A DIFF-IN-DIFF ANALYSIS OF THE IMPACT OF VOTING TURNOUT ON INFANT MORTALITY

A Focus on the United States

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A Diff-In-Diff analysis of the impact of voting turnout on infant mortality: A focus on the United States

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Abstract

The notion that democratic societies tend to have a better health systems and outcomes sounds natural. Since people are involved in the system and electoral process, democratic governments give significance to the health system. There is a vast academic work done in the aim of finding a correlation between the political regimes on health outcomes. There is a general conclusion that there is a positive correlation between democracy and health outcomes, however, there are instances of authoritative regimes doing well in health sector. To estimate the relation in a simple analysis, this paper uses voter turnout data of states in the United States of America, as a basic democracy index, and tries to relate it with the change in the infant mortality rates by conducting a difference-in-differences analysis. Contrary to what we expected, it is found in the analysis that the decrease in the infant mortality rates in the states with higher voter turnout is not considerably higher than that of in the states with lower voter turnout. Findings in this paper indicate that the higher voter turnout does not necessarily means a lower infant mortality rate, that the impact is insignificantly low.

Keywords: Health, democracy, voter turnout, infant mortality, elections, health system

Literature Review

The notion that the regime of a state can be a huge determinant factor for numerous aspects of the state is often accepted as true. Historically, major stories show us that democracy is a favorable way to improve the economic and social state of a country. However, to understand how important democracy, or any other form of management, specifically for the health sector, we should analyze specific cases where reverse regimes took place at different timelines. There are many cross-sectional studies and before-after analyses done under the aim of finding the relation between dictatorship, democracy, and health outcomes.

In their article named "Health and Democracy" (Besley, Kudamatsu, Merlo, Olken, & Nunn, 2006), authors investigate the relation between democracy and health using panel data from a cross section of countries varying from Ghana to United States. Their data cover from 1960s to the 2000s. After series of analysis, the paper concludes that there is a robust correlation between democracy and health, meaning that democracies lead to greater life expectancy. They also mention that the structural development of the political institutions also matters to improve the health outcomes.

There is a case study in the article named "The effects of dictatorship on health: the case of Turkmenistan" (Rechel & McKee, 2007). The paper mainly focuses on the health crisis in Turkmenistan and its relationship with the dictatorship regime under president Niyazov who died in 2006. The authors aim to find a connection between the policies implemented under Niyazov and the health crisis that the country faced during 2000s. They use series of semi-structured in-depth interviews with key people supported by a wide range of articles on the internet, initially published as a report in April 2005, which later included feedback on the report. One of the most important findings of the paper is that the dictatorship under Niyazov has contributed to the health

crisis via the policies in the health sector such as secrecy, concealment, trafficking of drugs from Afghanistan, and mainly the neglection of the health care system.

In his article named "Health and political regimes: Evidence from quantile regression" (Okada, 2018), Keisuke Okada runs a wide range of data analysis to investigate the impact of the political regime on the health outcomes such as infant and child mortality, and life expectancy by using data from 180 countries observed between 1960 and 2013. He uses panel quantile regression to find the effects at variety of intervals. The paper examines different levels of health outcomes separately. As a result of the analysis, Okada reaches to the conclusion that there is a positive correlation between the democracy and health outcomes. He presents that the impact of the democratic regimes on the worse health quantile of health outcomes is greater. Although the types of democracies do not affect the health outcomes dramatically different, the parliamentary form of democracy has the highest positive effect on health outcomes at the worst quantile of health outcomes. Finally, he also suggests that the democratization has greater effects on the health outcomes when the health outcomes are worse.

Looking from another perspective, in their article named "Making sense of dictatorships and health outcomes" (Geloso, Berdine, & Powell, 2020), the authors try to understand reason behind the success of the states ruled by dictatorship which yet have impressive levels of health outcomes. The countries in the debate include Cuba, former Union of Soviet Socialist Republics (USSR), China, and Ethiopia. In their discussion, authors point out that it is nearly impossible to accept that dictatorships are good for health outcomes. They suggest that it is favorable to take the good parts of such regimes while avoiding the "bad". Even though they accept that there are good examples of dictatorships which have been successful in health, they still believe that these are mainly due to their ability to forcibly mandate the allocation of resources towards achieving the

regime's objectives. They also mention that some dictatorship regimes invest in health sector only if it will improve their authority.

In another case study named "Spending on primary healthcare in two government administrations in Chile since the dictatorship" (Moraga-Cortés, Bahia, & Prada, 2021), authors analyze two periods of dictatorship in Chile. They compare the governments of Sebastián Piñera and Michelle Bachelet. They find that there was a permanent increase in the primary health care expenditure in two periods. They also mention that the second period has a little less investment on primary health care. They suspect that the distribution of health might not be equal by looking at the regional data.

There are variety studies done to investigate the impact of the political regimes on health outcomes. While some of them says that there is a positive correlation between democracy and health outcomes, there are examples of dictatorships who became successful in health sector.

Introduction

Democracy is a form of government which always puts people in the first place. One of main characteristics that separates democracy from other types of governments is that it allows people to choose the people under whom they will be governed. In that sense, people have the right to say their ideas about the governors via elections. The election process is a very important feature of democracy. Voter turnout is an important concept in democracies. It is the percentage of eligible voters who in fact voted. It is often accepted that a higher voter turnout means a better democracy. Indeed, the voter turnouts in democratic countries are usually higher. The lower voter turnouts often referred as a signal that trust in government and authorities is low. Therefore, in democratic regimes, voting is always recommended by the authorities. Hence, we can say that there is at least

a slightly positive relation between voter turnout and the democracy level. In this study, the voter turnout is used as a tool to calculate a simple democracy index. We used the change in the voter turnout in US states in the diff-in-diff analysis as a parameter that differentiates the states.

Data Analysis

An Overview

The data used in this paper include US states' voter turnout data, infant mortality data, percentage of GDP data, life expectancy data. The data of voter turnout is taken from the United States Elections Project's website ("Voter Turnout Data - United States Elections Project," n.d.). The data of infant mortality is taken from Centers for Disease Control and Prevention's website ("Stats of the States - Infant Mortality," n.d.). A certain number of correlation analysis has been done to see the initial picture of the states and data. At first, we should look at the data of US states' voter turnout change in its own sense. The table below shows the change in the voter turnout rates in US states between the years 2005 and 2020. The voter turnout is shown in the percentage form.

Figure 1: The table showing the change in the voter turnout rates in US states' from 2005 to 2020

State	2004	2020	Difference	% Increase
North Carolina	58,7	71,48	12,78	22%
South Carolina	53,2	64,51	11,31	21%
Georgia	56,4	68,03	11,63	21%
Arizona	54,8	65,92	11,12	20%
Virginia	61,1	73,00	11,90	19%
Hawaii	48,5	57,52	9,02	19%
Nevada	55,4	65,36	9,96	18%
New Jersey	64,2	75,27	11,07	17%
District of Columbia	54,9	64,08	9,18	17%
Utah	59,8	69,17	9,37	16%
California	59,6	68,50	8,90	15%
Colorado	67,3	76,41	9,11	14%
Maryland	63,1	71,10	8,00	13%
Washington	67,5	75,71	8,21	12%
Montana	65,2	73,10	7,90	12%
Massachusetts	64,6	72,11	7,51	12%

Vermont	66,7	74,21	7,51	11%
Rhode Island	58,9	65,34	6,44	11%
Florida	64,7	71,66	6,96	11%
Michigan	67,1	73,90	6,80	10%
Indiana	55,8	61,37	5,57	10%
Alabama	57,4	63,13	5,73	10%
Delaware	64,5	70,68	6,18	10%
Kentucky	59,4	64,94	5,54	9%
Nebraska	64,1	69,89	5,79	9%
New York	58,5	63,57	5,07	9%
Connecticut	66,2	71,49	5,29	8%
Illinois	62,4	67,02	4,62	7%
New Hampshire	71,5	75,46	3,96	6%
Tennessee	56,8	59,81	3,01	5%
Idaho	64,8	67,96	3,16	5%
Kansas	62,9	65,86	2,96	5%
Louisiana	61,5	64,30	2,80	5%
West Virginia	55,1	57,58	2,48	5%
Oregon	72,6	75,52	2,92	4%
Iowa	70,6	73,25	2,65	4%
Arkansas	54,4	56,07	1,67	3%
Maine	74,9	76,32	1,42	2%
Minnesota	78,8	79,96	1,16	1%
New Mexico	60,4	61,25	0,85	1%
Wisconsin	75,3	75,77	0,47	1%
Missouri	66,1	65,74	-0,36	-1%
Ohio	67,9	67,43	-0,47	-1%
Alaska	69,6	68,76	-0,84	-1%
North Dakota	65,5	64,45	-1,05	-2%
Wyoming	66,3	64,56	-1,74	-3%
South Dakota	69,4	65,97	-3,43	-5%

The table itself does not tell too much about what happened between these years. However, we can see that nearly all the states saw a positive increase in their voter turnout rates during this period. We can see that North Caroline has the highest change in its voter turnout rate with 22% followed by South Caroline with 21%. The graph below shows geographic distribution of the change in voter turnouts, making it easier to understand.

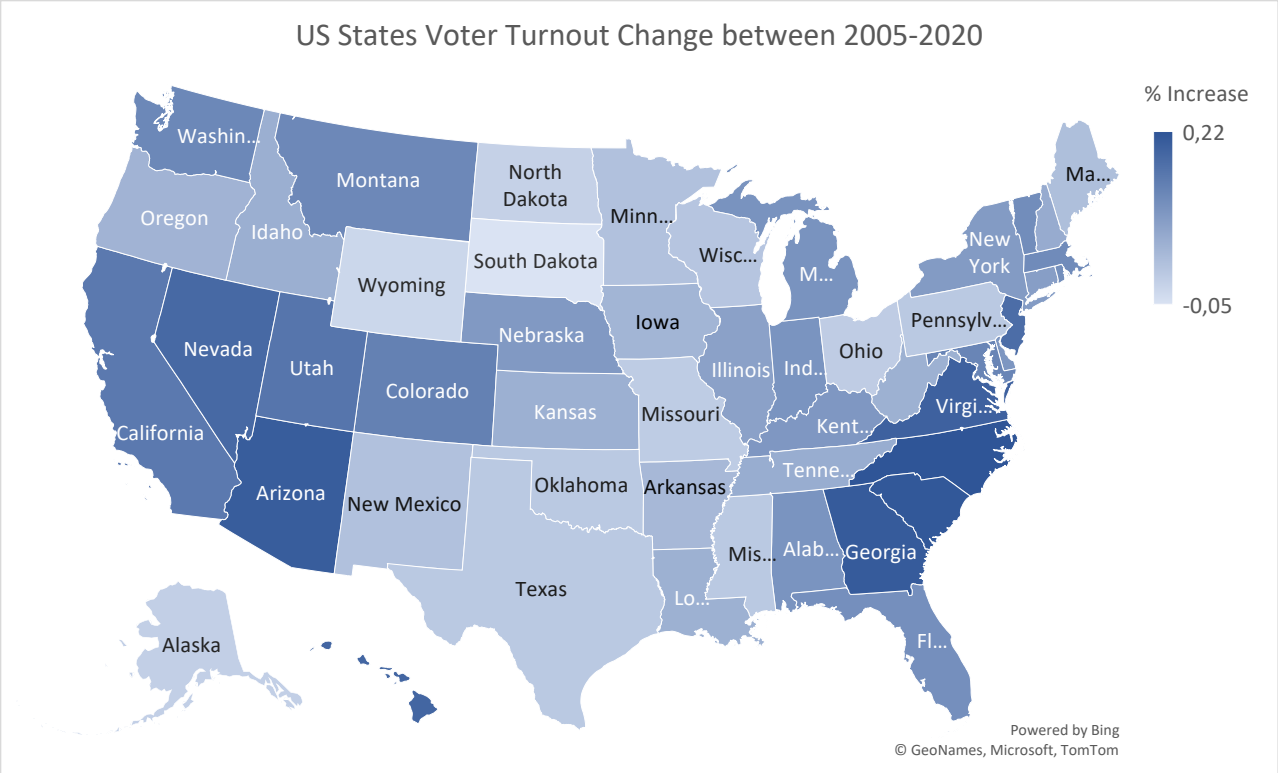

Figure 2: The map showing the change in voter turnout by US states

This map shows the visual distribution of the voter turnout changes in US. We can say that the middle part of the country had less increase in the voter turnouts while the coast states had it higher. However, to understand the relation, we should also look at the changes in the infant mortality rates and compare two data. Infant mortality is the death of an infant before his or her first birthday. The infant mortality rate is the number of infant deaths for every 1,000 live births. The bar chart below shows the infant mortality rates in 10 states with the highest infant mortality rates in 2019.

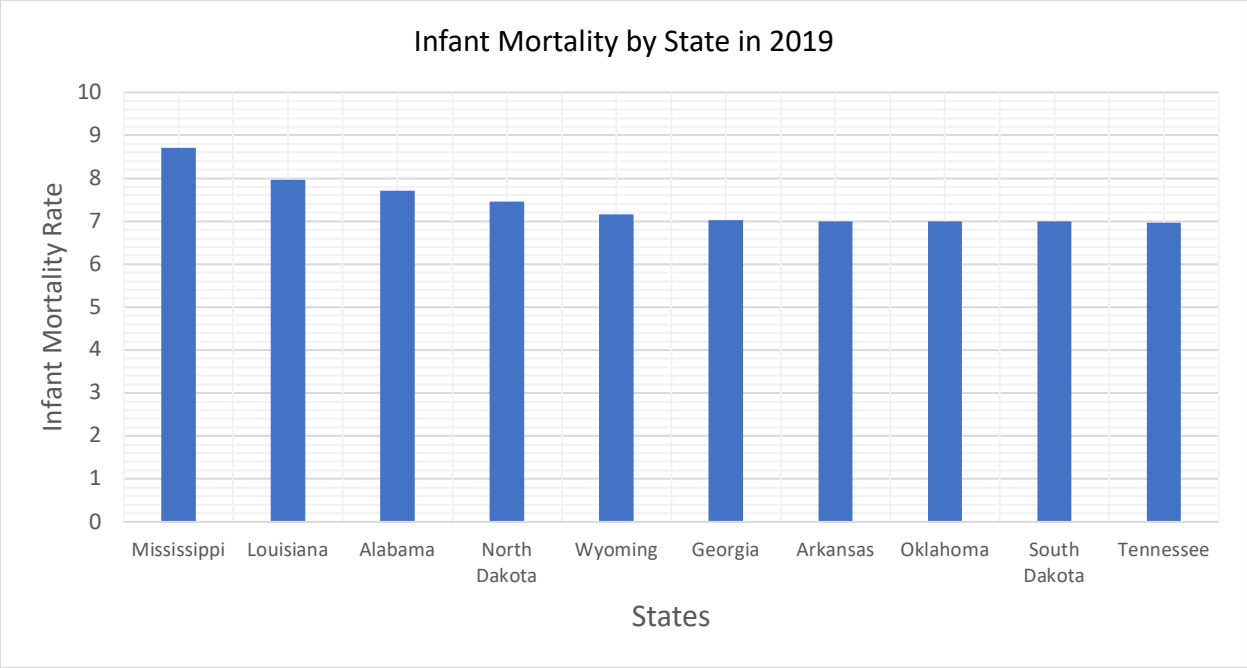

Figure 3: Bar chart showing the infant mortality rates in US states

The graph shows that Mississippi had the highest infant mortality rate in US in 2019 with 8.71 infants dying in every 1000 live birth of a child. Louisiana and Alabama are following with the rate of nearly 8. This data is giving us information about the current situation in US. However, we would like to see the change over the years to compare it with the change in the voter turnout. The map below shows the distribution of the change in infant mortality rates between 2005 and 2019 in US states.

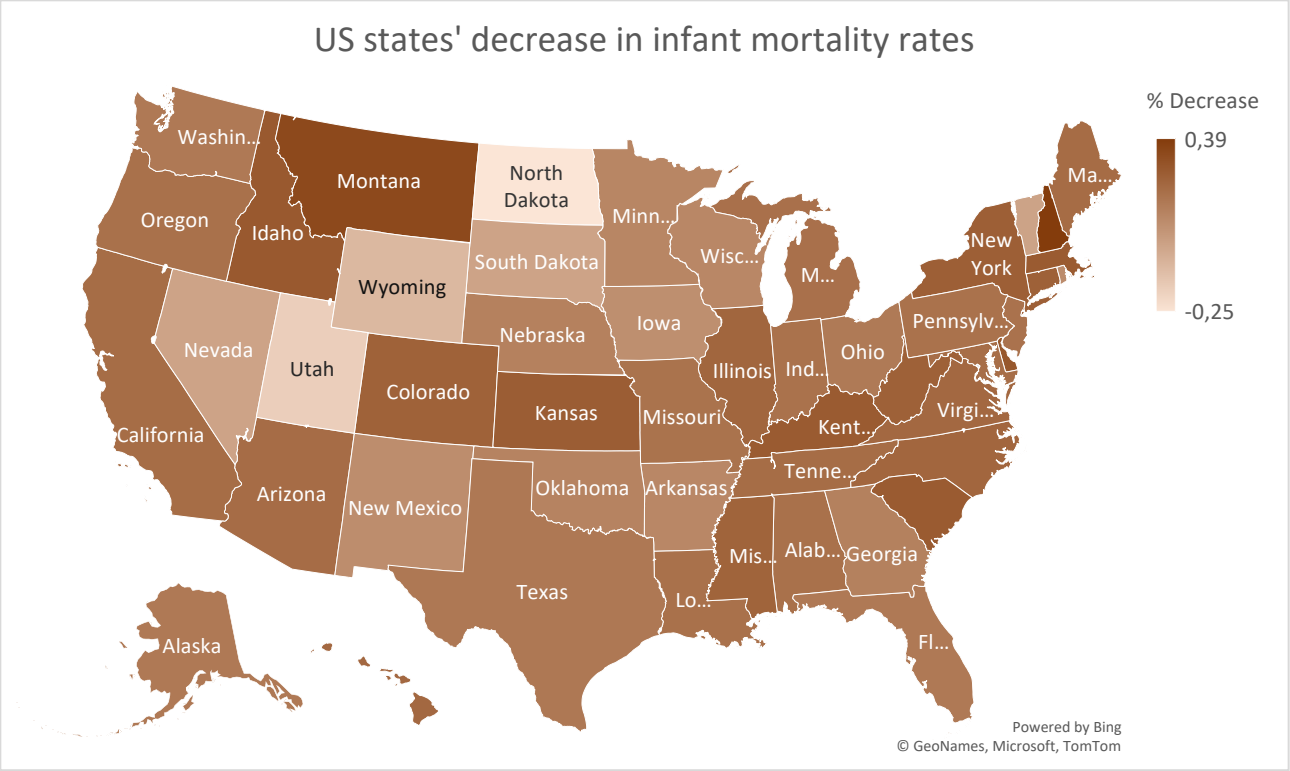

Figure 4: Map showing the distribution of the change in the infant mortality rates in US states

The change in the infant mortality rates does not seem very differently distributed among the states. New Hampshire has the highest with the 39% decrease in the infant mortality rate between 2005 and 2019. After having a clear idea of what these data mean and see their visual structure, now we can look at the relation among them. The scatter below shows the relation between the change in the voter turnout and the change in the infant mortality rates.

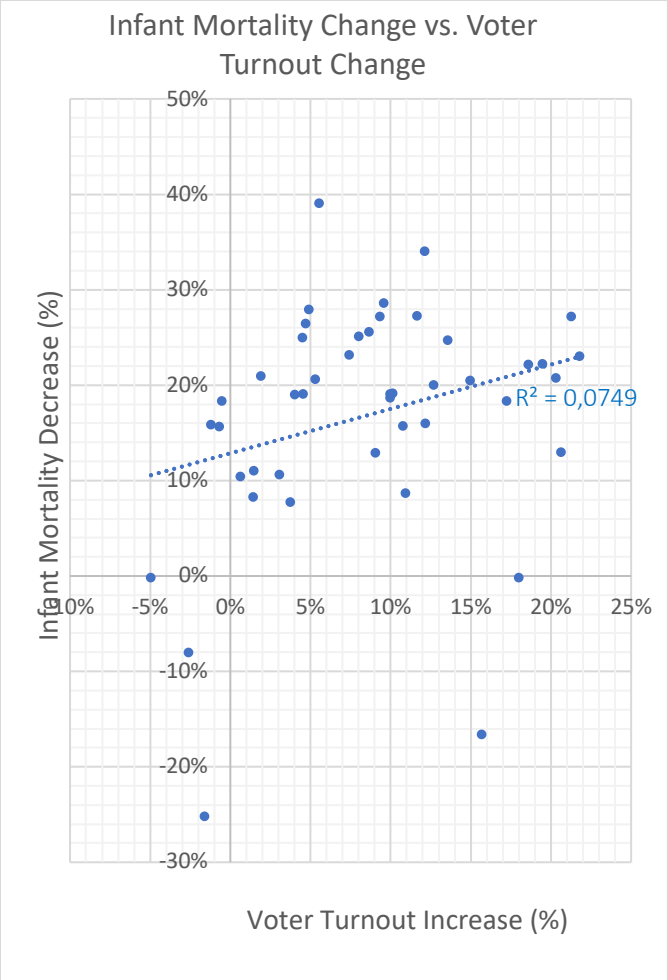

Figure 5: The scatterplot showing the relation between the change in the voter turnout and the change in the infant mortality rates in US states.

As we can see from the scatterplot on the left, there is a slightly positive relation between these two variables with R-square value equals to 0.0749. This shows us that there is a positive but not significant relation. There are certain states where the change in the voter turnout is lower while the decrease in the infant mortality rates is higher. So, we cannot conclude that there is a strong relation between these two variables by just looking at this scatterplot. To understand the causal effect of the voter turnout on infant mortality, we should make a difference-in-difference analysis. The remaining part of the data analysis is about the diff-in-diff approach done by using R-markdown and R Studio.

Difference-in-differences Analysis

The difference-in-differences analysis is a common concept used in research community. In this paper, it is used to understand the causal effect of the change in the voter turnout on the change in the infant mortality rates in US states. At first, states should be divided into two categories. The first category is called the treatment group. In this paper, the separation of the states is done by the

increase in their voter turnout rates. The states with the change in the voter turnout rate higher than 10% are the treatment group. The reason for this is that the change in their inclusion of voters is higher than other states. The second group is called the control group, which includes the states with the change in the voter turnout rate lower than 10%.

Treatment Group: Change in the voter turnout higher than 10%

Control Group: Change in the voter turnout lower than 10%

This way, we will mostly exclude the effects other than voter turnout rate. Our analysis focuses on finding the differences between 2005 and 2020 for both groups and then finding the difference between the differences. The average infant mortality rates in 2005 and 2020 for both treatment and control groups with a 95% confidence interval is shown in the plot below which is created in R environment.

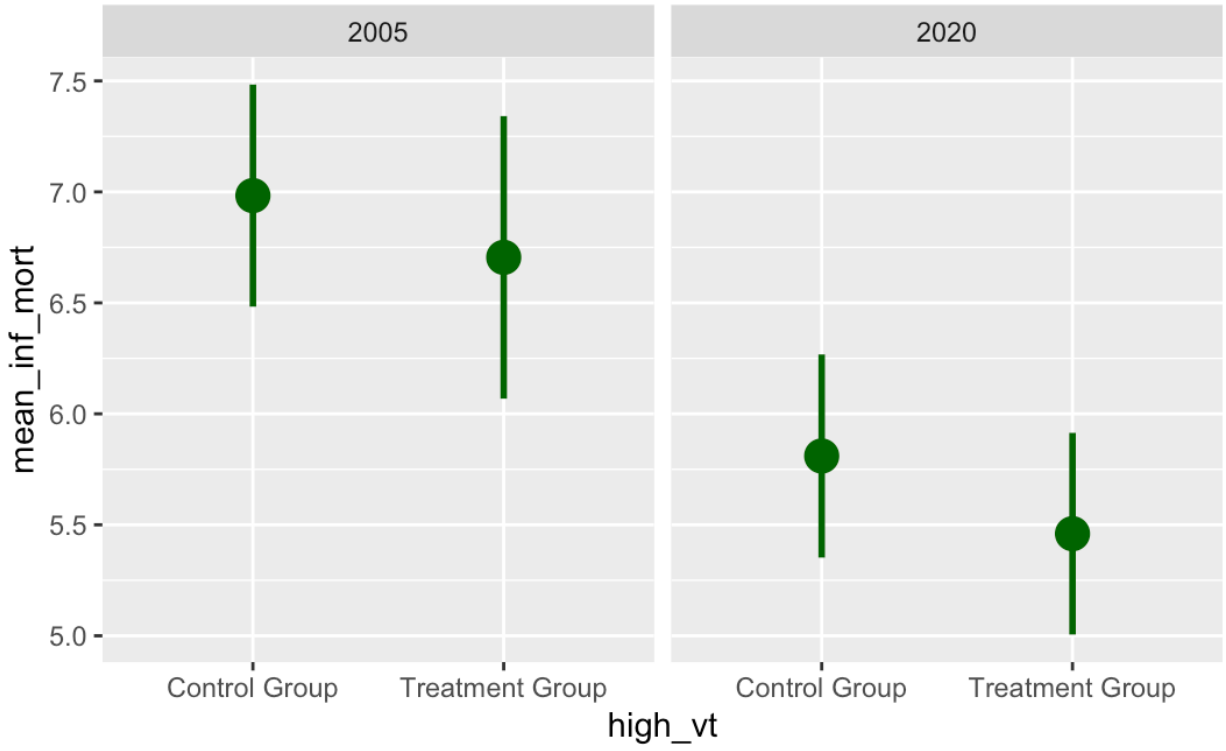

Figure 6: Plot showing the average infant mortality rates for both groups in 2005 and 2020

Just as we expected, the average infant mortality rate decreases for both groups when we go from 2005 to 2020. The initial position of the control group, states with the change in their voter turnout lower than 10%, is a rate somewhere around 7, while the rate for the treatment group, states with the change in their voter turnout higher than 10%, is around 6.75. After the change, the change in the voter turnout between 2005 and 2020, the rate for the control group decreases to nearly 5.80. The average infant mortality rate for the treatment group in 2020 is somewhere around 5.5. If we look at the plot below, it is clear that the decrease in the mean of the infant mortality rate is nearly the same.

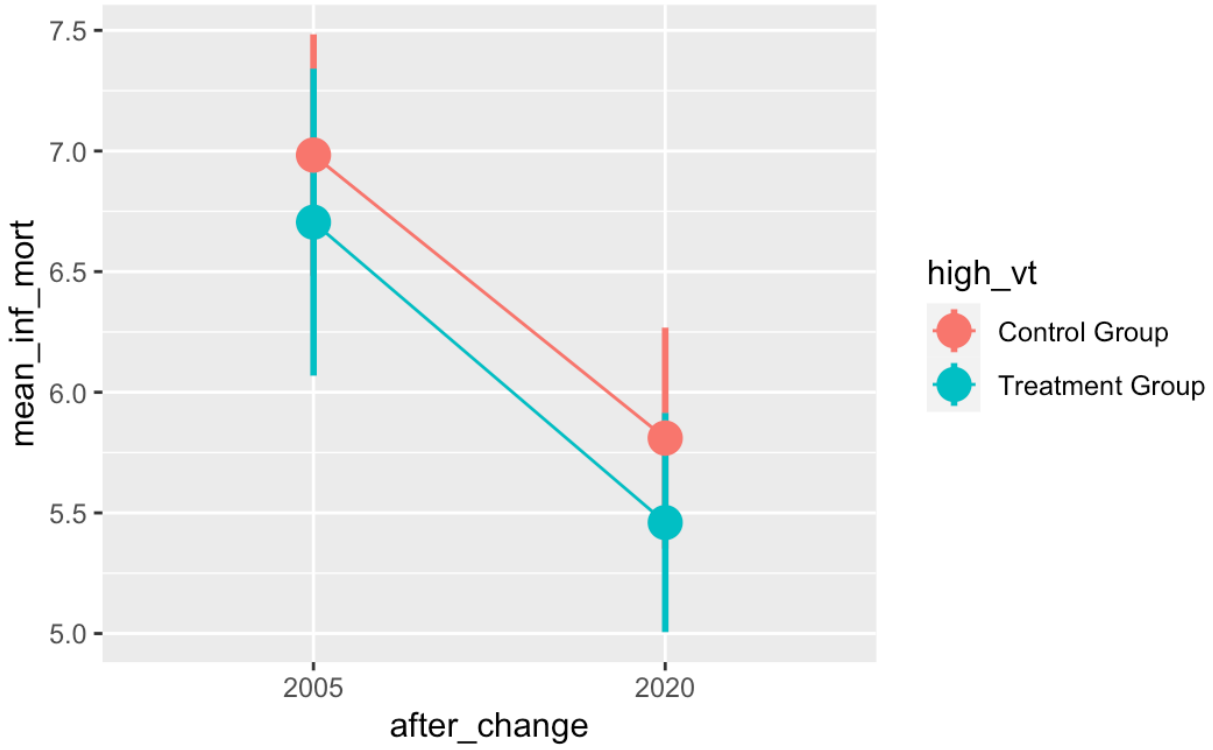

Figure 7: The plot showing both 2005 and 2020 in the same area

To see the effect more clearly, from now on, the logarithmic version of the variable infant mortality is used. This way we can make conclusions about the casual impact of the voter turnout on the infant mortality. The table below is used in R environment to find the differences.

Year	Group	Logarithmic mean of infant mortality rate
2005	Control Group	1.927037
2005	Treatment Group	1.882778
2020	Control Group	1.737778
2020	Treatment Group	1.680556

Figure 8: The table showing the log values for the diff-in-diff analysis

Now, we will get the difference for each group;

D1 = difference of the treatment group = 1.882778 - 1.680556 = **0.202222**

D2 = difference of the control group = 1.927037 - 1.737778 = **0.189259**

After finding the difference in each group, we will look at the difference between these two numbers;

Diff-in-diff = D1 - D2 = 0.202222 - 0.189259 = **0.012963**

The crucial number for the diff-in-diff analysis is 0.013. This is an estimation for the impact of the change the voter turnout on the change in the infant mortality.

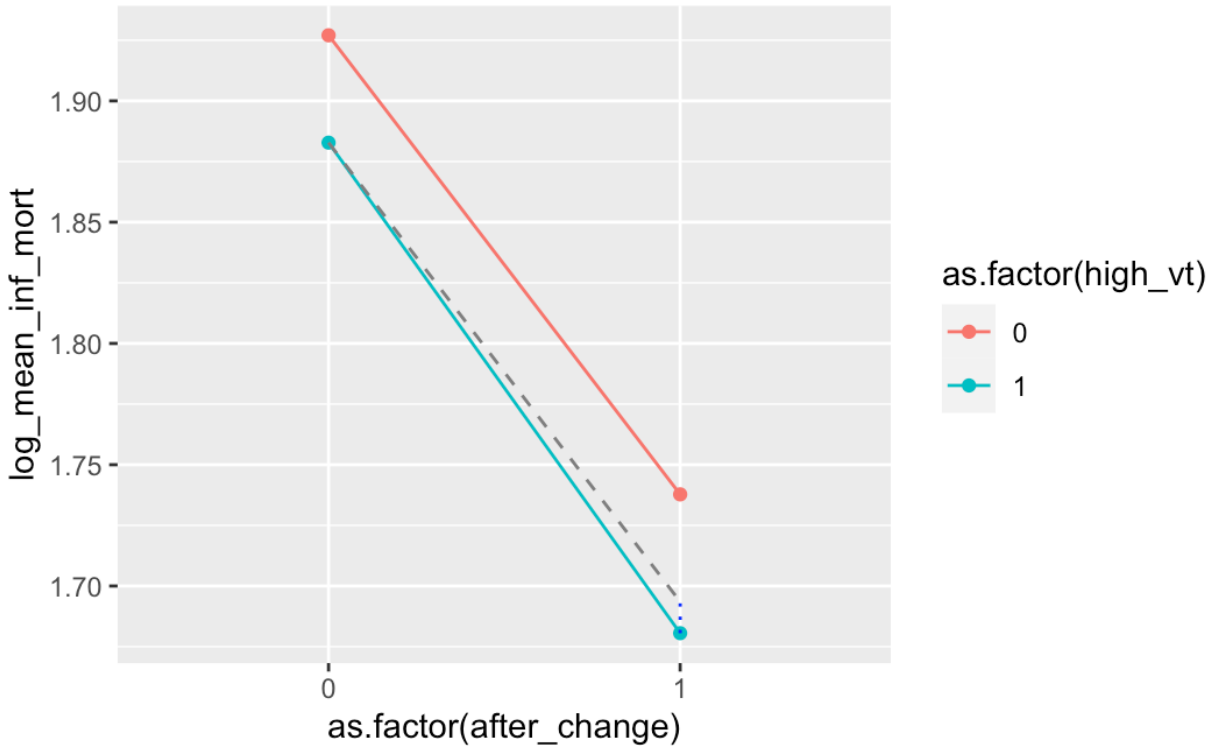

Figure 9: The plot showing the difference in differences

If we look at the plot above, the dotted line is the control group's parallel line which has the same initial value with the treatment group. We can see that the blue line decreases more than the dotted line. This what we expected since the diff-in-diff estimate we found was positive. The difference between the endpoints of the dotted line and the blue line is equal to the diff-in-diff estimate.

Difference-in-differences analysis with regression

We can use regression to get the estimate for the diff-in-diff. This way we can test the significance of the estimate. Our model is a simple regression model;

$$\log(infant\ mortality) = \beta_0 + \beta_1\, group + \beta_2\, year + \beta_3\, group * year$$

Our diff-in-diff estimate is β_3 as shown in the model.

We ran the model in R environment and found these values;

Term	Estimate	Std. Error	Statistic	p-value
β_0	1.92703704	0.03858995	49.9362453	2.673595e-65
β_1	0.04425926	0.06101606	0.7253706	4.701939e-01
β_2	0.18925926	0.05457443	3.4679111	8.215222e-04
β_3	0.01296296	0.08628974	0.1502260	8.809381e-01

Figure 10: Table showing the results of the regression

The important coefficient for us is β_3 since it is the coefficient of the related variable. As we can see from the table it is the same as the value we found when we did the diff-in-diff analysis manually: **-0.01296296**

Now, we are going to test the significance of this estimate for our model.

We are going to use p-test for the analysis;

$H_0 : \beta_3 \neq 0$

$H_1 : \beta_3 = 0$

Now, since we know the p-value for the null hypothesis;

From p-test:

p-value for the null: **0.8809381**

Significance level $\alpha = 0.05$

Since $0.8809381 > 0.05$, we fail to reject out null hypothesis.

It means that the impact of the change in the voter turnout on the infant mortality rates in the confidence interval of 95% is significant.

Conclusion

In this paper, we tried to analyze the impact of the voter turnout on the infant mortality rates. We focused on the US states specifically. After observing the data in certain graphs, we made a difference-in-differences analysis to understand the casual effect of the change in the voter turnout on the change in the infant mortality rates. We divided the states according to their change in the voter turnout rates between the years 2005 and 2020. The states with the higher change in the voter turnout were put into the treatment group while the states with the lower change in the voter turnout were in the control group. After series of analysis, we found specific diff-in-diff estimate value, which, after the p-test on 95% confidence interval, 0.05 significance value, turned out to be a signal showing us that the impact of the change in the voter turnout in US states on the infant mortality of the states is statistically significant. Even though our research focuses on the voter turnout especially, we aimed to find a relation between the democracy and the health outcomes. We used voter turnout as a simple democracy index. And the health outcome we dealt with was the infant mortality. As a result, we found that there is a higher decrease in the infant mortality rates in the states where there is a higher increase in the voter turnout rates.

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