The Impact of Government Containment Policies on COVID Spread

Spring 2024 Analyzing Pandemic Responses Project

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Abstract

This research investigates the effectiveness of government containment policies in reducing the spread of COVID-19 in the United States using data from the Oxford COVID-19 Government Response Tracker. Data from March 1, 2020 to November 30, 2020 had been analyzed, eliminating altered factors post-vaccine. Eight containment policies were analyzed: school closings, workplace closings, public event cancellations, public gathering restrictions, public transport closings, stay at home requirements, internal movement restrictions, and international travel restrictions.

Materials and Methods

The research and the analysis was completed using Google Colab. The initial steps of the analysis involved preprocessing the Oxford COVID-19 Policy Compact Subnational dataset. This part entailed filtering out policies unrelated to containment and closure measures, eliminating null values and duplicates, and standardizing column names using Python on Google Colab for enhanced readability. The data was filtered to specifically include dates ranging from March 1, 2020, to November 30, 2020, thus allowing for an analysis of policies which excluded the vaccine previously released in December. The cleansed data was subsequently converted into a CSV file to where each government containment and closure policy had been isolated and examined. Extraneous columns were eliminated from the dataset, focusing solely on relevant policy data and then adjusted to a comprehensive format. These daily cases were then calculated, summed weekly and presented in a new column. The maximum confirmed cases for each state was compiled into a CSV file and ranked in order of total cases. The population and population density of each state (US Census Bureau, 2020) were similarly compiled and ranked. The best and worst performing states were determined by identifying unexpected rank differences in bar graphs (See Fig. 1 and Fig. 2).

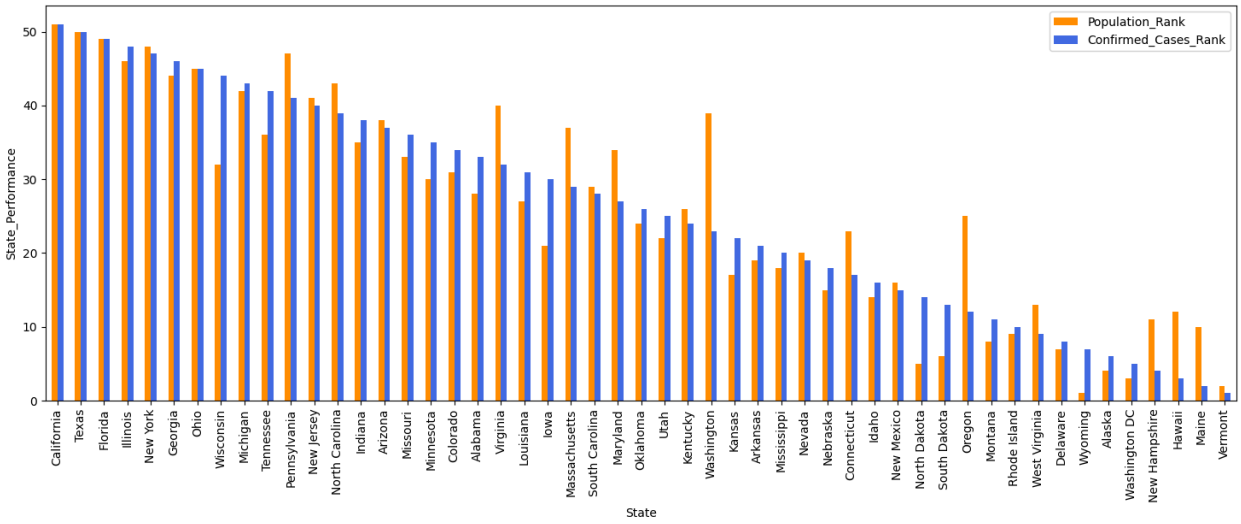

Figure 1. Maximum Confirmed Cases Rank vs Population Rank

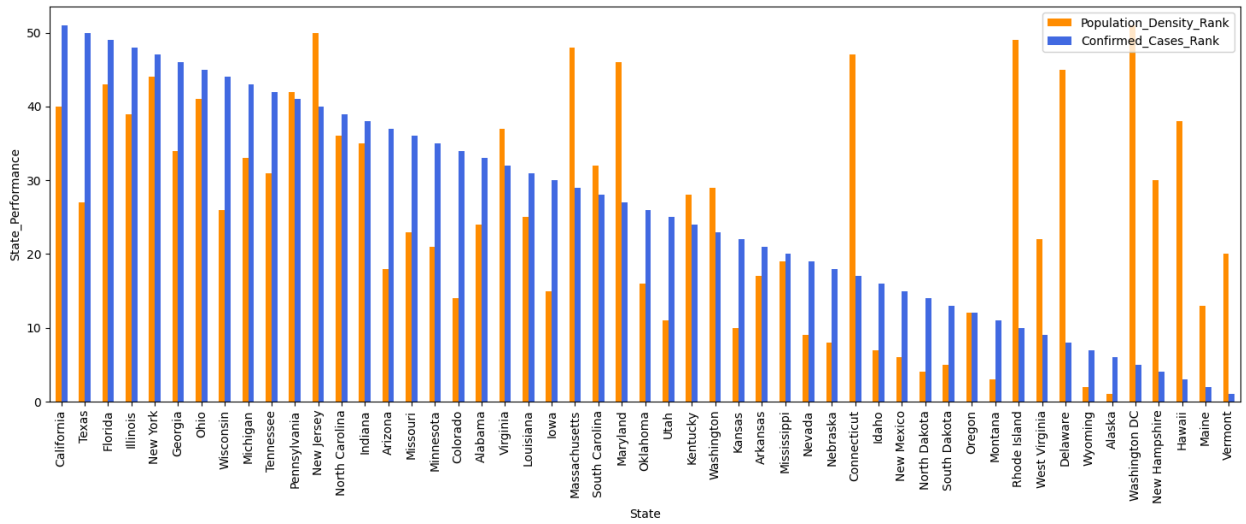

Figure 2. Maximum Confirmed Cases Rank vs Population Density Rank

In the initial analysis (Fig. 1), Washington emerged as the top-performing state, while Wisconsin ranked the lowest. Several additional states were chosen using this method, including control states that exhibited expected performance. Each state's analysis focused on key columns such as month, week, daily cases, and policy details. This condensed table facilitated an examination of policy effects and variations among state measures contributing to increased COVID spread. The study ranked each US state based on factors related to their maximum confirmed COVID-19 cases, utilizing 2020 population data from the government census alongside the respective state's maximum confirmed COVID-19 cases. The initial ranking method involved subtracting each state's rank based on population from its rank based on confirmed cases. Through this approach, Washington emerged as the highest-ranked state, while Wisconsin ranked the lowest.

In the second analysis (Fig. 2), population density was assessed using 2020 government census data, resulting in a new ranked list based on population density. Using the population density rank subtracted from the confirmed cases rank, the second-ranked list was calculated. Texas attained the highest rank through this method, while Arizona earned the lowest rank. Each policy was analyzed individually to obtain a more in depth comprehension of the underlying effects within each of the states. The policies' values were altered to analyze the modifications and the severity of each policy during the selected time period. Columns that were not related to the specific policy being analyzed were filtered from the cleansed data. Each state was individually filtered and the display format was transformed using groupby(). Using these two main methods of ranking and analyzing, 16 different states for each of the government policies were investigated to analyze how each policy affected states. The analysis involved eight government policies and showcased the relationships between changes in policy severity and corresponding changes in weekly cases. Trends between different states were compared to analyze the effectiveness of each policy.

Data Analysis

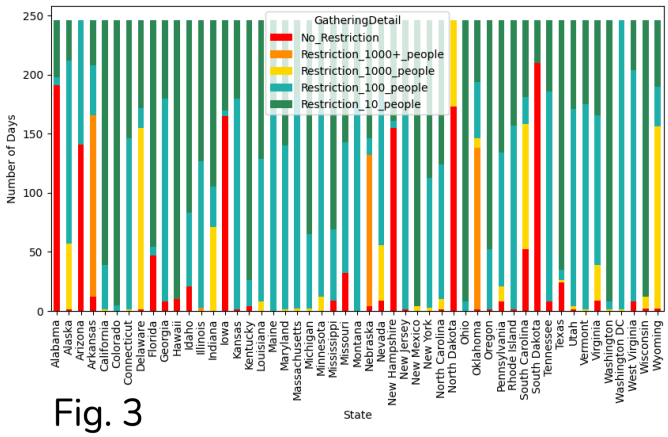

Fig. 3

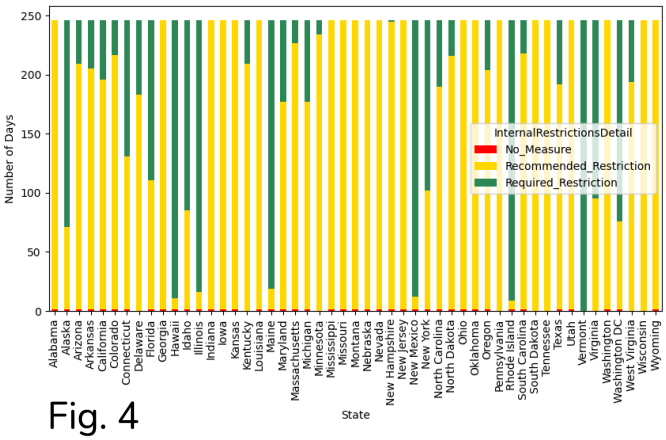

Fig. 4

The results of the government policy on public gathering restrictions demonstrate that when states followed restrictions at 100 people or lower, confirmed cases did not exceed a concerning value. However, when states did not follow these restrictions (North and South Dakota) they tended to have a higher confirmed cases rank compared to their population or population density rank. This exemplified the theory that states that didn't follow this government policy tended to perform poorly with their total confirmed cases and proved that the government policy of public gatherings was effective. Similarly, the analysis of the policy of Internal Restrictions showed that the states that enforced required restrictions performed well in stopping COVID spread. Most states implemented a recommended restriction for this policy, but when looking at states that had stricter restrictions, (New Mexico, Hawaii, Vermont and Rhode Island) all of the states performed similar to or better than expected. Therefore, the policy was largely effective for states in which it was implemented.

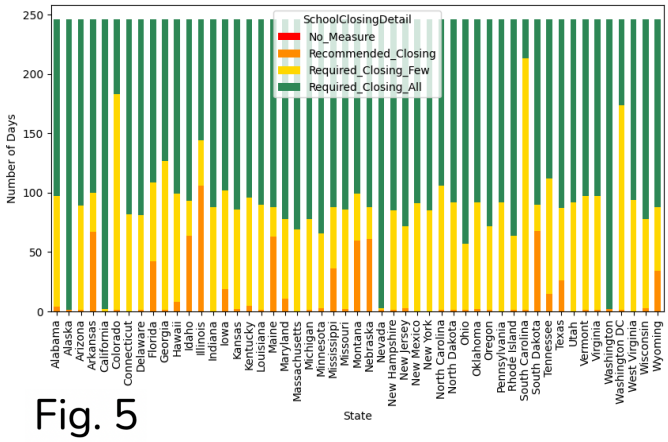

Fig. 5

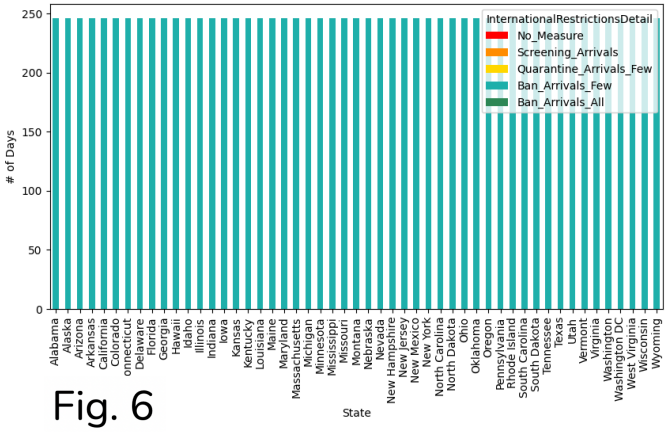

Fig. 6

School closing policies varied greatly among states during this timeframe. Leniency in regards to school closing policies included longer time spans of recommended closing, while a strict policy involved longer time spans of required closing for all levels. States with strict school closing policies (Washington, Nevada, California) all performed well by the population rank standard, while states with lenient school closing policies (Illinois, Arkansas, South Dakota) all performed worse by the same rank analysis. This demonstrates that school closing policy was a key factor in regulating the spread of COVID-19 in the United States. International travel restrictions did not vary at all between states during the timeframe, therefore, international travel restrictions did not change COVID spread among different US states.

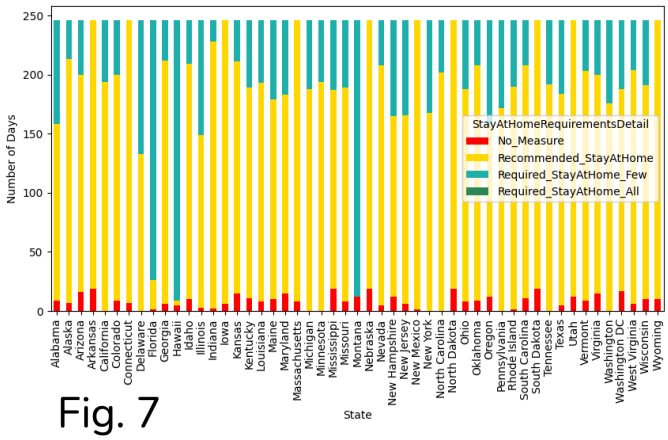

Fig. 7

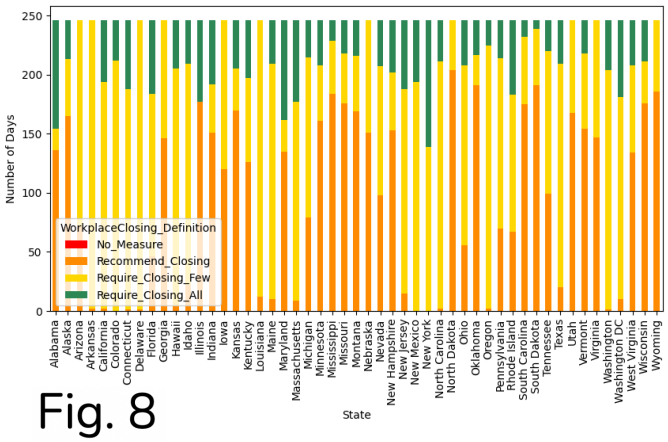

Fig. 8

In regards to stay at home policies, almost all states had short time periods of no measures, and no states had a mandated stay at home with no exceptions. Therefore, stricter policies involved mandated stay at home with few exceptions while lenient policies involved states having longer periods of recommended homestay. The lenient states (Utah, Arkansas, and Wyoming) correspond to the states that performed badly by the rank analysis for population and population density. However, states with stricter stay at home policies (Montana, Florida) did not directly correspond to lower COVID-19 cases. Therefore, stay at home policies, although having some influence on COVID spread regulation, were not as impactful in state variance as other containment policies. Analyzing the policies regarding workforce attentiveness. majority of states phased from a period of recommended leave, to select, to strictly all closing. The more stringent policies which required the majority of those in a field to remain at home in states such as Maryland was met with a low confirmed case to population ratio. In comparison, states with a larger enforcement on lenient policies such as North Dakota performed much work.

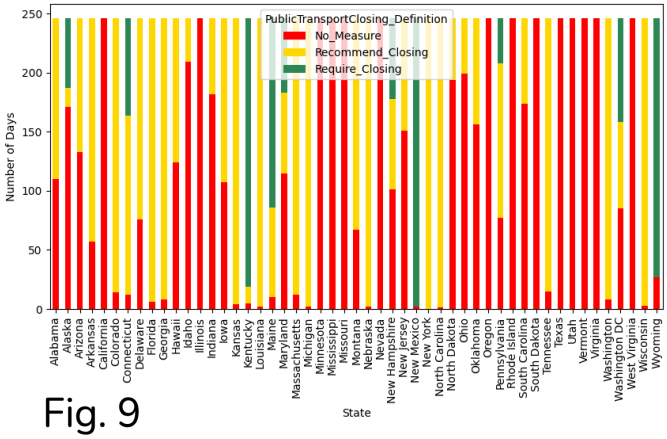

Fig. 9

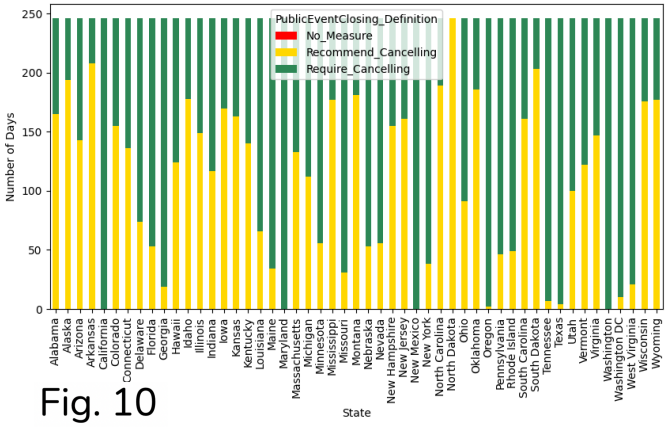

Fig. 10

The PublicTransportClosing graph clearly displays a very large spread of states who frequently authorized no specific policy in addressing concerns about transportation. Majority of states did not employ any specific strategy for the majority of the spread, and then even after only recommended restrictions. States that enforced such policies, among a select few, such as Washington imposed a lenient restriction on public transport, and as such was one of the prevailing states during the COVID-19 spread. As opposed to states which opposed little to no avid policy such as California and Illinois which performed substantially worse in regard to a case by population ratio. In the PublicEventClosing graph, there are no states that did not employ some sort of measure. States which had rigid regulations for public exposure (Maryland,

New Mexico) were not associated with high levels of cases. Unlike states which only and strongly enforced a lenient policy, such as North Dakota, were bred with larger amounts of cases.

Results and Conclusion

Key findings include:
-Lenient states in terms of containment policies had greater rates of COVID spread than expected compared to states with stricter restrictions.
-Government containment policies regarding public gathering, public event, internal movement, school closings and workplace closing had the greatest impact on the spread of COVID-19 in the United States.
-Government containment policies regarding international travel, stay at home restrictions and public transport had less significant impacts on the spread of COVID-19 in the United States.

The results demonstrated that stricter restrictions on government containment policies, most specifically Public Gathering, Public Event, Internal Movement, School Closings and Workplace Closing were highly impactful in reducing the spread of COVID-19 in the United States. Although each policy had the potential of reducing COVID-19 spread, these containment policies outperformed the others, proven by COVID-19 spread in states with varied restriction levels amongst states. Lenient states in terms of containment policies had greater rates of COVID spread than expected compared to states with stricter restrictions. In the future, research will be conducted on similar containment policies in different countries to assess its worldwide impact in the broader meaning of Life.

References

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