The Economic Effects of American Slavery: Tests at the Border*

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Abstract: To engage with the large literature on the economic effects of slavery, we use antebellum census data to test for statistical differences at the 1860 free-slave border. We find evidence of lower population density, less intensive land use, and lower land values on the slave side. This does not support the view that abolition was a costly constraint for landowners. Indeed, the lower demand for similar, yet cheaper, land presents a different puzzle: why wouldn't the yeomen farmers cross the border to fill up empty land in slave states, as was happening in the free states of the Old Northwest? On this point, we find evidence of higher wages on the slave side, indicating an aversion of free labor to working in a slave society. This evidence of systemically lower economic performance in slave areas suggests that the earlier literature on the profitability of plantations was misplaced, or at least incomplete.

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I. Introduction

Social scientists have long sought to understand the effects of slavery on economic growth and development. Alexis de Tocqueville and Gustave de Beaumont, for example, wrestled with the issue during in their famous visit to America in 1831-32. While in the Northeast, the French visitors heard much about the distinctiveness of the American South, but they felt unable to sort out the impacts of slavery from those of climate and soil. When they traveled to the Ohio River valley, they discovered a setting where the environment was the same on both sides of the river; but the institutions differed.[1] They observed that free state of Ohio was more dynamic, more industrious, and more attractive to immigrants, than the slave state of Kentucky. De Tocqueville wrote: "It is impossible to attribute those differences to any other cause than slavery. It brutalizes the black population and debilitates the white…. Man is not made for servitude. (Pierson 1938, p. 569)."

Over the next century, historians largely echoed the conclusion that slavery harmed economic performance. They argued that slavery was unprofitable and was kept in place by an elite who sought to maintain their political and social hegemony (see Aitken 1971). In the mid-twentieth century, economic historians brought to bear quantitative evidence that seemed to challenge this view. They argued that plantations were profit-maximizing businesses and slavery was a dynamic economic form, far from dying out due of unprofitability (Conrad and Meyer 1958, Fogel and Engerman 1974). In the last two decades, economic historians and others have advanced a more nuanced position that slavery in the Americas had an economic rationale early on but created institutional impediments to subsequent growth (Engerman and Sokoloff 2011). Places with coercive labor in the 1800s appear to have started modern economic growth later and have worse development experiences today than places with free labor. This was becoming the standard view. But, more recently, the "1619 Project" of the *New York Times Magazine* (2019) has popularized the New History of Capitalism, which founds US economic success directly on slavery (Beckert 2015). The core issues remain contested.

In this paper, we return to an investigation of the impact of slavery on economic performance during its existence. To proceed in a controlled yet tractable way, we examine the effects of the peculiar institution at the border that divided the country in half, slave and free, circa 1860. Following in the footsteps of de Tocqueville and de Beaumont, we seek a testing ground

[1] See Yale Tocqueville Manuscripts. American Trip, Diary and Notes, Cashier E. DeTocqueville's words read: "Il est impossible d'attribuer ces differences a una autre cause que a il esclavage. Il abrusit la population noire et inerve [sic] la population Blanche….l'homme n'est pas fait pour la servitude." See also Zunz (2010, pp. 180-81).
By the 1830s, local observers had made frequent contrasts between the development patterns on the two sides of the river. See *Edwardville* (IL) *Spectator*, 1 May 1821, p. 3.

where the environmental differences do not confound the comparisons. Much of economics literature on slavery conducted tests for whether marginal benefits of something equal its marginal cost at the farm level: roughly speaking, tests of productive efficiency and profit maximization. We argue that these are the wrong questions for assessing the economic effects of the institution. If a slave-based firm was unprofitable, one would expect it to go out of business, leaving fewer in operation. Instead, we propose a different perspective: the policy variable on either side of the free-slave border should affects how those free-to-choose could use their land. Local public economics teaches us that the inelastic factor bears such policies (Tiebout 1958). Physical capital is mobile, free labor is mobile, and slave labor is mobile, even if not by the will of the enslaved. Land, in contrast, is immobile. If we wish to measure the systemic productivity of a local or regional policy, we should therefore direct our attention to land use and price.[2]

On the one hand, the institution of slavery created different, arguably larger set of production possibilities. It allowed labor to be coerced, which should have lowered the cost of labor to the slave owner. The institution of slavery also facilitated the attainment of greater scale. The institution allowed the possibility of raising human beings for sale. And it facilitated the use of human as chattel to be pledged as collateral in credit transactions. More generally, the ability to enslave others generated profit opportunities for the enslavers; sites where profitable activities were legal should, all other things equal, be more valuable than sites where such activities are not legal.

On the other hand, the institution of slavery was a social system that oppressed and degraded the enslaved. In doing so, the system also levied taxes on and inhibited the activities of the non-slave-holders. Complicity with the violent system imposed costs that some free people might seek to avoid. Slavery had existed in many parts of the world for millennia. In many places, including the US South, the use of coerced labor was so importance as to shape the region's institutional core, creating not just a society with slaves, but what Moses Finley (1980) and Ira Berlin (1998) call a "slave society." The US North prided itself on being a place where slavery was not permitted and "free labor" was celebrated (Foner 1970; Lincoln as quoted in Basker 1953, pp. 471-82). This was a choice.

This paper seeks to measure the relative strengths of these opposing forces affecting the use and value of land in areas with and without slavery. We take the testing ground of de Tocqueville and de Beaumont -- the Ohio River valley-- and extend the comparison east to cover the borders dividing Pennsylvania and New Jersey from Virginia, Maryland and Delaware and west to contrast free states of Illinois and Iowa with the slave state of Missouri (de Tocqueville 1838, Chase and Sanborn 1856, Thomas and Ayers 2003, Wright 2006). The border was the divided line between

[2] Land prices also have the virtue of being comparable across regions. See Appendix A for model of the effect of labor scarcity on land values.

slavery and free labor institutions within the same country, with a common language, national laws, and shared heritage.[3] We use antebellum census data to test for statistical differences, as captured by a coefficient on the legality of slavery, at the 1860 free-slave border.[4] We find evidence (in Section V) of less intensive land use and lower land value on the slave side of this border. This does not support the view that abolition was a costly constraint for landowners.

Indeed, the lower use of land that was cheaper presents a prima facie puzzle: why wouldn't the yeomen farmers cross the border to fill up "empty" land in slave states, in the same ways they did in the free states of the Old Northwest? More puzzling still is that we find evidence (in Section VIII) of higher wages on the slave side of the border. We then turn to interpret the results in a variant of the Rosen-Roback locational choice model (Roback 1982). The combination of lower land rents and higher wages would indicate that there was a large disamenity for free households to live and work in the slave region. In Section IX, we seek to account the farm-value difference. Farm improvements --relative levels on investment in farm buildings and land clearing-- explain a meaningful fraction of the gap; the differences in wages explain much or most of what remains. Differences in agricultural total factor productivity appears to explain only a small fraction of the gap, while differences in pecuniary taxes work in the opposite direction. Furthermore, the estimated reduction in land wealth in the slave side of the border region was of the same magnitude as the slave wealth held there, which suggests that the institutional structure sustaining slavery was itself hindering the region's economic performance.

We are treating the two sides of the border as competing for settlement and economic activity. They are not separate testing grounds, but rather interact and compete. Some spillovers such as the prospect for the enslaved to escape complicate the contrast and we seek to control for these effects by also looking off the immediate border. It is important to notice that in addition to sharing similar climate and soils, the two sides of the river face similar product prices. There are no internal duties on physical commodities and transportation costs to global markets are the same. Many of the border segments were on navigable waterways, making differences in investments in internal improvements less immediately salient. These differences, which deserve the attention that they have received in the literature (Majewski 2000), matter less in these border segments. An obvious concern is whether differences observed in the border region extend to the broader slave-

[3] The recent economic literature includes many studies making border comparisons (Dell 2010, Acemoglu and Robinson 2012). The border considered here lies at the heart of the main issue in early US history, the competition and co-existence of the slave and free labor systems within the same nation-state.

[4] The main data that we use were collected during the period of study under a common statistical authority; they are relatively abundant, but of course do not address every question of interest. Our tests of the "slavery effect" are based on the legality of slavery circa 1860; they differ from tests in the existing literature of the relationship, within the slave region, between various outcomes and the slave share of the total population. We thank Gavin Wright for highlighting this contrast.

free comparison. Our analysis indicates that they do, and if anything, many differences become more pronounced as the geographic scope of our investigation widens.

II. The Legal Basis of the Institutional Differences

Allowing for slavery was the default condition of the North American colonies. Colonists petitioned at various points to ban further importation of slaves, but royal representatives denied them. Georgia restricted the institution at its founding in 1732 but by 1750 revised its laws to permit slave holding. Following the start of the War of Independence, the Northern states began to eliminate the slave system and emancipate those held in bondage. Pennsylvania was a leader, passing the "Act for the Gradual Abolution of Slavery" on 1 March 1780. The 1787 Northwest Ordinance, passed by the US Congress during the Articles of Confederation period, forbad slavery in the territory north of the Ohio River. The Sixth Article read "There shall be neither slavery nor involuntary servitude in the said territory, otherwise than in punishment of crimes whereof the party shall have been duly convicted." This law was contested at times and laborers in the region were sometimes bound under indentured servitude contracts. But the founding document of the Northwest Territory prohibited chattel slavery. South of the river, in Kentucky, the legal system adopted Virginia practices; chattel slavery was in place when Kentucky became a state in 1792. In 1820, Missouri was also admitted to the union as a slave state, as part of a compromise excluding slavery in the other parts of the territory of the Louisiana Purchase above the longitude 36 degrees 30 minutes (Wright 2006, pp. 44-46; Simeone 2000).

Readers who question our framing might be persuaded by the words of Honest Abe Lincoln. On his speaking tour through Ohio and Indiana in September 1859, Lincoln repeatedly attributed that the absence of chattel slavery in the states formed from the Northwest territory to 1787 Ordinance and to the refusal of Congress to allow early legislatures to backtrack on the provisions of Article VI. "There is no difference in soil nor in climate" along the border, Lincoln noted, but the different institutional choices at founding led to different outcomes.[5] Relatedly, Lincoln's argument against 'popular sovereignty' included a notion of path dependence: once slave owners were present in a territory, it created a constituency seeking to preserve and expand the peculiar institution.

We compare the operation of slavery and free labor in a classic testing ground (de Tocqueville 1838, Wright 2006).[6] This region includes the core domain of slavery in the country's

[5] Speeches at Indianapolis, IN, 19 Sept. 1859 and at Cincinnati, OH, 17 Sept. 1859 in Basker (1953, pp. 456-57, 467).
[6] An additional reason to examine the border region is its importance. It was hardly a marginal area. In 1860, over one half (52.1 percent) of the total population of the free states lived within the 150-mile band. Almost four-tenths (38.6 percent) of the population of the slave states did so. For the country as a whole, almost one-half (46.8) did so. The 300-mile band covered 91.4 percent of the population of the free states, 67.8 percent of the slave states, and 82.2 percent of the total. Nearly 900 (898k) thousand enslaved African-Americans, 23 percent of the total number of slaves, lived within the 150-mile band. Over 2 million (2098k), or 53 percent of the total, lived within the 300-mile band. The

early history. Slave labor was commonly used to produce the region's staple crops. And there were repeated attempts, during crop booms, to introduce slavery into the places where it was legally prohibited in the founding period. These attempts failed, but many voters in the Free States were not convinced that nature alone would forever keep slavery out. The contest went the other way as well. By 1860, slavery had almost completely disappeared in New Jersey; it was on the decline in Delaware; other parts of the border South might be next. The border test has relevance for how US history played out and how the participants saw it playing out.[7]

III. The Free-Slave Boundary and Census Data

Figure 1, Panel A, maps the Free-Slave Boundary in the United States in 1860 and the surrounding regions (see Appendix B for details).[8] The thick line is the boundary and the thin lines are 1860 state borders, plus the subsequent border that split the two Virginias. We will investigate the effects of slavery using the abundant county-level data from the antebellum censuses: population, by demographic type, land value, land use, crop mix, farm size, and other variables of interest.

We offer two leading examples in the remaining panels of Figure 1: Panel B represents non-white population (mainly blacks) and Panel C represents the rural population. Each dot is placed at the county centroid and is proportional to the percentile of the respective outcome.[9] The propensity of nonwhites to be south of the boundary is noteworthy, while the rural population is far denser in free states. A few other features are evident in the maps: the relative emptiness of Appalachia and the settlement along the Missouri River, for example.

Table 1 provides summary statistics for some of the data in our sample. In Panels A and B, respectively, we consider two samples: counties with centroids within 300 miles of the border and counties on the border. The columns present numbers of observations, means, and standard deviations, for the entirety of each sample as well as for free-region and slave-region subsamples. There are three variables for population: nonwhite, white, and rural, all normalized by county area. There are 5.3 (4.2) nonwhites per thousand acres in the first (second) sample. However, there is a much greater density of nonwhites south of the boundary, with an additional 8.7 (5.0) per thousand acres on the slave side. In each of the subsamples, white population density is higher north of the

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shares of slave-holding households were even higher; 34 percent lived within the 150 mile-band and 64 percent within the 300-mile band. See also Smith (1927, pp. 2-3).

[7] The data that we are examining come from the 1850s. This is a period when the slave system is thriving. The price of an average slave rose from $377 in 1850 to $778 in 1860. (Ransom and Sutch 1988, Table A1.) The market for raw cotton is booming. In contrast to the first half of the nineteenth century, the tobacco market is doing well in the 1850s.

[8] The source for the spatial data is the National Historical Geographic Information System (NHGIS, Minnesota Population Center, 2011). Population data are from census counts compiled in ICPSR study No. 2896 (Haines 2010). The agricultural data are census statistics compiled in ICPSR study No. 35206 (Haines, Fishback, Rhode 2018).

[9] We use percentiles to make the graph legible. The statistical analysis below is based on levels and natural logarithms.

border: there are 43.9 (21.3) more whites per thousand acres on the free side. A similar pattern holds for rural population: more nonwhites on the slave side; and more whites on the free side. The offset is not one-for-one; the combined population density is much higher on the free side.

There are four agricultural outcomes of immediate interest. About 60 percent of acres were in farms, on average, and these numbers are fairly similar across samples on both sides of the border. A large gap is seen in land improvement, however, across the free and slave counties. Finally, we present farm values per county and also per farm acre. At the border, farms are valued at about $24 per farm acre, but there is an over $8 difference on either side. Measured in logs, the farm acres on the slave side are approximately 37 percent less valuable.

Moving to our more formal econometric tests, we employ the following estimation procedures. We focus on four samples: those counties that touch the border (the border sample), those that are near the border but do not touch it (the donut sample), those that are within 150 miles of the border, and those that are within 300 miles.[10] We run one of two specifications:

(1) $Y_i = \beta_1 * Slavery\_Legal_i + \gamma_1 * Longitude_i + \gamma_2 * Longitude_i^2 + \gamma_3 * Longitude_i^3 + \gamma_4 * Distance_i + \gamma_5 * Distance_i^2 + \gamma_6 * Distance_i^3 + \beta_0 + \varepsilon_i$

(2) $Y_i = \beta_1 * Slavery\_Legal_i + \gamma_1 * Longitude_i + \gamma_2 * Longitude_i^2 + \gamma_3 * Longitude_i^3 + \beta_0 + \varepsilon_i$

All of these specifications include controls for a cubic in longitude. For the 150- and 300-mile buffers, we run specification (1) which also includes controls for a cubic in distance to the boundary, which is defined as a positive to the North in a negative to the South. For the border county and donut samples, distance to the boundary is nearly collinear with free or slave. For these samples, we run specification (2) excluding the distance controls. This analysis is weighted by county area so as to not inflate the importance of states that subdivide more than others. To account for spatial correlation, we cluster by 15 bins of longitude.[11] The coefficient of interest is on an indicator for whether slavery is legal. Generally speaking, the slave region is south of the boundary.

Figure 2 provides evidence on environmental variables, e.g. weather and soil, which are--for the most part--pre-determined. This helps us assess the strength of our research design that

[10] The distances are measured from the county centroid. See Appendix Figure B-1 for a map of the buffers and the border sample in 1860. The donut sample is not on the boundary directly, but within 55 miles of it. The 55-mile cutoff is approximately double the maximum average distance to the boundary in the border sample and it ensures that there is at least one county on either side. We created the donut sample to address two concerns about a comparison right at the border: (1) slave owners fear enslaved workers might escape, and (2) opportunities for trade, especially on navigable rivers, might mute the effects of institutions on land use.

[11] We select this clustering method based on an analysis of the spatial correlation across bins. Smaller bins of longitude (e.g. 30 evenly sized groups instead) show statistically significant residual correlation across adjacent bins. We use Moran's I statistic to diagnose spatial correlation, as suggested by Kelly (2020). We also implement Kelly's and Conley's, (1999) proposed estimators in sensitivity analysis below.

compares area on either side of the border. Panel A contains results in the areas of weather, topography, river/water access, and seismology. Panel B represents tests for soil-related variables, including the glacial coverage (which is described in Appendix C). Some rows have numerous coefficients because the categories (listed on the y axis) are measured at various soil depths. We plot the p-value on the slavery coefficient for each variable and sample. A uniform distribution across [0,1] would imply no meaningful differences across the border. A departure from uniform indicates otherwise, with caveat that the coefficients are not independent draws (e.g. sandy soil 10 inches down is correlated with sand fraction at 15 inches). Panel A has 10 of 52 (19 percent) coefficients significant at the 10 percent level. Outside of the climate variables, 4 of 36 p-values are below 10 percent, and none are below five percent. There are not significant differences in elevation on either side of the river. The climate should also be quite similar on either side of these borders. Much of the boundary line is defined by a river that runs through flat terrain, so there are not issues of rain shadows from mountains.[12] Our review of the river course indicates that the bends on the river are evenly distributed. There is local heterogeneity but this averages out over the river course. The rest of the boundary is defined by geometric constructs (east/west lines and the Twelve-Mile Circle) that were set well before much was known about land quality. Nevertheless, the story is bit more complicated in Panel B, where 29 percent of coefficients have p-values before 10 percent. A few outcomes look reasonably uniform, e.g. porosity or bulk density. Several look uniform for some samples, but not others: for example, soil pH, which looks uniform for the buffer sample, but bad for the donut sample. Glacial extent (meaning fraction of the county covered by ice at the previous glacial maximum) and depth to bedrock are most significantly related to the free-slave boundary. All of the above controls will be used in the sensitivity analysis below.

IV: Demographics

Figure 3 graphs the point estimates and 95-percent confidence intervals for key demographics attributes in 1860 for the four samples. The top set of results represents the principal attribute, non-whites as a share of the population. These results demonstrate the non-white share was indeed higher in the slave region. Given that non-white people were more likely to be subject to labor coercion, finding this difference is something like a first-stage regression for our analysis.

Examining additional results, we observe the ratio of non-white population to total land area is higher in the slave region. But the white population per land area is lower, and total population density is lower. This gap is not due solely to differences in urbanization. Total rural population

[12] For temperature and rainfall, the standard errors of the kriging (interpolation) exercise are somewhat more related to free-slave region than are the interpolated climate variables themselves. This indicates that these effects come in part from the endogenous placement of weather stations rather than real differences in climate. Note that the climate data come from the mid-nineteenth century and are described in Bleakley and Hong (2017). We eschewed modern climate raster data because (endogenous) urban heat islands are clearly visible.

per land area is substantially lower – by about one-half– on the slave side. If we examine regressions using natural units rather than logs, we observe the slave side is associated with, per thousand acres, 6 more nonwhites and with 40 fewer whites. This defies the simple story that enslaved laborers and artisans displaced free workers at specific tasks, for which one might have expected estimates closer to parity. On the slave side, the mean densities are about 16 for nonwhites and 61 for whites per thousand acres, so these are large effects.[13]

For all the variables, the point estimates for border and 150-mile samples are very close to each other. Those for 300-mile sample shows larger gaps, a finding explored in Section IV: E below.[14] A parallel analysis of population attributes in 1850 would yield very similar results. The lower density speaks to land use; a given land area in the slave region was devoted to supporting far fewer people.

V. Land Use and Value

Figure 4 presents results on the effect of slavery on farmland use and values. As noted in the introduction, the local public finance literature considers such variables to be sufficient statistics for evaluating the economic effects of local institutions and policies affecting property rights. (Such a calculation does *not* account for equity issues, which are very significant in this case.)

We start with farmland use in 1860. The share of farmland in total land is smaller in the slave region, but just barely so. The differences are not statistically significant. The share of improved farm acreage in total land is lower, and, for both the donut and border samples, the differences are statistically significant. Parsing these two findings, we see the share of improved acres in farm acreage is lower in slave region. The differences are now all statistically significant at the 95-percent level. In summary, farmland was used far less intensively on the slave side.

Differences also appear in farm values. Farm values per capita are lower in the slave region, but the gaps are not so large as to be significantly different from zero. We then shift from dividing the value of farms by population to dividing by county land area. Here the gaps are large and statistically significantly different from zero. Then we divide instead by farm acres. Farm values per farm acre are substantially lower in the slave region. The gaps are economically huge, a

[13] See Table 2, Panel C. The use of levels instead of logs also facilitates the analysis of slave population, which is zero in many of the counties. If we put enslaved population density on the left-hand side, we obtain a coefficient of 5.5 more slaves per thousand acres. This is very close to the estimate for nonwhite population.

[14] Appendix Figures F-3 and F-4 extend the analysis to cover differences in the age composition of the 1860 population and in sex, race, and nativity, respectively. Appendix Figure F-3 shows the slave region had relatively more young people (10-14 years) and fewer older people (40-79 years). This pattern is in line with the characterization of the border South as an area where young slaves were raised to be sold "down river." The magnitudes of the differences, however, were not great. Appendix Figure F-4 shows more non-whites in the slave region, more males and more females. But again, the gender differences were not great. There were fewer free people of color and, marginally, fewer foreign-born whites. The evidence of lower fraction of foreign-born is weaker that one might expect given the common narrative that immigrants strictly avoided slavery. There appears to be little difference from the behavior of native-born whites.

reduction on the order of 55 percent.[15] In natural units, the reduction in farm value is about $8 per county acre or $11 per farm acre. (Furthermore, approximately 13 percentage points less of total farm acreage is improved on the slave side.) An analysis of farmland use and values in 1850 yields similar results.

In summary, farm values per farm acre were substantially lower – by over one-half–in the slave region. The ratio of improved land to farm acre was also lower.[16] These findings are puzzling for the models in which coercion made labor cheaper, which would have raised land rents. The puzzle extends to models where the legal capacity to engage in activities-of-value (such as raising slaves for sale) increases land values. At the strictly micro-level, producers had access to more modes of production south of the border. Yet there was lower demand for that land.

VI: Sensitivity Analysis

Results, reported in Tables 2, 3, and 4, should assuage reader's concerns about omitted variables, endogeneity, geospatial correlation, and external validity. The estimates are qualitatively similar under a variety of alternate assumptions. The time-pressured reader might wish to skip ahead, though the results on external validity (Section VI.E) merit special attention. That analysis shows the patterns observed extend far beyond the border comparison.

VI.A: Additional Variables

In Table 2, we present estimates of the effect being in the slave region on the main outcomes, in the full sample. In the first row of Panel A, we see the baseline results, which use land area as a weight in the regression. In the next two rows, we find broadly similar results if we weight by rural population or use no weights at all.[17] The final row of Panel A assigns the few observations with a zero or missing value for the outcome to the sample minimum value instead. This has its greatest effect on the sample size of the nonwhite population, as there were a comparatively large number of counties that were 100 percent white in the 1860 census. In any case, this adjustment does not affect the estimates to a great degree.

Panel B of Table 2 presents estimates using a variety of spatial controls. In the first three rows, we include dummy variables based on splitting the sample into five, ten, and then fifteen bins of longitude. The fourth row includes instead a cubic polynomial in latitude and longitude, which is

[15] Appendix Figure F-2 performs a parallel analysis of the z-scores associated with farmland use and value in 1860. The finding that farm value per acre was lower in the slave region again is apparent.

[16] One notable outcome comes from contrasting the third and sixth sets in Figure 4. The third set shows the fraction of farmland that was improved was lower in the slave region whereas the sixth set shows farmland values were lower. The point estimates in the third set of results are smaller than those in the sixth, so the farm value gaps are not explained mechanically by the gap in improved acreage in 1860. Similar results hold in 1850. See also Section IX:A below.

[17] Neither of these was the preferred specification because the former is endogenous to county land quality and institutions and the latter gives more weight to states, e.g. Kentucky, with greater proclivities to subdivide themselves.

distinct from the default specification based on longitude and distance from the free-slave border. Results including these purely spatial controls do not deviate substantially from the baseline. The next five rows show results controlling for the environmental factors. These variables were described already in reference to Figure 2, and most were not significant predictors of being on the free side of the boundary. The first row in this batch contains variables for topography, river access, groundwater, and climate. The second row controls for depth to bedrock, which is correlated in a statistically significant way with the institution of slavery, but whose inclusion in the model does not affect estimates associated with the free-slave boundary. The next row includes instead the remaining soil measurements described above. Results are generally similar, although there is now a statistically significant effect of slavery on farm acreage per county area and the estimated effect of slavery on farm value per county area is somewhat lower than the baseline. The next two rows control for the fraction of the county covered by the most recent glacier. The second row of this pair leaves out the Driftless region, mostly within southwest Wisconsin, and is therefore simply a measure of being north of the terminal moraine. These estimates are comparable to the baseline.

Panel C, Table 2 presents results for the standard outcomes, but defined in levels rather than in natural logarithms. These estimates differ because of the change of units, but the patterns of statistical significance are largely unchanged.

We now consider the possible confounding influence of land surveys. Notably, most of the Old Northwest was brought into the Public Land Survey System (PLSS), while much of the rest of the sample used non-rectangular, mostly metes and bounds, surveys for the demarcation of property (see Appendix D). Attention to this issue is motivated by three factors. First, the PLSS may affect transaction costs: perhaps reducing them, as argued by Libecap and Leuck (2011), or perhaps increasing them if the grid is set too far away from the optimal farm size, as argued by Bleakley and Ferrie (2014). Second, the Northwest Ordinance's demarcation scheme was in part motivated by a 'Jeffersonian dream' of yeoman farming (Gates 1996). Third, the use of the PLSS has said to induce more orderly, compact settlement, in contrast to a squatter-led regime.

The final row of Panel B reports results that directly control for the fraction of each county covered by the PLSS. Estimates are qualitatively similar to those with other specifications. We also split the sample based on whether the closest free-slave boundary is associated with the change in land demarcation system (specifically, PLSS versus something else). Most of the Ohio River, for example, is associated with a change, with the main exceptions near Cincinnati and Louisville. The Mason-Dixon line is not associated with a change, nor is most of the Missouri border, with the exception of riverside land near St. Louis that is associated with colonial French land claims. The first two rows of Table 3, Panel A, display these subsample estimates. Coefficients are remarkably

similar, with the exception that the effect size is almost halved for fraction improved of farm acreage.

VI.B: Subsamples

Table 3 presents results for select subsamples, an exercise which is informative for its own sake and sheds light on the possibility of certain alternative hypotheses and mechanisms. Panel A splits the sample based on characteristics at the closest segment of the free-slave boundary. The role of different land surveys, analyzed in the first two rows of Panel A, was discussed above. The next three rows split the sample into three, less heterogeneous chunks of boundary: the Mason-Dixon line (plus northern and eastern borders of Delaware), the Ohio River, and the state of Missouri. Estimates are qualitatively similar across segments.

Next, we stratify based on whether the boundary is defined by a natural feature (in our case, rivers) or an artificial, geometric construct --the Missouri/Iowa border, the Mason-Dixon line, and the arc of the northern border of Delaware.[18] Both choices are arbitrary in some sense, and often selected historically based on imperfect knowledge of what is on either side. In any case, estimates across these two subsamples are broadly similar.

We next turn to heterogeneity of this effect by the timing of settlement along the boundary. We already have seen similar effects across three different, contiguous border segments, which were settled at different points in time. The last two rows of Panel A do something similar by splitting the sample by whether the closest boundary is east or west of the confluence between the Miami and Ohio Rivers (at the Indiana/Ohio state boundary). Then, in Panel B, we use the Newberry (2010) data on historical county boundaries to approximate the timing of settlement. The first two rows discriminate by whether the county's FIPS code first appears before the median year in the sample; the second pair of rows split the sample based on the emergence of the current county boundaries.

Another important consideration is soil exhaustion. Planters, it was commonly asserted, were irresponsible stewards of the soil (Craven 1926, Majewski 2016). A number of reasons were given: plantation crops were hard on the soil, the planters' ability to coerce the migration of their slaves gave little incentive to conserve the soil on their existing farm, principal/agent problems on large farms, etc. If true, this could explain the lower farm values on the slave side. It might also explain lower land improvement, if previously tilled acreage was abandoned and reclaimed by nature. We should first note that this claim is not consistent with the evidence just presented. Generally, coefficient estimates are similar across the previous three sets of sample splits, even

[18] The main natural rivers, the Ohio and Mississippi, provided ready transportation to both regions. Many of the smaller rivers saw active batteaux and flatboat traffic. Investments in other types of transportation improvements—river clearing, wing dams & sluices, roads, canals, railroads—are best viewed as endogenous outcomes in the development process. See Zimran (2020).

though the timing of settlement would have been quite different. Furthermore, in two of the three splits, the effects on farm value are weaker for counties settled earlier, even though those would have had more time to ruin their soil. We can also use a direct measure of the soil's susceptibility to erosion: the kf-factor, which measures the "susceptibility of soil particles to detachment and movement by water," and the k-factor, which is the same measure but adjusted for the presence of rocks. (Miller and White 1998). In Panel C, we display results for subsamples with larger or smaller values of these factors. The effect of being in the slave region on nonwhite population density is quite similar across the subsamples. However, we see discrepant results for most of the other outcomes. Nevertheless, these discrepancies do not favor the soil-exhaustion claim; for example, the effect on farm value is greater in places *less* susceptible to erosion. The skeptical reader might now observe that the soil variables are based on 20th-century surveys, and that the susceptibility measure might have been affected by earlier bad farming. But recall from Figure 2 that the free-slave boundary is not a significant predictor of erosion susceptibility.[19]

As the data permit, we can see broadly similar patterns in earlier years. We focus on 1860 because it is the year of greatest data availability before the Civil War. However, all of the earlier censuses had population and a few subcomponents, if the county was organized. The 1850 census also reported farm values. Figure 5 plots the year-specific slave-region coefficients for nonwhite and rural population density 1790-1860 and farm value per farm acre for 1850-60. The coefficients vary by year, especially in the whole sample, which is influenced by the emergent county boundaries in the western part. However, the general finding throughout the antebellum years is similar to what we report above.[20]

VI.C: Spatial Correlation

We now consider alternative strategies for assessing the precision of our estimates above, in light of the spatial correlation in the data. A county should not be considered independent of its immediate neighbors, because so many of their outcomes have determinants that are either common or highly correlated. The strategy above is to use 15 bins of longitude as clusters, which follows on the work of Bester, Conley, and Hansen (2011) as a computationally efficient procedure to account for spatial correlation, at least within the stated groups. The averages across these 15 groups

[19] The boundary is a significant predictor of depth to bedrock, as seen in Figure 2, and the coefficients indicate five to 10cm deeper soil on the free side. For comparison, a typical depth to bedrock in the Old Northwest is greater than the 152cm (60in) measured in the soil surveys. However, our inspection of the detailed raster data on bedrock depth indicate that this is a footprint of the terminal moraine (extent of glaciation) and not of the free-slave boundary.
[20] The patterns, for example, predate the enactment of the 1850 Fugitive Slave Act (passed on September 18). The collection of the 1850 US Census began on June 1, several months earlier. Similar results for population density hold in 1840 and before. For recent studies into the effects of the 1850 Fugitive Slave Act, see Allen (2015) and Lennon (2016). The stability of the gap in the rural population density speaks as well to the potential role of soil erosion. If southern planters were more extensively engaged in soil mining, one would expect relative population density to decline over time. It does not. We thank Edward Glaeser for bringing this observation to our attention.

themselves exhibit low spatial correlation, suggesting that the strategy is adequate to mop up the variation that is correlated across county observations. In Table 4, Panel A, we compare the estimated standard errors for a few clustering strategies. The first row contains the estimated coefficient and the second row contains the baseline standard error. The next row uses instead 10 groups of longitude as clusters, which inflates the standard error to some degree. The following row uses only five groups of longitude, for still larger standard errors. The statistical significance would be judged essentially the same under all three of the strategies, with the exception of farm value per county area, whose coefficient becomes marginally significant when using only five bins of longitude. In the next row we use states as the clustering variable. There is some justification for this inasmuch the policy under analysis (among others) vary at the state level. The strategy yields still larger standard errors, and results for rural population and farm value per county area are rendered marginally significant. For comparison, we also report standard errors under the assumption of independence; these are considerably smaller than those using the large clusters.

We then turn to a parametric approach for dealing with space: the Conley (1999) estimator. This estimator uses a predetermined band of distance around each observation and estimates the correlation within it. The estimator, which is analogous to the Newey-West estimator for time series, uses a kernel that tapers off to zero, linearly with distance, within the band. We show results from the Conley estimator in Table 4, Panel B. The typical distance from the center of a county to that of its neighbor is 5-15 miles, so we start with a 20-mile band. This allows an observation to be correlated with its immediate neighbors which, in turn, can be correlated with their immediate neighbors. As seen in the second row, the estimated standard errors hardly budge, as compared to the plain-vanilla errors estimated in the final row of Panel A. Doubling the band to 40 miles increases the estimated standard error by perhaps 30 percent. We present, in the remainder of the panel, results for bands out to 150 miles.

Kelly (2020) introduces an alternative parametric adjustment for spatial correlation, which we employ here. This method uses for the spatial kernel a flexible function governed by three parameters: the fraction of idiosyncratic noise, the smoothness of the function, and the range of influence. The latter two parameters are difficult to identify separately, so we adopt Kelly's three suggested choices of smoothness (kappa) and then use maximum likelihood to estimate the other two parameters. Results are found in Panel C of Table 4. Kelly-type standard errors are comparable to the baseline estimates and also to Conley-type errors estimates with a 100-mile band. The standard errors are more than double those based on an assumption of independence. This does not change the conventional statistical significance of any of the coefficients. These robustness results offer important reassurance.

VI.D: Falsification Test

Panel D of Table 4 reports results for a falsification test of our border design. It shows the coefficients for the main outcomes for regressions for samples analogous to the border sample but with pseudo-borders that are displaced by 50 miles north or 50 miles south of the actual boundary.[21] The magnitudes of the coefficients, which are strong at the actual boundary, become much smaller at the pseudo-borders. And in almost all cases, they are no longer statistically significantly different from zero.

VI.E: External Validity: Adding Changes-in-Slope terms

The external validity of the findings merits special attention. Above we argue that the northern edge of the slave region is highly suitable to be "free soil." The climate and geology are similar to the southern edge of the free zone, where free labor was thriving. But farther south, the environment might become so unsuitable to free labor that the effects diminish or reverse in sign. In Table 4, we assess this claim in two ways: (i) expanding the buffer around the boundary and (ii) allowing for a 'kink' at the boundary in addition to the 'jump' already used. Ideally, there would be a free-soil zone randomly placed in the Deep South for comparison. But this is not possible. Instead, this analysis uses the spatial trends estimated within each region.[22] For Panels A through D, we use the default specifications, but for buffers of 300, 450, 600, and 900 miles from the boundary. As we zoom out, the effect on nonwhite population is somewhat smaller, but the effects on white population and on rural population double. There emerges a large negative effect of slavery on total farm acreage, and the negative effects on land improved and farm value intensify.

We next test for a kink at the boundary in the effect of slavery. Specifically, while there might be a jump at the boundary, there could also be a change in the slope that attenuates or amplifies the effect as one moves farther south. The remainder of Table 4 reports the results for regressions including an intercept term—slavery legal—and a change-in-slope term—slavery legal*(distance to boundary/100). The specification employed is:

$$(3)\quad Y_i = \beta_1 * \text{Slavery\_Legal}_i + \beta_2 * \text{Slavery\_Legal} * \text{Distance}/100_i + \gamma_1 * \text{Longitude}_i + \gamma_2 * \text{Longitude}_i^2 + \gamma_3 * \text{Longitude}_i^3 + \gamma_4 * \text{Distance}_i + \gamma_5 * \text{Distance}_i^2 + \gamma_6 * \text{Distance}_i^3 + \beta_0 + \varepsilon_i$$

[21] We focus on the border county sample because the 150- and 300-mile samples for proposed pseudo-boundaries would include the actual boundary.

[22] This might be modeled as a set of underlying natural factors that move smoothly over space, and enter into productivity with differing weights by institution (free soil vs. slavery). This would generate a jump and a kink at the boundary in the spatial pattern of land value.

Note the change-in-slope term is in addition to the (smooth) spatial controls included in the baseline specifications. For the most part, the slope effects reinforce rather than counteract the change in the intercept.[23]

Figure 6 illustrates these geographic patterns using farm value per county area. Each dot represents a county in 1860. The marker size is proportional to county area, which is also used as a weight in the estimation of spatial trends. The various lines denote estimated spatial trends (appended in obvious ways to specification 3). The solid line is a quadratic fit, specific to each side of the boundary. The gap between these two curves is approximately 1.75, at the boundary. This is comparable to the estimates in Table 4 that use the widest buffer. The slopes at the boundary are positive for both curves, and their second derivatives imply maxima south of the border. The spatial trend for the slavery region peaks at roughly 125 miles south, which is largely within states that are themselves on the border. In contrast, the estimated quadratic for the free region peaks at around 550 miles south, which reaches into north Florida and east Texas. The dashed lines are extrapolations of said quadratics to the other region. The curve is uniformly higher if estimated with the free region versus with the slave region. The trend in the slave region peaks within the region. In contrast, the trend in the free region indicates higher land productivity as one moves south, with only a minimal indication that this trend is abating. These estimates do not support the view that free-soil institutions would only be a suitable substitute in the more temperate north. One complication is the border's direct effect, which might distort our estimates. To wit, we add dotted lines for extrapolations that only use counties more than 50 miles from the boundary. The patterns at the boundary are similar to those already described, and the extrapolation of the free-soil trend peaks even further south.

Finally, while the extrapolation south becomes more speculative as we move far away from the border, the majority of the activity in the slave region in fact takes place within our default samples. Consider how the median latitude changes if we use different weighting variables: by county area, the median is just south of the confluence of the Arkansas and Mississippi rivers; by farm value, the median lies in the Boot-heel region of Missouri, some 150 miles north. The median distance to the boundary is approximately 180 miles, if we weight by farm value, population, or improved acreage. Even if the weight variable is slave or non-white population, the median distance to the boundary is less than 300 miles. The 300-mile buffer contains approximately 70 percent of the improved acreage and of the farm value in the slave region. If the estimated treatment effects on farm value were to drop to zero (in contradiction to the estimates above) after 300 miles, there would nevertheless be a large, negative effect of the institution. Even if the effect

[23] Note this is compatible with the Upper and Lower South having different land productivity, but this could be due to an underlying spatial trend, not the institutions.

south of this buffer was equal, but of opposite sign, the net effect would remain substantially negative.[24]

VII. Agricultural Activities and Wealth Distributions

VII.A. Farm Output

Delving deeper into the Census of Agriculture allows us to observe crucial differences in farming operations, in crop choices and farm sizes. (We will return to running specifications 1 and 2, without changes-in-slope terms. And to avoid clutter, we drop displaying results for the donut sample.) Figure 7 graphs the point estimates and confidence intervals for key variables related to farm production activities in 1860. We examine the top 20 farm products in the 300-mile band around the border. We will refer to these as crops although four– butter, cheese, wool, and honey— are technically animal products. Note that the slave-free border was sufficiently far north that cotton, rice, and sugar cane are not among the top 20 farm products. The extent of the production activity in each county is normalized by total farm acreage (US Census Office 1864b).

Analysis of the crop data reveal that the small grains --wheat, rye, oats, barley, and buckwheat-- were less common in the slave region. Wheat was grown in both regions, indeed even on slave plantations (see Irwin 1988 and Wright 2006). But it was less common on the slave side. The gaps for rye and buckwheat were small, but that for barley very large. Animal products (and their inputs such as hay and clover seed) were also less common in the slave region. Corn showed no difference at the border and only small differences in the widest band (in line with the standard findings of economic history that southern farms and plantations in the antebellum period were generally self-sufficient in maize.) The crops that were more common in the slave region were tobacco and hemp. Indeed, the differences for tobacco are most apparent. Tobacco had year-round labor requirements with intensive activity levels in close proximity, which facilitated direct surveillance by supervisors (Gray 1933). In general, crops producing more revenue per acre were grown on the slave side (see US Census Office 1854, p. 176).

The patterns of specialization may be compared with the stated intentions of Thomas Jefferson. Jefferson was one of the authors of the Northwest Ordinance and promoted the idea that the country would be better off if it were populated principally by free yeoman farmers. Small-scale operators might be expected to be engaged in producing grain, dairy, and other diversified outputs. The producers on slave side had access to a technology that those on non-slave side did

[24] The plantation regions of the Deep South, the so-called Black Belt, were noted for their slave majority populations. But the density of enslaved people per square mile in the Black Belt counties on Georgia, Alabama, Mississippi, Arkansas, and Louisiana was not higher than in the South-side of Virginia or the Blue Grass region of Kentucky. What differentiated the regions was the lower density of the white population in the Deep South.

not—they could coerce non-family labor to join their work-force and attain a larger scale of operations with greater ease (see Fleisig 1976, Naidu 2020).

The distribution of farm sizes also looks different on the two sides of the border. Figure 8 uses the Census of Agriculture data to provide a contrast of scale of farm operations. Operations of 500-999 acres were significantly (in both statistical and economic terms) more common in the slave region. There is a lower prevalence of farms at the yeoman's scale, in the 50-99 acreage range. The gap is nearly significant at conventional levels at the border but becomes statistically significant at the 95-percent level for the widest band considered, within 300 miles.

VII.B: Household-Level Wealth Distributions

We can extend the analysis of property holding by looking at Census micro data on wealth (Ruggles et al. 2021a). In 1860, the Census asked free people about the value of the real property and personal property that they owned. This is the universe of free people. Personal property in this case includes enslaved African Americans, so there is a mechanical aspect to the change at the border. The panels of Figure 9 graph the probability density functions for wealth (measured on the log scale) in the border area in 1860. The panels do so for real property, personal property, and total property, by household. (Results are similar if we restrict to the rural areas.) Figure 9 reveals extra mass at the high levels of wealth on the slave side, both in personal property and in real property. The Figure also reveals missing mass starting around $2,000, which seems to be shifted out to above $10,000. Again, the small-scale property holders appear less prevalent in the slave region.

There is a large historical literature on the place of "Plain Folk" in the American South (Owsley 1949, Linden 1946, Wright 1970). They are the class of white property holders working their own land with family labor (and perhaps a small number of enslaved African-Americans). "Plain Folk" are a "middle class" element in a social structure made up of plantation owners, slaves, and poor landless whites. The existence of "Plain Folk" or yeoman farmers in the South is no longer under contest. The above findings indicate that such people made up a smaller fraction of free households in the Border South than in the Border North.

VIII: Measurement and Interpretation of County-Level Wage Rates

VIII.A: Wage Gaps at the Free-Slave Border

Slavery effects also appear in the returns to labor and the differences are striking. The 1860 Census of Social Statistics collected county-level data on wage rates for various occupations (Lebergott 1964, Margo 2000).[25] In addition to using the (relatively noisy) individual series, we

[25] The manuscript records include monthly wages of farm hands, daily wages of day laborers and carpenters, weekly wages of female domestics, and the weekly price of board for laboring men. Unfortunately, the schedules for Ohio,

estimate the principal component of the natural logs of the five series to create a single, convex measure.[26] See Appendix G for details.

Figure 10 presents results for the effect of slavery on returns to labor. The wage gaps revealing higher returns on the slave side. A key initial observation is that regional differences in board are not the driver. The point estimates and confidence intervals for the county-level data on weekly board reveal the differences are not statistically significant. Turning to the specific wage series, we see the point estimates for female domestics were generally higher in the slave region; the confidence intervals, though wide, often lead to rejection of the hypothesis of no difference. Carpenter's wages were higher by statistically and economically significant magnitudes in the slave region. The results for day laborers show higher point estimates in the slave region. The confidence interval strays over and back across null hypothesis line. But we never see daily wages that were lower by statistically significant magnitudes in the slave region. The results for weekly farm wages show a gap that is positive and significant. The results without and with the Ohio supplementary data are not fundamentally different. Finally, we turn to the results for the estimated first principal component. Again, labor returns were higher by statistically and economically significant magnitudes in the slave region.[27]

The overall findings are striking: wages were about 10 percent higher on the slave side. Coercion might extract work from slaves at lower cost, but labor returns for workers on the slave side of the border were higher.

VIII.B: Interpreting the Results within the Rosen/Roback model.

There is a puzzle. A yeoman farmer from the East or from Europe coming down the Ohio River could unload on the left or the right bank. The land is essentially the same on either side. But on the southern bank, the land is cheaper and wages higher. What does this tell us about the preferences of the settlers?

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apart from one county, are lost. We supplement the sample with 1857 Ohio data for daily labor and farm hands (Ohio Board of Agriculture 1857, Ohio Commissioner of Statistics 1858). We convert the wages into daily equivalents by assuming a six-day week.

[26] To facilitate interpretation, we renormalize the principal component to be a convex combination. By convention, variable weights for principal components are vectors of unit length, meaning that their *squared* elements sum to one. This fails to produce a convex combination of what are, in this case, essentially similar objects: log wages. It instead implies a function that is homogeneous of some degree greater than one in the level of wages, analogous to a Cobb-Douglas with increasing returns to scale. To address these issues, we renormalize the variable weights to sum to one. We also wish all of the variables to have positive weights, so as to form a convex combination. This happens to be the case with these data, so there is no need to constrain the estimate further. As this weighting vector therefore points in the same direction as the conventional one for a first principal component, it yields the geometric mean of wages that best summarizes the variance in log wages.

[27] We examined whether the gaps were due to differences in human capital. For free workers identified as common laborers, farm laborers, carpenters, and domestic servants in the 1860 population micro-sample, literacy rates were lower on the slave side of the border. Accounting for human capital widened the gaps, rather than narrow them.

We can interpret the results using the Rosen/Roback spatial equilibrium model (Roback 1982). Firms and (free) households pick their preferred locations. In the most general version of the model, both firms and households use land.[28] In the variant that best fits our case, only firms (here farms) use land and households do not (as the land component of housing costs was negligible in rural areas). A free household's utility is affected by wages (positively) and amenities (positively). Farms' land rents (and land values) are determined by productivity (positively) and wages (negatively). The rents adjust to generate zero profits. The summary interpretation is that the observed combination of lower land values and higher wages is consistent with a strong household-side disamenity that free people associated with living and working in the slave region.[29]

The vast literature on "Free Labor" offers numerous reasons for such a disamenity (see, Ruffner 1847, Helper 1857, Foner 1970). One thing we know about slave societies is that the institution of slavery permeated all aspects of the society. Things were structured to accommodate, support, and perpetuate slavery and the interests of slaveowners. Those external effects can distort many other choices. A landless white might have to serve in the militia, or just worry about slave rebellions. Free workers might not want to work alongside slaves or just be in a place where the slavery existed. It is hard to distinguish between the different motives, but narrative evidence suggests that many yeoman farmers felt that the slave system did not work for them (Merritt 2017). Under slavery, governments emphasized enforcing order rather than providing services such as public education.[30]

There were strong flows of free heads of household born in Border South to free states (see Appendix I for details.) The early movement of Virginians to Ohio, Indiana, and Illinois is a common theme of the literature on the settlement of the Midwest. But channels persisted beyond the first decades of the nineteenth century. In 1850, when the federal census first reports data by place of birth, 29 percent of free heads of household born in Border South resided in free states; less

[28] See Appendix H for details. In more common variant of the Rosen-Roback model, only households use land. A firm's profits are determined by productivity (positively) and wages (negatively). Firms enter until a zero-profit condition holds. A household's utility is affected by amenities (positively), wages (positively), land values (negatively) through the effect on housing costs which depend on density (positively). Households pick their highest utility location, driving land values to equalized utilities. Land values do not directly enter in the firm's profits, only in the household's utility through the density-dependent cost-of-housing effect. The predictions of the standard model are simple and intuitive: (1) the combination of higher land value and higher wages is associated with the higher productivity of local firms; whereas (2) the combination of higher land value and lower wages is associated with higher amenity values for local households.

[29] The puzzle identified here is obviously related to the "Easterlin paradox" regarding robust westward movement into the North Central region where income per capita was apparently below than the national average during the late antebellum period. See Easterlin (1960, 1961) and Margo (1999).

[30] Go and Lindert (2010) and Bleakley and Hong (2021) document markedly lower rates of antebellum school enrollment and attendance, respectively, by whites in the South than in the North. Bleakley and Hong report that the fraction of white children in 1860 attending school in the south was approximately 40 percent, which compares to more than 60 percent in the north, and there was little overlap in the distribution of state averages. Go and Lindert further report a relationship between voting rates and school enrollment in the North, but not in the South.

than 5 percent resided in the Deep South. By way of contrast, heads of households born in the Yankee areas of the North (New England and New York) were very unlikely to move to the Border South. They show even greater aversion to locate in slave areas than foreign immigrants do. As George Tucker (1843, p. 116) put it, "The swarms from the New England hive prefer, at present, migrating to States where there are no slaves."[31] Moves often occurred along an east-west axis. But among those who changed longitude significantly to move to the counties in the border sample, the northern side was favored. And this pattern of revealed preferences is displayed even by whites born in the Deep South.

IX: Accounting for Slavery

The dominance of disamenity effects do not rule out negative effects of slavery on productivity as well. We examine here the role of several proximate determinants for farm values and then compare the magnitudes of slave wealth and of the gap in farm values. We find that farm improvements and higher wages explain much of the effect on farm values at the free-slave border. Differences in measured Total Factor Productivity (TFP) do not appear to explain much of the gap. Nor do differences in pecuniary taxation. We then argue that, in the borderlands, the reduction of land value was of the same magnitude as the region's slave wealth. Looking at the border example brings the economic costs of the slave system into sharper light.

IX.A: Investments in Improvements

A sizeable proportion of the difference in farm values stems from more investment in land on the free side. We quantify two channels here. First, the higher rural population on the free side (about 50 percent more) would have required more housing. And there were likely more barns and other structures. The 1860 Census of Agriculture lumped land and buildings together in its farm value measure. Authorities report structures as being almost one-fifth of farm value. Subtracting the estimated value of buildings from the farm values yields an estimate of the value of "land alone" (see Gallman 1972, Primack 1975; Lindert 1989a, 1989b). Second, we observe the free side had substantially more improved acres per total farm acre. The literature offers various ways to adjust for this difference. We report two methods, based on the ratio and subtraction approaches (see Appendix J for details).

Table 6 reports estimates of the effects of slavery on land values after attempting to adjust for differences in buildings and land clearing. The estimated effects are everywhere negative and typically statistically significant. Taking the 300-mile buffer as example, the results of farm land

[31] George Tucker 1843, *Progress of the United States in Population and Wealth in Fifty Years*, p. 116

(excluding building) indicate a 46 percent reduction, or $7.74 per acre, on the slave side. The results for farm land adjusting for improvements (in the first method), show a 36 percent reduction, or $4.20 decline per acre. The effects are larger in magnitude for the second method, but the estimation is less precise.[32] Thus, a sizeable fraction of the difference in farm values per acre is explained by differences in building values and land clearing, but a large fraction remains. Note differences in building and improvements were, in large part, outcomes of the institution of slavery.

IX.B: Total Factor Productivity in Agriculture

There is a vast literature on how the labor of coerced workers will be grudgingly given and how the ideas that generate long-run economic growth do not flow so readily in a slave economy.[33] But measured differences in agricultural TFP appear to explain only a small fraction of the differences in land values at the border. We can estimate TFP in 1859-60 agriculture at the county level using the approach developed by Fogel and Engerman (1971, 1974). See Appendix J for details. The county-level estimates do largely replicate their North-South comparisons. Many of the critiques directed against their regional analysis are less relevant for comparisons at the border. Absent here are the large differences in latitude, affecting the length of the growing season, types of crops grown, or hours of labor worked per year. Nor are there large differences in soil quality. The Border South did not grow the plantation crops, such as sugar, rice, and cotton, thought to be characterized by substantial economies of scale. Special conditions in the cotton sector during the 1859 crop year—the coincidence of high demand with abnormally high yields per acre—do not cloud the border comparison (see Fogel and Engerman 1977, 1980; David and Temin, 1979; Fogel 1989; Wright 1978, 2006).

To calculate TFP, we use county-level agricultural labor force estimates developed by Thomas Weiss, working with Lee Craig (Craig and Weiss 1998). We report estimates based on Weiss's numbers directly as well as a variant created to reflect the higher agricultural labor force participation rates assumed by Stanley Lebergott (1966). We also derive results where the contribution of improved land is up-weighted in line with the considerations raised above.

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[32] The land value estimates utilize state-level parameters which make comparisons in the border sample problematic. The changes may be artificially sharp at the points where the parameters shift as in the border counties. Comparisons in the 150-mile sample and 300-sample are not so greatly affected.
The gaps in raw land values do have an east-west gradient. The slavery-related differential in higher in the settled east than in the frontier west. This is to be expected as the federal government sold the public domain in the west for the same price-- $1.25 per acre in cash—in both the free and slave regions.

[33] Slave labor, wage labor, and family labor (yeomanry) systems all had aspects that enhanced or impeded labor productivity: slavery was backed by coercion, although agency problems were commonplace; wage labor was plagued by agency problems as well, along with uncertain recruitment and retention; yeomanry solved an agency problem, but under capital constraints or with a limited span of control.

Table 6 reports the effects of slavery of estimated TFP in the border sample. (National TFP is centered around unity.) In general, the slavery effect is negative, but small. In the 150-mile buffer sample, the measured effects are on the order of -2 to -5 percent, and not statistically significantly different from zero. In the 300-mile buffer, the effects are larger in magnitude, around -10 percent. As might be expected, the numbers calculated using the Lebergott method are less favorable to the slave side than those using Weiss's method for labor or using higher weights for improved land.[34] But the overall take-away message is the productivity gap at the border was small and can account for only a lessor fraction of land value gap.

IX.C: The Price of Free Labor

Free labor's preference for free soil explains a substantial part of the differences in farm values. Recall that, on the slave side, farm values per acre were roughly 55 percent lower and wage rates about 9-10 percent higher. The higher wage rates would, other things being equal, result in lower land rents and land values. To a first approximation, the elasticity of one factor to the other would be the ratio of the labor share to the land share in net output. A given percentage increase in the price of a mobile factor affects total cost in proportion to its cost share; the increase in total cost is incident on land (the immobile factor) in inverse proportion to its own cost share.[35]

For the purposes of this analysis, we can focus on the free side of the border and ask what land rents/values would be if wages were at the levels prevailing on the slave side. Estimates of the ratio of the labor share to the land share in nineteenth-century US agriculture vary greatly—from 1.5 to 3.2.[36] Our read of the evidence suggests a preferred ratio of 2. Using this number, the higher wages would reduce land rents by 18-20 percent. If the ratio was 3, the reduction would be 27-30 percent, by the same reasoning. Given the similarities in regional interest rates, the effects on land values should be proportionate to the effects on rents.[37] The wage differences, then, explain virtually all of the land value gap remaining after our previous adjustments (see Table 6).

IX.D: Taxes

It does not appear the land values and wages can be easily explained by higher overall rates of taxation in the slave areas. One can compare tax revenues collected relative to wealth reported by

[34] A major effect of coercion was to increase labor force participation, especially of prime-age women, in market production. This represents an increase in inputs per capita and will not be reflected directly in TFP.
[35] See Appendix A for a formal derivation. There we show that, at an interior solution, the second-order effect amplifies the impact on the land price. Therefore, this calculation is likely a lower bound.
[36] US Treasury (1871) land rental data yield a ratio of 1.5 (=0.5/0.33). Fogel and Engerman (1974, vol. 2, p. 132) used a ratio of 2.32 (=0.58/0.25); this revised their earlier (1971, p. 358) ratio of 3 (=0.6/0.2). Gallman (1972, p. 205) put the ratio of labor to farm real estate at 3.13 (=0.704/0.225) and the ratio of labor to land excluding buildings at 4.17 (=0.704/0.169). Atack and Bateman (1987, p. 193) offer a ratio of 2 (=0.6/0.3) as a plausible conjecture.
[37] Bodenhorn (2000, ch. 4) shows antebellum regional capital markets were well integrated, with roughly equalized interest rates.

state in the 1860 federal census (US Census Office 1866, pp. 511-12). The revenue numbers include the taxes levied by different levels of state and local governments within each state.

We compare tax collections to reported real estate wealth or all reported wealth, which includes the value of slaves. For both measures, the ratio was lower in the states of the Border South (DE, DC, VA, KY, MO) than those in the Border North (PA, OH, IN, IL, IA). The ratio of taxes collected to all wealth was 0.0040 in the Border South and 0.0065 in the Border North, substantially lower in the slave areas. The ratio of taxes collected to real estate wealth was 0.0077 in the Border South and 0.0089 in the Border North, lower in the slave areas. Both the relative and absolute magnitudes of these numbers are inconsistent with a story that higher state and local tax rates in the South created the land value differences. Non-pecuniary taxes, such as militia service, remain possible explanations (and are captured, in part, in the household disamenity story). Spending on internal improvements, however, are an unlikely part of the story, because border counties, especially those on rivers, would have similar transport access.

The 1860 state-level census data also reveal educational resources (spending and teachers) per pupil tend to be higher south of the border than north of it. This is in the case both in public schools and private academies. What distinguished the slavery region is lower enrollment in public schools (by whites). If a yeoman family was heading down the Ohio River and compared the left and right banks, they would note that the resources per pupil at the public schools are similar on either side. This is the correct comparison if they were the parents on the margin, and therefore there should not be a difference in wages to compensate for less-well-funded schools. The main exception is that the kids might have to walk farther if the family chose the south side. That said, there would still be 2.5-4.5 public schools per 36 square miles (the area of a standard township in the PLSS) south of the border.

IX.E: Cassius Clay's Calculation

With any welfare-enhancing reform, there are usually incumbent interests that stand to lose. Our estimates above suggest that land on the slave side of the free-slave boundary would have been more valuable as free soil. But would this gain from switching have been enough to compensate the slaveowners? Cassius Clay, the noted Kentucky abolitionist and sometime slaveowner himself, believed that land values would rise more than the loss in wealth if the enslaved were liberated. In 1834, Clay opined that, for the emancipation of his slaves: "I shall ask nothing in return but the enhanced value of my land which must ensure gradually from the day that we become indeed a free and independent state (quoted in Martin 1918, p. 112)." In 1845, Clay added: "Kentuckians will be

richer in dollars and cents by emancipation, and slaveholders will be wealthier by the change (Martin 1918, p 114)."[38]

Does this claim hold up to further inspection? As a simple first exercise, we note that in 1860 farm values were lower on the slave side by around $7.99 (se=2.79) per county acre while there were 5.5 more slaves per thousand acres.[39] The reduction in farm wealth was the equivalent of about $1450 per slave, which was almost double the typical price of a slave in the region. This suggests that, even before considering the value of freedom to the enslaved, there was enough economic surplus from abolishing slavery in the borderland to compensate the losers from such a policy.[40] But a part of the higher farm values in the North was due to costly improvements and buildings; how to treat their value and potential appreciation are open questions. If the differences in raw land values capture all of the potential appreciation effects, based on the estimates above, the surplus would not be sufficient. Other forms of real property must also rise in value, as they likely would, for Clay's proposal to work.

In Clay's view, there would be no need to compensate slaveowners directly, because they were also landowners. This second claim is stronger. To explore this claim, we inspect the IPUMS 1850 linked sample of slaves and slave-holdings which can be linked to the 1-Percent Population sample (Menard et al. 2004, Ruggles et al. 2021b). For free households, the Census recorded real estate wealth and slave-holdings by the enslaved person's age and gender. Using the 1850 prices for the Old South by demographic characteristics reported in Historical Statistics (Carter et al. 2006, Series Bb215-216), we can construct household slave wealth. We can then compare the distribution of real estate wealth and slave wealth to gauge the potential winners and losers from Clay's emancipation proposal. In the 1850 linked sample, total real estate wealth was 1.9 times slave wealth. A real estate appreciation rate above 53 percent would produce real estate gains covering slave wealth loses. Table 7 reports the distribution of the population, in all households and slaveholding households, in the 300-mile buffer region. Enslaved African-Americans, who bore the brunt of the system's oppression, would clearly benefit from its end. A substantial fraction of free southerners lived in households reporting neither slave wealth nor real estate wealth. The policy change would not affect their wealth status directly. Another large fraction lived in households reporting real estate wealth but no slave wealth. They would gain from real estate appreciation and lose nothing from emancipation. The tradeoff that Clay highlighted affected those living in

[38] Tallant (2003, pp. 100-101) notes such claims were common in antebellum Kentucky. Chase and Sanborn (1856, pp. 42-45) advance a similar argument for the entire border region.
[39] Clay had his own estimate: "I assert from my own knowledge, that lands of the same quality in the free, are from one hundred to one hundred and fifty per cent higher in value than in the slave states" (quoted in Martin, 1918, p. 114).
[40] Ransom and Sutch (1988) estimate the average price of a slave nationally in 1860 to around $800, a high value following two decades of appreciation. The 1860 value of the typical enslaved person in the border region was $685, using their Old South valuations. Clay's math would have been even more favorable when he made this claim.

households reporting both slaves and real estate. The figures in Table 7 indicate some would gain—with the fraction depending on the assumed percentage real estate appreciation. But given the distribution of real estate and slave holdings and the range of plausible appreciation rates, most slave holders would lose.

How would the timing of possible institutional change affect these calculations? As Cassius Clay assumed, the rise in farm value would be gradual, which would reduce the present value of the appreciation. But emancipation proposals floating around Upper South at the time would also have been gradual and reduced the cost to slaveowners. Thomas Jefferson Randolph (namesake of his famous grandfather) proposed in 1832 a gradual emancipation in which those born after 1840 would receive freedom as an adult (Freehling 1967). Henry Clay (distant cousin of Cassius) proposed a similar scheme in Kentucky in 1849 (Martin 1918).[41] Slaveowners would have ample opportunity to sell their slaves out of state before then, so gradualism would also limit the economic loss to slaveowners (and the restoration to the enslaved of what both Randolph and Clay acknowledged was a natural right to freedom).

X. Conclusion

In the mid-twentieth century, economists dropped into the historical debates about antebellum US slavery with systematic analyses of its profitability and productivity (Conrad and Meyer 1958; Fogel and Engerman 1971, *inter alia*). Earlier historians had argued that slavery was unprofitable and therefore moribund as a mode of production. In that sense, it bore more resemblance to feudalism, with its attention to rigid social hierarchies, than to the capitalism emergent elsewhere in the world. Economists reported a variety of evidence to the contrary: slave owners actively sought and achieved economic gains, agricultural operations using slave labor were competitive, and slave prices reflected underlying considerations of revenue and cost. Therefore, while slavery was, as Jefferson's first draft of the Declaration of Independence stated, an 'execrable commerce', it was not associated with unproductive misallocation of resources (so went their argument).

Later, North (1981) brought to the fore the idea that 'institutions' are fundamental determinants of economic performance. This idea has proved useful in understanding the large disparity of incomes per capita across countries, for example. In this framework, there could be disparities across countries or regions even if locally markets and firms are behaving as in the textbook model of competition, maximization, etc. Instead, a place with weaker institutions suffers from a systemic reduction in productivity.

[41] Clay's proposal was not adopted by the Kentucky Constitution Convention, but delegates voted nearly unanimously to affirm a statement that "slavery as it exists by law in this state is injurious to the prosperity of the Commonwealth" along with moral objections familiar to the modern reader (Martin 1918, p. 126).

These two strands came together in the work of Engerman and Sokoloff (2011), who argued that historical labor coercion constrained institutional development, even after slavery ended. They argue that the slave societies of the Americas were indeed quite productive early on, but that they grew more slowly than free-soil societies in the past century and a half. Societies with labor coercion (slavery, serfdom etc.) are often the last to acquire the modern institutions–depersonalized rule of law, competitive markets, universal suffrage, mass public education, public health and sanitation, etc.–associated with economic growth, enlightenment, and human flourishing. The story is one of path dependence. Engerman and Sokoloff argue that labor coercion might have been the highest productivity mode in colonial times, but it left behind institutions unable to adapt to modern economic growth.

Our results indicate instead that the path dependence started before slavery ended, at least in the US free-slave borderlands. Slavery endured not just by the coercion of the slaveowner, but by the force of the state, which had to become quite intrusive. Ira Berlin (1998, pp. 8-11) wrote that 'slave societies' were not just 'societies with slaves,' but rather societies in which every aspect was affected by protecting slaveholder's interests. Or as Frank Tannenbaum (1946, pp. 117-18), put it: "nothing escaped, nothing, and no one." The stark differences at the border highlight that the slave system depressed land productivity and repulsed potential settlers and migrants. Free labor demanded a wage premium to be on the slave side and those free-to-choose preferred (and improved) otherwise-comparable land on the free side. Amazingly, in the area of this study, the reduction in land value associated with slavery was of a similar magnitude as the value of slave wealth itself.

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