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Does Slavery's Historical Presence Impact Economic Development?

Evidence from the Free-Slave State Border

By Charlie Hanzel

Advised by Lakshmi Iyer

April 16, 2021

Abstract:

The past year has drawn increased attention to the role of racism in contemporary American life and has highlighted the importance of understanding the impact racist historical institutions such as slavery have had on the development of the United States. In my analysis, I test the effect of slavery's historical presence by applying a regression discontinuity model to economic outcomes at the free-slave state border in the US – with distance to the border as the running variable. I find that under multiple specifications and in analyses as far back as 1970, there is no discontinuity for major modern economic outcomes such as median household incomes and poverty rates. In combination with past evidence, these findings suggest that in the United States, the intensity of historical slavery is a much stronger predictor of long-run economic outcomes than whether or not it was present.

I would like to acknowledge those who have helped with my research throughout the last year. First and foremost, I thank my advisor Lakshmi Iyer for her advice, feedback, and guidance throughout this process. I also thank William Evans for his initial advice on data sources and James Sullivan and Levi Bognar for their feedback during my revisions stage. I thank Matthew Sisk at the Hesburgh Library for his essential assistance with learning to work with ArcGIS. Lastly, I thank Christiane Baumeister for her guidance and advice throughout the Fall 2020 semester.

I. Introduction

The link between institutions and economic development has been widely investigated in recent decades. In particular, institutional variation in cross-country and sub-national settings has been identified as a major driver of the vastly divergent levels of output seen around the globe (Acemoglu et al., 2001). In the United States, one of the most prominent institutional features of early economic development was the presence of slavery. At the outset of the Civil War, there were 33 states in the US, of which 15 continued to allow slavery and increasingly held a systematic reliance upon the institution to drive their economies. A simple comparison between former free and slave states today finds the former have a level of GDP per capita 20% higher on average than the latter.¹ This degree of divergence between states with the same country-level institutions but different initial state institutions is striking, but it may not solely reflect the impact of slavery on economic development. Differences in geography, immigration patterns, demography, and resource endowments across states make it difficult to draw conclusions about the impact of slavery alone on contemporary economic output.

In order to mitigate the risk that omitted factors may be biasing conclusions on the effect of slavery's historical presence on economic development, it is necessary to limit the analysis to places that are roughly equivalent in terms of their natural endowments. The history of American slavery makes this difficult, because slavery developed differentially across regions precisely because of variation in soil and climate, both between North and South and within areas it was legal. However, the existence of a free-slave state border, where on one side there were slaves and the other none, provides an opportunity to measure the long-run effects of slavery's presence on economic outcomes.

¹ Calculations based upon 2019 data from the Bureau of Economic Analysis.

To assess the effect of slavery's extensive margin on modern economic development, I have compiled economic, geographic, and resource data at an extremely disaggregated (census block group or tract) level for areas close to the free-slave state border. I first verify that counties on either side of this line are roughly similar in geography, resources, and climate, differing only in whether or not slavery was legal. I then use a regression discontinuity model, with distance to the border as my running variable, to estimate the impact of slavery's presence. The slave population proportions were quite low in border counties, so differences between areas on either side of the boundary would likely be driven more by the extensive than the intensive margin.

Existing evidence in the United States – largely from only within slave states – suggests that the historical slave proportion negatively impacts economic development today (O'Connell, 2012; Lagerlaf, 2005; Nunn, 2007). In Colombia, meanwhile, it is slavery's presence – the extensive margin – rather than its fraction of the population – the intensive margin – that is most predictive of modern development (Acemoglu et al, 2012). To date, no attempt has been made to examine whether or not the extensive margin of slavery has an effect on development in the United States.

From a theoretical standpoint, there could be several reasons that the extensive margin would be important to development. Many of the historical factors linked to slavery's aftermath that could hamper commercial and industrial development – one party rule under the Democratic Party, discriminatory legal systems, and black voter disenfranchisement – existed at least in part at the state rather than local level. If any of these discouraged investment and weakened development, the impact may be apparent through the extensive rather than intensive margin. On the other hand, there are reasons to expect that the impact on development would be closely linked to the intensive margin. The factors mentioned before were present at a local level as well,

so local slavery intensity could be significant. Furthermore, other legacies of slavery – educational inequities, coercive labor practices, and an unequal application of criminal justice – would have been likely to have their most significant impacts in places with larger freed black populations.

In my analysis, I find little evidence that a statistically significant discontinuity exists at the border for major outcomes such as median household income, income per capita, and the poverty rate. This conclusion is robust across several specifications and bandwidths. To test whether an effect has existed in the past and only more recently diminished, I conduct a similar regression discontinuity test at the census tract-level with data from 1970-2000, finding the same lack of statistically significant discontinuities. Though the sample is more limited, I use 1950 county-level data to report suggestive evidence that there may have been a gap between the north and south sides of the free-slave state border at the time. However, this effect appears to be driven by the intensive margin and is only marginally significant.

Pulling together all of this evidence, there is little indication that slavery's extensive margin has – at least within the last half century – had a significant impact on economic development in the United States. In turn, slavery's developmental impact in the United States appears to be driven by its historical intensity and to have persisted through localized factors dependent on former slave populations.

II. Long Run Effects of Slavery

Slavery existed in what is now the United States for around 250 years, first under European colonialism and then under the US Constitution. Between the beginning of the American Revolution and 1804, all states above a boundary connecting the northern borders of Maryland, present-day West Virginia, Kentucky, and Missouri – depicted in Figure 1 – abolished

slavery. It then took 60 years until the end of the Civil War and the ratification of the 13th Amendment before the practice was abolished anywhere to the south of that border. After abolition, however, slavery's legacy lived on as Southern white elites reasserted control over the Southern economy, society, and politics following the departure of US troops in 1877. This reassertion manifested itself in voting restrictions, a pseudo-feudal sharecropping economy, and a patchwork of segregationist laws commonly known as Jim Crow. Only in the mid-20th Century did a series of federal interventions undo much of this unjust system, though its legacy undoubtedly continues.

Figure 1: Free-Slave State Border²



There is strong evidence of the crucial role played by institutions, including slavery, on economic and political development. At a cross-country level, Acemoglu et al. (2001) find that increased settler mortality for colonial powers drove them to establish extractive institutions rather than to settle, which in turn harmed post-colonial institutions and subsequent economic

² The stretch of New Jersey's border along the Atlantic Ocean is included in this map but was removed from the analysis.

development. Other research has looked more specifically at institutional slavery and its effect on development, with Sokoloff and Engerman (2000) noting that countries heavily dependent upon slavery during the colonial period are significantly less wealthy today. They hypothesize that these initial institutions propagated economic inequality, which worsened institutions in the post-colonial period and hampered economic development to the present.

Since these papers, several studies have been conducted in the United States to investigate their hypotheses. Mitchener and McLean (2003) examine the causes of state-level variation in productivity from 1880 to 1980 and find that, among other factors, antebellum slavery is negatively related with productivity over time. Additionally, Lagerlaf (2005) observes that the white-black income gap is larger in Southern counties that had higher slave shares of their populations in 1850. This is driven by the fact that not only are black incomes today lower in more slave-dependent counties, but white incomes are *higher*. Similarly, O'Connell (2012) finds that differences between black and white poverty rates are positively related to the antebellum prevalence of slavery.

Nunn (2007) investigates the relationship between pre-abolition dependence upon slavery and contemporary economic development across countries, US states, and US counties. His findings support the conclusions of Sokoloff and Engerman with respect to the negative long-run economic effect of higher historical reliance upon slavery. However, he does not find evidence that large-scale plantation slavery was more detrimental to development than small-scale slavery at a cross-country level or that greater wealth inequality was the mechanism through which slavery harmed development across US states and counties. These conclusions suggest that additional work is needed to determine the mechanisms through which slavery has had a detrimental effect on growth.

One piece of suggestive evidence pointing to institutional factors as a mechanism for slavery's negative long-run effect comes from Acharya et al. (2016). They analyze the effect of higher slave proportions of population in 1850 on modern political attitudes, finding that whites in counties with a higher historical slave presence are more likely to identify as Republican, oppose affirmative action, and express resentment toward non-whites. The authors hypothesize that post-Reconstruction, white elites in areas with larger black populations had a greater incentive to actively maintain their position by fomenting racial animosity and implementing political and economic restrictions on non-whites. They argue that, to some extent, these racial attitudes once cemented in institutions were passed down to the present; in a similar vein, Nunn & Wantchekon (2011) document a persistence of mistrust among Africans whose ancestors were enslaved at greater rates.

Importantly, all of the literature examining slavery's long-run impact in the United States has relied upon pre-antebellum slave intensity to predict economic outcomes. Though this tests the effect of slavery through its intensive margin, no attempt has been made to isolate the effect of its extensive margin. Outside of the United States, however, the evidence suggests that the mere presence of slavery and other extractive institutions is crucial in predicting contemporary development. In Colombia, Acemoglu et al. (2012) find that municipalities with gold mines in the 17th and 18th centuries are poorer, more unequal, and have lower levels of public good provision today than neighboring municipalities without gold mines. These gold mines are now defunct but were historically mined by slaves, indicating a negative relationship between the past prevalence of slavery and modern development at a local level. Central to this analysis is the separation of slavery's extensive margin – whether or not slaves were held in each municipality

– and the intensive margin – the slave population proportion before abolition. In Colombia, the extensive margin has far more predictive power for outcomes today than the intensive margin.

Meanwhile in Peru, Dell (2010) tests the contemporary impact of the *mita*, another coercive colonial institution which required a substantial fraction of the population in certain areas to work in mines on a rotating basis. Because the areas in question were well-defined and rigid, and labor conscription as a fraction of population was roughly constant across *mita* areas and over time, her analysis is similar to that of Acemoglu et al. in focusing on the extensive margin. Dell uses a regression discontinuity model, with a cutoff at the *mita* boundary, to isolate the long-run impact of the *mita*. Her findings support the conclusion that the presence of coercive institutions has significant negative long-run impacts on economic development.

To supplement this existing research, I examine the long-run economic effect of slavery's extensive margin in the United States by employing a similar spatial regression discontinuity, with a cutoff at the border (as depicted in Figure 1 above) between states that had slavery up to the Civil War and those which did not. While prior studies have found strong negative impacts of slavery's intensive margin, this is the first analysis seeking to identify whether slavery's mere historical presence has had an impact on long-term outcomes in the United States.

III. Data

a. Contemporary Economic Outcomes

In this paper, I draw on a variety of contemporary and historical data sources, with the unit of observation ranging from the census block group to the census tract to the county level. In the full United States, there are over 3000 counties, about 80,000 census tracts, and over 200,000 census block groups. For my analysis of contemporary outcomes, I am able to use census block group-level data from the 2014-2018 American Community Survey, which provides a large

sample and increased precision of my estimates. The survey involves over 2 million interviews per year with households across the country, from which a variety of economic, demographic, and population estimates are calculated.

Table 1: Summary Statistics for Contemporary Outcomes – Border Counties Only

OUTCOMES	All	Free State Mean	Slave State Mean	Difference
Median Household Income	63830	61730	65830	-4100 (4626)
Income Per Capita	31850	30876	32776	-1900 (1881)
Poverty Rate	0.141	0.143	0.140	0.004 (0.014)
<i>Observations</i>	9828	4788	5040	

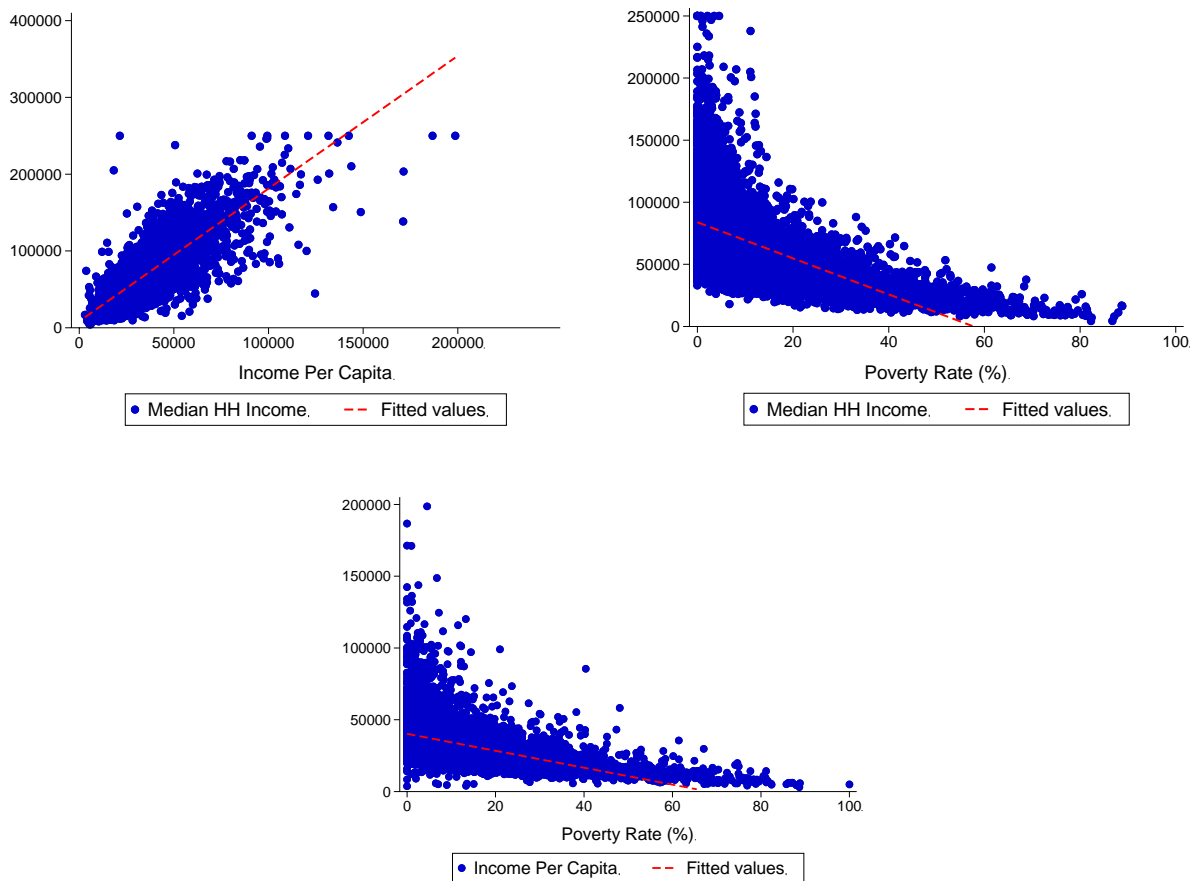
Summary statistics are displayed for contemporary outcome variables, listed in the first column, measured at the census block group level with means for all block groups in counties along the free-slave border in the 2nd column and then calculated separately by whether slavery was present in the 3rd and 4th. Observations are listed for income per capita and poverty rates; observations for median household income are 9588, 4911, and 4677, respectively. The final column shows the difference, with standard errors in parenthesis and clustered at the county level. Significance levels denoted by: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

To measure the impact of slavery's presence on modern economic development, I test three main outcome variables – median household income, per capita income, and the poverty rate. Each of these are estimated for census block groups from interviews conducted between 2014 and 2018. At the national level, the median household income for this time period is just over \$60,000, income per capita is just under \$33,000, and the poverty rate is just over 14%. In Table 1 above, I present summary statistics for census block groups in counties along the free-slave state border. Economic outcomes in these counties are roughly similar to the national averages, with almost the same poverty rate, slightly higher median household incomes, and slightly lower per capita incomes. There are slightly fewer observations for median household

incomes because the ACS did not get enough respondents in some block groups to calculate them.

In Figure 2 below, I present scatterplots depicting the correlations between each of my outcome variables. As would be expected, these measures are strongly correlated, but with sufficient variation to warrant including all three in my analysis.

Figure 2: Scatterplots of Correlations between Contemporary Outcomes



b. Climate, Geographic, and Resource Controls

Though data for my contemporary outcomes is available at the census block group-level, very little data on geography and climate exists at this level. To overcome this challenge, I collect GIS raster data on a variety of climate and geography measures for the United States and

extract the GIS value at the population centroid of each block group. Given the small land areas of block groups, these extracted values offer a good estimate of the overall geography of each. The GIS data comes from two sources. Soil suitability for the four largest US crops (corn, wheat, soy, and cotton) calculated on a 0-100 scale, altitude, and surface slope data is from the UN's Food and Agriculture Organization (FAO), while rainfall data comes from Oregon State's PRISM Climate Group. Summary statistics for each of these variables in border counties are presented in Panel 1 of Table 2 below, with no apparent differences between either side of the border other than a slightly higher level of annual rainfall south of the free-slave state border.

Where more geographically specific data is unavailable, I use county-level data and assign each census block group the county-level value. This is required for several measures of resource endowments, such as fossil fuel extraction and water resources. Though the data is less precise, resource endowments would be likely to impact local economies on a wider scale than the census block group-level so the county-level measures should provide a decent approximation of the natural resources available in each census block group.

I compile this resource endowment data from three sources. Data on the number of coal mines per county is collected from the US Energy Information Agency, data on the number of oil and gas wells per county is from the Department of Homeland Security, and data on the proportion of a county's land area covered in water is from the Department of Agriculture. Panel 2 of Table 2 includes summary statistics for these variables. The only statistically significant difference is for the percent of land area covered in water driven by a historical oddity in which Kentucky holds claim to the Ohio River, which also happened to form a substantial portion of the free-slave border. Thus, the river is included in the land area of counties along its southern bank. Additionally, there is a large but statistically insignificant difference in the number of oil

and gas wells per county driven by a few counties in southwest Pennsylvania that have developed substantial fossil fuel industries in recent years.

Table 2: Summary Statistics for Contemporary Controls – Border Counties Only

CONTROLS	All	Free State Mean	Slave State Mean	Difference
<i>Panel 1:</i>				
Wheat Suitability (0-100)	79.97	79.70	80.23	-0.53 (4.32)
Soy Suitability (0-100)	79.07	78.87	79.26	-0.39 (4.18)
Mean Slope (0-9)	4.27	4.33	4.21	0.13 (0.21)
Maize Suitability (0-100)	70.87	72.21	69.59	2.62 (2.95)
Cotton Suitability (0-100)	55.51	51.27	59.54	-8.27 (5.99)
Altitude	185.33	201.36	170.14	31.22 (24.41)
Avg. Annual Rainfall Last 30 Years (mm)	1096.8	1083.0	1109.9	-27.0* (14.5)
<i>Observations</i>	<i>9846</i>	<i>4791</i>	<i>5055</i>	
<i>Panel 2:</i>				
Number of Oil Wells	220.0	448.2	1.5	446.7 (249.2)
Number of Coal Mines	0.640	0.750	0.535	0.215 (0.539)
% of Land Area Covered by Water	2.34	1.46	3.19	-1.73* (0.85)
<i>Observations</i>	<i>139</i>	<i>68</i>	<i>71</i>	

Census block group-level controls are included in Panel 1 and county level controls are in Panel 2. Control variables are in the first column, with the means for all block groups in counties along the free-slave border in the second column and then calculated separately by whether slavery was present in the third and fourth.. The final column shows the difference, with standard errors in parenthesis and clustered at the county level in Panel 1 and the state level in Panel 2. Significance levels denoted by: *** p<0.01, ** p<0.05, * p<0.1

c. Historical Analysis

After examining contemporary outcomes, I turn to the question of whether or not there was evidence of a developmental effect from slavery historically. Unfortunately, historical economic data at the local level is highly limited, so my analysis does not extend before 1950, the first year in which income data was collected by the Census. However, much of the economic convergence between the northern and southern United States occurred after 1950, so if this historical trend mitigated any slavery-induced differences, they should still have been apparent in 1950.

Table 3: Summary Statistics for Historical Tract-Level Outcomes – Border Counties Only

OUTCOMES	All	Free State Mean	Slave State Mean	Difference
Median Household Income- 1980	17227	17223	17231	-7 (1621)
Median Household Income- 1990	29810	29208	30496	-1288 (3039)
Median Household Income- 2000	42793	41870	43770	-1901 (3439)
Poverty Rate- 1970	0.108	0.106	0.110	-0.004 (0.023)
Poverty Rate- 1980	0.109	0.105	0.114	-0.010 (0.022)
Poverty Rate- 1990	0.132	0.132	0.132	0.000 (0.023)
Poverty Rate- 2000	0.118	0.117	0.120	-0.004 (0.018)
<i>Observations</i> ³	1713	872	841	

Summary statistics are displayed for 1970-2000 outcome variables, listed in the first column, measured at the census tract-level with the means for all tracts in counties along the free-slave border in the second column and then calculated separately by whether slavery was present in the third and fourth. The final column shows the difference, with standard errors in parenthesis and clustered at the county level. Median household incomes are in nominal terms. Significance levels denoted by: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

³ Observations are listed for the 1980. The number of tracts increases gradually to 2514 between 1980 and 2000.

The earliest year that census block group-level data becomes available is 1990. As a result, for the analyses I conduct from 1970-2000, I use census tract-level time series data on poverty rates and median household incomes and generate control variables by taking the mean control values for census block groups within each tract. The sample size is smaller but in my analysis the bandwidths are expanded to ensure the estimates have sufficient power. Summary statistics for these variables are reported in Table 3 above. The median household incomes for each decade are in nominal terms and, as before, are very close to the national averages. Similarly, poverty rates are close to national averages over this period and mirror national trends – a rise during the 1980s and early 1990s and a decline at the end of the century.

In Figure A1 of the Appendix, I include scatterplots showing that the relationship between poverty and median household incomes over time has been roughly consistent. Additionally, in Figure A2, I plot the close relationships between 1980 and 2000 median household incomes and between 1970 and 2000 poverty rates.

Before 1980 for median household incomes and 1970 for poverty rates, tract-level data is unavailable. To provide an indication of outcomes before this period, I use county-level median household income data from the 1950 US Census and aggregate control values to the county level by taking the mean of block group-level values within each county. Though the control values are contemporary, they are largely for environmental and resource variables that should be relatively unchanged over time. The available data does not provide a continuous variable for median household income in 1950. Instead, the data is in the form of a categorical variable from 0 to 9 indicating which the range a county's median household income falls into. In the results section, I discuss this issue further and test several methods of estimating a slavery impact. In

that section, I also incorporate county-level US Census data for median household incomes from 1980-2010 and data on slave population proportions from the 1860 US Census.

IV. Using Regression Discontinuity to Estimate the Impact of Slavery

a. Regression Specification

To measure the long-run impact of slavery's extensive margin on development in the United States, I employ a spatial regression discontinuity model with the running variable specified as distance to the free-slave state border. Central to this analysis is the fact that slave population proportions before abolition were small in counties along this boundary relative to the rest of the South.⁴ As such, the main driver of any differences at this boundary ought to be the presence of slavery rather than its intensity. I use ArcGIS to calculate the running variable, distance to the border in kilometers, from the tract or block group population centroid to the boundary illustrated in Figure 1.

My specification is as follows:

$$(1) y_{ics} = \alpha + \beta_1 Slave_s + \beta_2 f(Distance_{ics}) + \beta_3 Slave_s * f(Distance_{ics}) + X_{ics}'\delta + Z_{cs}'\phi + \varepsilon_{ics}$$

where y_{ics} is an outcome in census block group or tract i , county c , and state s ; $Slave_s$ is dummy variable equal to 1 if state s was a slave state; $f(Distance_{ics})$ is the running variable, specified as either a linear or a quadratic function of distance to the border; X_{ics}' is a vector of census block group or tract-level geographic, climate, and topographic controls; Z_{cs}' is a vector of county-level resource and geographic controls; and ε_{ics} is the error term. β_1 is the main coefficient of interest.

⁴ Per the 1860 Census, border counties had about 8% of their populations in slavery before the Civil War compared to about 30% across the South.

For each of the outcome variables, I restrict the sample to census block groups or tracts within the optimal bandwidth of the boundary, calculated using the Stata algorithm based on Calonico et al. (2014). The bandwidths for each outcome variable are displayed in my results tables. Additionally, in all regressions, standard errors are clustered at the county level because the error terms of block groups within the same counties – and often in the same metropolitan areas or with similar local economic conditions and geographic characteristics – are likely correlated.

b. Validity of the Regression Discontinuity Specification

The regression discontinuity approach rests on the assumption that areas on either side of the free-slave state border are similar in characteristics other than the historical presence of slavery. The validity of this specification will therefore be violated if discontinuities exist at the boundary for geographic, soil suitability, or resource characteristics.

In Table 4 below for block groups and Table A3 in the Appendix for tracts, I include estimates from a regression discontinuity model with the running variable measured as the distance from each population centroid to the free-slave state border. The samples are restricted to census block groups and tracts located in border counties and within 25km of the boundary. Given that the running variable – distance to the free-slave state border – is measured at the census block group and tract-levels, I exclude controls measured at the county level. The cross-border balance of these variables is discussed in Section III. Column 1 specifies the running variable as a linear function of distance to the border while Column 2 uses a quadratic function. Under both specifications and at both the block group and tract levels, none of the controls are discontinuous, supporting the internal validity of my specification using the free-slave state border as a cutoff.

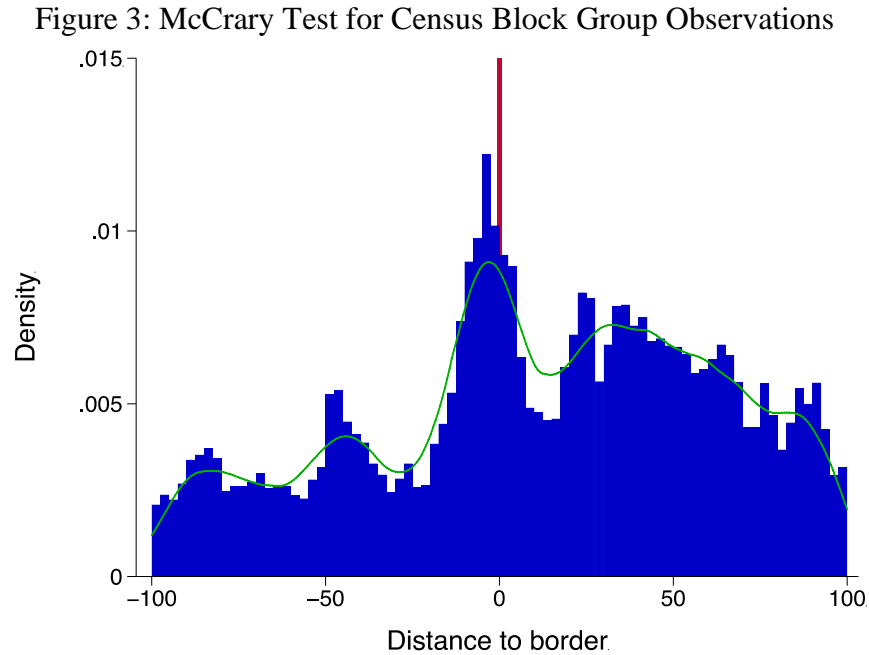
Table 4: Testing the Continuity of Control Variables at the Free-Slave State Border

	(1)	(2)
CONTROLS		
Cotton Suitability	-1.46 (7.59)	-3.58 (8.52)
Maize Suitability	-1.94 (5.58)	-5.41 (6.13)
Soy Suitability	-0.448 (6.181)	-4.449 (6.750)
Wheat Suitability	-0.355 (6.496)	-4.185 (7.266)
Altitude	-27.07 (29.90)	2.46 (28.07)
Rainfall	13.04 (18.33)	3.54 (17.54)
Slope	-0.304 (0.427)	0.102 (0.503)
<i>Observations</i>	7,980	7,980

Each cell reports the coefficient on the slave state dummy from the regression specified in equation 1 with each control as the outcome. Column (1) uses a linear specification of the running variable, distance to the border, while Column (2) uses a quadratic. The sample includes only census block groups in counties along the free-slave border and within 25km of it. Standard errors are in parentheses and clustered at the county level. Significance levels denoted by: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Another important criterion for my regression discontinuity specification is that the running variable is continuous across the boundary. In Figure 3 below for block groups and A4 in the Appendix for tracts, I conduct a McCrary test of the density of the running variable – with negative distances for locations south of the boundary – to ensure there is not a discontinuity at the free-slave state border. Since this variable depends on the density of census block groups and tracts, which are themselves functions of population density, the densities fluctuate at larger population centers. However, at the free-slave state border itself, the density increases in a

roughly symmetric manner on both sides of the cutoff, supporting the validity of the running variable.



V. Impact of Slavery on Economic Outcomes

a. Recent Economic Outcomes at the Census Block Group-Level

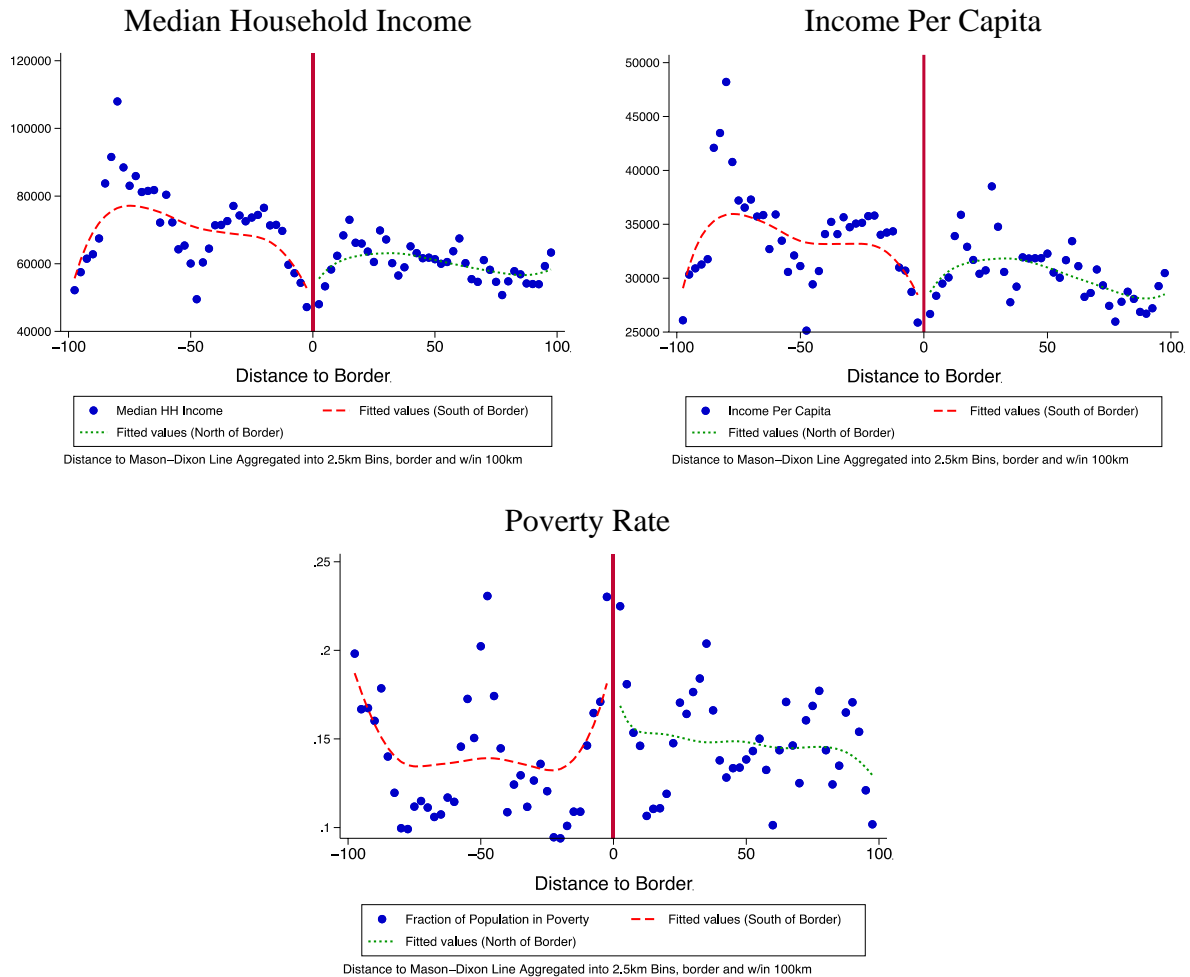
My main regression results are presented in Table 5, with the optimal bandwidth calculated for each outcome also reported. These findings suggest that there is no discontinuity at the border for the outcome variables used. The one exception is for median household income, which in the linear specification has a marginally significant, negative discontinuity crossing from former free to slave states. However, this discontinuity is not supported by the quadratic specification and taken together, these results suggest that economic outcomes are continuous at the census block group-level on either side of the free-slave state border today.

Table 5: Historical Slavery and Modern Economic Outcomes

OUTCOMES	(1)	(2)	Optimal Bandwidth (km)	Observations
Med. Household Income	-7,356* (3,853)	-3,455 (4,475)	19.73	6,683
Income Per Capita	-2,930 (2,049)	-1,262 (2,535)	23.28	7,741
Poverty Rate	0.0156 (0.0212)	0.00858 (0.0266)	19.25	6,759

Each cell reports the coefficient on the slave state dummy from the regression in equation 1 for each outcome variable. Column (1) uses a linear specification of distance to the border while Column (2) uses a quadratic. Standard errors are clustered at the county level. The outcome variables are in the left column and the coefficients are for a slave state dummy variable. The sample includes only census block groups within the bandwidth prescribed by Calonico et al. (2014), which are listed above. Standard errors are in parentheses, and significance levels are denoted by: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Figure 4: Regression Discontinuity Figures



This conclusion is supported by the graphs in Figure 4 above, which do not reflect a clear discontinuity at the border for any of the outcome variables. These figures are made by grouping block groups by distance to the border, plotting the average among them, and fitting a line through the points. For each outcome – median household income, per capita income, and the poverty rate – there is no apparent discontinuity, supporting the conclusion that the outcomes are continuous across the border.

This finding is striking, given that other research has found a negative impact of slavery's intensive margin in the United States. Furthermore, slavery's extensive margin and the existence of other coercive labor institutions have been found to be central predictors of development in other countries. The lack of a similar finding in the United States is notable and raises questions as to both why the situation along the free-slave state border is different and whether this has always been the case or reflects more recent trends.

One interesting takeaway from the graphs in Figure 4 is that, while there is no discontinuity, there is a clear trend approaching the border from each side. Both median household income and per capita income drop sharply within 10-20 km of the border while the poverty rate spikes. A clue to why this may occur is that a number of urban centers, from St. Louis to Louisville to Cincinnati, are found along the border. The corresponding increases in population are evidenced by the increased block group and tract densities in Figure 3. If these cities also have higher poverty rates and lower incomes than their surrounding areas, this could explain the trends close to the border. Further research is needed to examine the role that the free-slave state border may have played in geographical population sorting.

b. Robustness Checks

In order to reinforce the null effects reported above, I conduct a number of robustness checks for the contemporary estimates and report the results in Appendix Table A5. First, I employ a cubic rather than a linear or quadratic specification of the running variable. Second, I expand the bandwidth from the optimal bandwidths reported in the Table 5 to the 100km range used in my regression discontinuity figures. Third, I drop the top and bottom 5% of block groups by outcome variable to test whether the results are sensitive to the inclusion of outliers. Fourth, I use logged values of the outcome variables in both a linear and quadratic specification.

In all but three cases, the null effects persist, and no statistically significant discontinuity is detected. The exceptions are that, like before, the slave state dummy is marginally significant with a linear specification for logged median household income and median household income for the block groups in the middle 90 percentiles. It is also marginally significant in the linear specification with logged per capita income as the outcome. Nonetheless, the preponderance of my findings supports the conclusion of no statistically significant discontinuity at the border.

I also conduct a placebo test, with results reported in Table A6, of whether a discontinuity exists at the state borders directly north and south of the free-slave state border as depicted in Figure A7 in the Appendix. Though the border one row of states to the north does not have an external significance, the border to the south marks the boundary of the Confederacy and is thus an interesting test in its own right. By and large, the regression results find no statistically significant discontinuities at the borders, although there is a marginally significance increase in poverty just north of the confederate border using the linear specification. Overall though, these findings suggest that the null effects found at the free-slave state border are in line with similarly continuous outcomes at parallel boundaries.

c. Historical Results

Though no discontinuity exists at the free-slave state border today, it is important to see whether this is reflective of a longer-running parity or convergence in recent decades. There is a considerable body of evidence pointing toward a remarkable economic convergence between the South and North in the last 100 years, accelerating in the mid-1900s. Whereas Southern wages were approximately 45% those of Northern wages in 1900, they had reached 90% by 1980 (Caselli & Coleman, 2001).

Though this broader trend could have eliminated a historical discontinuity, there are reasons to believe otherwise. In their paper, Caselli & Coleman find that growth in agricultural wages and the Southern economy's transition away from a primarily agricultural economy were the main drivers of convergence. Figure A4 in the Appendix shows that the increased population density at the free-slave state border was present historically, so we would expect these trends to have less of a convergent impact. Furthermore, if the mid-century desegregation and democratization of the South played a role in convergence, areas along the border with smaller black populations could be less affected, though these events could also shape state-level policies.

The main obstacle to this historical analysis is the limited availability of historical data. Census block group-level economic data is unavailable before the 1990s, tract-level income data first becomes available in 1980 and poverty data first in 1970, and the Census only began collecting income data in 1950. Though county-level median household income data exists for 1950, it is in the form of a categorical variable for income ranges of \$500 (i.e. \$0-\$499, \$500-\$999, etc.).⁵

⁵ The IPUMS 1950 Census sample includes household income but is missing a substantial proportion of the county variable, making it impossible to accurately calculate median household incomes by county from the sample.

In Tables 6-7 below and Figures A8-A9 in the appendix, I test the regression discontinuity specification for tract-level poverty rates beginning in 1970 and median household incomes beginning in 1980. I report the bandwidth cutoffs in the tables below as well. In both the regression discontinuity figures and the tables, I find little evidence of a statistically significant impact of the slave state dummy on median household incomes or poverty rates. The one exception is for the quadratic specification of distance to the border with 2000 median household income as the outcome, which is marginally significant but inconsistent with linear specification. Taken altogether, the results mirror those for the contemporary census block group-level analysis and broadly support the conclusion that slavery's historical extensive margin does not have a clear long-run effect on economic outcomes in the United States – at least in the past half century.

Table 6: Historical Slavery and Poverty 1970-2000 Regression Discontinuity Results

OUTCOMES	(1)	(2)	Optimal Bandwidth (km)	Observations
1970 Poverty Rate	-0.0168 (0.0205)	-0.0195 (0.0307)	71.93	6,046
1980 Poverty Rate	-0.0432 (0.0268)	0.0134 (0.0345)	59.34	6,230
1990 Poverty Rate	-0.0217 (0.0210)	-0.00821 (0.0245)	88.88	6,496
2000 Poverty Rate	-0.0294 (0.0240)	0.0118 (0.0317)	63.19	8,857

Each cell reports the coefficient on the slave state dummy from the regression in equation 1 for each outcome variable. Column (1) uses a linear specification of the running variable, distance to the border, while Column (2) uses a quadratic. Standard errors are clustered at the county level. The sample includes only census tracts within the bandwidth prescribed by Calonico et al. (2014), which are listed above. Standard errors are in parentheses, and significance levels are denoted by: *** p<0.01, ** p<0.05, * p<0.1

Table 7: Historical Slavery and Nominal Median Household Income 1980-2000 Regression
Discontinuity Results

OUTCOMES	(1)	(2)	Optimal Bandwidth (km)	Observations
1980 Median HH Income	2,153 (1,784)	16.30 (1,923)	60.25	6,438
1990 Median HH Income	1,130 (2,467)	-4,311 (3,255)	40.10	5,876
2000 Median HH Income	4,050 (3,958)	-8,566* (4,650)	43.29	6,912

Each cell reports the coefficient on the slave state dummy from the regression in equation 1 for each outcome variable. Column (1) uses a linear specification of the running variable, distance to the border, while Column (2) uses a quadratic. Standard errors are clustered at the county level. The sample includes only census tracts within the bandwidth prescribed by Calonico et al. (2014), which are listed above. Standard errors are in parentheses, and significance levels are denoted by: *** p<0.01, ** p<0.05, * p<0.1

Table 8: Historical Slavery and 1950 Median Household Income at the County Level

VARIABLES	(1) Logit	(2) Logit	(3) OLS	(4) OLS
Slave State	-0.635* (0.366)	-0.226 (0.440)	-0.344 (0.231)	-0.0544 (0.274)
1860 Slave Proportion		-4.829* (2.901)		-3.642* (1.910)
Observations	139	139	139	139

Each cell reports the coefficient on the variable in the left column from a regression of the categorical median household income variable on a function of the slave dummy, controls, and – in columns (2) and (4) – the 1860 slave population proportion. Columns (1) and (2) report estimates from an ordered logit regression, while Columns (3) and (4) report OLS estimates. Standard errors are in parentheses, and significance levels are denoted by: *** p<0.01, ** p<0.05, * p<0.1

In Table 8 above, I report regression results for the 1950 county level data. The sample is limited to the 139 counties located on the free-slave state border. I include control variable averages aggregated from the census block group-level in all regressions. Column 1 reports results from an ordered logit regression of the categorical median household income variable on a dummy equal to 1 if the county was in a slave state. Column 2 reports results from the same

regression but including a variable with the fraction of the county's 1860 population that was enslaved – with values of 0 for all counties north of the border. Columns 3 and 4 report corresponding OLS regressions with the categorical variable as the outcome. Though the sample is small, the ordered logit results suggest that in 1950, there was a marginally significant, negative relationship between slavery and median household income. Interestingly, this negative effect is driven entirely by the intensive rather than the extensive margin in both OLS and ordered logit regressions.

Table 9: 1980-2010 County Level Results

VARIABLES	(1)	(2)
<i>Panel 1: 1980</i>		
Slave State	-150.4 (558.4)	-333.8 (672.8)
1860 Slave Proportion		2,305 (4,685)
<i>Panel 2: 1990</i>		
Slave State	-684.1 (1,112)	-411.2 (1,341)
1860 Slave Proportion		-3,431 (9,337)
<i>Panel 3: 2000</i>		
Slave State	-1,772 (1,510)	-2,321 (1,819)
1860 Slave Proportion		6,904 (12,668)
<i>Panel 4: 2010</i>		
Slave State	-2,013 (2,044)	-2,715 (2,462)
1860 Slave Proportion		8,827 (17,147)
Observations	139	139

Each cell reports the coefficient on the variable in the left column from a regression of median household income on a function of the slave dummy, controls, and – in column (2) – the 1860 slave population proportion. Standard errors are in parentheses, and significance levels are denoted by:

*** p<0.01, ** p<0.05, * p<0.1

In Table 9 above, I test whether this effect persists. I was unable to obtain county-level household income data for 1960-1970 but report the results for 1980 to 2010. In these regressions, I find no statistically significant effect for either the slave state dummy or the 1860 slave proportion on median household income.

There are several potential explanations for the disappearance of this negative slave proportion effect. First, the format of the 1950 data, the limited sample, and marginal significance of the effect raise questions about the robustness of the estimate. The impact of the small sample is particularly noticeable in the variation of estimates across decades. However, if the intensive margin did have a negative impact in 1950, it is possible that this effect diminished during the major social transformation of the South during the Civil Rights Era. Given the smaller slave proportions in the sample in contrast to the broader South, the contemporary estimates may also lack the precision to detect the contemporary impact that has been reported in other studies using historical slave proportions as an explanatory variable.

VI. Conclusion

In this analysis, I applied a regression discontinuity specification to economic outcomes at the free-slave state border to test the long-run effect of slavery's historical extensive margin in the United States. Although past research has found the intensive margin to be highly predictive of contemporary outcomes in the US, while the extensive margin is highly predictive of outcomes today in Colombia, my findings suggest little impact of slavery's presence on outcomes in the past 70 years.

In both regression discontinuity graphs and tables, there is no discontinuity for major economic outcomes such as median household income, income per capita, and the poverty rate.

These results are relatively unchanged between current Census block group-level data and tract-level time series data from 1970-2000 and are robust to a variety of specifications. Using 1950 Census data, I find suggestive evidence that at the time, counties directly south of the free-slave state border had lower median household incomes than those directly north of it. This effect appears to be driven by the intensive margin, however, rather than the extensive margin. Furthermore, the sample size is extremely small, and similar results are not present in data from more recent decades.

Altogether, the findings suggest that in the United States, slavery's extensive margin has had no effect on long-run economic development. Between limited evidence from 1950 and the extensive documentation of the intensive margin's negative impact today, it appears that the intensity rather than existence of a historical reliance on slavery has had a much more substantial effect. Future research is needed to determine the mechanisms – whether through coercive labor market practices, discrimination, racial intimidation and violence, or other factors – by which the intensive margin's impact has persisted long after slavery's abolition.

VII. Citations

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VIII. Appendix

Figure A1: Scatterplots of Correlations between Poverty Rates and Median Household Incomes over Time

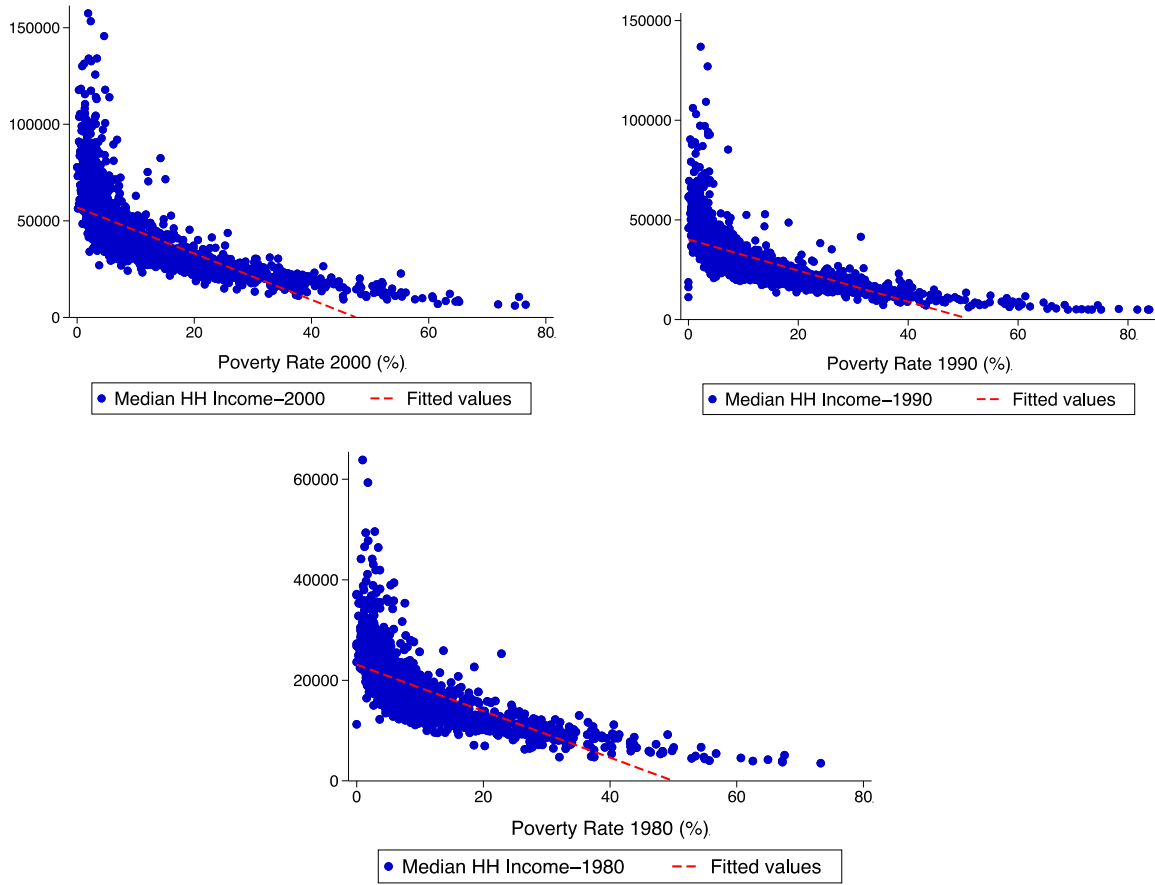


Figure A2: Scatterplots of Correlations within Poverty Rates and Median Household Incomes over Time

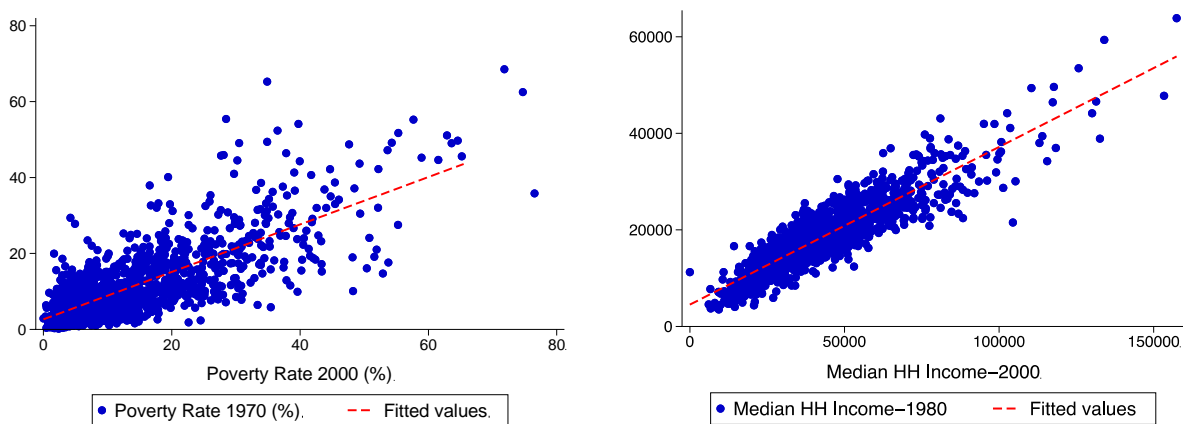


Table A3: Testing the Continuity of Tract-Level Controls at the Free-Slave State Border

	(1)	(2)
CONTROLS		
Cotton Suitability	-7.380 (8.467)	-6.834 (10.07)
Maize Suitability	-6.868 (5.831)	-7.099 (7.509)
Soy Suitability	-3.445 (6.989)	-7.453 (8.153)
Wheat Suitability	-3.963 (7.310)	-7.426 (8.581)
Rainfall	3.127 (25.12)	13.83 (25.10)
Slope	-0.239 (0.537)	-0.204 (0.681)
Altitude	10.20 (38.65)	-27.72 (35.62)
<i>Observations</i>	2,098	2,098

Each cell reports the coefficient on the slave state dummy from the regression in equation 1 with each control variable as the outcome. Column (1) uses a linear specification of the running variable, distance to the border, while Column (2) uses a quadratic. The sample includes only census tracts in counties along the free-slave border and within 25km of it. Standard errors are in parentheses and clustered at the county level. Significance levels denoted by: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Figure A4: McCrary Test for Tract-Level Observations

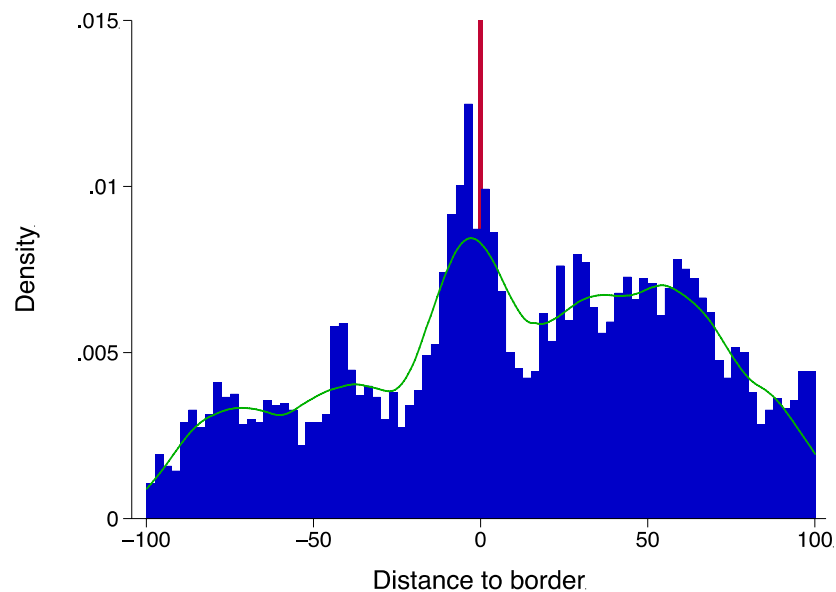


Table A5: Estimates from Robustness Checks for Contemporary Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
OUTCOMES							
Median HH Income	-3,983 (6,599)	-3,127 (4,508)	-5,216 (4,490)	-5,037* (2,563)	-3,229 (3,589)	-0.118* (0.0701)	-0.0775 (0.0842)
Income Per Capita	-3,467 (3,032)	-2,166 (1,909)	-1,379 (1,840)	-1,559 (1,154)	121.8 (1,507)	-0.120* (0.0623)	-0.0532 (0.0839)
Poverty Rate	0.0114 (0.0347)	0.00430 (0.0184)	0.0106 (0.0227)	0.0134 (0.0125)	-0.000802 (0.0164)	0.164 (0.133)	0.0310 (0.159)

Each cell reports the coefficient on the slave state dummy from the regression in equation 1 for each of the outcome variables. Column (1) uses a cubic specification of the running variable, distance to the border; Columns (2)-(3) use linear and quadratic, respectively, and a bandwidth of 100km; Columns (4)-(5) use linear and quadratic, respectively, and remove the top and bottom 5% of block groups by the outcome variable. Columns (6)-(7) use logs of the outcomes for linear and quadratic specifications. Standard errors are clustered at the county level. The sample in columns (1) and (4)-(7) includes only census block groups within the bandwidth prescribed by Calonico et al. (2014). Standard errors are in parentheses, and significance levels are denoted by: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

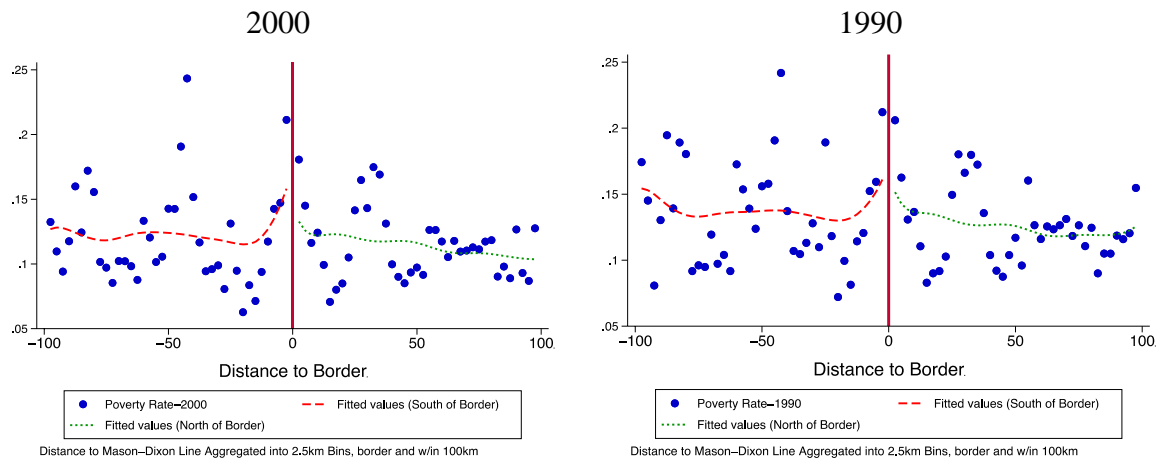
Table A6: Placebo Tests

	(1)	(2)	(3)	(4)
OUTCOMES	Confederate Border		Northern Border	
Median HH Income	-962.4 (14,732)	-3,529 (26,806)	5,752 (9,494)	9,054 (13,122)
Income Per Capita	1,371 (9,702)	4,379 (17,466)	10,769 (9,045)	16,242 (11,995)
Poverty Rate	-0.0313* (0.0172)	-0.0328 (0.0274)	-0.00167 (0.0315)	-0.00237 (0.0388)

Each cell reports the coefficient on the confederate or northern state dummy from the regression in equation 1 for each of the outcome variables. Columns (1) and (3) use a linear specification of the running variable, distance to the border, while Columns (2) and (4) use a quadratic. Columns (1)-(2) report results for the confederate border, with the main explanatory variable being a dummy of whether or not the census block group was in the confederacy. Columns (3)-(4) report results for the border in blue in Figure 7, with the main explanatory variable being a dummy of whether or not the census block group is north of the boundary. Standard errors are clustered at the county level. The regressions use the bandwidths prescribed by Calonico et al. (2014). Standard errors are in parentheses, and significance levels are denoted by: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Figure A7: Placebo Test Boundaries⁶

Figure A8: 1970-2000 Regression Discontinuity Figures for Poverty Rates



⁶ Portions of Illinois along Lake Michigan remain in the map but are removed from the analysis.

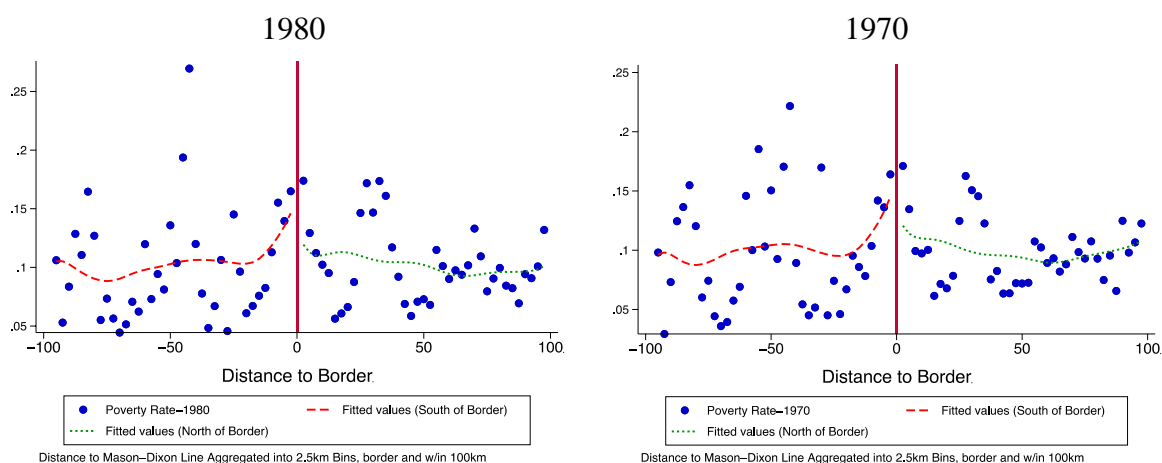


Figure A9: 1980-2000 Regression Discontinuity Figures for Median Household Income

