Senior Project

Department of Economics

The Racial Divide in the Impact of COVID-19 Mask Mandates in the U.S.

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Abstract

Mask mandates implemented at the statewide level in the United States are hypothesized to reduce airborne viral transmission. In certain contexts, such as close-quarter air pollution scenarios and health care settings, masking provides a shield from the inhalation of potentially dangerous microscopic pathogens. There is increasing awareness in the medical community for adjunct health policy that can swiftly mitigate the effects of contagion by halting the infection and death rates of a population. This provides a unique opportunity to analyze the effects of a major health policy decision during the most recent COVID-19 pandemic, while taking into account racial disparity in outcomes between White and Black Americans. Utilizing the available dataset compiled by researchers that collect United States COVID racial and ethnic data, a difference-in-differences regression analysis with two-way fixed-effects is designed and partially explains the impact of mask mandates on total population and racial outcomes. This paper observes that US mask mandates are effective when it comes to reducing the total number of weekly Black cases, but ineffective in reducing general population total cases/deaths, White deaths/cases, and Black deaths. After introducing a political party affiliation variable, the models show statistical significance when estimating White and Black weekly deaths in republican states with a mask mandate compared to democratic states, revealing an increase in the number of weekly deaths rather than a presumed decrease. The main results show that mask mandates have a modest effect, but only occurring in some circumstances where political party affiliation and racial disparities are present. Furthermore, this study contributes to the literature by advancing the need for improvised healthcare strategies, and helps to uncover potential effects of a health policy, gaining a better understanding of health policy effects and cultural adherence/attitudes.

I. Introduction

Coronavirus disease 2019 (COVID-19) is the most recent viral pandemic to occur and drastically changes the preconceptions of the inherent capabilities of viruses. Pandemics are caused by viruses and/or bacteria that spread uncontrollably in many ways throughout a population of people. COVID-19 is categorized in the family of coronaviruses represented as SARS-Cov-2 variant, and is transmitted through respiratory actions, e.g., coughing, sneezing, talking, and ordinary respiration (Joo et al.,2021). From a worldwide optic, the first cases of the virus were identified in Wuhan, China, and over 6 million people (about the population of Maryland) worldwide have died from this disease. In the United States, African Americans and other ethnicities were dying at a higher proportional death rate than people of Caucasian descent (Hamilton et al., 2021). The enacting of contemporary state-level mask mandates during this health crisis, especially in the US, offers an immediate springboard for learning more about the impact of these types of health policies on a general populace and specific racial sub-groups of a society. Masks intrinsically are successful in maintaining optimal lung health during instances of heavy air pollution, i.e., by-products of fuel and energy production, and they achieve this by blocking microscopic airborne particulate matter. These scenarios where masks are needed for airborne pollutants are few and far-between and usually occur in industrial factories. Throughout the history of the US there has been few instances of mask requirements in public spaces and were mainly recommended for hospital workers in the late 1900s (Strasser & Schlich, 2020), which gives credulity to this type of policy for impeding the transmission of viruses. At the individual-level, evidence through experimental and mathematical modelling is accumulating showing that facial mask usage can effectively block droplet transmission. This reduces the rate of infection in coronavirus outbreaks (Eikenberry et al., 2020). Furthermore, this investigation aims to answer questions surrounding the controversy of the effectiveness of mask mandates on reducing general population and racial case/mortality rates, specifically White and Black Americans. The emphasis remains on questioning the impact that these mask mandates might have on ethnic death rates in the US, possibly leading to further research with respect to improving socioeconomic conditions and revealing previously unidentified cultural preferences in the context of pandemics.

In general, the government officials who enact these laws such as masking mandates, usually have a good reason for their implementation. In this case, they noticed the benefit of masks from early groundwork examining the effectiveness of the variety of the masks that were available during the pandemic (e.g., cloth masks, surgical masks, and N95 respirators) on exposure to severe air pollutants for a wide range of demographics (Kodros et al., 2021). Uncovering the possible effects of masking laws are not only important for citizens and policymakers alike, but provides a critical examination into the hospitalizations/infection rates, mortality rates, political influences, and geographical pooling aspect of impromptu health policy. This study can signify the future application of masking policy, potentially paving the way for additional interventions such as vaccinations and antiviral drug therapies. Further research on this type of policy and its effects is important, especially considering the severity of the pandemic and striking racial/ethnic disparities in COVID-19 infections and outcomes (Franz et al., 2021).

There are a few studies in the literature that have evaluated this topic, along with other social, political, and cultural factors that are purported to impact infection and mortality rates of multiple groups during this pandemic, and the researchers of those papers are decidedly in disagreement regarding the results. This study hopes to derive an answer to this perplexity, replacing ambiguity with certainty. In an attempt to better explain mask mandates' effects, this paper utilizes a difference-in-differences with two-way fixed-effects regression method to arrive at an empirical conclusion. Econometric techniques such as this, are useful for the main analysis of this paper, along with an examination of the initial 13-week period of COVID-19 beginning in April of the second quarter of 2020. Also, looking into the outcomes for subdivisions of races in the US, White and Black, while including an interaction between states' political affiliation and mask mandates, helps to disseminate information with respect to cultural attitudes, political beliefs, and racial disparities. Nearly all of the ethnic groups in the US saw population gains this decade and an increase of 276% for the multiracial population was especially large. The Caucasian alone population declined by 8.6% since 2010 (US Census Bureau, 2024). When assessing these disparities, it only adds to the difficulty for lawmakers in the business of productive policymaking. The health sector is highly regarded in the US and at times is under a great amount of established scrutiny because they demand a more quantitative approach in their research methods. The panel data used in this study is widely available for use in health-care research and consists of quantifiable statistics on case and death rates of numerous groups of people; made applicable by efforts from Boston University and The COVID Tracking Project. When researchers analyze government policy, they have a subtle task to understand how their data can describe different populaces of a region and how those groups in the data respond to laws, in this case mask mandates.

The main results of this paper show statistical significance in the coefficient of one model for the main regressor (mask mandate) and in two models for the interaction between mask mandate and republican party affiliation, i.e., Black cases, White deaths, and Black deaths, respectively. The initial 13-week analysis solely estimated statistical significance for the coefficient of the interaction term in the model for total cases of the US general populace. This approach to estimating the effect of mask mandates on deaths by racial orientation will help complete the database of current literature on this subject, bringing forth a more causal understanding of how policymaking can affect outcomes in certain groups. Additionally, the content of this paper will further overview relevant studies and ideologies, the methodology used, and the succeeding results. Implementing an event study analysis of this type is essential to investigating broad and initial effects of mask mandates on different population outcomes, and is conducive to advancing new ideas on this topic. The overall contribution of this study to the pre-existing literature hopes to provide insight into estimating the effects that mask mandates have on general population and racial case/deaths rates during COVID-19 in the United States, and to present a unique, and comprehensive interpretation of the overall metrics in conjunction with contemporary research published by authors in this field.

II. Literature Review

Evidence for the effectiveness of masking on SARS-CoV-2 transmission at the individual level shows promising outcomes in curtailing infection and mortality rates (Huang et al., 2022), but at the collective level there is more room for evaluation. Hamilton et al. (2021) show that the rate of monthly cases and deaths per ethnic group for policies and political factors are significant except for the mask mandate policy in the United States during COVID-19. They further emphasize that mask mandates were not a factor in the cases or death rates of any ethnic group based on the data analyzed. This is applicable because they apply methodology that would not account for pre-treatment differences between the treatment and control groups. This is an interesting finding because in the US, the general public commonly claim that the issue of racial disparity is present and is foundational to many policy decisions. Research in the field acknowledges, that once outcome data separated by time and demographics (e.g., daily, weekly, age, race, gender) is more widely available at the state or county level, an important question for future work is to investigate the differential impact of mask mandates over these demographic groups (Adjodah et al., 2021). The analysis of the current literature shows few commonalities amongst the findings, especially in the overall effects of masking policy. Researchers additionally admit that their studies fail to assess causality in patterns of masking (Franz et al., 2021). Moreover, interest in the effectiveness of mask mandates on different races remains a major theme among academia.

Early research by Eikenberry et al. (2020) show that face mask use by the general public for limiting the spread of the COVID-19 pandemic is controversial. They further mention the increase of awareness across multiple nations for policy reform and that there is probable benefit to masking, but the influence is not well understood. Masks were mandatory in twenty-one states by mid-July 2020, but only one month later a national poll found less than two-thirds of American agreed it was important to wear masks (Franz et al., 2021). Some limitations of earlier studies, regarding masking policy, mention that they are primarily data driven because the access point for causal analysis requires a time dimension that cross sectional data does not record (Franz et al., 2021). On a separate note, early groundwork examines the effectiveness of the variety of masks available (e.g., cloth masks, surgical masks, and N95 respirators) on exposure to severe air pollutants for a wide range of demographics (Kodros et al., 2021). They describe the simultaneous nature of their study with the onset of the coronavirus pandemic. This raises a compelling question concerning the accessibility of higher quality masks in racially diverse communities. For example, Franz et al. (2021) describe that mask wearing and outcomes may involve aspects of structural racism and a corresponding unwillingness to engage in health-protective behaviors within the borders of the United States. Furthermore, survey research in the beginning of the pandemic by Knotek et al. (2020) illustrate that mask mandate enforcements have beneficial effects on actual individual mask use. These early studies reinforce the need to obtain longitudinal data to better estimate the effect of mask mandates on mask use and other behavioral outcomes (Wright et al., 2020).

A more recent investigation, Huang et al. (2022), examines the beneficial effect of masking mandates varied across regions of different population densities and political leanings, and the most concentrated effects of these masking policies are seen in urban counties. Different urbanicity and political affiliations were the primary focus of their analysis, and their conclusions show a reduction in community case incidences. They employ a matched pair analysis which does not require the conditional parallel slopes assumptions. Earlier studies that are closer to the beginning of the COVID-19 pandemic show uncertainty in the mask mandates, while other evaluations show supporting evidence of the protective effect of mask wearing adherence regardless of mask wearing policy (Fischer et al., 2021). Towards the end of the mask mandates the focus turned to vaccine mandates and their effects on infection and fatality rates. Martin & Vanderslott (2022) note, that the main reasons in opposition to masks and vaccines, were impositions on freedom and other beliefs that related to conspiracy conspiracies. It is interesting to consider the misinformation that takes place in poorer communities, which might play a role when analyzing the effects of masking on racial disparity with an event study format. The public health messaging and government advice was set against a backdrop of confusion during the pandemic (Martin & Vanderslott, 2022). Certain estimates of the more contemporary papers explain how the reduction in COVID-19 related deaths and infections were related to the mask mandates, but the infection rates and mortality rates regarding people of color living in segregated communities are confounding.

The evidence for the effectiveness of masking on COVID-19 transmission and mortality rates is well defined among individual groups (Huang et al., 2022), but there is additional space for evaluating the possible initial effects that mask mandates have on racial groups during the pandemic. The literature in-review shows an interest in addressing the causal effects of mask wearing on ethnic disparities in deaths from the pandemic (Franz et al., 2021). The early research of the pandemic primarily investigates infection rates and hospital growth rates, as well as masking adherence and attitudes. Findings from a study by Joo et al. (2021) predicts statistically significant statewide declines in weekly COVID-19 growth rates for adults aged 40-64 years less than 3 weeks after the week that the mandate was implemented, and for adults aged 18-64 years greater or equal to 3 weeks after the implementation week. Later research validates the masking mandates' effectiveness on nationwide morbidity and mortality rates. Furthermore, there are protective effects of mask wearing adherence regardless of mask wearing policy (Fischer et al., 2021). An event study of this type is capable of filling in the gap in the literature. Outcome data availability on demographics (e.g., age, race, gender) at the state and county level is lacking and investigating the differential impact of mask mandates over these demographic groups is a necessity for future work (Adjodah et al., 2021). Alongside the current literature, this paper can contribute to a better understanding of the possible effects of mask mandates on racial disparities in deaths during the COVID-19 pandemic.

III. Theoretical Discussion

A portion of the current research that investigated this topic argues that mask mandates in the US at the time of the COVID-19 pandemic were not a factor in the cases or death rates of any ethnic group and alone are not sufficient to reduce growth rates (Hamilton et al., 2021; Näher et al., 2024). Others propose masks were a factor in reducing growth rates. Comprehensively, the literature surrounding this theoretical framework posits that masking policies do have an overall positive effect on reducing the spread of deadly airborne diseases, and microscopic particle matter inhalation (Adjodah et al., 2021; Hansen & Mano, 2023; Kodros et al., 2021).

When it comes to overall mortality rates in controlled environments masks are beneficial, specifically the N95 type mask, but researchers in the field are uncertain about the effects of masking policy across general and ethnic populations that are collectively dispersed throughout a geographic region. Adjodah et al. (2021) explain that their results point to a positive effect of mask mandate policies, mask adherence and mask attitudes on COVID-19 cases, hospitalizations, and deaths. Moreover, the theoretical framework for this study is subsequently based on a robust review of the current, but limited literature and exclaims that there might be an overall benefit to masking in pandemic scenarios, albeit a small improvement. Interestingly, at the ethnic level there is uncertainty to any benefit or detriment that masking has on case and death rates. One of the more recent investigations of statewide masking mandates attempts to exploit county-level variation through a discontinuity regression design, and finds that mask mandates could in fact help counter pandemics and ultimately save lives, if widely accepted (Hansen & Mano, 2023). It is necessary to obtain panel data to better estimate the effect of mask mandates on mask use and other behavioral outcomes (Wright et al., 2020).

The research that exists also points towards inconclusive effects of the mask mandates in states throughout the US involving case and death rates. Franz et al. (2021) argue that mask wearing can be viewed as a race-based policy when deaths are disproportionately concentrated among Black and Hispanic Americans and other ethnic groups, because then mask usage decreases for Caucasian Americans during that time of disproportionate deaths between Whites and other minorities in the US. This aforementioned paper quantifiably examines how mask usage relates to differential outcomes in COVID-19 deaths by race, but the main results of their findings were structured around racial segregation and perceived masking adherence, making few claims of mask policy effectiveness. They explain further that their research is potentially the first of its kind (Franz et al., 2021). The conclusion of that study is focused around the relationship between surveyed mask adherence and the case/death rates of a population. This study is important to consider when discussing the theoretical framework for this paper, because a couple of papers surrounding this topic have nothing substantial to conclude about mask policy in the region or abroad (De Giorgi et al., 2022; Franz et al., 2021; Hamilton et al., 2021; Näher et al., 2024). Most of the studies in the literature that are similar to this topic use methods and techniques to put forward theories that have certain caveats making the results permissive to their conclusions and benefactors.

Furthermore, the research being conducted in this paper not only hypothesizes a potential positive effect of mask mandates on COVID outcomes, but an initial effect of the mask mandates on case/death rates in the early stages of the policy rollouts for both the general population and different ethnicities. The expected relationship between masking policy and the general population and ethnic case/mortality rates should be positive, i.e., when the policy is implemented, corresponding population and ethnic case/mortality rates should decrease. The inherent ability of the N95 masks to filter airborne pathogens makes this a plausible assumption. Therefore, if the theory is sound, it could allow policymakers to maximize the effectiveness of public health laws pertaining to mask adherence within at-risk communities, and generate a smoother transition during initial rollouts and final terminations of these laws. There are significant findings in the overall consequences of the COVID-19 pandemic worldwide and in the US. The theory presented alludes to the importance of obtaining a better understanding of how mask mandates affect the overall and minority population case/death rates during these types of health-crisis scenarios.

IV. Data

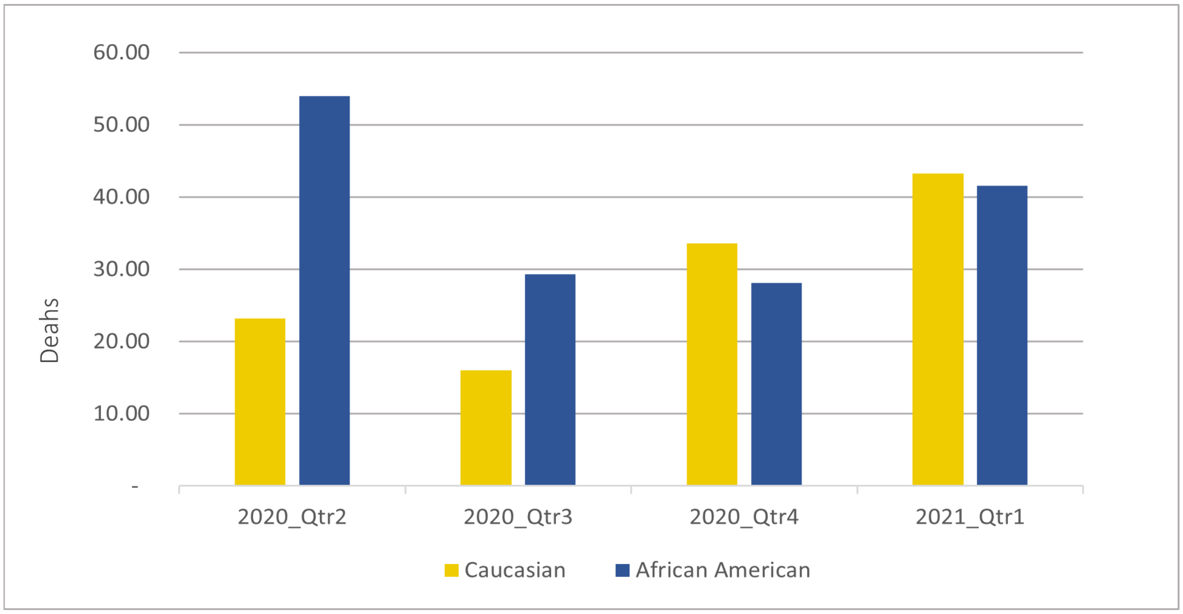
The data on COVID-related cases and deaths are made possible by an effort from the Boston University Center for Antiracist Research and the COVID Tracking Project. Complete and up-to-date race and ethnicity data on COVID-19 in the United States is presented in a panel data format and made easily accessible by the efforts of these two organizations (*(Racial Data Tracker | Center for AntiRacist Research, n.d.)*. Mask mandates were first advised by the Center for Disease and Control (CDC) on April 3, 2020. They were advising the use of mask mandates as a supplemental form of protection from the airborne contraction of the virus, along with social distancing and regular health practices. The data recordings begin at the beginning of April in 2020, specifically on the second Sunday of the month, and continues until the first Sunday of March 2021. The deaths, cases, hospitalizations, and tests are the variables being measured for different racial groups. These recordings are for, White, Black, Latinx, Asian, AIAN, NHPI, Multiracial, Other, Unknown, Ethnicity Hispanic, Ethnicity Non-Hispanic, and Ethnicity Unknown. This study's main focus is on White and Black racial groups. The original data source is recording the values for every couple of days in a running summation format for all the variables. The values for the days are first recorded every third day after the initial day observed, for each state that available data. Then, the observations are recorded every fourth day after that initial observation, and the values alternate between being recorded every three days to every four days. This measurement sequence continues throughout the period recorded in the database.

The necessary variables for this type of investigation are constructed through cleaning and organizing the data into weekly aggregates. The weekly cases/deaths for total population, White, and Black racial groups during the pandemic for residents within the US are the dependent variables and are analyzed with state and week fixed effects to estimate the main consequences of statewide mask mandates on various outcomes. Furthermore, COVID cases/deaths for the general population and each race are the main outcome variables, along with mask mandate policy as the regressor of interest. When creating the mask mandate policy variable, the data is further categorized based on the timing of the state level mandates and differentiated into control and treatment states. When isolating the start of a mask mandate within a state, the theorized impact of reducing the cases and deaths of people who contracted the virus could possibly be noticed at a more intricate level within the data. Also, a political affiliation variable is created and integrated into the database and represents if a state voted republican in the last election, if not, then the state would be designated as democratic. Finally, these variables are categorized in a way that makes an event study possible over this period of time. When assessing the impact of masking policy on the cases and deaths of the general population and the races observed during the COVID-19 pandemic in the US, this database along with created variables is a key determinant in calculating appropriate estimates for the variables in question.

V. Data Analysis

Beginning in the second quarter of 2020, COVID-19 data was accumulated for the total cases, deaths, hospitalizations, and tests in the US for different ethnicities (*Racial Data Tracker | Center for AntiRacist Research*, n.d.). Data tracking among the variables continue until the first quarter of 2021 and recording values every couple of days throughout the period. Interestingly, there are higher rates of cases and deaths within the racial minority groups and when analyzing specific states, the discrepancy is substantially larger in the beginning of the pandemic. As shown in Figure 1, there is significant disparity in deaths per 100,000 US residents between African Americans and Caucasians. This difference in death rate between Black and White is confirmed in the literature and it shows that during a pandemic the negative implications are far worse for minorities. Moreover, Latinxs have the highest rate of positive cases and Black individuals have the highest rate of confirmed deaths (Hamilton et al., 2021). Figure 1 considers the relevant US population statistics of the races displayed and generates the number of deaths as a percentage rate. At the time of writing, White or Caucasian alone represents 75.5% of the total population of the United States and Black or African American alone only constitutes 13.6%. Naturally, the overall White deaths and cases are much larger than any other race in the US, but when comparing these variables proportionately across races, there are noticeable differences in specific outcomes that can be discerned. Figure 1 shows that the Black population in the US is dying from COVID at almost double the rate of the White population and the largest discrepancy is shown in the initial stages of the coronavirus pandemic.

Figure 1: COVID-19 Deaths for Caucasians and African Americans per 100,000 Residents of Each Race



Sources: The COVID Racial Data Tracker | *Center for Antiracist Research. (n.d.).*; and own adaptations.
Notes: Preliminary bar chart depicting racial disparity in the recordings of the database.

Figure 1 and Table 1 required augmenting the running cumulative totals of the variables in the dataset. Once the variables were changed from cumulative to daily values, then an accurate representation of the data could be better displayed graphically. Additionally, the data needed to be aggregated into weekly counts from Sunday to Sunday beginning with the first available Sunday recording in the data. As shown in Table 1, there are a few statistical measurements for variables in the data, i.e., count, average, standard deviation, minimum, and maximum values. The mean is a good indicator for noticing the large population difference between White and Black racial groups in the US population. The maximum figure is of special interest, which displays the highest number of cases or deaths for a given, and when comparing cases to deaths in the overall population of the US the table shows that 1.6% of the people who contracted the virus ultimately ended up dying. On a more optimistic note, during this time there was a 98% chance of surviving for people with the virus. In addition to the cumulative population case/death statistics, there are also White and Black case and death numbers. The standard deviation shows the average distance from the mean and is critical to understanding the variability of the values in a database, and the total cases display the largest deviation because of the larger values.

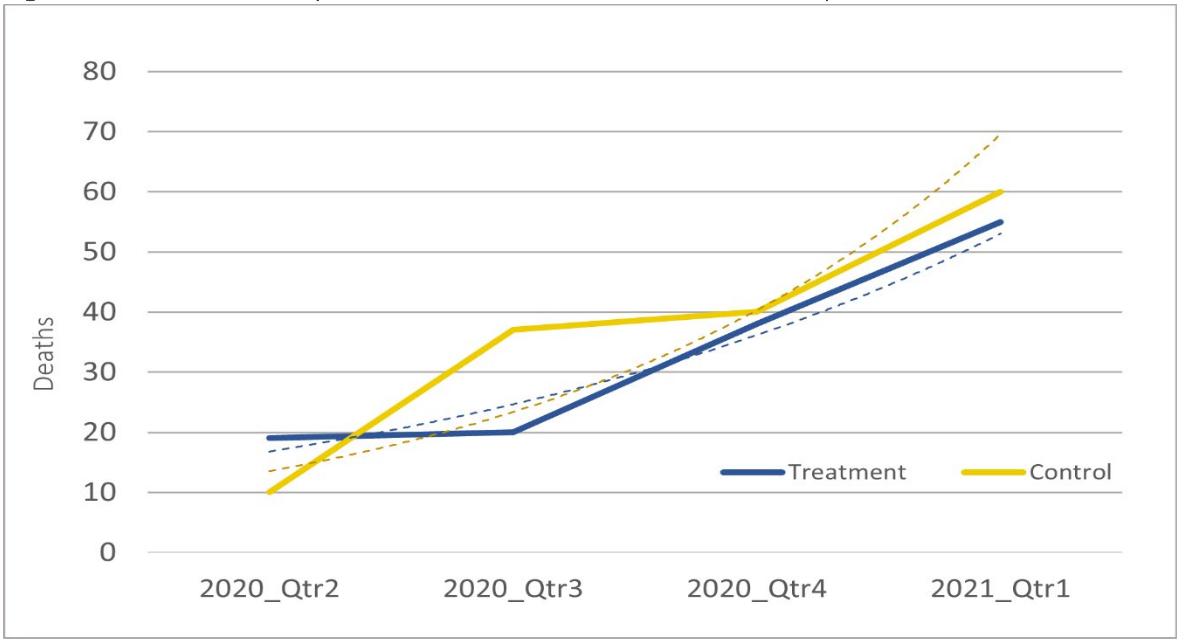
Table 1: Weekly COVID-19 Cases and Deaths

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Cases Total	2,044	13,392.89	23,536.21	84	302,690
Cases White	2,044	5,021.55	6,982.86	0	72,260
Cases Black	2,044	1,139.29	1,825.54	0	21,394
Deaths Total	2,044	226.68	377.97	0	4,739
Deaths White	2,044	131.85	210.54	0	3,863
Deaths Black	2,044	29.67	58.01	0	1,439

Sources: The COVID Racial Data Tracker | *Center for AntiRacist Research. (n.d.).*; and own adaptations.
Notes: Summary statistics for the observations in the database.

This pandemic marks the first time that mask mandates, for limiting viral transmission, have been hastily implemented on a federal and state level in the United States. Depicted below, Figure 2 takes a preliminary glance at the trends in overall deaths for a grouping of states that never introduced a masking law (Control), and for a grouping of states that implemented a mask mandate at any possible stage of the COVID-19 pandemic (Treatment) within the observed time period. The states included in the control group, i.e., AZ, FL, GA, ID, MO, NE, OK, SC, SD, TN, exhibit an increasing exponential trendline over the time period, but during the second and third quarter there is a sharper increase when compared to the treatment group. This indicates that overall weekly death rates per 100,000 residents were rising more aggressively during that time period for the control states. Incidentally, the states that had the highest rate of racial mortality were Alaska, District of Columbia, Hawaii, Texas, and West Virginia, respectively. Furthermore, the states included in the treatment group, i.e., AK, AL, AR, CA, CO, CT, DC, DE, HI, IA, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MS, MT, NC, NH, NJ, NM, NV, NY, OH, OR, PA, RI, TX, UT, VA, VT, WA, WI, WV, WY show an increasing exponential trendline over the same period of time, but without the sharp increase in weekly death rate per 100,000 residents depicted during the second and third quarter of 2020 in the control states. States listed in the treatment group have an average masking law duration of approximately 345 days, e.g., Hawaii's mask mandate duration was active for 704 days, while in contrast the control states do not have any masking mandate durations. Finally, when observing the weekly COVID-19 death rates for treatment and control states per 100,000 residents it becomes apparent that mask mandates are not generating a wide reduction in mortality rates. Although, there seems to be an initial notable difference between the two groups. Further analysis adds racial orientation outcomes into the model as dependent variables, which creates a more comprehensive evaluation on case and death metrics.

Figure 2: COVID-19 Weekly Deaths for Treatment and Control States per 100,000 Residents



Sources: The COVID Racial Data Tracker | *Center for AntiRacist Research. (n.d.).*; and own adaptations.
Notes: Dashed lines show exponential trend line. Also, despite the initial discrepancy in weekly deaths between control and treatment groups, both are increasing at relatively the same rate over time.

VI. Methodology

$$TotalCases_{st} = B_0 + B_1 MaskMandate_{st} + X_{st} + State_s + Week_t + \varepsilon_{st} \quad (1)$$

$$TotalDeaths_{st} = B_0 + B_1 MaskMandate_{st} + X_{st} + State_s + Week_t + \varepsilon_{st} \quad (2)$$

The two-way fixed effects difference-in-differences models used in this paper are displayed in equations (1) and (2). $MaskMandate_{st}$ is the main regressor of interest. The dependent variables are being regressed on $MaskMandate_{st}$. There are four additional equations replicated from the two equations above that differ in the dependent variable by interchanging the total weekly US cases and deaths, i.e., $TotalCases_{st}$, $TotalDeaths_{st}$, with total weekly US cases and deaths for White and Black racial groups, i.e., $WhiteCases_{st}$, $BlackCases_{st}$, $WhiteDeaths_{st}$, $BlackDeaths_{st}$. There are six overall equations representing the models that are used for the analysis. The equation (3) listed below is an example of the construct of the aforementioned racial differentiated equations, displaying the total weekly Black cases as the dependent variable and the political variable interacting with the mask mandate variable, all else being equal. In the first two models, the X_{st} term contains the interaction between a state's political affiliation (GOP_{st}) and an abbreviated mask mandate variable (MM_{st}) that can be seen in the subsequent equation (3), i.e., $GOP * (MM)_{st}$. Along with the interaction term, the time and location fixed effects are contained in all equations as, $State_s$, and $Week_t$. Lastly, in all of the models the white noise is represented as ε_{st}.

$$BlackCases_{st} = B_0 + B_1 MaskMandate_{st} + B_2 GOP(MM)_{st} + State_s + Week_t + \varepsilon_{st} \quad (3)$$

The main research method being utilized in this paper renders relationships that are more causal in nature. This type of conventional method of analysis proves to be very beneficial when being applied across many sectors of the economy where the effects of a certain policy are the main focus, especially in an environment where it isn't feasible or ethical to perform a laboratory experiment that frequently takes place inside the research center of a medical institution. The significance of this methodology relies on establishing a causal relationship rather than a mere correlation, and in these models the treatment and control groups, constraining for other variables and fixed effects, are generally considered to be comparable based on conventional wisdom. When the two groups are comparable it allows this experimental design to depict causality rather than correlation, which plays a significant role in the action of policymakers.

This natural experiment, where two groups are observed simultaneously over one time period, closely resembles the methodology used in the medical sector dealing with placebo-controlled trials. In the business sector of the economy, and in the presence of policymakers a difference in differences (DID) with two-way fixed-effects (TWFE) method is one noteworthy type of approach that is employed for accurate non-biased estimations of variables of interest. First, a treatment group is assigned, and in this case the variable, $MaskMandate_{st}$, is designated "1" if a US state has a mask mandate active in a given week observed, "0" otherwise. Also, the variable GOP_{st} is designated "1" if a state voted for a republican candidate in the last election, or indicated a "0" if the state observed voted for a democratic candidate in the last election. The control group is represented in the $MaskMandate_{st}$ variable when a state never issues a mask mandate during any given week. Then, those two groups are accompanied by one time period, along with other control variables and the residual which does not contain any autocorrelation. The goal of this methodology is to evaluate and compare the two groups based on the occurrence of a statewide mask mandate during one time period where one group received treatment (mask mandate), and the other group did not receive treatment. The dependent variable measures the number of deaths and/or cases for White and Black ethnicities for a corresponding group in a given state and in a given week, and is regressed on the $MaskMandate_{st}$ independent variable. Furthermore, the variable $State_s$ and $Week_t$ are state and week fixed effects.

Another key component for this estimation technique to infer causality lies within the previous established popular assumptions. Establishing parallel trends is one of these assumptions that helps by providing evidence for the comparability of the treatment and control groups, but in this paper, there is not enough data recordings before the intervention period to establish the validity of the parallel trend assumption. Moreover, whenever causality needs to be reinforced, it is important to have data with enough time before the treatment period to establish that the treatment group and the control group are comparable, and are trending in the same direction before the time that the policy is administered. Crucial econometric assumptions underpin the prescribed methodology in this paper and through a DID regression with TWFE analysis, most of these assumptions are met. This is an excellent method to analyze the effects of policy decisions and helps the constructed regression models in this study record a more accurate estimation for the variables of interest. In order for the models to display accurate estimates for the coefficients, causality needs to be established rather than mere correlation. Validating some assumptions such as, parallel trends, is infeasible for this analysis, but after a quick assessment of the data it seems that the two groups can be compared based on other less weighted conjectures, e.g., both groups are located in the United States and are governed loosely by the same federal constraints. In this study, the constructed model equations primarily focus on providing estimates for the differences in cases/deaths across the general populous and White and Black ethnicities, while accounting for the presence of mask mandates within states. Furthermore, the control group, i.e., states without a mask mandate, are generally comparable to the treatment group, states with a mask mandate. Therefore, the parameter estimate for the effect of statewide mask mandates on COVID-19 cases/deaths for multiple demographics would have a causal interpretation.

VII. Results

The first model estimated the effect of state mask mandates on the total weekly cases of COVID-19 in the US, the next two models are separated into the total weekly White cases and Black cases, respectively. The fourth model looked at the impact of state mask mandates on the total weekly deaths from COVID-19 in the US, succeeded by total weekly White cases and Black cases, respectively. Table 2 depicts a summary of the main results of the methodology employed with the first regressor being the main variable of interest. The second variable is the interaction between state political party affiliation and mask mandate, followed by the intercept. Next, state and week fixed effects, and the number of observations is displayed. Then, adjusted rsquared, which considers the overall fit of the models. Finally, overall significance, which shows the accuracy of the models based on if the models are an improvement to alternative models that do not contain any independent variable are recorded in Table 2.

The regressor of interest, $MaskMandate_{st}$, is statistically significant at the 1% level for Model 3 “Black Cases”, which estimates a state masking policy’s racial impact on the total weekly COVID-19 Black cases in the US, as depicted in Table 2. The coefficient of the regressor of interest in Model 3 indicates a decrease of 552 viral cases for Black Americans in a US democratic state that instituted a mask mandate during the recorded time period in the database. Interestingly, once political affiliation is interacted with mask mandates in the Model 3, all else being equal, a mask mandate for Republican states would lead to 200 more Black cases than Democratic states, which nevertheless remains insignificant. Model 5 and Model 6 depict the number of weekly White deaths and the number of weekly Black deaths as the response variable, respectively. Additionally, Models 5 & 6 both show statistically significant coefficients for the interaction term involving political party affiliation in the US, suggesting the fact that republican states that administer mask mandates show noteworthy differences in White and Black deaths from COVID-19 than democratic states. This difference indicates that death rates for White and Black Americans in republican states with a mask mandate increased by 42 deaths and 7 deaths, respectively.

Table 2: The Division in the Impact of COVID-19 Mask Mandates (Main)

	COVID-19 Cases			COVID-19 Deaths		
Regressors	Total	White	Black	Total	White	Black
Mask Mandate	-650.25	-321.1	-552.34***	7.34	-4.15	3.83
	(1,889.60)	(488.52)	(104.36)	(28.74)	(15.36)	(4.29)
Mask Mandate*GOP	-2,211.38	510.59	200.17	21.33	42.07**	7.55*
	(2,336.66)	(624.20)	(126.11)	(35.37)	(18.69)	(4.24)
Intercept	-5,301.06**	-1,492.86	-316.36*	2.24	2.64	7.56
	(2,164.57)	(914.76)	(170.42)	(42.75)	(31.45)	(8.96)
State and Week Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	2,044	2,044	2,044	2,044	2,044	2,044
Adjusted R-Square	0.54	0.59	0.63	0.50	0.40	0.32
Overall Significance	18.11***	25.06***	25.79***	19.60***	16.79***	22.62***

Sources: The COVID Racial Data Tracker | *Center for AntiRacist Research. (n.d.).*; and own adaptations.
Notes: Robust Standard Errors are in Parentheses. *, **, and *** indicate 10%, 5%, and 1% significance levels, respectively.

Table 3: The Division in the Impact of COVID-19 Mask Mandates (Initial 13 Weeks)

	COVID-19 Cases			COVID-19 Deaths		
Regressors	Total	White	Black	Total	White	Black
Mask Mandate	-2,086.71	-403.63	-137.74	13.25	-0.71	-9.44
	(2012.99)	(264.00)	(123.65)	(121.92)	(28.65)	(12.51)
Mask Mandate*GOP	3,704.50*	-167.45	-141.24	-6.52	23.19	14.96
	(2118.53)	(454.04)	(263.44)	(121.64)	(37.10)	(14.47)
Intercept	94.85	143.10**	-11.45	-15.44	-32.24	-9.34
	(183.84)	(55.08)	(36.81)	(18.88)	(33.70)	(9.45)
State and Week Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	188	188	188	188	188	188
Adjusted R-Square	0.88	0.74	0.78	0.83	0.51	0.65
Overall Significance	105.30***	164.17***	106.29***	96.62***	47.97***	64.74***

Sources: The COVID Racial Data Tracker | *Center for AntiRacist Research. (n.d.).*; and own adaptations.
Notes: Robust Standard Errors are in Parentheses. *, **, and *** indicate 10%, 5%, and 1% significance levels, respectively. This secondary inspection of mask mandates looks into the initial 13 weeks of the pandemic, observing the potential early effects of the mask policy rollouts.

Beyond discussing the important coefficients of the variables in the main results, as shown in Table 2, an evaluation of the impact of mask mandates on the initial weeks of the pandemic is performed. Early expectations of the mandates' ability to curb the initial spread of the virus are rescinded through an analysis of the initial 13 weeks. Table 3 displays the results of this initial examination and the results are predominantly insignificant, except for total cases in republican states that issued a mask policy. This secondary analysis helps to understand the differences between initial effects and the main effects when looking at the time dimension of the mask mandate rollouts. Initially, the expectations surrounding the models' efficacy to explain mask mandates and their impact on COVID-19 weekly racial deaths/cases hoped to coincide with the positive results from previous studies such as "Quantifying the Health Benefits of Face Masks and Respirators to Mitigate Exposure to Severe Air Pollution" (Kodros et al., 2021). Nevertheless, the initial-weeks analysis is concurrent with preexisting literature presuming to see no great effect of public masking policy on case and mortality rates for multiple groups (Hamilton et al., 2021; Hansen & Mano, 2023). Conversely, one model in Table 2 predicts a significant estimate for the regressor of interest, i.e., Black cases. There could be many reasons for the lack of effectiveness of mask mandates for other groups during pandemic scenarios, but these analyses estimate that mask mandates do have a significant effect when considering weekly case rates for Black Americans living in democratic states, and weekly death rates for White and Black Americans living in republican states with a mask mandate, and in the initial weeks for total cases in a republican state with a mask mandate (Table 3). The overall significance levels of the models in the analyses are unique and statistically significant when compared to hypothetical baseline models as depicted in the last row of both Table 2 and Table 3.

VIII. Conclusion

Overall, the main results indicate that mask mandates during the COVID-19 pandemic in the US are effective in reducing Black case rates, at the 1% significance level, in democratic states, and are moderately impactful causing an increase in the White and Black death rates at the

5% and 10% significance level in republican states, respectively. Furthermore, no effect in the overall cases and deaths for the population of the United States can be seen in the study, except for in the initial-weeks investigation, where it's shown that total cases in republican states that issued a mask mandate actually increased by 3,704 cases more than their democratic counterparts at the 10% significant level. It is expected that the interaction term for total deaths would be significant along with White deaths and Black deaths in the main analysis, but due to the power of the model and lack of observations the value remains insignificant. One reason for the overall outcome of the models could be interpreted as being caused by the innate contractability of airborne viruses. The general consensus in the literature is stuck between masking policy having a slight effect on viral transmission, and no effect. In this case, the racial aspect generates some significance across the models, and plays a role in estimating the disparity of outcomes for all races, especially people of color. Also, the inclusion of political affiliation seems to increase the number of racial deaths to a certain degree which is a concern for future research. Further investigations can also prod deeper into mask adherence and cultural attitudes to uncover limitations of the current models' ability to predict the overall efficacy of mask mandates during worldwide pandemic scenarios.

This study provides a foundation for estimating the effects of masking policy during COVID-19. There are significant effects when viewing the primary net result for Black cases, which shows a marked decrease, and when looking at the number of White deaths and Black deaths through a political lens, all else being equal, a mask mandate administered in republican states significantly increased the deaths by 43 and 8, respectively, when compared to democratic states. This could be explained by republican citizens reacting to the mandates in such a way that would cause death rates among White and Black races to slightly rise, perhaps congregating frequently during the mandate announcement, foiling any attempt by the government to enact policy. It is widely known that republicans are conflicted with government and enjoy their limited involvement (Bartels, 2020). The overall hypothesized outcomes are contrary to the results of both the initial-weeks and main analyses, and it remains uncertain whether statewide masking laws reduce transmission of the COVID-19 virus. The ineffectiveness of statewide masking policy on overall population cases and deaths in the US can possibly be explained by mask adherence and other variables dealing with innate viral transmission capabilities. When taking into account the large-scale policy changes that demand a certain sense of individual accountability there needs to be precise rules and regulations put in place in order to make sure everyone is adhering to the ideal standard. If those standards are not being upheld consistently, the estimation technique would have a hard time controlling for propensity to consistently adhere to a masking mandate in all locations where viral transmission easily occurs.

There are a few limitations to the study, and one was mentioned in the previous paragraph regarding masking adherence. Further research on this subject should note the difficulty in obtaining and using survey data to illuminate masking adherence under loose regulation. Highly contagious viruses that cause pandemics are evolving alongside humanity and their ability to go virtually undetected in our environments remains concerning at the least. Another limitation of this analysis occurs in the scope of the data and the number of observations. Many states in the US started implementing masking mandates simultaneously with the start of the pandemic, allowing for little time to measure cases and deaths in the period before the treatment or policy was administered. A further emphasis on recording county-level measurements and deciphering political affiliations in the counties would be interesting areas to study in future research. These implications for future researchers should very likely lead to a more substantial effect being recorded for democratic-leaning counties with mask mandates (Hansen & Mano, 2023).

This paper demonstrates several modest effects of mask mandates on case and death rates of White and Black races, most notably by estimating a reduction in overall Black cases in democratic states, and a marked increase in White and Black deaths in republican states compared to democratic states. Political affiliation and locality seem to be important factors attributing to mask adherence and attitudes. The effectiveness of mask mandates in the US is few and far between in the current models, showing an effect in some parameters and no effect in others. Policymakers can look at the efficacy of mask mandates in certain groups and tailor laws accordingly. In addition, researchers can use this investigation to validate the perceived uncertainty of the effectiveness of mask mandates in reducing viral transmission and inquire into other laws that could curtail the possible effects. Lack of control variables, along with the scope of the data, yields to the limitations of this type of analysis. There are many situations where this type of natural experiment can provide more extensive implications. Further research on this subject can help to paint a larger picture of the potential overall impact of mask mandates during pandemics on the transmission and mortality rate of different groups of people at the local-level in the US, and throughout other nations of the world.

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Appendix

SAS Codes

```
*****************************************************************************;
        /* The Racial Divide in the Impact of COVID-19 Mask Mandates in the U.S */

*****************************************************************************;



/*Importing of Excel Covid, Mask Mandate, & GOP Data, with Initial 8 Weeks Analysis
Commented Out*/


/*****************************************************************************

Proc Import datafile="/home/u60745743/MySAS/ASeniorProject2024/Initial 8 Weeks
COVID.xlsx"
        out=work.COVID
        dbms=xlsx
        replace;
getnames=yes;
run;

Proc Import datafile="/home/u60745743/MySAS/ASeniorProject2024/Initial 8 Weeks
MaskMandate.xlsx"
        out=work.MaskMandate
        dbms=xlsx
        replace;
getnames=yes;
run;
*****************************************************************************/


Proc Import datafile="/home/u60745743/MySAS/ASeniorProject2024/Final-CovidRegression
Data.xlsx"
        out=work.COVID
        dbms=xlsx
        replace;
```

```
getnames=yes;
run;

Proc Import datafile="/home/u60745743/MySAS/ASeniorProject2024/Final-MaskMandate
Data.xlsx"
		out=work.MaskMandate
		dbms=xlsx
		replace;
getnames=yes;
run;

Proc Import datafile="/home/u60745743/MySAS/ASeniorProject2024/Final-GOP Data.xlsx"
		out=work.GOP
		dbms=xlsx
		replace;
getnames=yes;
run;

/*Sorting data by state*/
proc sort data=COVID;
		by State;
run;

proc sort data=MaskMandate;
		by State;
run;

/*Merging data*/
Data MergedData;
		Merge COVID MaskMandate;
		By State;
Run;

/*Creating new dataset with two new variables; MaskMandate, GOP, and (Treatment-
excluded)*/
Data MergedData2;
		Set MergedData;
		if Week_ID => Start1_WeekID & Week_ID =< End1_WeekId then MaskMandate=1;
				else MaskMandate=0;
		if Start1_WeekID >0 then Treatment1=1;
				else Treatment1=0;
```

```
Run;

/*Merge GOP*/
Data MergedData3;
		Merge MergedData2 GOP;
		By State;

Run;

/*TWFE Non-Linear Regression Model example, before interaction between
GOP*MaskMandate*/

/*TotalCases*/
Proc surveyreg data=MergedData3 ;
		class State Week_ID;
		model Weekly_Total= MaskMandate State Week_ID / solution adjrsq;
		/*coefficient for MaskMandate is statistically insignificant, therefore the model
(MaskMandate) shows no effect
		 on weekly TotalCases*/
run;

Proc surveyreg data=MergedData3 ;
		class State Week_ID;
		model Weekly_Total_1= MaskMandate State Week_ID / solution adjrsq;
		/*coefficient for MaskMandate is statistically insignificant, therefore the model
(MaskMandate) shows no effect
		 on weekly TotalCases*/
run;

******************************************************************************
*******;
/* TWFE Surveyreg Non-Linear Regression, 6 Models with State and Week fixed effects */
******************************************************************************
********;

/*TotalCases*/
Proc surveyreg data=MergedData3 ;
		class State Week_ID;
		model Weekly_Total= MaskMandate GOP*MaskMandate State Week_ID / solution
adjrsq;
		/*The coefficient for MaskMandate is statistically insignificant, therefore the model
```

```
(MaskMandate) shows no effect
           on weekly TotalCases*/
run;

/*WhiteCases*/
Proc surveyreg data=MergedData3;
         class State Week_ID;
         model Weekly_Total_1= MaskMandate GOP*MaskMandate State Week_ID / solution
adjrsq;
run;

/*BlackCases*/
Proc surveyreg data=MergedData3;
         class State Week_ID;
         model Weekly_Total_2= MaskMandate GOP*MaskMandate State Week_ID / solution
adjrsq;
run;

/*TotalDeaths*/
Proc surveyreg data=MergedData3;
         class State Week_ID;
         model Weekly_Total_3= MaskMandate GOP*MaskMandate State Week_ID / solution
adjrsq;
run;

/*WhiteDeaths*/
Proc surveyreg data=MergedData3;
         class State Week_ID;
         model Weekly_Total_4= MaskMandate GOP*MaskMandate State Week_ID / solution
adjrsq;
run;

/*BlackDeaths*/
Proc surveyreg data=MergedData3;
         class State Week_ID;
         model Weekly_Total_5= MaskMandate GOP*MaskMandate State Week_ID / solution
adjrsq;
run;

************************************************************;
/* Running The 6 Regression Models & Cleaning Main Results Table */
```

```
***********************************************************;

ods output ParameterEstimates=PEforModel1  DataSummary=ObsModel1
FitStatistics=AdjRsqModel1  Effects=OverallSigModel1;
Proc SurveyReg data=MergedData3 plots=none;
	class State Week_ID;
	Model1: Model Weekly_Total=MaskMandate GOP*MaskMandate State
Week_ID/Solution Adjrsq;
run;

ods output ParameterEstimates=PEforModel2 DataSummary=ObsModel2
FitStatistics=AdjRsqModel2  Effects=OverallSigModel2;
Proc SurveyReg data=MergedData3 plots=none;
	class State Week_ID;
	Model2: Model Weekly_Total_1=MaskMandate GOP*MaskMandate State
Week_ID/Solution Adjrsq;
run;

ods output ParameterEstimates=PEforModel3 DataSummary=ObsModel3
FitStatistics=AdjRsqModel3  Effects=OverallSigModel3;
Proc SurveyReg data=MergedData3 plots=none;
	class State Week_ID;
	Model3: Model Weekly_Total_2=MaskMandate GOP*MaskMandate State
Week_ID/Solution Adjrsq;
run;

ods output ParameterEstimates=PEforModel4 DataSummary=ObsModel4
FitStatistics=AdjRsqModel4  Effects=OverallSigModel4;
Proc SurveyReg data=MergedData3 plots=none;
	class State Week_ID;
	Model4: Model Weekly_Total_3=MaskMandate GOP*MaskMandate State
Week_ID/Solution Adjrsq;
run;

ods output ParameterEstimates=PEforModel5 DataSummary=ObsModel5
FitStatistics=AdjRsqModel5  Effects=OverallSigModel5;
Proc SurveyReg data=MergedData3 plots=none;
	class State Week_ID;
	Model5: Model Weekly_Total_4=MaskMandate GOP*MaskMandate State
Week_ID/Solution Adjrsq;
run;
```

```
ods output ParameterEstimates=PEforModel6 DataSummary=ObsModel6
FitStatistics=AdjRsqModel6  Effects=OverallSigModel6;
Proc SurveyReg data=MergedData3 plots=none;
		class State Week_ID;
		Model6: Model Weekly_Total_5=MaskMandate GOP*MaskMandate State
Week_ID/Solution Adjrsq;
run;


*******************************;
/* Building The Results Table */
*******************************;

/* Step 1: Clean-up outputs [regression analyses]. */
Data Table_Long;
		length Model $10; /* Makes sure the variable Model has the right length and its
values are not truncated */
		length Parameter $30; /* Makes sure the variable Parameter has the right length and
its values are not truncated */
		set PEforModel1 PEforModel2 PEforModel3 PEforModel4 PEforModel5 PEforModel6
indsname=M; /*"indsname" creates an indicator variable (here I call it "M") that tracks the
name of databases use in the "set" statement */
		keep Model Parameter EditedResults;
		if		M="WORK.PEFORMODEL1" then Model="Model1";
				else if M="WORK.PEFORMODEL2" then Model="Model2";
				else if M="WORK.PEFORMODEL3" then Model="Model3";
				else if M="WORK.PEFORMODEL4" then Model="Model4";
				else if M="WORK.PEFORMODEL5" then Model="Model5";
				else if M="WORK.PEFORMODEL6" then Model="Model6";
		Where Estimate ne 0;

		if Probt le 0.01 then Star="***";
				else if Probt le 0.05 then Star="**";
				else if Probt le 0.1 then Star="*";



		Results=Estimate;
		EditedResults=Cats(put(Results,comma16.2),Star);
		output;
```

```
		Results=stderr;
		EditedResults=Cats("(",put(Results,comma16.2),")");
		output;

run;

/* Step 2: Sorting Step; i.e., multiple regression. */
Proc sort data=Table_Long out=Table_Long_Sorted;
		by Model Parameter;
run;


/* Step 3: Creating separate results columns (in the form of separate databases) corresponding
to each model */
data Model1Results(rename=(EditedREsults=Model1))
			Model2Results(rename=(EditedREsults=Model2))
Model3Results(rename=(EditedREsults=Model3))
			Model4Results(rename=(EditedREsults=Model4))
Model5Results(rename=(EditedREsults=Model5))
			Model6Results(rename=(EditedREsults=Model6));
		set Table_Long_Sorted;
		if Model="Model1" then output Model1Results;
			else if Model="Model2" then output Model2Results;
			else if Model="Model3" then output Model3Results;
			else if Model="Model4" then output Model4Results;
			else if Model="Model5" then output Model5Results;
			else if Model="Model6" then output Model6Results;
		drop Model;
run;


/* Step 3.5: Creating the final results table that includes all models side-by-side*/
data Table_Wide;
		merge Model1Results Model2Results Model3Results Model4Results Model5Results
Model6Results ;
		by Parameter;
		if mod(_n_,2)=1 then Regressors=Parameter;

		length Order 3;
		if Parameter="MaskMandate" then Order=1;
			else if Parameter="GOP*MaskMandate" then Order=2;
```

```
                    else if substr(Parameter,1,11)="intercept " then Order=3;

run;

/* Ordering variables in the results table */
proc sort data=Table_Wide out=Table_Wide_Sorted(drop=Order Parameter);
        by Order;
run;

/*Step 4: Creating the rows for other statistics*/

/* The row for Number of Obs */
data NumofObs(keep=Label1 Model1 Model2 Model3 Model4 Model5 Model6);
        merge ObsModel1(rename=(nvalue1=NVMoel1))
ObsModel2(rename=(nvalue1=NVMoel2)) ObsModel3(rename=(nvalue1=NVMoel3))
                        ObsModel4(rename=(nvalue1=NVMoel4))
ObsModel5(rename=(nvalue1=NVMoel5)) ObsModel6(rename=(nvalue1=NVMoel6));
        by Label1;
        where Label1="Number of Observations";
        Model1=put(NVMoel1,comma16.0);
        Model2=put(NVMoel2,comma16.0);
        Model3=put(NVMoel3,comma16.0);
        Model4=put(NVMoel4,comma16.0);
        Model5=put(NVMoel5,comma16.0);
        Model6=put(NVMoel6,comma16.0);
run;

/* The row for Adj R-sq */
Data AdjRsq;
        merge AdjRsqModel1(rename=(cvalue1=Model1))
AdjRsqModel2(rename=(cvalue1=Model2))
         AdjRsqModel3(rename=(cvalue1=Model3))
AdjRsqModel4(rename=(cvalue1=Model4))
          AdjRsqModel5(rename=(cvalue1=Model5))
AdjRsqModel6(rename=(cvalue1=Model6));
        by Label1;
        Where Label1="Adjusted R-Square";
        drop nvalue1;
run;

/* The row for Overall Significance */
```

```
data OSM1(rename=(EditedValue=Model1)) OSM2(rename=(EditedValue=Model2))
OSM3(rename=(EditedValue=Model3))
	OSM4(rename=(EditedValue=Model4)) OSM5(rename=(EditedValue=Model5))
OSM6(rename=(EditedValue=Model6));
	set OverallSigModel1 OverallSigModel2 OverallSigModel3 OverallSigModel4
OverallSigModel5 OverallSigModel6 indsname=M;
	Where Effect="Model";
	Label1="Overall Significance";

	if ProbF le 0.01 then Star="***";
		else if ProbF le 0.05 then Star="**";
		else if ProbF le 0.1 then Star="*";

	EditedValue=Cats(Put(FValue,comma16.2),Star);

	if M="WORK.OVERALLSIGMODEL1" then output OSM1;
		else if M="WORK.OVERALLSIGMODEL2" then output OSM2;
		else if M="WORK.OVERALLSIGMODEL3" then output OSM3;
		else if M="WORK.OVERALLSIGMODEL4" then output OSM4;
		else if M="WORK.OVERALLSIGMODEL5" then output OSM5;
		else if M="WORK.OVERALLSIGMODEL6" then output OSM6;
	keep Label1 EditedValue;
run;

Data OverallSig;
	merge OSM1 OSM2 OSM3 OSM4 OSM5 OSM6;
	by Label1;
run;

/* Combining all rows for other statistics */
Data OtherStat;
	set NumofObs AdjRsq OverallSig;
	rename Label1=Regressors;
Run;

Data FE;
	Regressors="State and Week of the Year Fixed Effects";
	Model1="Yes";
	Model2="Yes";
	Model3="Yes";
	Model4="Yes";
```

```
            Model5="Yes";
            Model6="Yes";
run;


/* Step 5: Adding other statistics to the results table */
Data Table_Wide_Sorted_WithStat;
            Length Regressors $40;
            set Table_Wide_Sorted FE OtherStat;
run;

/*
Data Table_Wide_Sorted_WithStat2;
            set Table_Wide_Sorted_WithStat;
            where substr(Regressors,1,5) ne "State";
Run;
*/

/* Clean results table */
ods excel file="/home/u60745743/MySAS/ASeniorProject2024/Table_SimpleReg.xlsx"
options(Embedded_Titles="ON" Embedded_Footnotes="ON"); /*Use the path to your MySAS
folder */
Title "Table 2: The Division in the Impact of COVID-19 Mask Mandates (Main Results)";
footnote justify=left "Note: Robust Standard Errors are in Parentheses. *, **, and *** indicate
                                                            10%, 5%, and 1% significance levels,
respectively.";
proc print data=Table_Wide_Sorted_withstat noobs;
            var Regressors;
            var Model1-Model6 /style(header)={just=center} style(data)={just=center
tagattr="type:String"};
            format Regressors $VariableName.;
run;
ods excel close;
```