8-2021

COVID-19 Outcomes and the Incidence of Slavery

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Abstract

Environmental factors have been shown to correlate with COVID-19 outcomes. This study advances the literature on health economics by examining the importance of socioeconomic factors. In addition to standard economic factors, I consider the relationship between the past incidence of slavery and COVID-19 outcomes. I analyze county-level U.S. Census data and Georgia Department of Public Health county-level COVID-19 data using regression analysis. I find that the Covid-19 county vaccination rate in Georgia is related to 1860 slave concentration. No statistically significant relationship is found between 1860 slave concentration and COVID-19 death rate, case rate, or vaccination rate when health, socioeconomic, and demographic differences across counties are controlled for. The findings from this study suggest the importance of further research on slavery's legacy for better informed policy making.

1. Introduction

The novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which causes coronavirus disease 2019 (COVID-19), has reached almost every part of the world. As of July 29th, 2021, there have been 34,722,631 cases and 609,853 deaths in the United States (Centers for Disease Control and Prevention). Over a year after SARS-CoV-19 was first reported and despite the availability of vaccines, the pandemic does not appear to be ending any time soon (Cambon).

Even more resolute than SARS-CoV-2 is a geological formation. A coastline from between 145 and 65 million years ago may still be having effects on our society today. Figure 1 below maps the distribution of enslaved persons in 1860, showing a higher concentration along the western border of Mississippi and horizontally across the middle of Alabama, Georgia, and up toward the Carolinas. Dr. Craig McClain attributes this pattern to the coastline during the

Cretaceous period (see fig. 2). Higher concentrations of enslaved persons are found on the counties along the coastline, where prolific tropical waters induced large chalk formations that eventually became a band of nutrient rich soils. Southern slave plantations were primarily located along this ancient coastline as a response to basic economic incentives: fertile soil is more cost effective than the alternative and therefore more profitable.

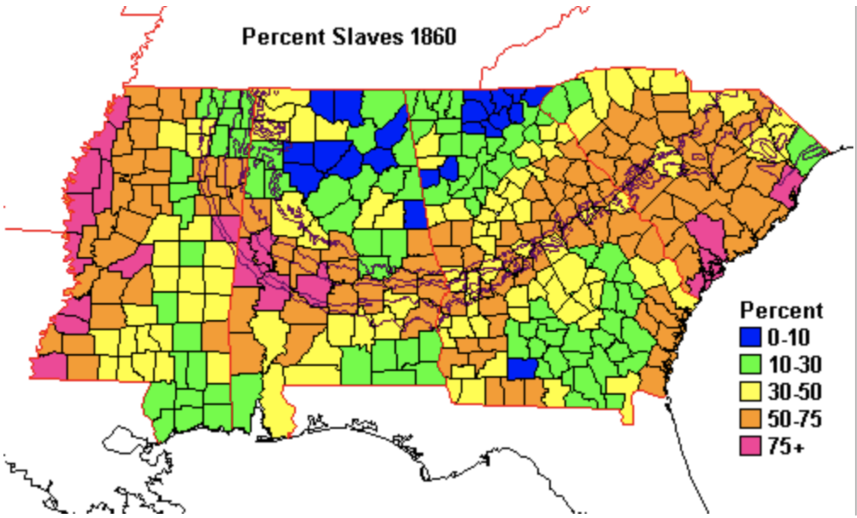

Figure 1. 1860 Percent of Enslaved Persons from Steven Dutch; "Geology and Election 2000." *Steve Dutch*, 23 January 2002, stevedutch.net/research/elec2000/geolelec2000.htm.

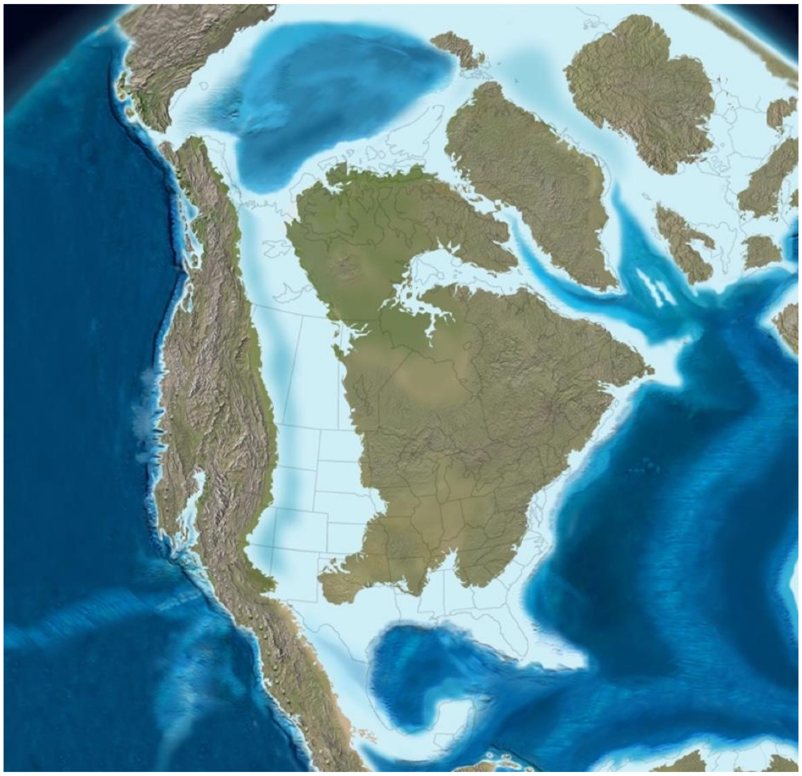

Figure 2. Cretaceous Coastline from Dr. Craig McClain; "How presidential elections are impacted by a 100 million year old coastline." *Deep Sea News*, 27 June 2012, www.deepseanews.com/2012/06/how-presidential-elections-are-impacted-by-a-100-million-year-old-coastline/

The Cretaceous period Southern coastline remains visible in socioeconomic maps long after the abolition of slavery. It is most clearly seen in county level maps of Presidential elections. Figure 3 below shows the coastline is paralleled by the counties that voted majority democratic in the 2020 Presidential election, which are denoted in blue. This does not mean that an over-million-year-old coastline dictates American election results. More likely it is suggestive of slavery's influence on elections.

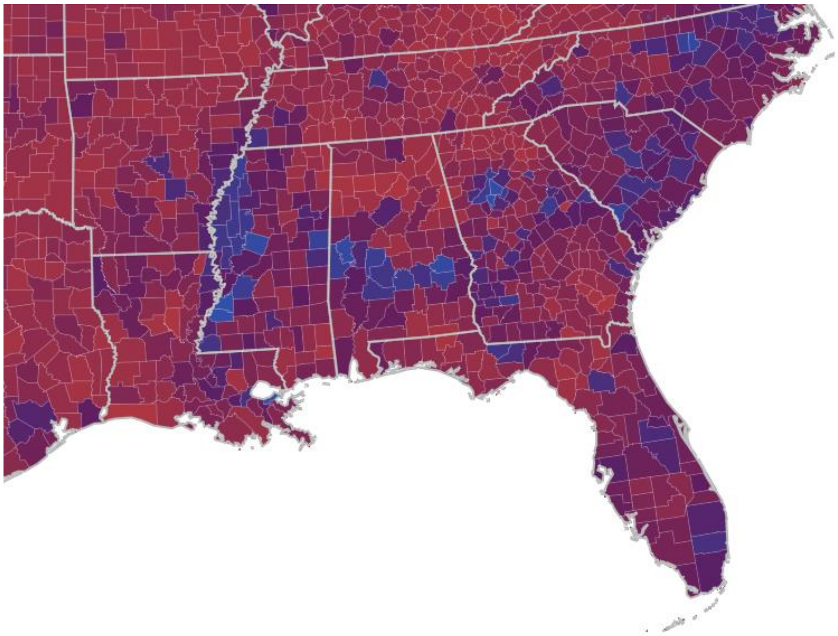

Figure 3. 2020 Presidential Election Results by County from Mitchell Thorson et al.;“Four maps that show how America voted in the 2020 election with results by county, number of voters.” *USA TODAY*, 10 Nov. 2020, www.usatoday.com/in-depth/graphics/2020/11/10/elec

COVID-19 arrived in America after years of political unrest and the government’s careless response only worsened the political divide Partisanship is correlated with mask wearing and overall adherence to CDC guidelines (Katz et al.). Research has also found that counties that voted for Biden in 2020 have higher vaccination rates than counties that voted for Trump (Ryan). COVID-19 vaccines have been found to be highly effective at decreasing the rate of transmission of SARS-CoV-2 as well as preventing serious illness from COVID-19. County level election results are thus likely to be associated with COVID-19 outcomes.

Chattel slavery shaped the demographics of the American South since plantation owners forced the creation of majority black counties along the fertile lands. While many African Americans fled the South during the Great Migration, a map of majority black counties still reflects the Cretaceous coastline, albeit to a lesser degree (Dutch). The coastline visible in election results is likely a result of the Democratic Party’s decision to align itself with the Civil Rights movement, which earned the party the unfaltering support of African Americans (Dutch).

Another mechanism by which a county's racial makeup contributes to COVID-19 risk is that it has been found that communities of color have experienced an increased incidence of COVID-19 when compared to white people (Ogedegbe). Research suggests that this may be due to African Americans and Hispanics having a higher prevalence of comorbid conditions associated with increased COVID-19 risk, such as diabetes and hypertension, than the white population (Webb Hooper et al.). Additionally, research has found that implicit biases in healthcare workers lead to differential quality of healthcare based on the patient's race (Bridges). An example of the discrepancies in health outcomes across race is that pregnancy-related death is three to four times more likely for black women than white women (Hartman et al.). COVID-19's discriminatory effects are also a result of racial inequality since access to economic resources is closely tied with health outcomes.

The Cretaceous coastline is present when looking at the concentration of poverty at the county level, although it is not very defined (Dutch). Much like election results, poverty being more widespread along the coastline is presumably a direct consequence of slavery and an indirect consequence of geology. Research on slavery's legacy has found a negative relationship between the incidence of slavery and economic development (Nunn). African enslavement was abolished only to have segregation take its place which was then replaced by housing and employment discrimination, over policing, and mass incarceration (McGhee). Systemic racism has all but ensured slavery's pervasive impact (Hartman et al.).

Race, socioeconomics, and political beliefs, all shape an individual's COVID-19 risk factor. The preceding maps suggest that county level percentage of enslaved persons in 1860 is likely correlated to present day demographics, economic development, and political ideology.

This paper explores the possible association between the concentration of enslaved persons in 1860 and COVID-19 outcomes in Georgia.

The current research on COVID-19 has explored racial and economic disparities, but it has failed to consider whether these disparities can be traced back to slavery. This research seeks to find whether the prevalence of slavery in a county has any observable association with Covid-19 outcomes. A better understanding of slavery's role in the current state of the American economy would allow for policy that better addresses health disparities and racial inequality.

To test the relationship between COVID-19 outcomes and 1860 slave concentration, I use regression analysis on the counties of Georgia. More specifically, I perform three separate regressions with case rate, death rate, and vaccination rate as the dependent variables. I hypothesize that counties with a higher percent of enslaved populations, should have higher COVID-19 case rates and death rates, and higher vaccination rates.

2. Literature Review

The current literature has yet to quantitatively evaluate a direct relationship between slavery and COVID-19 outcomes, therefore the following review includes a combination of COVID-19 and slavery research.

In a study of slavery's relationship with inequality in poverty, O'Connell finds a relationship between contemporary black-white inequality in poverty and 1860 slave concentration. She analyzes U.S. Census county-level data from 1860 and 2000 with ordinary least squares regression and spatial data analysis techniques. Her findings suggest that Southern counties with larger concentration of enslaved persons have greater racial inequality in poverty. O'Connell's research suggests that county level analysis appropriately captures the legacy of slavery.

Nathan Nunn tests the relationship between the use of slavery and economic development in the former New World colonies and counties within the U.S. His research finds a negative correlation between the use of slavery and economic development, regardless of the size of the plantation. His findings reinforce the hypothesis that county level slavery concentration is likely to have a negative effect on COVID-19 outcomes, through its increase on poor economic outcomes.

Richardson et al. test the effect of reparations programs on SARS-CoV-2 transmission risk by comparing Louisiana with South Korea. This research finds that reparations programs could mitigate COVID-19 risk for the beneficiaries of the reparations and in turn the general population as well, through decrease in the spread of the virus. The findings in this research emphasize the relationship between structural racism and COVID-19 risk, however they do not address the role of slavery itself.

Millett et al. examined the differential impacts of COVID-19 on counties with disproportionate black populations using county level COVID-19 case and death data. This study found that a higher proportion of black residents in a county is positively correlated with higher COVID-19 diagnoses and deaths. This research shows that environmental factors at the county level can have significant impacts on COVID-19 outcomes.

3. Data

All the data used in this study is at the county level, for the state of Georgia. Due to inconsistencies across data reporting agencies, there is variation in the years of contemporary county characteristic data. This study uses only publicly available data sets. I looked at a total of 80 variables with 159 observations, representative of the 159 counties in Georgia.

3.1 *Demographic Data*

County-level population data from the 1860 U.S. Census for the state of Georgia was collected and used for the percentage of enslaved persons variable. To control for Georgia's current county demographics, the 2018 estimates from the U.S. Census Population Estimates Vintage 2019 were used. The key variables from this data set were the county-level populations by race and age group, with African American and Hispanic populations of primary interest. Total population was used as a control for county size differences and sex was analyzed independently from race and ethnicity to avoid overfitting the models.

3.2 *COVID-19 Data*

The May 27th, 2021, Georgia Department of Public Health (DPH) Daily Status Report was used for the COVID-19 outcomes variables. The variables of primary interest from this report are case rate (measured as cases per 100,000 persons) and death rate (measured as deaths per 100,000 persons). Rates were used as opposed to total amounts because they account for differences in populations across counties. Vaccination rate data was downloaded from the Georgia DPH Vaccine Distribution on May 20th, 2021, and the data reported for May 19th was used. Because of the testing inflicted delays in case reporting and the time necessary for death from COVID-19 to be present, the time discrepancy between infection outcome data and vaccination data is negligible.

3.3 *Health and Economic Data*

To control for health disparities across counties, variables from the health data set of GeorgiaDATA were used. The primary variables of interest were physician rate per 100,000 population and percent of uninsured persons under the age of 65. Both variables are 2018 values.

Economic variables analyzed come from the labor and economics data sets in GeorgiaDATA. The key variables from these data sets are the 2018 estimates for median household income, percent of persons living in poverty, and unemployment rate.

3.4 *Data Limitations*

A caveat about the regression results is that the variables used come from three separate years, which may introduce additional variation. We must also recognize that county lines have shifted from 1860 to 2021, so the percentage of enslaved persons is only available for the counties that existed in 1860. Since Georgia did not gain any land, all new counties in Georgia come from the 1860 counties. This means that using a sample size of only the counties that existed 1860 would be just as inappropriate as estimating the percentage of enslaved persons for the new counties, since the old counties are only like their 2021 counterparts in name. I opt for estimating a new concentration of enslaved persons since it results in a higher number of observations and the original 132 counties are not necessarily more reliable. I estimate the new counties by taking the average of the counties it was created from. For example, Douglas was created out of land from Campbell and Carroll, so I took the average of their enslaved populations and used that as the Douglas enslaved percentage. This method ignores the unequal spread of enslaved persons across a county due to the plantation system, but it provides consistent estimates for each county.

4. Econometric Methodology

I use ordinary least squares regression on three dependent variables (case rate, death rate, vaccination rate) to test the relationship with percentage of enslaved persons in a county. First, I consider the simple regression between each dependent variable and percentage of enslaved persons in a county. Then I consider the effect of controlling for county level health, economic, and demographic factors. The health control variables are percent uninsured and physician rate (measured as number of physicians per 100,000 persons). The economic controls are unemployment rate and median household income. The demographic controls are percent of black persons, percent of female persons, percent of Hispanic persons, and total population.

Percent enslaved was turned into a binary variable, with a value of 0 for counties with under 40% of the population enslaved and a value of 1 for counties with over 40% of the population enslaved. I chose to distinguish between over and under 40% enslavement since that was the median percentage for the counties. The use of a binary variable is more appropriate than a percentage because of the uncertainty regarding the estimated values for counties formed after 1860. I use the log form for median household income to address the heteroskedasticity that resulted from the variable having larger units than all others in the regression. All regressions were tested for heteroskedasticity using the Breusch-Pagan test (Breusch and Pagan).

The regression equations that account for all control variables listed are shown below.

$$\begin{aligned} death\ rate = {} & Percent\ enslaved + Physician\ Rate + Percent\ Uninsured \\ & + Unemployment\ Rate + \log(Median\ Home\ Income) \\ & + Percent\ Hispanic + Percent\ Black + Percent\ Female \\ & + Total\ Population \end{aligned} \tag{1}$$

$$\begin{aligned} case\ rate = {} & Percent\ enslaved + Physician\ Rate + Percent\ Uninsured \\ & + Unemployment\ Rate + \log(Median\ Home\ Income) \\ & + Percent\ Hispanic + Percent\ Black + Percent\ Female \\ & + Total\ Population \end{aligned} \tag{2}$$

$$vaccination\ rate = Percent\ enslaved + Physician\ Rate + Percent\ Uninsured + Unemployment\ Rate + log(Median\ Home\ Income) + Percent\ Hispanic + Percent\ Black + Percent\ Female + Total\ Population \quad (3)$$

Table 1 shows the summary statistics of all variables used in these regressions. Percent enslaved persons ranges from 2.48% to 76.44%, showing just how unevenly distributed the enslaved population was in 1860 Georgia. The range for percent black persons in 2018 closely matches that of percent enslaved, going from 1.20% to 74.17%. This indicates that regardless of correlation, county level racial segregation has persisted since 1860. The percentage female of a county has a surprisingly low minimum of 32.59% and a standard maximum of 56.88%. This could be due to some counties being primarily made of traditionally male-dominated industries, such as agriculture. Percent Hispanic ranges from 1.60% to 35.90%, also indicative of racial segregation at the county level. The range for unemployment rate is misleadingly small, since economists would argue that the minimum observed of 3% is dangerously low and the maximum of 7.7% is concerningly high.

Table 1 - Summary Statistics

Variable:	**Min:**	**1st Quarter:**	**Median:**	**Mean:**	**3rd Quarter:**	**Max:**
Percent Enslaved	2.48%	20.91%	40.95%	38.94%	55.01%	76.44%
Percent Black	1.20%	16.32%	29.55%	29.60%	42.19%	74.17%
Percent Female	32.59%	50.25%	51.08%	50.38%	51.97%	56.88%
Percent Hispanic	1.60%	3.16%	5.04%	6.84%	7.73%	35.90%

Total Population	1,612	11,499	22,617	66,108	55,640	1,050,131
Unemployment Rate	3.00%	3.70%	4.20%	4.438%	5.0%	7.7%
Median Home Income	$28,298	$38,399	$43,439	$47,507	$51,704	$105,921
Percent Uninsured	10.20%	15.20%	16.80%	16.89%	18.40%	25.10%
Physician Rate	0	40.4	82.9	118.6	157.3	726.9

Table 1

5. Results

5.1 *Death Rate Regression Results*

Table 2 shows the regression results when death rate is the dependent variable. Death rate is best explained by log median household income, which is significant at the 5% level and has a coefficient of -145.937. Because of the level log model, the effect of a 1% increase in median household income is predicted to decrease death rate by around 1.5 deaths per 100,000 persons, ceteris paribus. This negative relationship is consistent with research that shows the relationship between wealth and health (Holmes Finch and Hernandez Finch). However, this effect is negligible because of the high standard error of 60.419. Percent enslaved persons is significant when controlling for health variables or demographic variables only. This suggests that 1860 concentration of enslaved persons is encapsulating effects unexplained by percentage of uninsured persons and physician rate, as well as demographic variables. Percent black is significant at the 1% level when only controlling for demographic variables but is made insignificant by the addition of health and economic controls.

Table 2 – Death Rate Regression Results

		(1)	(2)	(3)	(4)	(5)
Intercept	(1)	216.375 (12.127) ***	102.771 (62.275)	2,106.621 (446.447) ***	264.185 (131.218) **	1,774.857 (709.259) **
Percent Enslaved Binary	(2)	20.020 (17.097)	31.142 (17.864) *	7.085 (15.036)	-44.343 (18.485) **	-15.837 (19.686)
Physician Rate	(3)		-0.043 (0.075)			0.024 (0.072)
Percent Uninsured	(4)		6.699 (3.352) **			-0.634 (4.306)
Unemployment Rate	(5)			17.383 (10.801)		10.035 (12.312)
log(Median House Income)	(6)			-182.667 (38.604) ***		-145.937 (60.419) **
Percent Hispanic	(7)				-0.729 (1.481)	-0.859 (1.718)
Percent Black	(8)				2.883 (0.521) ***	1.083 (0.726)
Percent Female	(9)				-1.563 (2.505)	-0.600 (2.609)
Total Population	(10)				-0.0003 (0.0001) ***	-0.0001 (0.0001)
Adj. R2		0.002	0.019	0.276	0.219	0.266
F Statistic		1.371	2.012	21.079***	9.876***	7.355***

Table 2 Standard errors are reported in parenthesis. *,**,*** denote statistical significance at the 0.10, 0.05, and the 0.01 levels. Simple ordinary least squares is used to test death rate =percent enslaved+ physician rate + percent uninsured+ unemployment rate+ percent Hispanic + percent black + percent female + total population. Column 1 is a simple OLS output and columns 2 – 5 are multiple OLS outputs. Adjusted R2 and F-statistic is reported at the bottom for all tests.

5.2 *Case Rate Regression Results*

Table 3 shows the regression results when case rate is the dependent variable. The percent enslaved is significant in the simple OLS regression, as well in the multiple OLS regression that control for health variables and economic variables. In all three of these regressions the coefficient is negative and significant at the 5% level. This indicates a negative correlation between the incidence of slavery and COVID-19 case rates, however the adjusted R^2 of the regression is very low so the relationship is likely not accurate.

The coefficient of physician rate is positive and significant at the 1% level in regressions 2 and 5, suggesting a positive effect on case rate, however the effect is almost negligible since the coefficients are 6.836 (1.890 se) and 8.407 (1.839 se) respectively and the minimum case rate in the data is 3,425 cases per 100,000 persons. The positive relationship, however small, is not surprising since physician rate is highest in the more populated counties, which are bound to have higher case rates.

The coefficient of percent black is significant at the 5% level and negative, however, it is also almost negligible since it is just -44.749 (18.548 se). The direction of this variable is surprising, since prior research has shown a positive relationship (Millett et al.). However, it can be explained by the long-term support of the Democratic party by African Americans, which is associated with decreased vaccine hesitancy and increased use of masks and other preventive measures.

The coefficient of percent female is significant at the 5% level and negative, at -156.110 (66.683 se). This relationship can be explained by the likelihood of counties with lower percentages of female persons to be made up of traditionally male dominated labor industries, such as agriculture, which have been found to have higher COVID-19 risk due to poor work conditions (Richardson et al.).

The coefficient for percent Hispanic is significant at the 1% level and positive, with the second largest quantifiable effect on case rate at 197.781 (43.903 se). This positive correlation can be explained by increased COVID-19 comorbidities in Hispanics, the over representation of

Hispanics in the agricultural sector, and by lower economic resources in Hispanic versus non-Hispanic populations (Hanson et al.).

The coefficient for percent uninsured is significant at the 1% level in the fifth regression, with a coefficient of -267.155 (110.064 se). The negative coefficient is surprising but could suggest that case rates are influenced more by other factors that are uncorrelated with case rate such as population density.

Table 3 – Case Rate Regression Results

		(1)	(2)	(3)	(4)	(5)
Intercept	(1)	8,380.003 (312.627) ***	7,230.779 (1564.415) ***	7,711.202 (13,596.450)	15,917.220 (3,522.562) ***	44,084.700 (18,127.950) **
Percent Enslaved Binary	(2)	-1,093.293 (440.738) **	-1,048.608 (448.756) **	-1,107.071 (457.908) **	-230.225 (496.235)	-211.772 (503.155)
Physician Rate	(3)		6.836 (1.890) ***			8.407 (1.839) ***
Percent Uninsured	(4)		18.719 (84.202)			-267.155 (110.064) ***
Unemployment Rate	(5)			37.331 (328.953)		136.438 (314.671)
Log(Median House Income)	(6)			47.516 (1,175.672)		-2,356.450 (1,544.261)
Percent Hispanic	(7)				155.309 (39.760) ***	197.781 (43.903) ***
Percent Black	(8)				-15.448 (13.994)	-44.749 (18.548) **
Percent Female	(9)				-169.943 (67.240) **	-156.110 (66.683) **
Total Population	(10)				-0.0002 (0.002)	-0.002 (0.002)
Adj. R2		0.032	0.096	0.019	0.178	0.299
F Statistic		6.153 **	6.567***	2.030	7.852***	8.503***

Table 3 Standard errors are reported in parenthesis. *,**,*** denote statistical significance at the 0.10, 0.05, and the 0.01 levels. Simple ordinary least squares is used to test case rate =percent enslaved+ physician rate + percent uninsured+ unemployment

rate+ percent Hispanic + percent black + percent female + total population. Column 1 is a simple OLS output and columns 2 – 5 are multiple OLS outputs. Adjusted R2 and F-statistic is reported at the bottom for all tests.

5.3 *Vaccination Rate Regression Results*

Table 4 shows the results for the regressions with vaccination rate as the dependent variable. The percent enslaved binary variable coefficient is significant at the 10% level in regressions 1 and 2, and significant at the 5% level in regressions 3 and 4. The coefficient is positive in all regressions, indicating a positive relationship between vaccination rates and 1860 enslaved persons percentage. This relationship appears contradictory but can be explained by lower vaccine hesitancy in communities of color (Kates et al.).

The coefficient on log median household income is positive and significant at the 1% level in regressions 3 and 5. The coefficient for log median household income in regression 5 is 23,886.870 (6,023.281 se), indicating that a 1% increase in median household income is predicted to increase vaccination rate by about 239 vaccines per 100,000, ceteris paribus. This relationship is consistent with research showing that wealth and access to vaccines are related (Chen).

The coefficient on physician rate is positive but negligible since it only is predicted to increase vaccination rate by 16.186 (7.174 se) vaccines per 100,000 in regression 5. The coefficient on percent female persons is positive and indicates a 1% increase in percent of female persons in a county is predicted to increase vaccination rate by 722.143 (260.094 se). This is possibly suggestive of lower vaccination rates in small, majority male persons counties, because of decreased access to vaccine clinics or increased vaccine hesitancy. The coefficient for percent uninsured is significant at the 1% level in the fifth regression, with a coefficient of 1,146.262 (429.298 se). The positive coefficient can be explained by the economic principle of rationality since at the individual level, lack of access to health insurance signals a higher monetary burden from being ill, making vaccinations a rational choice since they lower the risk of serious illness.

Table 4 – Vaccination Rate Regression Results

		(1)	(2)	(3)	(4)	(5)
Intercept	(1)	47,380.850 (1,239.623) ***	48, 475.520 (6,154.298) ***	-160,819.800 (50,126.70) ***	-6,430.679 (13,362.700)	-274,338.500 (70,706.800) ***
Percent Enslaved Binary	(2)	3,393.539 (1,747.604) *	3,027.440 (1,765.375) *	3,449.776 (1,688.191) **	3,858.102 (1882.448) **	2,020.474 (1,962.522)
Physician Rate	(3)		28.198 (7.435) ***			16.186 (7.174) **
Percent Uninsured	(4)		-251.798 (331.247)			1,146.262 (429.298) ***
Unemployment Rate	(5)			1,327.299 (1,212.768)		1,407.280 (1,227.353)
Log(Median House Income)	(6)			18,843.770 (4,334.407) ***		23,886.870 (6,023.281) ***
Percent Hispanic	(7)				-114.941 (150.830)	-341.988 (171.240) **
Percent Black	(8)				-12.702 (53.085)	132.796 (72.347) *
Percent Female	(9)				1,052.845 (255.073) ***	722.143 (260.094) ***
Total Population	(10)				0.026 (0.006) ***	0.007 (0.007)
Adj. R2		0.017	0.097	0.140	0.237	0.312
F Statistic		3.771*	6.632***	9.540***	10.798***	8.964***

Table 4 Standard errors are reported in parenthesis. *,**,*** denote statistical significance at the 0.10, 0.05, and the 0.01 levels. Simple ordinary least squares is used to test vaccination rate = percent enslaved + physician rate + percent uninsured + unemployment rate + percent Hispanic + percent black + percent female + total population. Column 1 is a simple OLS output and columns 2 – 5 are multiple OLS outputs. Adjusted R2 and F-statistic is reported at the bottom for all tests.

6. Conclusion and Implications

The results from this research are inconclusive because of the methods used to estimate county level 1860 enslaved person percentage and because of inconsistent regression results across the three dependent variables of interest. The wavering significance of percentage of enslaved persons suggests that contemporary county level factors may be a result of the incidence of slavery. Further research should treat percentage of enslaved persons as an instrumental variable to better deduce its legacy.

This research can primarily be improved by considering the rest of the Southern states' counties. This would decrease uncertainty about the percent enslaved persons variable and increase the observation count. There is an urgent need for more research surrounding both slavery and COVID-19, to ensure that coming public policy accurately addresses the root of American problems.

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