UHERO
THE ECONOMIC RESEARCH ORGANIZATION AT THE UNIVERSITY OF HAWAI'I

The effects of COVID-19 vaccine mandates in Hawai'i

by

Ruben Juarez, Nicole Siegal, and Alika Maunakea

Working Paper No. 2022-1

January 6, 2022

The effects of COVID-19 vaccine mandates in Hawai'i

Ruben Juarez,[1][*] **Nicole Siegal,**[1] **Alika Maunakea**[2]

[1]University of Hawai'i - Mānoa, Department of Economics and UHERO
Honolulu, 96822, U.S.A.
[2]University of Hawai'i - Mānoa, John A. Burns School of Medicine
Honolulu, 96822, U.S.A.
[*]Corresponding author; E-mail: rubenj@hawaii.edu

ABSTRACT

Having been affected by the highest increase in COVID-19 cases since the start of the pandemic, Honolulu and Maui counties in Hawai'i implemented vaccine passport mandates for select industries in September 2021. Herein, we describe the effects of these mandates on three areas: (1) changes in foot traffic for businesses affected by mandates in comparison to businesses unaffected by the mandates; (2) changes in the number of COVID-19 cases per 100,000 and (3) COVID-19 vaccination rate increases across counties affected by mandates in comparison to counties that were unaffected by the mandates. Although businesses affected by mandates experienced a 4.0% decrease of foot traffic in the 10 weeks after the mandates were implemented, the number of COVID-19 cases significantly decreased (47.3%, $p < 0.01$), and the vaccination rate significantly increased (1.47%, $p < 0.05$) in counties that implemented mandates. As the trend of foot traffic towards the end of this period indicates impacted businesses converging towards the levels of non-impacted businesses, the trade-off in temporary losses during the adjustment period is met with significant gains in public health and safety.

Introduction

Faced with the largest increase in cases since the beginning of the COVID-19 pandemic, on September 13, 2021, the counties of Honolulu and Maui in the state of Hawai'i mandated that customers and employees of establishments in the food and beverage, fitness, and entertainment industries provide proof of full vaccination or a recent negative COVID-19 test. [1] This is sometimes referred to as a "vaccine or test passport." Some business owners did not approve of the measure, fearing further losses as those seen at the beginning of the pandemic [2], when there was a 22% decline in the number of active small businesses in the U.S. from February to

1

April of 2020. [3] Previous reports from previous safety mandates have demonstrated decreased spread of COVID-19, such as in states with face mask mandates that observed a 2.0% decrease in cases over 21 days after implementation from March to May 2020. [4] However, the impacts of other public health mandates such as for COVID-19 vaccines has yet to be reported. In order to evaluate the degree to which vaccine mandates impacted businesses and COVID-19 mitigation efforts we analyzed data in Hawaii as it was the first state in the U.S. to implement vaccine mandates during the pandemic.

Specifically, we evaluated the impacts on the 7-day average daily foot traffic to a panel of nearly 20,000 businesses, the 7-day average daily new COVID-19 cases per 100,000 individuals, and the weekly vaccination rate increases in the state using a difference-in-difference regression. We found that businesses that required employees and customers to be vaccinated (or regularly tested for COVID-19) experienced a significant decrease in foot traffic compared to those not required in the 10 weeks following the implementation of the vaccine mandate. We also found that the counties that implemented this mandate (Honolulu and Maui counties) experienced a significantly lower rate of new COVID-19 cases per 100,000 than those that did not implement the same measures (Kauai and Hawai'i counties). Finally, we observed that counties with the mandates had a significantly higher rate in the weekly increases of the adult vaccination rate compared to counties without a mandate. These results held when including controls for flight passenger arrivals and fixed effects for businesses, counties, days, and day-of-the-week.

In part as a result of the COVID-19 vaccine mandate, 96% of adults in Hawai'i have been vaccinated as of December 1, 2021, surpassing every state in the U.S. [5] Although some businesses suffered an initial loss due to decreased number of customers in the early stage of the mandates, the increased safety of individuals and promotion of public health later allowed them to return to normal operations. As the trend for COVID-19 cases decreased and vaccination of adults increased, Hawai'i counties allowed businesses under these mandates to loosen capacity

restrictions. [6] Overall, our results show that the benefits of the vaccine mandates to public health safety and long-term economic recovery far outweighed the acute disruptions to Hawai'i's businesses.

Results

Noticeable Trends

The state requirement imposed on employees and customers to be either vaccinated or subjected to regular COVID-19 testing, hitherto referred to as the "vaccine mandate", was announced in August 30, 2021 and implemented in September 15, 2021 for businesses in the food, beverage, entertainment, fitness and arts industries located in Honolulu and Maui counties. Businesses located in other counties (Hawai'i and Kauai) were not subjected to this mandate. To measure the impact this mandate on businesses across various sectors, we first focused on daily foot traffic data obtained in collaboration with SafeGraph from August 1 to November 30 2021, summarized in Table 1 and discussed in detail in the Methods section. Of 19,625 individual businesses included in this evaluation, 28.70% were subjected to the vaccine mandate; data from the remaining 71.30% that were not subjected to the mandate were used for comparison. The primary outcome variable measured relevant to businesses is the daily average foot traffic. In addition, two additional variables measured relevant to public health are the 7-day rolling average of new COVID-19 cases per 100,000 and the increase in county vaccination rates of the first dose administered weekly for all adults.

In Figure 1, we show the trends for all three of the outcome variables before and after the mandates or announcement of the mandates. In Figure 1(a), the rolling 7-day average daily foot traffic for businesses impacted and not impacted by the mandates was quite similar prior to implementation. However, once the mandates took effect, there was a lower level of foot traffic in impacted businesses. Towards the end of the 10 weeks following implementation,

it can be seen that impacted businesses had increased foot traffic, returning towards levels similar to those found in non-impacted businesses. Figure 1(b) shows the COVID-19 cases per 100,000 in counties with and without mandates. Prior to implementation, all counties followed a similar trend, including throughout the Delta variant spike just before the mandates began. Once the mandates were in effect, impacted counties had a notably lower level of cases per 100,000. Lastly, in Figure 1(c), we can see that counties with the mandates had a higher weekly vaccination increase throughout the period, with a large increase following the announcement of the mandates, as many individuals prepared for the requirement. In order to capture this uptake, we evaluate vaccinations in later regressions from June 17, 2021, to October 11, 2021.

The mandates' impacts on the trend of foot traffic can be seen in Figure 2(a). Prior to the mandates, both impacted and not impacted businesses saw similar trends in decreasing foot traffic, most likely due to confusion surrounding the start of the requirements and the decreasing number of tourists as summer was ending. In our regressions, we will control for the tourism levels, as well as COVID-19 spikes in cases that may also have impacted the number of visits to businesses. Following the implementation of the mandates, all businesses showed a slow upward trend, with impacted businesses at a lower level of foot traffic than not impacted businesses. This leads us to believe that the mandates initially decreased visits to businesses following its implementation.

Although businesses are shown trending back towards normal levels as more people became accustomed to the mandates and got vaccinated, the impact on the spread of the virus shows the necessity of such a policy, as seen in Figure 2(b). Prior to the mandates, the state was experiencing an increase in cases due to both the Delta variant and increased tourism in the summer months for all counties, with the counties that would implement mandates having a very similar number of cases per 100,000 compared to those which will not. However, once the mandates were in effect, the counties with a mandate showed a lower number of cases per

100,000 than the counties without mandates.

One of the direct goals of the mandates were to increase vaccine uptake in these counties. Prior to the announcement, the weekly increases in the vaccination rate were fairly similar across counties, as seen in Figure 2(c). However, following the announcement of the mandates on August 5, 2021, many individuals chose to become vaccinated. We focus on adults (age 18 or older) in this paper, as the mandates' main focus was on working-age adults and those that frequent bars, restaurants, and gyms.

Regression Results
Impacts of COVID-19 Vaccine or Test Passport Mandates on Foot Traffic

Columns (1)-(4) of Table 2 show the results of the difference-in-differences models described in equations 3 and 4. Across specifications, the difference-in-difference coefficient on the interaction shows that the businesses that fell under the mandates had a significantly $[p < 0.01]$ lower amount of foot traffic compared to the trend seen for not-impacted businesses during this period. This holds when including individual business, county, and day-of-the-week fixed effects. Looking at column (4) which includes all fixed effects, the significant $[p < 0.01]$ coefficient of -0.0461 represents a 4.6% decrease from the trend seen in non impacted businesses, or with an average of 8 visits per day, an average of 0.37 fewer daily visits for impacted businesses.

The other coefficients provide a consistent story as well. There was a small decrease in visits after the mandates went into effect, which may in part be due to some impacted businesses switching from dine-in to takeout and delivery only. Businesses that fell under the mandates had higher daily visits. As the impacted businesses included restaurants, bars, and gyms, they were expected to have many visitors. The daily COVID-19 cases in each county decreased the number of visitors, as individuals may venture out less if they are avoiding infection. Lastly, as expected, the number of flight passenger arrivals in each county increased foot traffic as there were more people, particularly tourists, visiting the various businesses.

Impacts of COVID-19 Vaccine or Test Passport Mandates on COVID-19 Cases per 100,000

Columns (5)-(7) of Table 2 show the results of the difference-in-difference models describing the impacts on the rolling 7-day average COVID-19 cases per 100,000, as described in equations 5 and 6. In each regression, the interaction of counties with mandates and when the mandates were in effect, the difference-in-difference coefficient, was negative and significant [$p < 0.01$]. When including day fixed effects, the post-implementation period saw counties with mandates having 7.1 fewer cases per 100,000 than counties without a mandate. When instead using day-of-the-week fixed effects, this impact was slightly higher at 9.9 fewer cases per 100,000. For reference, this is 47.3-66.0% of the daily average prior to the mandates of 15 cases per 100,000.

Impacts of COVID-19 Vaccine or Test Passport Mandates on Weekly COVID-19 Vaccination Rate Increases

Columns (8)-(13) of Table 2 show the estimates for the difference-in-difference models in equations 7 and 8. In each regression, we see the trend of the weekly vaccination rate increase is positive and significantly [$p > 0.5$] higher in counties with mandates following the announcement than those without mandates. When including weekly fixed effects, the coefficient of 0.157 on the interaction indicates that mandated counties had a vaccination rate 1.41 percentage points higher after 9 weeks due to the announcement of the mandates compared to counties without one.

Discussion

We find strong evidence that the vaccine or test passport mandates implemented in Honolulu and Maui counties in Hawai'i impacted businesses and public health by decreasing daily foot traffic to impacted businesses and decreasing COVID-19 cases per 100,000 and increasing weekly vaccination rates in the impacted counties. While the initial impact on businesses, many of whom struggled throughout the pandemic, may have caused initial losses, the gains to public health through decreasing COVID-19 cases and increasing vaccination as shown in this report

will provide the state with future security and allow it to more quickly return to "business as usual." While this study stops short of evaluating the welfare impact of mandates, the results demonstrate the plausibility that mandates can be welfare increasing inasmuch as the costs of reduced commerce may be offset by a faster return to more normal levels.

As other states around the country implement similar measures or other vaccination incentive programs, Hawai'i's program can provide insight into potential outcomes. The positive impact on public health may influence others to follow suit. However, the resulting decrease in foot traffic must also be acknowledged for businesses. Measures can be taken to limit these losses. It should be noted that many businesses in the food and beverage industry chose to provide only takeout or delivery rather than dine-in options due to the mandates. This would imply decreased foot traffic was not necessarily decreasing revenue at the same rate, as some businesses may sell a similar amount of products for takeout or delivery that groups of customers would have previously eaten at the restaurant.

During the first week of the mandate's implementation, the University of Hawai'i Economic Research Organization (UHERO) surveyed 1,987 businesses throughout the state regarding their support of the mandates, expectations for how it would impact their businesses, and concerns. [2] Of businesses surveyed, 70.50% supported the mandates for employees to be vaccinated or regularly tested, and 61.75% supported the same for customers. The report estimates that the mandates led to an 8.00% increase in vaccination among employees, compared with prior to the mandates. The main concerns cited among businesses included the ability to verify the vaccination or test status of both employees and customers.

As similar policies may be implemented in other states or Hawai'i counties, this survey provides insight into how to combat potential business losses. Nearly half the businesses surveyed reported a need for technical assistance in verifying vaccination or test status, and more than one-third reported a need for further educational material for employees and customers. [2] Future use

of such policies may find it beneficial to provide more information prior to implementation for both businesses and customers. Entities that implement COVID-19 mandates in the future may also wish to provide a way to verify vaccination and testing status beyond manually inspecting vaccination cards and test results.

Our report found that the vaccine or test passport program had a positive impact on public health in the state of Hawai'i. Although this is encouraging in light of mixed results of other vaccination incentive programs ([*7, 8, 9, 10*]), the state of Hawai'i is unique in its geographic location. Being an isolated island, the state has had much more autonomy in determining rules for entrance than mainland states. This evaluation cannot determine spillover effects that may be present in other states that implement similar policies. Additionally, the SafeGraph data used were limited to the individuals who agreed to location tracking and businesses in their panel. Finally, the vaccination data provided to the authors by the State of Hawai'i Department of Health included only vaccines reported to the Vaccine Administration Management System and transferred to the Hawai'i Immunization Registry, which does not include reports from many federal agencies. The non-reporting agencies include the military, which has a large presence in the state of Hawai'i.

The COVID-19 vaccination or test passport program mandated in Honolulu and Maui provides evidence of a positive impact on public health and an initial loss for businesses. The significant $[p < 0.01]$ decrease in both foot traffic and the COVID-19 case positivity rate and the significant $[p < 0.05]$ increase in vaccination rate for impacted businesses and counties provides insight for future programs aimed at combating the pandemic. As these counties have been able to lift other restrictions following this program due to decreasing trends in cases and increasing trends in vaccination [*6*], businesses are likely to regain losses as they invest in the future safety of their communities.

Methods

Data Sources

The data for this report were compiled from five sources. The foot-traffic data was provided by SafeGraph. The data was created from a panel of 20 million devices that collect anonymous location data. All device users gave permission for a variety of mobile apps to track their location. This report uses data for visits to 19,625 businesses in the state of Hawai'i. SafeGraph tracks the number of times a member of their panel enters one of these businesses each day. This data is primarily targeted for use in firms to analyze retail traffic. They also share data with academic researchers. As stated on their website, "SafeGraph, a data company that aggregates anonymized location data from numerous applications in order to provide insights about physical places, via the SafeGraph Community. To enhance privacy, SafeGraph excludes census block group information if fewer than five devices visited an establishment in a month from a given census block group." [11] Other researchers have used this data to analyze social distancing in the pandemic, including studies on how inequality contributes to individuals' ability to social distance. [12, 13] Another study used this data to track movement following the Sturgis motorcycle rally in August, 2020 on the resulting spread of COVID-19. [14]

We match this data by day and county with COVID-19 positive case data provided by the State of Hawai'i Department of Health's Disease Outbreak Control Division. [15] They provide the number of COVID-19 test encounters and number of positive cases. The population data is from the United States Census Bureau estimates from the 2020 Census. [16] We create the new cases per 100,000 rolling 7 day average for each county by dividing the 7 day average of new positive tests by the population over 18 for each county in each day and multiplying by 100,000, using the following formula:

$$CasesPer100,000_{cd} = \frac{7DayAverageNewCases_{cd}}{over18population_c} * 100,000 \tag{1}$$

The weekly vaccination data was provided by the State of Hawai'i, Department of Health (DOH) Disease Outbreak Control Division. [17] This data is unpublished DOH data, derived from the Hawaii Immunization Registry (HIR). These numbers include vaccines administered in the State of Hawai'i reported to the Vaccine Administration Management System and transferred to HIR, as well as doses reported by providers directly to HIR. Some federal agencies have not reported administered doses to either system, so most federal agency doses are not reflected in these counts. These counts are the most accurate and reliable available in the state. The data was provided by week, county, age group, and dose (1, 2, or 3). We focus on initial doses taken by adults. The weekly vaccination rate increase is measured by the number of adults who received their first COVID-19 vaccine divided by the over-18 population for each county and multiplied by 100, as shown in the following formula:

$$VaccinationRateIncrease_{cw} = \frac{NewVaccinations_{cw}}{over18population_c} * 100 \tag{2}$$

Finally, this data is matched again by day and county with the number of airline passanger arrivals. The State of Hawai'i's Department of Business, Economic Development & Tourism provides visitor statistics on the Daily Passenger Count Dashboard. [18] As many businesses and employees in the state depend on tourism, this value is expected to impact both foot traffic and COVID-19 case rates.

Empirical Strategy

To determine the impact of the COVID-19 vaccine or test passport mandates on foot traffic to impacted businesses, COVID-19 cases per 100,000, and the vaccination rate in counties with mandates, we use difference-in-difference regressions.

Foot Traffic Model

The following model is used to evaluate the mandate's impact on foot traffic from August to November of 2021, with the mandates beginning on September 13, 2021:

$$ln(FootTraffic_{idc}) = \beta_0 + \beta_1 t_d + \beta_2 Impacted_i + \beta_3 t_d * Impacted_i +$$
$$\beta_4 ln(CovidCases_{cd}) + \beta_5 ln(Arrivals_{cd}) + \gamma_c + \gamma_{weekday} + e_{idc} \tag{3}$$

and when including individual business fixed effects:

$$ln(FootTraffic_{idc}) = \alpha_0 + \alpha_1 t_d + \alpha_2 t_d * Impacted_i + \alpha_3 ln(CovidCases_{cd})$$
$$+ \alpha_4 ln(Arrivals_{cd}) + \gamma_{weekday} + \gamma_i + e_{idc} \tag{4}$$

Where $FootTraffic_{idc}$ represents the number of visitors to business i on day d in county c. t_d is equal to one on days following the mandates going into effect (September 13, 2021 and after) and equal to zero prior. $Impacted_i$ is equal to one for businesses that fall into the impacted categories, including food, beverage, entertainment, fitness, and the arts. $CovidCases_{cd}$ and $Arrivals_{cd}$ represent the new COVID-19 cases and passenger arrivals in county c on d. γ_c, $\gamma_{weekday}$, and γ_i represent fixed effects for county, day-of-the-week, and individual business, respectively. When including individual business fixed effects, the county and impact status become redundant.

The coefficient on the interaction of post-treatment and impacted business, β_3 and α_2 represent the difference-in-differences coefficients. These represent the change in the trend between impacted businesses and non-impacted businesses following the implementation of the mandates, making this our variable of interest.

COVID-19 Cases per 100,000

We use a similar model to determine the mandate's impact on COVID-19 cases per 100,000 in counties that did and did not implement the mandates. As more recent data was available and to create a balanced panel, data from July 13, 2021 through December 10, 2021 was used in the following regression:

$$CasesPer100,000_{cd} = \delta_0 + \delta_1 t_d + \delta_2 HM_c + \delta_3 t_d * HM_c + \delta_5 ln(Arrivals_{cd}) +$$

$$\gamma_c + \gamma_{weekday} + e_{cd}$$

(5)

and when including daily fixed effects:

$$CasesPer100,000cd = \lambda_0 + \lambda_1 HM_c + \lambda_2 t_d * HM_c + \lambda_5 ln(Arrivals_{cd}) + \gamma_c + \gamma_d + e_{cd} \quad (6)$$

where t_d, $ln(Arrivals_{cd})$, γ_c and $\gamma_{weekday}$ have the same meaning as the prior model. In addition, the variable $CasesPer100,000_{cd}$ represents the rolling 7-day average COVID-19 cases per 100,000 in county c on day d. HM_c is equal to one in counties that have a mandate (Honolulu and Maui) and equal to zero in those without (Kauai and Hawai'i). γ_d represents daily fixed effects. Again, the interaction of post-mandate and impacted observations will provide us the difference-in-differences estimate, coefficients δ_3 and λ_2.

Vaccination Rate Increases

A third difference-in-difference model is deployed to estimate the impact of the mandates on the weekly vaccination rate increases in counties with and without the mandates. As many individuals needed to be vaccinated by the start of the mandates to maintain their current employment or frequent certain establishments, the main impact on vaccination is seen after the announcement of the mandates on August 5, 2021. We estimate this model weekly from June 17, 2021, to October 11, 2021. The following model is used:

$$VaccinationRateIncrease_{cw} = \zeta_0 + \zeta_1 announce_w + \zeta_2 HM_c + \zeta_3 announce_w * HM_c +$$

$$\zeta_4 PosRate_w + \zeta_5 ln(Arrivals_{cw}) + \gamma_c + e_{cw}$$

(7)

and when including week fixed effects:

$$VaccinationRateIncrease_{cw} = \rho_0 + \rho_1 HM_c + \rho_2 announce_w * HM_c + \rho_3 PosRate_w +$$

$$\rho_4 ln(Arrivals_{cw}) + \gamma_c + \gamma_w + e_{cw}$$

(8)

where $ln(Arrivals_{cd})$, HM_c γ_c have the same meaning as the prior models. In addition, the variable $VaccinationRateIncrease_{cw}$ is the increase in the vaccination rate in county c in week w. $announce_w$ is equal to one following the announcement of the mandates (August 5, 2021 and after) and zero prior. γ_w represents weekly fixed effects. The coefficients of interest, ζ_3 and ρ_2, represent the difference-in-difference interaction to estimate the difference in trends between counties with and without mandates, following the announcement.

Software

The summary statistics, regressions, and figures were calculated and created using STATA 13.1 Software.

References

1. Mayor of the City and County of Honolulu. Second amendment to the orderimplementing tier 5 of honolulu's post covid-19 vaccine framework. *Vax-Order*https://www.honolulu.gov/rep/site/may/may_docs/2108156-CCH_Second_Amendment_to_Order_Implementing_Tier_5_certified_-_signed.pdf (2021).

2. Juarez, R., Maunakea, A., Okihiro, M. & Bonham, C. The efficacy of hawaii covid-19 business mandates. *UHERO* https://uhero.hawaii.edu/wp-content/uploads/2021/10/TheEfficacyofHawaiiCOVID-19BusinessMandates.pdf (2021).

3. Fairlie, R. The impact of covid-19 on small business owners: Evidence of early-stage losses from the april 2020 current population survey. Tech. Rep., University of California, Santa Cruz (2020). DOI: 10.3386/w27309.

4. Lyu, W. & Wehby, G. L. Community use of face masks and COVID-19: Evidence from a natural experiment of state mandates in the US. *Heal. Aff.* **39**, 1419–1425, DOI: 10.1377/hlthaff.2020.00818 (2020).

5. New York Times. See how vaccinations are going in your county and state. *mostvax*https://www.nytimes.com/interactive/2020/us/covid-19-vaccine-doses.html (2021).

6. Office of the Governor of Hawai'i. Next phase of state and county covid-19 measures announced. *capacity:2021* https://governor.hawaii.gov/newsroom/office-of-the-news-release-next-phase-of-state-and-county-covid-19-measures-announced/ (2021).

7. Brehm, M., Brehm, P. & Saavedra, M. H. The ohio vaccine lottery and starting vaccination rates. *SSRN Electron. J.* DOI: 10.2139/ssrn.3875021 (2021).

8. Barber, A. & West, J. Conditional cash lotteries increase COVID-19 vaccination rates. *SSRN Electron. J.* DOI: 10.2139/ssrn.3894034 (2021).

9. Walkey, A. J., Law, A. & Bosch, N. A. Lottery-based incentive in ohio and COVID-19 vaccination rates. *JAMA* **326**, 766, DOI: 10.1001/jama.2021.11048 (2021).

10. Dave, D., Friedson, A. I., Hansen, B. & Sabia, J. J. Association between statewide COVID-19 lottery announcements and vaccinations. *JAMA Heal. Forum* **2**, e213117, DOI: 10.1001/jamahealthforum.2021.3117 (2021).

11. SafeGraph. Hawaii patterns data. *FootTraffic* safegraph.com (2021).

12. Zhai, W., Liu, M. & Peng, Z.-R. Social distancing and inequality in the united states amid COVID-19 outbreak. *Environ. Plan. A: Econ. Space* **53**, 3–5, DOI: 10.1177/0308518x20932576 (2020).

13. Chiou, L. & Tucker, C. Social distancing, internet access and inequality. Tech. Rep., Occidental College (2020). DOI: 10.3386/w26982.

14. Dave, D., McNichols, D. & Sabia, J. J. The contagion externality of a superspreading event: The sturgis motorcycle rally and COVID -19. *South. Econ. J.* **87**, 769–807, DOI: 10.1002/soej.12475 (2020).

15. Hawaii Department of Health. Hawaii covid-19 cases and testing. *Cases* https://health.hawaii.gov/coronavirusdisease2019/current-situation-in-hawaii/ (2021).

16. United States Census Bureau. Quick facts hawaii. *Dash* https://www.census.gov/quickfacts/fact/dashboard/hawaiicountyhawaii/PST045219 (2020).

17. Hawaii Department of Health. Daily vaccinations by county, age group, and dose. DOH Unpublished Data (2021).

18. Hawaii Department of Business, Economic Development & Tourism. Daily pax dashboard. *DailyPax* http://dbedt.hawaii.gov/visitor/tourismdata/ (2021).

Acknowledgements

Author contributions statement

R.J. conceived the manuscript, edited final writing and supervised the overall project; N.S. conducted data analysis and the first writing; A.M. reviewed and supported the data analysis; All authors reviewed the manuscript.

Competing Interests

Authors declare that they have no competing interests.

Data and materials availability

All code and data used for this project will be available de-identified.
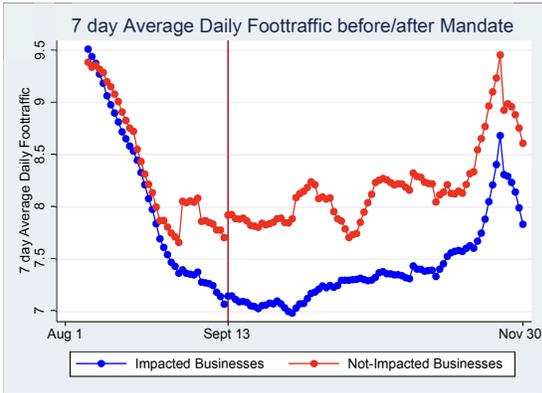
(a) Daily average foot traffic before and after implementation of the mandates, by businesses impacted or not. Impacted businesses include those in food, beverage, entertainment, fitness, and arts.
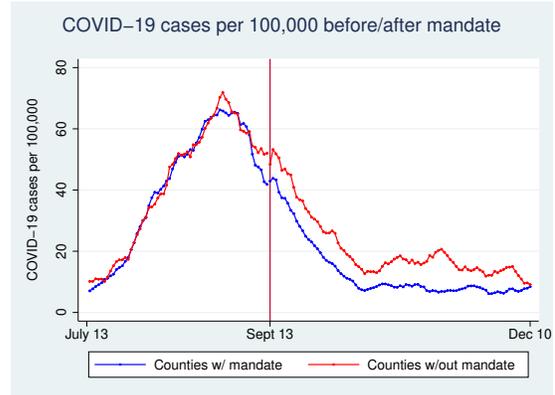
(b) 7-day rolling average of new COVID-19 cases per 100,000 before and after implementation of the mandates, by counties with or without mandates. Honolulu and Maui counties implemented mandates, while Kauai and Hawaiʻi did not.
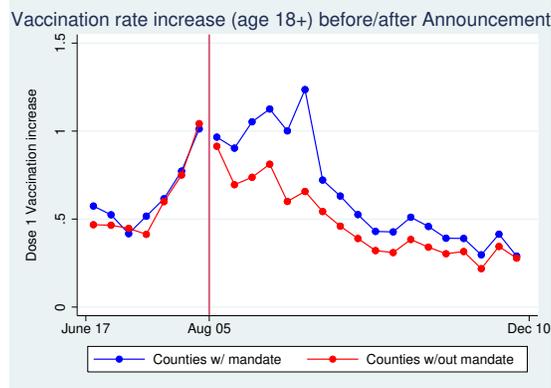
(c) Increase in county vaccination rates of the first dose administered weekly for all adults before and after announcement of the mandates, by counties with or without mandates. Honolulu and Maui counties implemented mandates, while Kauai and Hawaiʻi did not.

Figure 1. Pre- and post- mandates values for impacted and non-impacted businesses or counties

(a) Fitted trends of daily average foot traffic before and after implementation of the mandates, by businesses impacted or not. Impacted businesses include those in food, beverage, entertainment, fitness, and arts.
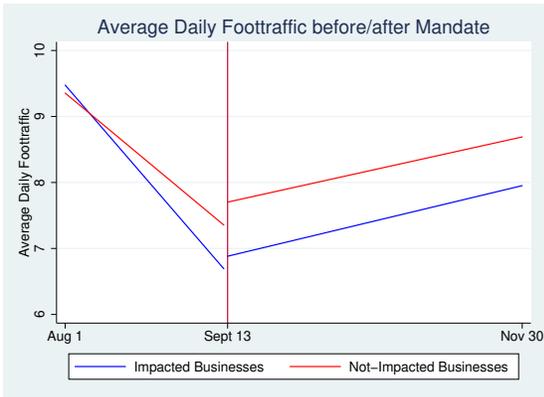

(b) Fitted trends of the 7-day rolling average of new COVID-19 cases per 100,000 before and after implementation of the mandates, by counties with or without mandates. Honolulu and Maui counties implemented mandates, while Kauai and Hawai'i did not.
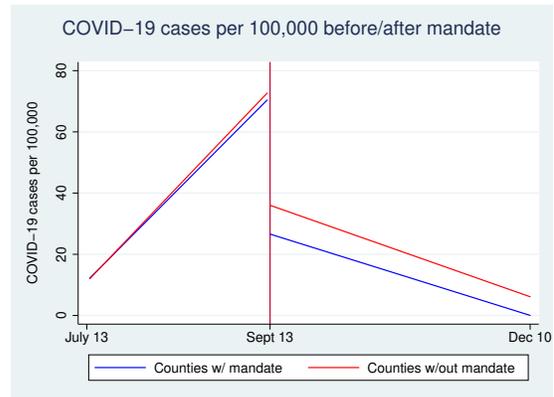

(c) Fitted trends of the increase in the county vaccination rates of the first dose administered weekly for all adults before and after announcement of the mandates, by counties with or without mandates. Honolulu and Maui counties implemented mandates, while Kauai and Hawai'i did not.
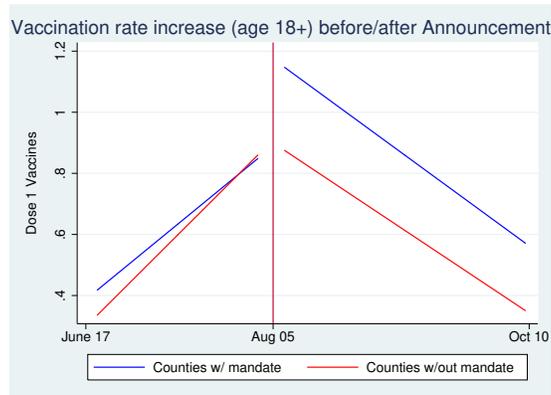
Figure 2. Pre- and post- mandates trends for impacted and non-impacted businesses or counties

Table 1. Summary Statistics

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
Total:					
7-day average daily business visits	2,174,000	8.068	36.12	0	3,676
Businesses that fall under mandate	2,394,000	0.287	0.452	0	1
7-day average COVID-19 cases per 100,000	600	27.20	20.70	4.156	89.38
Weekly vaccination rate increase	68	0.686	0.287	0.250	1.523
County Arrivals	596	5,898	4,443	1,174	18,380
Counties with Mandate (Honolulu & Maui):					
7-day average daily business visits	1,574,000	9.043	41.36	0	3,676
Businesses that fall under mandate	1,733,000	0.299	0.458	0	1
7-day average COVID-19 cases per 100,000	300	24.69	20.395	2.913	69.79
Weekly vaccination rate increase	34	0.766	0.271	0.0204	4.675
County Arrivals	298	3,898	685	2,510	18,380
Counties without Mandate (Hawai'i and Kaui):					
7-day average daily business visits	599,991	5.509	15.21	0	521.1
Businesses that fall under mandate	660,752	0.255	0.436	0	1
7-day average COVID-19 cases per 100,000	300	29.71	20.739	0	185
Weekly vaccination rate increase	34	0.607	0.284	0.250	5.898
County Arrivals	298	2,485	686	581	4,672

Estimates for 19,625 individual businesses from 8/1/21-11/30/21. COVID-19 case estimates from 7/13/21-12/10/21. Vaccination rate increases from 6/17/21-10/11/21.

Table 2. Results

VARIABLES	ln(7-day average daily business visits)				7-day average COVID-19 cases per 100,000			Weekly dose-1 vaccination rate increase					
								(all 18+)		(18-49)		(50+)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Post-Mandate (9/13)	-0.0109***	-0.0109***	-0.0112***	-0.0113***	-27.82***	-	-28.42***	-	-	-	-	-	-
	(0.000634)	(0.00218)	(0.000666)	(0.00225)	(1.708)		(1.689)	-	-	-	-	-	-
Businesses that fall under mandate	0.338***	-	0.338***	-	-	-	-	-	-	-	-	-	-
	(0.0159)		(0.0157)										
Post-mandate * under mandate	-0.0461***	-0.0461***	-0.0461***	-0.0461***	-	-	-	-	-	-	-	-	-
	(0.000829)	(0.00418)	(0.000829)	(0.00418)	-	-	-	-	-	-	-	-	-
Counties with mandate	-	-	-	-	61.82***	3.375	68.92***	-0.137	-0.953***	0.0480	-0.628**	-0.185***	-0.325***
					(4.841)	(6.338)	(5.007)	(0.175)	(0.340)	(0.129)	(0.247)	(0.0570)	(0.116)
Post-Mandate * county with mandate	-	-	-	-	-9.628***	-7.082***	-9.937***	-	-	-	-	-	-
	-	-	-	-	(2.338)	(1.327)	(2.307)	-	-	-	-	-	-
Post Mandate Announcement (8/5)	-	-	-	-	-	-	-	-0.188**		-0.144**		-0.0438*	
								(0.0749)		(0.0550)		(0.0243)	
Post-Announcement * county with mandate	-	-	-	-	-	-	-	0.130*	0.157**	0.0897*	0.106**	0.0398*	0.0511**
	-	-	-	-				(0.0721)	(0.0623)	(0.0530)	(0.0453)	(0.0234)	(0.0213)
ln(New County COVID-19 Cases)	-0.00145***	-0.00145*	-0.00200***	-0.00199**	-	-	-	-	-	-	-	-	-
	(0.000281)	(0.000783)	(0.000306)	(0.000924)									
ln(County Arrivals)	0.123***	0.123***	0.135***	0.135***	-41.79***	-4.197	-46.35***	0.0380	0.518**	-0.0467	0.355**	0.0847**	0.163**
	(0.00104)	(0.00266)	(0.00108)	(0.00290)	(2.797)	(4.005)	(2.925)	(0.102)	(0.211)	(0.0751)	(0.154)	(0.0332)	(0.0723)
7-day COVID-19 test positivity rate					-	-	-	0.107***	0.0338*	0.0800***	0.0280*	0.0266***	0.00575
					-	-	-	(0.0105)	(0.0197)	(0.00768)	(0.0143)	(0.00339)	(0.00676)
Observations	2,173,683	2,173,683	2,173,683	2,173,683	596	596	596	68	68	68	68	68	68
R-squared		0.012		0.013	0.549	0.267	0.566	0.771	0.732	0.771	0.720	0.716	0.682
Business fixed effects	No	Yes	No	Yes	-	-	-	-	-	-	-	-	-
Day-of-the-week fixed effects	No	No	Yes	Yes	No	No	Yes	-	-	-	-	-	-
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day fixed effects	-	-	-	-	No	Yes	No	No	Yes	No	Yes	No	Yes
Number of Businesses	19,625	19,625	19,625	19,625	-	-	-	-	-	-	-	-	-
Number of Days	121	121	121	121	149	149	149	17	17	17	17	17	17

Standard errors reported in parentheses. Columns (1)-(4) regress variables onto the natural logarithm of the rolling 7-day average of daily visits to each individual business between 8/1/2021-11/30/2021. Businesses that fall under the vaccine or test passport mandates include those in the food and beverage industry, fitness, entertainment, and arts. Columns (5)-(7) regress variables onto the 7-day rolling average of new COVID-19 cases per 100,000 for each county from 7/13/2021-12/10/2021. The counties which implemented the mandates are Honolulu and Maui. Foot traffic and COVID-19 test positivity observations are on the daily level. Columns (8)-(13) regress variables onto the increase in the county vaccination rates of the first dose administered weekly for all adults, those aged 18-49, and then for those 50+ from 6/17/2021-10/11/2021.
*** p¡0.01, ** p¡0.05, * p¡0.1