	(4)	(5)
Cumulative GZ-certified restaurants, log	-0.088^{***}	-0.105^{***}	-0.107^{***}		-0.126^{***}
	(0.015)	(0.024)	(0.025)		(0.028)
Cumulative GZ-certified restaurants and hotels, log				-0.104^{***}	
				(0.024)	
Infectious, log	0.558^{***}	0.569^{***}	0.566^{***}	0.565^{***}	0.544^{***}
	(0.048)	(0.045)	(0.040)	(0.040)	(0.042)
Susceptible, log	−45.353	−45.843	−44.997	−61.487	32.518
	(69.254)	(92.506)	(89.342)	(82.870)	(121.902)
State of Emergency	0.030	0.141	0.085	0.096	−0.183
	(0.223)	(0.198)	(0.180)	(0.180)	(0.200)
Tests (2 week lag), log	0.047^{*}	0.051^{*}	0.049^{**}	0.050^{**}	0.052^{**}
	(0.021)	(0.021)	(0.019)	(0.019)	(0.018)
Customers per restaurant, log		0.550	0.548	0.612	0.540
		(0.419)	(0.449)	(0.446)	(0.480)
Average temperature, log			−0.342	−0.344	−0.317
			(0.470)	(0.466)	(0.501)
Average rainfall, log			−0.107	−0.104	−0.115
			(0.058)	(0.058)	(0.061)
School closure					−0.252
					(0.275)
Gathering restriction					0.336^{**}
					(0.083)
Prefecture FE	X	X	X	X	X
Week FE	X	X	X	X	X
Observations	396	396	396	396	396
R^2	0.929	0.930	0.930	0.930	0.931
Adjusted R^2	0.913	0.913	0.913	0.913	0.914

Notes: *p<0.1; **p<0.05; ***p<0.01 The dependent variable is the log-transformed value of the number of new infection cases (2 week lag). The unit of analysis is prefecture and week, and the fixed effects are introduced in all models. For the observations, six prefectures are targeted, and the period of analysis is for 66 weeks from the third week of January, 2020 to the third week of April, 2021. The values in parentheses are cluster-robust standard errors. Clustering is at the prefecture level. Cumulative GZ-certified restaurants, log is the log-transformed value of the number of cumulative certified-GZ restaurants. Cumulative GZ-certified restaurants and hotels, log is the log-transformed value of the number of cumulative certified-GZ restaurants and hotels. Infectious, log is the log-transformed value of the number of potentially infected people. Susceptible, log is the log-transformed value of the total number of susceptible population. State of Emergency is the dummy variable that takes the value 1 if the state of emergency is declared. Tests (2 week lag), log is the log-transformed value of the number of COVID-19 tests. Customers per restaurant, log is the log-transformed value of the number of customers per restaurant. Average temperature, log is the log-transformed value of the mean temperature (Fahrenheit degrees). Average rainfall, log is the log-transformed value of the aggregated rainfall (in millimeters). School closure is the dummy variable that takes the value 1 if the school closure is declared. Gathering restriction is the dummy variable that takes the value 1 if the large-scale gathering restriction is declared. For the variables that take absolute value 0 (New infection cases (2 week lag), log, Cumulative GZ-certified restaurants, log, Cumulative GZ-certified restaurants and hotels, log, Infectious, log, and Tests (2 week lag), log), we add value 1 before log-transforming to avoid the logarithm of 0.

D.2 Infection prevention effects (1 week lag analysis)

Table 3: COVID-19 new cases (1 week lag) and the Green Zone certification

	Dependent variable:				
	New infection cases (1 week lag), log				
	(1)	(2)	(3)	(4)	(5)
Cumulative GZ-certified restaurants, log	−0.083***	−0.094***	−0.093***		−0.108***
	(0.015)	(0.020)	(0.019)		(0.022)
Cumulative GZ-certified restaurants and hotels, log				−0.090***	
				(0.018)	
Infectious, log	0.562***	0.575***	0.574***	0.573***	0.560***
	(0.048)	(0.043)	(0.041)	(0.041)	(0.041)
Susceptible, log	−107.523	−102.924	−99.505	−113.259	−29.163
	(75.138)	(90.837)	(86.466)	(80.316)	(132.249)
State of Emergency	0.009	0.089	0.090	0.100	−0.123
	(0.185)	(0.194)	(0.213)	(0.215)	(0.191)
Tests (1 week lag), log	0.049*	0.053**	0.053*	0.054*	0.052*
	(0.021)	(0.020)	(0.022)	(0.021)	(0.022)
Customers per restaurant, log		0.395	0.365	0.422	0.333
		(0.412)	(0.412)	(0.417)	(0.413)
Average temperature, log			0.355	0.352	0.397
			(0.433)	(0.445)	(0.413)
Average rainfall, log			−0.008	−0.005	−0.014
			(0.117)	(0.116)	(0.115)
School closure					−0.285
					(0.189)
Gathering restriction					0.263*
					(0.111)
Prefecture FE	X	X	X	X	X
Week FE	X	X	X	X	X
Observations	402	402	402	402	402
R^2	0.932	0.932	0.932	0.932	0.933
Adjusted R^2	0.916	0.916	0.916	0.916	0.916

Notes: *p<0.1; **p<0.05; ***p<0.01 The dependent variable is the log-transformed value of the number of new infection cases (1 week lag). The unit of analysis is prefecture and week, and the fixed effects are introduced in all models. For the observations, six prefectures are targeted, and the period of analysis is for 67 weeks from the third week of January, 2020 to the fourth week of April, 2021. The values in parentheses are cluster-robust standard errors. Clustering is at the prefecture level. Cumulative GZ-certified restaurants, log is the log-transformed value of the number of cumulative certified-GZ restaurants. Cumulative GZ-certified restaurants and hotels, log is the log-transformed value of the number of cumulative certified-GZ restaurants and hotels. Infectious, log is the log-transformed value of the number of potentially infected people. Susceptible, log is the log-transformed value of the total number of susceptible population. State of Emergency is the dummy variable that takes the value 1 if the state of emergency is declared. Tests (1 week lag), log is the log-transformed value of the number of COVID-19 tests. Customers per restaurant, log is the log-transformed value of the number of customers per restaurant. Average temperature, log is the log-transformed value of the mean temperature (Fahrenheit degrees). Average rainfall, log is the log-transformed value of the aggregated rainfall (in millimeters). School closure is the dummy variable that takes the value 1 if the school closure is declared. Gathering restriction is the dummy variable that takes the value 1 if the large-scale gathering restriction is declared. For the variables that take absolute value 0 (New infection cases (1 week lag), log, Cumulative GZ-certified restaurants, log, Cumulative GZ-certified restaurants and hotels, log, Infectious, log, and Tests (1 week lag), log), we add value 1 before log-transforming to avoid the logarithm of 0.

D.3 Economic effects (restaurants' sales and the number of customers)

Table 4: Restaurants' sales and customers (POS) and the Green Zone certification

	Dependent variable:							
	Sales per restaurant, log				Customers per restaurant, log			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cumulative GZ-certified restaurants, log	0.018***	0.016***	0.016***	0.016***	0.040***	0.037***	0.037***	0.037***
	(0.002)	(0.003)	(0.004)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)
State of Emergency	−0.267***	−0.264***	−0.257***	−0.261***	−0.223***	−0.219***	−0.217***	−0.219***
	(0.018)	(0.017)	(0.014)	(0.037)	(0.032)	(0.030)	(0.030)	(0.040)
The number of new COVID-19 cases, log		−0.013	−0.015	−0.015		−0.017	−0.018	−0.018
		(0.010)	(0.011)	(0.011)		(0.012)	(0.013)	(0.012)
Average temperature, log			0.296*	0.298*			0.188*	0.187*
			(0.129)	(0.128)			(0.089)	(0.091)
Average rainfall, log			−0.007	−0.007			−0.012**	−0.012**
			(0.005)	(0.005)			(0.004)	(0.004)
School closure				0.085				−0.062
				(0.108)				(0.072)
Gathering restriction				0.004				0.002
				(0.041)				(0.035)
Prefecture FE	X	X	X	X	X	X	X	X
Day FE	X	X	X	X	X	X	X	X
Observations	5,106	5,106	5,106	5,106	5,106	5,106	5,106	5,106
R^2	0.935	0.935	0.935	0.935	0.947	0.947	0.947	0.947
Adjusted R^2	0.921	0.922	0.922	0.922	0.936	0.936	0.937	0.937

Notes: *p<0.1; **p<0.05; ***p<0.01 The dependent variable is the log-transformed value of POS sales per restaurant and the number of customers per restaurant. The unit of analysis is prefecture and day, and the fixed effects are introduced in all models. For the observations, six prefectures are targeted, and the period of analysis is for 912 days from January 1st, 2019 to April 30th, 2021. The values in parentheses are cluster-robust standard errors. Clustering is at the prefecture level. Cumulative GZ-certified restaurants, log is the log-transformed value of the number of cumulative certified-GZ restaurants. State of Emergency is the dummy variable that takes the value 1 if the state of emergency is declared. The number of new COVID-19 cases, log is the log-transformed value of the daily number of infection cases. Average temperature, log is the log-transformed value of the mean temperature (Fahrenheit degrees). Average rainfall, log is the log-transformed value of the aggregated rainfall (in millimeters). School closure is the dummy variable that takes the value 1 if the school closure is declared. Gathering restriction is the dummy variable that takes the value 1 if the large-scale gathering restriction is declared. For the variables that take absolute value 0 (Cumulative GZ-certified restaurants, log, and The number of new COVID-19 cases, log), we add value 1 before log-transforming to avoid the logarithm of 0.

D.4 Restaurant information views online

Table 5: Restaurant information views online (percentage change) and the Green Zone certification

	Dependent variable:		
	Restaurant information views online (percentage change)		
	(1)	(2)	(3)
Cumulative GZ-certified restaurants, log	1.900***	1.497***	1.297***
	(0.252)	(0.253)	(0.308)
State of Emergency	−3.842**	−4.281**	−8.499**
	(1.164)	(1.390)	(2.792)
The number of new COVID-19 cases, log		−1.709**	−1.984***
		(0.449)	(0.466)
Average temperature, log		−25.388	−24.386
		(17.074)	(17.322)
Average rainfall, log		−0.372	−0.517
		(0.480)	(0.512)
School closure			6.563**
			(2.242)
Gathering restriction			4.808
			(4.042)
The mean of dep. variable in Yamanashi Prefecture		-21.052	
The mean of dep. variable in the control group		-22.641	
Prefecture FE	X	X	X
Week FE	X	X	X
Observations	408	408	408
R^2	0.947	0.950	0.953
Adjusted R^2	0.935	0.939	0.941

Notes: *p<0.1; **p<0.05; ***p<0.01 The dependent variable is the percentage change in the number of restaurant information views online compared to the 2019 baseline (V-RESAS). The unit of analysis is prefecture-week, and the fixed effects are introduced in all models. For the observations, six prefectures are targeted, and the period of analysis is for 68 weeks from the third week of January, 2020 to the fifth week of April, 2021. The values in parentheses are cluster-robust standard errors. Clustering is at the prefecture level. Cumulative GZ-certified restaurants, log is the log-transformed value of the number of cumulative certified-GZ restaurants. State of Emergency is the dummy variable that takes the value 1 if the state of emergency is declared. The number of new COVID-19 cases, log is the log-transformed value of the daily number of infection cases. Average temperature, log is the log-transformed value of the mean temperature (Fahrenheit degrees). Average rainfall, log is the log-transformed value of the aggregated rainfall (in millimeters). School closure is the dummy variable that takes the value 1 if the school closure is declared. Gathering restriction is the dummy variable that takes the value 1 if the large-scale gathering restriction is declared. For the variables that take absolute value 0 (Cumulative GZ-certified restaurants, log, and The number of new COVID-19 cases, log), we add value 1 before log-transforming to avoid the logarithm of 0.

D.5 Human mobility by facility type

Table 6: Human mobility by facility type and the Green Zone certification

	Dependent variable:											
	retail/recreation		grocery/pharmacy		parks		transit stations		workplaces		residential	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Cumulative GZ-certified restaurants, log	0.372***	0.366***	0.051	0.099	2.804***	3.138***	0.448***	0.548**	−0.029	−0.003	−0.061***	−0.060***
	(0.042)	(0.045)	(0.038)	(0.062)	(0.101)	(0.346)	(0.051)	(0.180)	(0.051)	(0.048)	(0.013)	(0.006)
State of Emergency	−3.992***	−3.890***	−0.245	−0.393	4.231	5.191	−2.007	−1.387	−1.410***	−1.282***	1.006***	0.964***
	(0.583)	(0.421)	(0.468)	(0.357)	(4.044)	(3.188)	(2.514)	(2.132)	(0.343)	(0.258)	(0.234)	(0.171)
The number of new COVID-19 cases, log		−0.180		0.121		0.538		0.127		0.031		0.060*
		(0.107)		(0.129)		(0.972)		(0.527)		(0.070)		(0.029)
Average temperature, log		8.489**		5.912**		74.310***		27.060**		6.769**		−3.482**
		(2.193)		(1.679)		(7.775)		(7.974)		(1.881)		(0.989)
Average rainfall, log		−0.769***		−1.084***		−4.338***		−0.653		−0.261***		0.298***
		(0.101)		(0.088)		(0.520)		(0.329)		(0.061)		(0.031)
Prefecture FE	X	X	X	X	X	X	X	X	X	X	X	X
Date FE	X	X	X	X	X	X	X	X	X	X	X	X
Observations	2,646	2,646	2,646	2,646	2,627	2,627	2,646	2,646	2,646	2,646	2,646	2,646
R^2	0.965	0.967	0.897	0.910	0.837	0.860	0.899	0.905	0.991	0.991	0.984	0.987
Adjusted R^2	0.958	0.961	0.876	0.891	0.803	0.830	0.879	0.885	0.989	0.989	0.981	0.984

Notes: *p<0.1; **p<0.05; ***p<0.01 The dependent variable is the percent change in human flow for a given facility type compared to the January 2020 baseline (Google Mobility). The unit of analysis is prefecture and day, and the fixed effects are introduced in all models. For the observations, six prefectures are targeted, and the period of analysis is for 441 days from February 15th, 2020 to April 30, 2021. The values in parentheses are cluster-robust standard errors. Clustering is at the prefecture level. Cumulative GZ-certified restaurants, log is the log-transformed value of the number of cumulative certified-GZ restaurants. State of Emergency is the dummy variable that takes the value 1 if the state of emergency is declared. The number of new COVID-19 cases, log is the log-transformed value of the daily number of infection cases. Average temperature, log is the log-transformed value of the mean temperature (Fahrenheit degrees). Average rainfall, log is the log-transformed value of the aggregated rainfall (in millimeters). School closure is the dummy variable that takes the value 1 if the school closure is declared. Gathering restriction is the dummy variable that takes the value 1 if the large-scale gathering restriction is declared. For the variables that take absolute value 0 (Cumulative GZ-certified restaurants, log, and The number of new COVID-19 cases, log), we add value 1 before log-transforming to avoid the logarithm of 0.

D.6 Inter-regional Mobility

Table 7: Inter-regional mobility and the Green Zone certification

	Dependent variable:								
	intracity			intercity			interprefectural		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Cumulative GZ-certified restaurants, log	-0.115^{***}	-0.106^{***}	-0.109^{***}	0.224^{**}	0.177^{*}	0.204^{*}	1.055^{***}	1.132^{***}	0.788^{***}
	(0.022)	(0.026)	(0.024)	(0.060)	(0.081)	(0.083)	(0.163)	(0.148)	(0.148)
State of Emergency	0.630^{**}	0.589^{**}	0.533^{**}	-5.249^{***}	-5.128^{***}	-4.586^{***}	−0.125	−0.212	-7.466^{*}
	(0.240)	(0.166)	(0.190)	(0.585)	(0.459)	(0.589)	(2.457)	(2.680)	(2.932)
The number of new COVID-19 cases, log		0.050	0.046		−0.254	−0.220		0.424	−0.050
		(0.050)	(0.047)		(0.177)	(0.178)		(0.466)	(0.371)
Average temperature, log		−1.461	−1.465		6.131	6.090		−10.450	−8.691
		(1.701)	(1.705)		(3.778)	(3.707)		(16.018)	(16.521)
Average rainfall, log		0.007	0.005		−0.167	−0.149		0.552	0.303
		(0.107)	(0.108)		(0.317)	(0.319)		(0.735)	(0.743)
School closure			−0.124			0.231			11.736^{***}
			(0.184)			(0.850)			(1.441)
Gathering restriction			0.062			−0.611			8.271^{**}
			(0.145)			(0.354)			(3.190)
Mean of Mobility in Yamanashi		5.49			-7.079			-27.778	
Mean of Mobility in Control		5.165			-7.584			-27.881	
Prefecture FE	X	X	X	X	X	X	X	X	X
Week FE	X	X	X	X	X	X	X	X	X
Observations	408	408	408	408	408	408	408	408	408
R^2	0.980	0.980	0.980	0.963	0.963	0.963	0.942	0.943	0.949
Adjusted R^2	0.975	0.975	0.975	0.954	0.955	0.955	0.929	0.929	0.936

Notes: *p<0.1; **p<0.05; ***p<0.01 The dependent variable is the percentage change in inter-regional human flow (within a city, within a prefecture, and across prefectures) compared to the 2019 baseline (V-RESAS). The unit of analysis is prefecture and week, and the fixed effects are introduced in all models. For the observations, six prefectures are targeted, and the period of analysis is for 68 weeks from the third week of January, 2020 to the fifth week of April, 2021. The values in parentheses are cluster-robust standard errors. Clustering is at the prefecture level. Cumulative GZ-certified restaurants, log is the log-transformed value of the number of cumulative certified-GZ restaurants. State of Emergency is the dummy variable that takes the value 1 if the state of emergency is declared. The number of new COVID-19 cases, log is the log-transformed value of the daily number of infection cases. Average temperature, log is the log-transformed value of the mean temperature (Fahrenheit degrees). Average rainfall, log is the log-transformed value of the aggregated rainfall (in millimeters). School closure is the dummy variable that takes the value 1 if the school closure is declared. Gathering restriction is the dummy variable that takes the value 1 if the large-scale gathering restriction is declared. For the variables that take absolute value 0 (Cumulative GZ-certified restaurants, log, and The number of new COVID-19 cases, log), we add value 1 before log-transforming to avoid the logarithm of 0.

D.7 Stay-home rate

Table 8: The stay-home rate by male age group and the Green Zone certification

	Dependent variable:						
	Male 15-19 y/o	Male 20s	Male 30s	Male 40s	Male 50s	Male 60s	Male 70s
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cumulative GZ-certified restaurants, log	0.003**	−0.002**	−0.003***	−0.002***	−0.002***	−0.003*	−0.003**
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
State of Emergency	0.003	0.011**	0.020***	0.013***	0.011***	0.028***	−0.018*
	(0.016)	(0.003)	(0.003)	(0.003)	(0.002)	(0.006)	(0.008)
The number of new COVID-19 cases, log	0.001	0.004**	0.003*	0.002*	0.002*	0.000	0.005**
	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Average temperature, log	0.027	−0.039	−0.027	−0.013	−0.015	−0.084	−0.128*
	(0.050)	(0.024)	(0.039)	(0.039)	(0.027)	(0.048)	(0.062)
Average rainfall, log	0.009*	0.002*	0.004***	0.006***	0.006***	0.008***	0.015***
	(0.004)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.002)
School closure	0.007	0.019*	0.017**	0.007	0.012**	0.024	0.024
	(0.050)	(0.008)	(0.005)	(0.005)	(0.004)	(0.015)	(0.013)
Gathering restriction	0.040**	0.005	0.014***	0.011***	0.011***	0.012**	0.021***
	(0.013)	(0.004)	(0.003)	(0.002)	(0.002)	(0.003)	(0.004)
Prefecture FE	X	X	X	X	X	X	X
Day FE	X	X	X	X	X	X	X
Observations	2,694	2,694	2,694	2,694	2,694	2,694	2,694
R^2	0.925	0.931	0.950	0.964	0.964	0.959	0.947
Adjusted R^2	0.910	0.917	0.940	0.956	0.957	0.951	0.936

Notes: *p<0.1; **p<0.05; ***p<0.01 The dependent variable is the day-time (from 9 am to 6 pm) stay-home rate for males, which indicates the percentage of people who refrain from going out compared to the baseline value; the closer to 1, the more people refrain from going out, and the closer to 0, the more people go out. The unit of analysis is prefecture and day, and the fixed effects are introduced in all models. For the observations, six prefectures are targeted, and the period of analysis is for 449 days from January 1st, 2020 to March 24th, 2021. The values in parentheses are cluster-robust standard errors. Clustering is at the prefecture level. Cumulative GZ-certified restaurants, log is the log-transformed value of the number of cumulative certified-GZ restaurants. State of Emergency is the dummy variable that takes the value 1 if the state of emergency is declared. The number of new COVID-19 cases, log is the log-transformed value of the daily number of infection cases. Average temperature, log is the log-transformed value of the mean temperature (Fahrenheit degrees). Average rainfall, log is the log-transformed value of the aggregated rainfall (in millimeters). School closure is the dummy variable that takes the value 1 if the school closure is declared. Gathering restriction is the dummy variable that takes the value 1 if the large-scale gathering restriction is declared. For the variables that take absolute value 0 (Cumulative GZ-certified restaurants, log, and The number of new COVID-19 cases, log), we add value 1 before log-transforming to avoid the logarithm of 0.

Table 9: The stay-home rate by female age group and the Green Zone certification

	Dependent variable:						
	Female 15-19 y/o	Female 20s	Female 30s	Female 40s	Female 50s	Female 60s	Female 70s
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cumulative GZ-certified restaurants, log	−0.002	−0.002	−0.003**	−0.002***	−0.001*	−0.002***	−0.003**
	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
State of Emergency	−0.009	0.009	0.011	0.012**	0.020***	0.019***	0.023**
	(0.015)	(0.006)	(0.006)	(0.004)	(0.005)	(0.003)	(0.007)
The number of new COVID-19 cases, log	0.002	0.002	0.003	0.002	0.002	0.003**	0.004*
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)
Average temperature, log	0.006	−0.063	−0.024	0.006	−0.022	−0.032	−0.136*
	(0.062)	(0.038)	(0.051)	(0.029)	(0.028)	(0.043)	(0.057)
Average rainfall, log	0.006*	0.004***	0.006***	0.006***	0.006***	0.007***	0.012***
	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
School closure	0.007	0.025	0.016	0.006	0.015**	0.009	0.012
	(0.052)	(0.016)	(0.010)	(0.014)	(0.005)	(0.016)	(0.012)
Gathering restriction	0.048***	0.005	0.014***	0.014***	0.009***	0.009***	0.019***
	(0.011)	(0.004)	(0.003)	(0.002)	(0.002)	(0.002)	(0.004)
Prefecture FE	X	X	X	X	X	X	X
Day FE	X	X	X	X	X	X	X
Observations	2,694	2,694	2,694	2,694	2,694	2,694	2,694
R^2	0.936	0.943	0.960	0.966	0.966	0.961	0.948
Adjusted R^2	0.922	0.931	0.951	0.959	0.959	0.953	0.938

Notes: *p<0.1; **p<0.05; ***p<0.01 The dependent variable is the day-time (from 9 am to 6 pm) stay-home rate for females, which indicates the percentage of people who refrain from going out compared to the baseline value; the closer to 1, the more people refrain from going out, and the closer to 0, the more people go out. The unit of analysis is prefecture and day, and the fixed effects are introduced in all models. For the observations, six prefectures are targeted, and the period of analysis is for 449 days from January 1st, 2020 to March 24th, 2021. The values in parentheses are cluster-robust standard errors. Clustering is at the prefecture level. Cumulative GZ-certified restaurants, log is the log-transformed value of the number of cumulative certified-GZ restaurants. State of Emergency is the dummy variable that takes the value 1 if the state of emergency is declared. The number of new COVID-19 cases, log is the log-transformed value of the daily number of infection cases. Average temperature, log is the log-transformed value of the mean temperature (Fahrenheit degrees). Average rainfall, log is the log-transformed value of the aggregated rainfall (in millimeters). School closure is the dummy variable that takes the value 1 if the school closure is declared. Gathering restriction is the dummy variable that takes the value 1 if the large-scale gathering restriction is declared. For the variables that take absolute value 0 (Cumulative GZ-certified restaurants, log, and The number of new COVID-19 cases, log), we add value 1 before log-transforming to avoid the logarithm of 0.

Table 10: The night-time stay-home rate and the Green Zone certification

	Dependent variable:		
	Night-time stay-home rate		
	(1)	(2)	(3)
Cumulative GZ-certified restaurants, log	-0.004^{***}	-0.003^{**}	-0.004^{***}
	(0.001)	(0.001)	(0.001)
State of Emergency	0.086^{***}	0.088^{***}	0.070^{***}
	(0.014)	(0.015)	(0.017)
The number of new COVID-19 cases, log		0.005	0.004
		(0.003)	(0.003)
Average temperature, log		0.023	0.024
		(0.031)	(0.032)
Average rainfall, log		0.009^{***}	0.009^{***}
		(0.002)	(0.002)
School closure			-0.001
			(0.004)
Gathering restriction			0.021^{*}
			(0.010)
Prefecture FE	X	X	X
Day FE	X	X	X
Observations	2,724	2,724	2,724
R^2	0.947	0.948	0.948
Adjusted R^2	0.937	0.937	0.938

Notes: *p<0.1; **p<0.05; ***p<0.01 The dependent variable is the night-time (from 8pm to 0am) stay-home rate, which indicates the percentage of people who refrain from going out compared to the baseline value; the closer to 1, the more people refrain from going out, and the closer to 0, the more people go out. The unit of analysis is prefecture and day, and the fixed effects are introduced in all models. For the observations, six prefectures are targeted, and the period of analysis is for 454 days from January 1st, 2020 to March 29th, 2021. The values in parentheses are cluster-robust standard errors. Clustering is at the prefecture level. Cumulative GZ-certified restaurants, log is the log-transformed value of the number of cumulative certified-GZ restaurants. State of Emergency is the dummy variable that takes the value 1 if the state of emergency is declared. The number of new COVID-19 cases, log is the log-transformed value of the daily number of infection cases. Average temperature, log is the log-transformed value of the mean temperature (Fahrenheit degrees). Average rainfall, log is the log-transformed value of the aggregated rainfall (in millimeters). School closure is the dummy variable that takes the value 1 if the school closure is declared. Gathering restriction is the dummy variable that takes the value 1 if the large-scale gathering restriction is declared. For the variables that take absolute value 0 (Cumulative GZ-certified restaurants, log, and The number of new COVID-19 cases, log), we add value 1 before log-transforming to avoid the logarithm of 0.

E Treatment Effect

E.1 Comparison of Treatment and Control prefecture

	Yamanashi	Shizuoka	Tochigi	Nagano	Gunma	Ibaraki
Population (in thousands)	811	3,644	2,049	1,942	1,934	2,860
Population density ($/km^2$) *	4,668	5,267	4,244	3,997	4,691	4,570
Distance to Tokyo (km)	101.7	142.8	172.8	96.4	98.8	99.3

Notes: Population and population density are from the 2019 and 2014 National Census, respectively. For distance to Tokyo, see "Distance between Prefectural Offices" by the Geospatial Information Authority of Japan. *In prefectures in the Tokyo metropolitan area that are excluded from the control group, population density is about two to three times that of Yamanashi. In particular, the population densities of Tokyo, Kanagawa, Saitama, and Chiba prefectures are 12,022, 8,979, 8,340, and 7,145 persons/km^2, respectively.

E.2 Comparison of policies in Treatment and Control prefecture

	Yamanashi	Shizuoka	Tochigi	Nagano	Gunma	Ibaraki
Title of the certification policy	Yamanashi Green Zone Certification	Fujinokuni Safety and Security Certification	Tochimaru Reliable Certification	Shinshu Safe Store Certification System	Stop Covid-19! Countermeasure Certification System	Ibaraki's Amabie-chan
Introduction date	May 2020	May 2021	May 2021	April 2021	July 2020	June 2020
Third-party onsite inspection requirements	Yes	Yes	Yes	Yes	Yes	Yes (from April 14, 2021)
Subsidies on indoor infection control measures	From July 10, 2020	Only in Hamamatsu City	From January 22, 2021	From September 15, 2020 – December 28, 2020	Only in Maebashi City	From October 2, 2020 to December 31, 2020
Prefectural/municipal support on the introduction of delivery services	In certain cities	From April 17, 2020	From January 22, 2021	From September 15, 2020 – December 28, 2020	Only in Maebashi City	In certain cities

Notes: Prepared by the authors with reference to prefectures' press releases and newspaper articles. Gunma Prefecture introduced a certification system around the same time as Yamanashi, but the penetration rate remains 21.6% as of October 2020 (see Reference List 17–35).

E.3 List of Business suspension request

	First Emergency Declaration (April 2020 – May 2020)	Second Emergency Declaration (January 2021 – March 2021)	Third Emergency Declaration (April 2021 – June 2021)
Yamanashi	April 20 – May 14 (business closure on bars and nightclubs) May 15 – February 12 (qualified facilities were individually exempted)	January 25 – February 7	No
Shizuoka	April 25 – May 17 (bars and nightclubs only)	December 23 – January 5 (only in Fuji City)	May 19 – June 1 (only in Kosai City)
Tochigi	April 18 – May 15 (restriction on alcohol service hours only)	January 8 – February 21 (in specified cities until January 12)	No
Nagano	April 23 – May 15	January 18 – February 4 (in specified cities)	April 2 – 9 (Nagano City) April 21 – 29 (in specified cities)
Gunma	April 18 – May 15	December 15 – March 1 (in specified cities)	May 8 – June 20
Ibaraki	April 18 – May 17 (bars and nightclubs only)	November 30 – December 20, January 6 – 17 (in specified cities) January 18 – February 22 (entire Prefecture)	April 22 – June 16 (in specified cities)

Notes: Prepared by the authors with reference to each prefecture's official website and newspapers (see Reference List 36–64).

E.4 Yamanashi Green Zone Certification criteria

Standards pertaining to measures for prevention of infectious diseases (Restaurant industry)

E.4.1 Prevention of infectious diseases among visitors

(1) Store entry, order, and payment

- Disinfection equipment shall be installed at the entrance of the store, and hand sanitization shall be indicated at the entrance.
- When there is a queue due to waiting for a turn, etc., a minimum distance of 1 meter (2 meters if no mask is worn) shall be maintained between visitors.
- When serving customers face-to-face at the cash register, etc., use acrylic panels, transparent vinyl curtains, partitions, etc. to shield the customers. In addition, use coin trays or introduce cashless payment.
- Those with fever (e.g., 1 degree above normal), cold symptoms (e.g., cough, sore throat), vomiting, diarrhea, etc., even if they have mild symptoms, should not be admitted.
- Make it known that people should wear masks except when eating or drinking, and request that people wash their hands and disinfect their hands regularly.
- Remind people to practice good cough etiquette.
- If there is an elevator, limit the number of passengers by adjusting the weight sensor of the elevator. Capacity:______, Passenger limit:_____
- If there is a pick-up truck, shield the driver's seat and rear seat of the pick-up truck with an acrylic plate or transparent vinyl curtain.

(2) Meals and in-store use

[One of these must be met for placement between tables]

- Tables used by the same group and tables used by other groups should be placed so that there is at least 1 meter of interpersonal distance between them.
  - Table-to-table distance: _____ m
- Use acrylic panels, transparent plastic curtains, partitions, etc. to shield the space between tables used by the same group and tables used by other groups.

[One of the following conditions must be met for placement on the same table]

Exclude cases where a small number of family members, elderly people with caregivers, infants, disabled people, etc. wish to sit face-to-face.

- Do not place seating directly in front of each other. Seating should be arranged so that the distance between seats is at least 1 meter. Seat-to-seat distance: _____m.
- Install partitions on tables to shield them.

- Avoid having too many people at the same time by limiting the length of stay* and using a reservation system. (*Approximately 2 hours).

- Avoid large plates and serve food individually, or have employees serve the food.

[In buffet style, one of the following must be met]

- A new small plate should be used by each user for each serving, and food and drinks should be protected by covers to prevent splashing, and masks, disposable gloves, etc. should be worn when serving. When serving, make sure to wear masks, disposable gloves, etc., and do not share tongs or chopsticks for serving.
- Serve food on small plates or have staff serve food.

- Avoid setting up common tabletop condiments, pots, etc., or disinfect them when changing customers.
- Remind customers not to share or use spoons, chopsticks, or other utensils.
- Reduce the volume of background music in the store and remind customers to avoid loud conversations.
- Coughing etiquette should be strictly observed. (For ventilation standards, see "3. Hygiene Management of Facilities and Equipment" for ventilation standards).
- If the toilet has a lid, indicate that waste should be flushed after the lid is closed.
- Indicate that people should wash their hands and disinfect their hands after using the restroom.
- If there is a smoking area, reduce the number of people using it at one time, and keep a distance between people. If there is a smoking area, request that the three densities be avoided by reducing the number of people using the area at once, keeping a good distance between people, etc.
    - Size of the smoking space: ________ m^2 Maximum capacity: ________

E.4.2 Prevention of infectious diseases among employees

- Make sure to wear masks.
- Take your temperature and check your physical condition before starting work.
- If there are multiple rooms, limit per smoking space. If you have a fever (e.g., more than 1 degree above normal), a cold (cough, sore throat, etc.), vomiting, diarrhea, or other symptoms, even if they are mild. symptoms such as vomiting or diarrhea.
- Employees who are infected or suspected to be infected, or who are judged to be in close contact with infected employees, are prohibited from working. Employees who are infected, suspected to be infected, or determined to be a close contact shall not be allowed to work.
- Hand disinfection and hand washing are to be performed regularly at the beginning of work, after touching areas or items that come into contact with others, after cleaning, and after using the toilet.
- When accepting orders from users or serving food, be careful not to stand in front of users and maintain a safe distance from them.
- In the break area, reduce the number of people taking a break at one time, and avoid eating and talking face-to-face.
- Ventilate the break area at all times (for ventilation standards, refer to "3. Thorough hygiene management of facilities and equipment") and disinfect shared items on a regular basis.
- Employees' uniforms should be laundered regularly after work on the day in question.
    - Frequency of uniform washing: ____________

E.4.3 Thorough hygiene management of facilities and equipment

- For facilities subject to the Building Management Law*, check whether they meet the standards for air quality control based on the law, and if not, maintain and manage the ventilation equipment appropriately, including cleaning and maintenance.
  - * Law Concerning the Protection of Sanitary Environments in Buildings

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[For facilities not covered by the Building Management Law, one of the following must be met]

- The required ventilation volume (30 m^3 per hour per person) shall be secured by ventilation equipment. If the required ventilation volume is not enough, the ventilation system shall be installed.
- If the required ventilation volume is not sufficient, adjust the number of people entering the store to secure the required ventilation volume per person, and properly maintain the ventilation equipment, including cleaning and maintenance.
- For ventilation by opening windows, open all windows in two directions (or open the door if there is only one window) once every 30 minutes for about 5 minutes to ensure sufficient ventilation.

[Appeal items] This is not a mandatory requirement for certification, but it is an item that can be appealed as a voluntary effort by the business.

- The details of ventilation (air flow) in common areas where people are crowded in the facility are clearly shown.
- In order to secure the required amount of ventilation per person in a densely populated common area in the facility, the ventilation system should be designed for each area.
  - (In the case of limiting the number of persons to ensure the required ventilation volume) Ventilation volume: m^3/hour ÷ 30 m^3/person/hour = _____person

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- Prohibit the use of hand dryers and common towels, and provide paper towels or encourage the use of personal towels.
- Wipe down and disinfect items shared with others and areas that are touched by multiple people regularly, such as when changing users, using disinfecting ethanol, sodium hypochlorite, or commercially available detergents containing surfactants.
  - [areas shared with others in the restaurant industry and frequently touched]
    - Tables, chairs, menu books, condiments, drink bars, doorknobs, light switches, touch panels, tabletop bells, cash registers, faucets, handrails, toilet seats, washing levers, coin trays, ticket vending machines, elevator buttons, etc.

[Appeal items]

- In order to reduce the risk of contact and droplet infections, the following measures should be taken to avoid overlapping lines of flow for users. Describe in detail: ________________________

- Those who collect garbage should wear masks and gloves, and always wash their hands after work.
- Garbage, hand towels, etc. that may have food residue, snot, saliva, etc. on them should be sealed in plastic bags. sealed in a plastic bag for disposal.

E.4.4 Preparation and publication of checklists

- Each facility or business operator shall prepare a checklist that specifies specific methods and procedures, frequency of cleaning and disinfection, spacing between people, etc., after assessing the risks in the facility, and disclose the daily checks using the checklist.

E.4.5 Policy for dealing with an outbreak of infection

- In the event that an employee of the facility is found to be infected, the facility will respond and cooperate with the public health center's instructions and investigations in a sincere and proactive manner, take measures to prevent the spread of infection from the facility, and if necessary, publicize information to prevent the spread of infection, such as business days when there is a possibility of infection.
- Provide employees with training opportunities to ensure that they are taking appropriate actions to prevent the spread of infection, such as refraining from going to work if they are suspected of being infected until the test results are known.
- If the results of a proactive epidemiological survey conducted by the public health center reveal that an infected person has been using the facility in question, take measures to prevent the spread of infection through the facility in question by responding and cooperating with the public health center's advice and instructions in good faith and proactively.

[Appeal Items]

- In order to identify the risk of infection at an early stage, employees should be encouraged or required to use an application for notification of close contact provided by the government.
- In addition to the above, introduce a system for early identification of infection risk.

Describe in detail: ____________________

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