Coerced Labor, Insurrection and the Economic Costs: Theory and Evidence From the Antebellum United States

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Abstract

This paper investigates the causal factors which increased the incidence of slave insurrections and conspiracies in the antebellum Southern United States. The analysis relies on a novel dataset, which is an amalgam of plausibly exogenous geographic data, occupational data from the Integrated Public Use Microdata Series (IPUMS), county-level census data and a compilation of incidents of slave unrest as recorded by Aptheker (1993). Instrumental variables and a bias-corrected matching estimator proposed by Abadie et al. (2004) are used to analyze the causal effect of urbanization on the incidence of insurrection. The role of geographic factors is also evaluated, and I find that slave insurrections and conspiracies were more likely in areas which enjoyed a greater degree of productivity in cotton production. To interpret these results, I develop a game-theoretic of slave insurrection which incorporates slaves' incentives to rebel, as well as slaveowners' incentives to surveil.

JEL codes: C72, D02, I10, J47, N31, N51, P14

Keywords: Coercion, slavery, labor productivity, insurrection.

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1 Introduction

A review of recorded human history illustrates that wage labor is a modern phenomenon. Traditionally an absence of clearly defined, enforceable property rights allowed labor market transactions across the globe to exhibit coercion, forceful appropriation or the threat thereof as a means to secure labor from slaves, serfs, and bonded laborers.[1] Even today coerced labor persists as a thriving institution, particularly in the developing world, as the United Nations' International Labor Organization (UNILO) estimates that there are currently 21 million forced laborers worldwide.[2] While a growing body of literature attempts to elucidate the historical and present-day prevalence of coerced labor,[3] relatively little scholarship has been devoted to explaining instances of organized, violent resistance to its imposition. This represents an important lacuna, as violent outbreaks often plague societies which choose to employ coercive institutions as a means to secure their labor.[4] Such violence often entails tremendous opportunity costs in terms of foregone income.[5] Moreover, these conflicts contribute to salient costs associated with maintaining institutions which provide the basis for coercive labor relations.[6]

The antebellum southern United States provides a unique opportunity to ameliorate this deficiency, and explain instances of violent conflict within the context of coerced labor. First of all, slave insurrections, uncovered conspiracies, and panics were a part of daily life in the American plantation, despite the fact that those detailed below rarely achieved their stated aims. As John Hope Franklin (2002, p. 70-71) states, "The slave

[1]Skaperdas (1992) provides a theoretical underpinning for the historical use of coercion. Patterson (1982) argues that slavery and forced labor were common practice in labor markets in most ancient civilizations including Egypt, Greece, Rome and Japan. In the feudal era, restrictions on labor mobility and the various customary labor services serfs were obliged to provide landlords were a defining feature of the "ties of dependence" described by Bloch (1964). Slavery was an integral component of plantation economies formed in the Caribbean, parts of Brazil and Colombia, while coercion was an important factor in the organization of labor in mining operations, encomiendas, as well as the later hacienda system that persisted throughout much into the post-colonial era. See Lockhart and Schwartz (1983) and Curtin (1990).

[2]UNILO (2012). The UNILO also estimates that there are currently 175 million migrant laborers across the globe, and it is well documented that these transients often toil under dubious conditions. See Taylor (1977).

[3]Early contributions include Domar (1970), Fogel and Engerman (1974), Ransom and Sutch (2001, reprint) and Aston and Philpin (1985). See Steinfeld (2001), Genicot (2002), Conning (2004), Acemoglu and Wolitzky (2011) and Naidu and Yuchtman (2013) for more recent discussions.

[4]*cf.* Moore (1966), Wolff (1968), Huizer (1972), Migdal (1974), Scott (1976), Skocpol (1979), Christodoulou (1990) Goldstone (1991). More recently, Murshed and Gates (2005) describe the Kamaiya system of bonded labor as a key motivation behind the Maoist insurgency in Nepal which claimed as many as 15,000 lives from 1996-2006.

[5]Oxfam (2007) estimates that armed conflicts across the African continent, for example, cost roughly $18 billion.

[6]See Wade (1964), Henry (1968), Hadden (2001) and Goldin (1976) for instances of these costs and their defrayal. See Acemoglu and Robinson (2000, 2001) for the role of conflict, or threat of conflict, in erroding coercive institutions.

was never so completely subjugated as to allay all fears that he would make desperate, bloody attempt to destroy the institution which bound him. Slaveholders could never be quite certain that they had established unquestioned control; fear and apprehension were always present."[7] Wade (1964) argues that fears of unrest in the wake of discovered conspiracies were so trenchant among urban slaveholders that slaves, particularly young males, were sold in large numbers to the countryside to reduce the probability of insurrection.[8] Second, Aptheker (1993), utilizing court minutes, probate records, plantation records (i.e., journal entries, correspondence, etc.), government archives and newspaper articles, provides a detailed account of these violent outbreaks. Lastly, due to the motivating effect of overlapping economic and ethnic cleavages on armed conflict today, the antebellum South is a natural parallel for investigation.[9]

Yet despite the importance of this form of organized resistance, and the available historical record, a rigorous empirical analysis of the causal factors influencing slave unrest in the antebellum Southern United States has yet to be undertaken. Several scholars have offered theories regarding the various precipitates of rebellion, ranging from the density of slave populations,[10] access to transportation via navigable waterways,[11] and the relative size of the free African American population.[12] Although each of these seem plausible *prima facie*, their marginal effect on the probability of a slave outburst remains to be empirically verified.

This paper theoretically and empirically investigates various channels which explain the incidence of slave insurrections and discovered conspiracies in the antebellum

[7]Even insurrections and conspiracies which ended in resounding failure often had long-standing politico-economic ramifications. Hadden (2001) argues that slave patrols, often created in the wake of insurrections, were the antecedent to modern police forces in the South. In the wake of the failed plot surmised by Denmark Vesey, in which rebels were to lay siege to Charleston, S.C. in 1822, the mobility of urban slaves was severely restricted, and regulations which forbade African Americans, free or slave, from entering certain public spaces were instituted. Wade (1964) and Radford (1976, p. 346) assert that these and other legal restrictions passed in response to outbursts of slave violence were a precursor to the legalized segregation exhibited throughout much of the South in the postbellum era. Sheldon (1970, p. 33) notes the legal reaction in Richmond Virginia to the discovery of the Gabriel Prosser conspiracy in 1800, and the resultant tightening of laws regulating manumission.

[8]"Rumors of plots and imminent uprising marked the ordinary routine of every city. If whites learned to live with this anxiety, they could not long forget it. Just as the patrols, whipping posts, and auction blockes reminded Negroes of their servitude, so these symbols made the townspeople aware of their own insecurity." (*Ibid.*, p. 242). Goldin (1976, p. 2) argues this reaction was accelerated by the availability of cheap immigrant labor, as well as the fact that the financial burdens of policing and restricting slave autonomy were increasingly shifted to slaveowners through taxes and permits. Sheldon (1979, p. 36) makes a similar point when describing the reaction of Richmond, VA citizens to a discovered conspiracy during the War of 1812.

[9]See Collier and Hoeffler (2004), Murshed and Gates (2005), Gates (2002) and Esteban and Ray (2008) for a discussion of ethnicity and its role in incentivizing armed conflict.

[10]Genovese (1979), Aptheker (1993), Wade (1964).

[11]Morgan and Terry (1982).

[12]Radford (1976), Sheldon (1970).

United States. First, the impact of geographic "first-nature"[13] variables, such as those describing geoclimatic productivity and the surrounding terrain, on the incidence of slave unrest is critically evaluated.[14] Next, the relationship between "second-nature" variables, such as distance to the nearest city and the degree of urbanization within a given geographic unit, and the probability of violent outbreak is determined. As such, my analysis also investigates an influential strand within the economic history literature, first put forth by Cairnes (1862) and Wesley (1927), and later reinvigorated by Wade (1964), which attributes the backwardness of Southern industry on the eve of the Civil War to an inherent incompatibility between slavery and urbanization.[15] As a definitive explanation for the reticence of the antebellum South to industrialize remains elusive, I view this as an instructive result.

In this paper I construct a novel dataset, and my empirical analysis implies that slave insurrections and conspiracies were both more likely in areas which, due to natural geographic factors, enjoyed a greater degree of productivity in cotton production, while areas naturally endowed with a greater degree of productivity in tobacco were less likely to experience discovered slave conspiracies. I show that in the period 1800-1860 insurrections and discovered conspiracies both become significantly more likely as the distance from the nearest river increases, and as the distance to the nearest Southern city decreases. Nevertheless, in the period 1840-1860 there is no statistically significant relationship between the degree of urbanization in a given county and the incidence of slave unrest, and I explain this absence by illustrating the increased police presence in Southern cities *vis-a-vis* their northern counterparts.

In order to rigorously interpret these results, I develop a simple model of insurrection, the overarching goal of which is to highlight the incentives and risks faced by slaves in deciding whether or not to rebel, and those faced by slaveowners in determining the degree to which their slaves are monitored. The theory suggests that the relatively more arduous work regime associated with cotton incentivized insurrection on the part of slaves, and as a result greater supervision by cotton planters. The theory also suggests that the distance variables referred to above influence the costs borne by slaves in the event of a successful insurrection. Efforts to control and apprehend runaway slaves, whether through slave patrols, inspection points or deployment of slave catchers, were

[13]See Krugman (1993) and William Cronon (1992).

[14]In this vein, this paper contributes paper adds to a sizable literature which attempts to explain the incidence of violent conflict within the context of varying resource endowments. See Acemoglu et al. (2011), Mehlum et al. (2006), Robinson et al. (2006), Van der Ploeg (2011), among many others. Koubi et al. (2013) provides a useful summary of the various complications that arise in ascertaining causal relationships between resource endowments and the prevalence of conflict. It should be noted, however, that the plausible exogeneity of the productivity measures in my analysis, as well as the focus on intra-state conflict, are a significant advantage over many of these studies. See Aslasken (2010), Torvik (2009), Buhaug and Gates (2002) and Van der Ploeg and Poelhekke (2010) for a discussion.

[15]See, for example, Bateman and Weiss (1981), Cobb (1984), Genovese (1965) and Wright (1986).

particularly effective along water routes, but were conversely especially ineffective in an urban environment. My model predicts that these factors influenced both the calculus of slaves weighing the costs and benefits of an insurrection, as well as the surveillance effort put forth by slaveowners, thus leading to disparate empirical results.

The organization of the paper is as follows: Section 2 formalizes my theoretical model and its predictions, Section 3 describes the novel data brought to bear, Section 4 illustrates the empirical analysis used to test my theoretical predictions and Section 5 closes with a brief conclusion.

2 Model

2.1 Primitives and Assumptions

The model is positive in nature, and parsimoniously depicts an archetypal slave-slaveowner relationship as a sequential game.[16] The set of players is discrete, and consists simply of a slave and slaveowner, both of whom are assumed to be risk neutral. The strategy set of the slave is discrete, and consists of the decision whether or not to revolt: $\{Revolt,\ No\ Revolt\}$. If the slave chooses *Revolt*, they put forth some positive, finite effort $\alpha > 0$ toward planning and executing the rebellion. The strategy set of the slaveowner is also discrete, and includes the decision of whether or not to employ some additional means of slave surveillance in order to monitor the slave: $\{Monitor,\ No\ Monitoring\}$. If the slaveowner chooses $Monitor$, they put forth some positive, finite effort $m > 0$ toward discovering and preventing a potential rebellion.

As such, the decision to $Monitor$ may be interpreted as the employment of additional overseers, managers, and even spies among the slave community, each of whom aided in the constant supervision of slaves and therefore the uncovering of slaves' plots for rebellion. Gray (1958, p. 545), for example, argues that the employment of overseers and managers specifically for surveillance purposes was common practice.[17] In fact, the presence of such auxiliary supervision over and above that provided by slave patrols and police forces was often mandated by law.[18] An example of the purely supervisory

[16] Utilizing the terminology of Fudenberg and Tirole (1991), it is assumed that players are endowed with perfect recall and common knowledge of the game. That is, each player knows the strategic form of the game, knows that their opponent knows it, and knows that their opponents know that they know, and so on. This also ensures that players may costlessly observe the history of play in choosing their strategy.

[17] "On a large plantation the numerous details of oversight required the assistance of an additional manager, without whose aid the owner would have been compelled to remain every day upon his plantation." Hadden (2001) affirms this point.

[18] According to Williams (1972, p. 400), the Louisiana state legislature passed a statute in 1815 mandating that "one white man of accountable age per thirty slaves had to be provided on each farm or plantation owning or employing blacks. Failure to comply with the statute carried a monetary fine

roles played by overseers can be found in the instructions to overseers issued by one of the largest planters of Louisiana:

> "It is strictly required of the manager, that he rise at the dawn of the day every morning; that he ring a bell for the assembling of the hands; require all hands to repair to a certain and fixed place, in twenty minutes after the ringing of the bell, and there himself see that all are present, or notice absentees; after which the hands will receive their orders, and be started to their work under charge of their foreman....The manager will, every Sunday morning after breakfast, visit and inspect every quarter.."[19]

In addition, it was not uncommon for planters to employ spies among their slave populations in order to uncover plots of rebellion, and evidence of this practice can be found in the testimonials of former slaves.[20]

Such efforts at subverting potential revolts appear to have been successful, as countless instances in Aptheker (1993) refer to the uncovering of plots through these means. In particular, spies were instrumental in uncovering one of the most infamous slave conspiracies in the antebellum era, that of Denmark Vesey, who planned to set fire to the city of Charleston, South Carolina, slay the cities' white residents, and sail to the black republic of Haiti in 1822.[21] Though rumors of an insurrection in the planning abounded in the months before the failed uprising, the commission of two slaves in particular was critical to ultimately suppressing the uprising.[22] Informants also subverted the planned uprising of Gabriel Prosser in Richmond, Virginia in the summer of 1800.[23] Such practices were likely incentivized by the fact that, in many areas, slaveowners had

for offenders."

[19]Gray (1958, p. 547). Further evidence for the important surveillance role played by overseers can be found in Davis (1939, p. 47). The author notes that in a contract between Alabama planter William Gould and his overseer, Ludwig Henderson, the latter agreed to "inspect the cabins at different hours of the night as often as once a week" in order to detect subversive activities. Moreover, Henry (1968, p. 18) states "An overseer was necessary for the proper control and management of the negroes on a plantation. He was not only an economic necessity to the plantation, but he acquired the character of a plantation quasi-police officer by virtue of the legal provision that all slaveowners were required to have white men on the plantations, in cases where the owners were not resident throughout the year."

[20]According to Steward (1857, p. 32), "A domestic slave will for the sake of his master and mistress, frequently betray his fellow-slave...he is often rewarded by his master who knows it is for his interest to keep such ones about him... hence it is that insurrections and stampedes are so generally detected. Such slaves are always treated with more affability than others, for the slave-holder is well aware that he stands over a volcano."

[21]Wade (1964).

[22]"Another slave, William, now turned informer, and more arrests followed, the most damaging of which was that of Charles, slave of john Drayton, who agreed to act as a spy. This quickly led to complete exposure. One hundred and thirty-one Negroes of Charleston were arrested and 49 were condemned to die. Twelve of these were pardoned and transported, while thirty-seven were hanged, the executions taking place from June 18 to August 9 (Aptheker (1993, p. 271))."

[23]Egerton (1991).

little faith in the local patrol to restore order in the event of a slave outbreak.[24]

The surveillance effort put forth by the landlord, m, and the insurrection effort put forth by the slave, α, together determine the probability (P) that an insurrection, if undertaken, is successful in granting the slave's freedom. This probability is determined by a Tullock (1980) contest success function function,[25] that is:

$$P(\alpha, m) = \frac{\alpha}{\alpha + m + \delta} \tag{1}$$

If the slave decides not to insurrect this tantamount to him setting $\alpha = 0$, and thus the probability of a successful insurrection is 0. Conversely, if the slaveowner chooses $No\ Monitoring$ this is equivalent to him setting $m = 0$, and therefore the probability of a successful insurrection becomes $\frac{\alpha}{\alpha+\delta}$. A positive, finite institutional parameter, (δ), is included to ensure that an insurrection is not guaranteed to be successful (i.e., with probability one) if the slaveowner does not choose $Monitor$. This accords with the historical record of the antebellum United States, in which insurrections were rarely successful in achieving their goal of freeing slaves from bondage. Even if a slaveowner chose not to employ additional, private means of surveiling his slaves, a degree of institutional slave control was guaranteed through police forces, slave patrols, local militias and inspection points along transportation routes, for example.[26]

As mentioned previously, it is assumed that the level of surveillance chosen by the landlord has no impact on his agricultural output, and thus the revenue from such output is represented by the exogenous parameter (π). The payoff function of the slaveowner with a linear cost of surveillance may thus be written as:[27]

$$U^O = \pi(1 - P) - m, \tag{2}$$

where it is implicitly assumed that if the slave successfully rebels, then the output garnered by the slaveowner is 0.[28]

For simplicity, the utility earned by a slave if he does not insurrect ($w > 0$), as well as the utility earned by successfully revolting and securing freedom are assumed to be

[24]See, for example, Taylor (1928, p. 28) and Williams (1972, p. 400).

[25]The use of such functions in the theoretical literature on contests is well established. A number of studies have provided an axiomatic justification for its use; see, for example, Skaperdas (1996) and Clark and Riis (1998). Moreover, Jia (2008) provides a stochastic justification for this ratio form in which the effectiveness of opponents' efforts is noisy. Lastly, Baye and Hoppe (2003) identify conditions under which a variety of rent-seeking contests, innovation tournaments, and patent-race games are strategically equivalent to the Tullock contest.

[26]See, for example, Henry (1968), Aptheker (1993), Wade (1964) and Hadden (2001).

[27]It should be noted that the results presented below are robust to a specification in which the marginal cost of surveillance is convex.

[28]This assumption is for parsimony, and is not necessary for the results presented below. All that is required is that the revenue garnered when an insurrection occurrs is strictly less than that when there is no insurrection.

exogenous. In the event of a successful revolt, the slave earns a payoff of $F - c - \alpha$; that is, the utility gained from earning one's freedom (F) less the costs associated with evading capture (c) and exerting effort in the planning of said revolt (α). The cost parameter c represents the efforts made by runaways slaves to avoid local patrols, inspection points and hired bounty hunters. It is assumed throughout the following analysis that $F - c - \alpha > w$, which simply affirms slaves' preference for freedom, despite the associated costs, as opposed to bondage. Putting these elements together, the payoffs earned by the slave as a function of their strategy may be written as:

$$U^s = \begin{cases} w & if\ No\ Revolt \\ P(F-c) - \alpha & if\ Revolt. \end{cases} \tag{3}$$

For simplicity, this utility function implicitly assumes that the slave earns a punitive payoff of 0 if they attempt an insurrection and are unsuccessful, although the results detailed below are qualitatively maintained as long as this punitive payoff is less than w. This specification is reasonable given the record of harsh repercussions faced by slaves caught engaging in rebellious activities.[29]

In order to most accurately mirror the conditions of the antebellum southern United States, the interaction between the slave and slaveowner is modelled as a sequential game in which the slaveowner is the first-mover. As Olmstead and Rhode (2010) note, the antebellum period was one characterized by the constant westward expansion of agriculture into virgin lands, in particular cotton, and a reallocation of labor from the Old South to the New South.[30] Biological innovation in the creation of higher-yielding cotton varieties were largely responsible for this shift, as most of these technologies were developed in the Mississippi Valley and were better suited for geoclimatic conditions there than for those common to Georgia and the Carolinas. As such, the model depicts an environment in which a slaveowner, perhaps after settling previously uncultivated land on the ever-expanding frontier,[31] first chooses their strategy for slave surveillance before commencing agricultural production. Figure 1 below gives an extensive form representation of the game.

[29] *cf.* Wade (1964), Aptheker (1993), Genovese (1979), Sheldon (1979) and Radford (1976).

[30] I follow Olmstead and Rhode's convention of defining the Old South as including the members of the original 13 colonies, and the New South as those states entering the Union after independence (Alabama, Arkansas, Louisiana, Mississippi, Tennessee, and Texas). As a single exception, Florida is considered part of the Old South.

[31] See Walton and Rockoff (2005) for the shrinking frontier in the fertile cotton lands of Louisiana, Alabama and Mississippi.

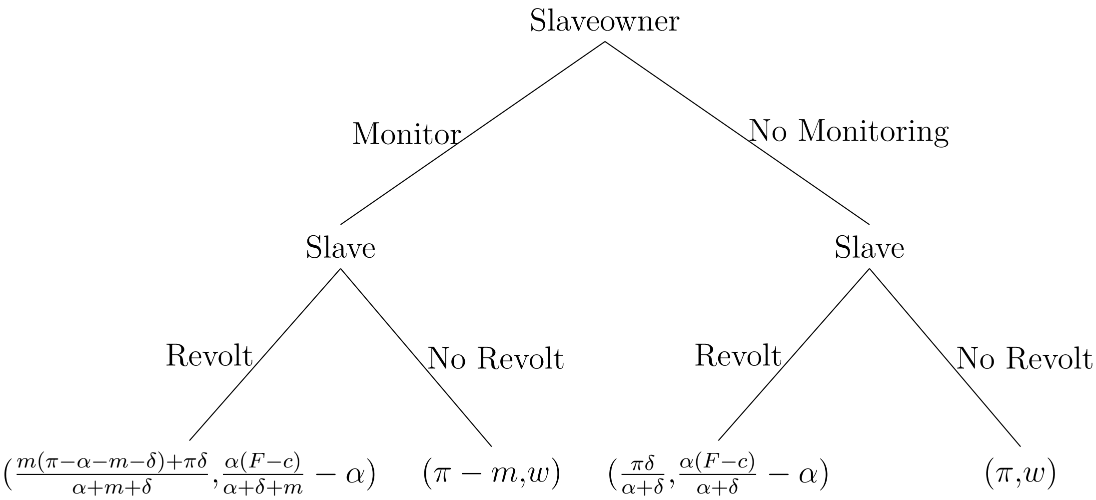


Figure 1: Extensive Form Representation

2.2 Equilibria and Proposition

The solution concept employed in the following analysis is that of subgame perfect Nash equilibrium (SPNE), which will be determined through backward induction. As such, the analysis will begin with an examination of the slave's best-responses.

2.2.1 Slave Best-Responses

Given the payoff functions described in Section 2.1, the best-responses of the slave can be determined by simply weighing the relative expected utilities of insurrecting and remaining on the plantation in the service of the slaveowner. Therefore, after observing the strategy *No Monitoring* by the slaveowner, the slave will:[32]

$$\begin{cases} \textit{Revolt} \text{ if} & \frac{F-c}{\alpha+\delta}-\alpha \geq w \\ \textit{No Revolt} & \text{otherwise.} \end{cases} \tag{4}$$

Similarly, after observing the strategy *Monitor* by the slaveowner, the slave will:

$$\begin{cases} \textit{Revolt} \text{ if} & \frac{F-c}{\alpha+m+\delta}-\alpha \geq w \\ \textit{No Revolt} & \text{otherwise.} \end{cases} \tag{5}$$

Trivially this implies three potential cases depending on the values of the exogenous parameters, each of which will be numbered for ease of exposition. First, if w is sufficiently small, so that $w \leq \frac{\alpha(F-c)}{\alpha+m+\delta}-\alpha < \frac{(F-c)\alpha}{\alpha+\delta}-\alpha$ (Case 1), then *Revolt* constitutes

[32]It is assumed that the slave will insurrect if the expected utility from doing so is equal to that yielded by not insurrecting.

a dominant strategy for the slave, and thus an insurrection will occur regardless of whether or not the slaveowner chooses $Monitor$ or $No\ Monitoring$. Second, if w is sufficiently large, so that $\frac{(F-c)\alpha}{\alpha+m+\delta} - \alpha < \frac{(F-c)\alpha}{\alpha+\delta} - \alpha < w$ (Case 2), then *No Revolt* constitutes a dominant strategy for the slave, and thus he will not attempt an insurrection, irrespective of whether or not the slaveowner decides to employ additional surveillance effort. An interesting third cases results if $\frac{(F-c)\alpha}{\alpha+m+\delta} - \alpha < w \leq \frac{(F-c)\alpha}{\alpha+\delta} - \alpha$ (Case 3), and therefore additional surveillance by the slaveowner acts as an effective deterrent to rebellious activity on the part of the slave.

This simple analysis highlights some of the salient incentives faced by slaves in rationally choosing whether or not to revolt. First of all, as one would expect, an insurrection is more likely to take place the lower the utility garnered from laboring for the slaveowner, or equivalently, the more difficult the work regime on the plantation. There existed variation across the antebellum south in terms of the arduousness of various work regimes, and this variation can largely be explained by the primary crop in production. Various theoretical and empirical arguments support the contention that working conditions for slaves were generally more difficult on cotton plantations *vis-a-vis* tobacco, thus resulting in a lower w.

In order to gauge the strenuousness of slave labor in the antebellum south a number of authors have utilized mortality and fertility data from the detailed records of planters of the era, and convincingly argued against the favorable conditions of slave life as posited by Fogel and Engerman (1974).[33] For example, Steckel (1992, p. 492) studies the probability of neonatal death among slave children on cotton plantations in South Carolina, Georgia, Alabama and Louisiana in the period 1780-1860, and suggests that the average probability per month in February to April and September to November was 280-390 percent higher than the average probability in other months. The months from February to April corresponded to the preparation and planting season, which was "particularly strenuous because the tasks were physically demanding, little help could be obtained form the old and the young, the owners pressed work at in intense pace to meet deadlines for successful planting of the crop."[34] The months from September to November were peak harvesting season. Due to the fact that pregnant women on cotton plantations often saw little reduction in work load before the fifth month,[35] and continued working in some capacity almost until delivery, Steckel concludes that the seasonal variation in neonatal mortality is likely due to the demands of the cotton work regime.[36] In addition, the work of Steckel (1992) suggests that post neonatal mortal-

[33] See Campbell (1984), Johnson (1981), Steckel (1992, 1986a, 1986b, 1986c).

[34] *Ibid.*, p. 492.

[35] See Campbell (1984) and Jones (1985).

[36] It should be noted that Steckel is not the first scholar to draw connections between strenuous work during pregnancy and neonatal mortality. See Hytten and Leitch (1971) and Tanner (1978) for general

ity rates, which are also linked to strenuous work during pregnancy, were significantly higher on cotton plantations than those devoted to sugar production. This is particularly surprising given the fact that sugar production is generally very arduous, requiring heavy labor for ditching and plowing, among other tasks.[37]

Lastly, the evidence presented by Johnson (1981) from the 1860 census suggests a linkage between the incidence of sudden infant death syndrome among slave children and the form of labor management (task vs. gang system) employed. In describing these results, Morgan (1998, p. 218) writes:

> "One aspect of the slaves' well-being that has been intensively studied in the antebellum South, namely the susceptibility of slave children to sudden infant death syndrome, reveals a marked contrast between areas of gang and of task labor. The smothering of slave infants, as contemporaries termed this phenomenon, is now thought to be closely related to the harshness of physical labor required of pregnant slave women. Death rates for smothered slave infants were much higher in areas where gang labor prevailed. In Georgia's cotton counties, the smothering death rate was more than four times greater than that of the same state's rice counties."

This observation, coupled with the fact that gang labor was never as pervasive on tobacco plantations as it was on those devoted to cotton,[38] suggests a greater difficulty of work on the latter than the former.

These empirical observations may be explained by the fact that tobacco production was a "care-intensive" process, requiring meticulous care in the tasks of harvesting, cur-

reference.

[37]Gray (1958).

[38]Fogel (1989, p. 36) writes, "Although gang-system plantations became more important as time wore on, they never became dominant in tobacco. An analysis of the farms in the tobacco region of Kentucky and Tennessee revealed that 65 percent of the tobacco crop in 1860 was produced on free or small slave farms." This, Fogel argues, was due to the fact that tasks such as the stripping and prizing of tobacco, for example, could not easily be specialized for the "organization of production on an assembly line basis." Cotton production, on the other hand, was more conducive to specialization of tasks (Gray(1958, p. 549)), and "by the 1840's those few Alabama and Mississippi plantations that operated under the task system stood out by their idiosyncrasy" (Miller (1993, 164)). For supporting evidence of the prevalence of the task system in tobacco cultivation, see Gray (1958, p. 552). Similarly, Walsh (1993, p. 172) argues that tobacco production did not exhibit the economies of scale which would have made "assembly-line" gang-system production more efficient. It should be noted that the prevalence of gang labor on large plantations also supports the hypothesis that slaves on cotton plantations were subject to harsher treatment than those devoted to tobacco. See, for example, Olmsted (1904, vol 2 p. 112). Stephen Crawford (1992, p. 541), in attempting to understand the greater frequency of punishment on large plantations writes, "There are at least two possible explanations of the observed effect of plantation size on the frequency of punishment...The gang-labor system, more prevalent on the larger plantations, could also have required increased physical punishment to enforce the more intense labor."

ing and packaging,[39] while cotton production was relatively more "effort-intensive."[40] This is evidenced by the fact that tobacco production was often limited to so many plants per hand in order to maintain quality, an important determinant in the market price.[41] In contrast, the development of Eli Whitney's cotton gin, which was instrumental in easing the task of separating seed from fiber, ensured that the "advantages of cotton far outweighed its disadvantages. It neither spoiled as easily as tobacco nor required as much painstaking cultivation."[42] According to Fenoaltea (1984), pain and the threat of punishment are more efficacious in guaranteeing greater effort in effort-intensive production processes, such as those associated with the cultivation of cotton. Conversely, rewards such as profit-sharing agreements and manumission are efficient methods of securing the requisite effort in care-intensive production processes.

> "...Pain incentives and ordinary rewards have meaningfully different effects on worker performance. Pain incentives, it would seem, are the more effective in generating effort. The main reason is that effort varies directly with the level of anxiety, and a threat to one's physical integrity produces very high anxiety indeed. A subsidiary reason is that threats can be of immediate pain, while rewards are typically of delayed gratification...On the other hand, pain incentives are the less effective in generating carefulness. One reason is that the ability to work carefully is enhanced by low levels of anxiety but inhibited by high ones, so that the severe tension produced by pain incentives is counterproductive even if one is doing one's best."[43]

The foregoing theory also highlights the importance of the costs of avoiding capture in the event of a successful insurrection (c) on the slave's decision making; as such costs decrease, and the slave is more easily able to evade police, slave patrols, bounty hunters, etc., the planning of an insurrection becomes more likely. This offers a convenient mathematical representation of the hypothesis put forth by Wade (1964) mentioned in the introduction. Wade (1964) argues that the dual tasks of slave management and supervision were inherently more difficult in an urban environment, and this invoked an ever-present fear of rebellion on the part of urban slaveholders which ultimately rendered slavery and urbanization incompatible. These inherent difficulties yielded urban slaves a degree of freedom which would have been unheard of to their rural counterparts.

[39] See Gray (1958) and Kulikoff (1986) for discussions of the detailed process by which tobacco was cultivated in this period.

[40] Fenoaltea (1984).

[41] Gray (1958, p. 217).

[42] Reidy (1993, p.139). In addition, Miller (1993 p. 159) notes that "...cotton needed only rudimentary processing at the point of production (unlike sugar and tobacco), plantations that grew the cotton required few workmen with artisanal or other special skills."

[43] *Ibid.*, p. 637.

For example, as a result of the widely accepted customs of "hiring-out" and "living out",[44] urban slaves were endowed with a freedom of movement between owner and employer, albeit highly regulated, that nevertheless would have been utterly alien to the plantation field hand. Frederick Douglas, comparing the life in Baltimore with his early days as a field hand in the Maryland countryside, aptly summarizes these points, "A city slave is almost a free citizen, he enjoys privileges altogether unknown to the whip-driven slave on the plantation."[45] As a result, cities offered opportunities for runaways to hide their identities, create new ones and pose as free African Americans, live with relatives, mingle with others and plan an embarkation for more distant locales. They could be accosted and questioned, but control was less intrusive than in the country, where black strangers were scrutinized and often arrested.[46] The opportunities for slaves to commingle in an urban environment, perhaps at the local groghouse, church or cabaret, also eased the search for sympathizers willing to aid and abet runaways.[47] As a result, the model predicts that in and around southern cities the costs associated with evading capture (c) and planning a rebellion (α) would be smaller, and therefore the strategy *Revolt* more likely.

2.2.2 Slaveowner Best-Responses and Equilibria

The best-responses of the slave thus established, backward induction proceeds by specifying the optimal strategies of the slaveowner. As before, the equilibrium strategy of the slaveowner is dependent on a number of exogenously determined parameters, and will be evaluated in cases.

First of all note, note that if Case 2 obtains, so that $\frac{(F-c)\alpha}{\alpha+m+\delta} - \alpha < \frac{(F-c)\alpha}{\alpha+\delta} - \alpha < w$, then $No\ Monitoring$ is the best-response for the slaveowner and the strategy profile $\{No\ Monitoring, No\ Revolt\}$ constitutes a SPNE. Intuitively, it is not optimal for the slaveowner to employ additional overseers, spies, etc., and bear the associated cost, if the laboring utility of the slave (w) is such that the slave would never wish to plan an insurrection. Conversely, if the slave always earns a higher utility by not revolting, even if the slaveowner decides not to employ additional surveillance, then of course this strategy will be adopted in equilibrium. Case 2 is therefore unique in that the revenue

[44]Under these practice masters who owned more African Americans than they could utilize either at home or in their business hired some to labor-strapped employers. This custom greatly lessened "the rigidity of slavery, allowing a constant reallocation of the labor supply according to demand" (*Ibid.*, p. 38). Goldin (1976, p. 35) also observes that, "not only were urban slaves hired out, but many...lived apart from their place of work. These slaves were allowed to locate their own place of residence and buy their own meals."

[45]Douglas (1855, reprinted 2009).

[46]Franklin and Schweninger (1999, p. 125).

[47]"Most urban migrants who remained undetected received assistance, at least in the early days following their escape." *Ibid.,* p. 131.

garnered by the slaveowner, π, does not factor into their equilibrium strategy.

By contrast, in order for the slaveowner to choose $Monitor$ in Case 1, where $w \leq \frac{(F-c)\alpha}{\alpha+m+\delta} - \alpha < \frac{(F-c)\alpha}{\alpha+\delta} - \alpha$, his agricultural revenue must be sufficiently large enough to incentivize additional surveillance. In particular, it can be shown that if:

$$\pi \geq \frac{(\alpha+\delta)(\alpha+\delta+m)}{\alpha}, \tag{6}$$

then the strategy profile $\{Monitor, Revolt\}$ obtains in equilibrium,[48] otherwise $\{No\ Monitoring, Revolt\}$ obtains as an SPNE. The profitability of American slavery on the eve of the civil war has been the subject of intense debate, as Fogel and Engerman (1974), Fogel (2003), Genovese (1972, 1965), Ransom and Sutch (2001), David and Temin (1979) and several others, with varying degrees of acrimony, have weighed in on this important issue.[49] Fogel and Engerman (1974) argue that slavery was "generally a highly profitable investment which yielded rates of return that compared favorably with the most outstanding investment opportunities in manufacturing." This also accords with the argument of Conrad and Meyer (1958), and is reaffirmed by Fogel (2003). Although the methodologies employed by Fogel and Engerman (1974) have been contested,[50] it is reasonable to assume, given the proclivity of slaveowners to monitor their slaves mentioned above, that profits were sufficiently large to incentivize planters to attempt the suppression of rebellion.

A threshold condition similar to (6) also determines the equilibrium behavior of the slaveowner under Case 3, in which it is assumed that: $\frac{(F-c)\alpha}{\alpha+m+\delta} - \alpha < w \leq \frac{(F-c)\alpha}{\alpha+\delta} - \alpha$. It can be shown that if:

$$\pi \geq \frac{m(\alpha+\delta)}{\alpha}, \tag{7}$$

then the strategy profile $\{Monitor, No\ Revolt\}$ obtains, otherwise $\{No\ Monitoring, Revolt\}$ is the unique subgame perfect Nash equilibrium. Thus the slave is willing to revolt if the slaveowner chooses not to employ additional surveillance, but is effectively deterred from engaging in such activity if the slaveowner chooses $Monitor$. Once again, given the historical record of the antebellum South, it is reasonable to assume that the revenues for planters were sufficiently high to incentivize such surveillance, particularly if a slave

[48]Here I have made the simplifying assumption that if the expected utility from $Monitor$ is equal to the expected utility of $No\ Monitoring$, then the slaveowner chooses $Monitor$. This assumption is retained throughout the following analysis.

[49]If in the language of Fenoaltea (1989, p. 304), this debate may be termed a "Great War", then a crucial battlefield is the issue of slave-labor productivity. Some historians have argued that slave labor was of such poor quality and given so reluctantly that the plantation system was too inefficient to be viable (see, for example, Genovese (1972, 1989) and Cairnes (1862)), while Fogel and Engerman (1971) argue that plantations employing slave-labor were more productive than free farms in the North.

[50]See, for example, the lengthy critique by Sutch (1975).

revolt was perceived to be a potential threat. This is corroborated by the observation that most revolts were uncovered and stymied before they could be brought to fruition.

2.2.3 Proposition and Discussion

Proposition 1 summarizes this analysis, and will be utilized to garner predictions regarding the surveillance and revolt efforts put forth by slaves and slaveowners on tobacco versus cotton plantations, as well as in urban versus rural environments.

PROPOSITION 1

If the labor regime is sufficiently laborious for the slave, or if the costs associated with evading capture in the event of a successful revolt are sufficiently small, so that $w \leq \frac{(F-c)\alpha}{\alpha+m+\delta} - \alpha$*, and if the revenue garnered by the slaveowner is sufficiently high, so that* $\pi \geq \frac{\delta(m+\delta)+\alpha(\alpha+m+2\delta)}{\alpha}$*, then* $\{Monitor, Revolt\}$ *will be the unique subgame perfect Nash equilibrium. Conversely, if the labor regime for the slave is sufficiently mild, so that* $\frac{(F-c)\alpha}{\alpha+\delta} - \alpha < w$*, then* $\{No\ Monitoring, No\ Revolt\}$ *will obtain in equilibrium.*

PROOF: See Sections 2.2.1 and 2.2.2 for a discussion.

The logic of Proposition 1 is straightforward. If the production process is sufficiently stringent for the slave, or if the cost of retaining their freedom after an insurrection is sufficiently small, there is a greater incentive for him to revolt and attempt to win his freedom through violent means. In order to deter the slaves from adopting this course of action which, if successful, would impose sizable costs in terms of agricultural revenue,[51] the slaveowner employs additional surveillance in order to make a successful insurrection less likely.[52] If, however, w or c are so small that *Revolt* becomes a dominant strategy, then surveillance effort of the slaveowner will not be effective in preventing an insurrection, and instead will be aimed at ensuring its success is less likely.

It was previously argued that, from the perspective of the slave, the arduousness of labor was the primary distinction of toiling on cotton versus tobacco plantations. Empirical and theoretical evidence suggest that while tobacco production was care-intensive, it was much less physically taxing *vis-a-vis* cotton production. Proposition 1 thus predicts that slave insurrections, and consequently greater surveillance effort on the part of planters, will be more likely on cotton plantations than tobacco plantations. In addition, because cities offered greater opportunities for runaways slaves to elude capture and plan rebellions, Proposition 1 also predicts that insurrections, as well as efforts to quell them on the part of slaveowners, should also be more prevalent in such environments.

[51]See Parker (1993) for the costs imposed by runaway and rebellious slaves.

[52]This prediction is corroborated by the historical record, as state-organized slave patrols in Virginia and the Carolina were instigated during periods of heightened fear of slave insurrection (Hadden 2001).

The theoretical mechanisms that incentivize slave rebellion and supervision thus established, the remainder of the paper will focus on an empirical examination of these claims. Section 3 describes the novel dataset employed, and Section 4 describes the empirical strategy and results.

3 Data

3.1 Revolts, Conspiracies and Panics

The source most heavily utilized for data on slave insurrections and discovered conspiracies between 1800-1860 is Herbert Aptheker's *American Negro Slave Revolts* (1993). This detailed work is the culmination of over 5 decades of investigation into court minutes, probate records, plantation records (i.e., journal entries, correspondence, etc.), government archives and newspaper articles. To the best of my knowledge, the only other empirical paper which has drawn upon this compilation is Kilson (1964), which is mainly concerned with the taxonomy of slave revolts, specifically classifying them as either systematic, vandalistic or opportunistic. It should be noted that Kilson arrives at a smaller number for organized slave resistance taking place in the United States during the period of investigation, but this may be attributed to our inclusion of discovered conspiracies as a dependent variable. It should also be noted that Aptheker's opus is not without criticism.[53] Though some refer to him as a "pioneering scholar",[54] others have charged that the instances of rebellion documented are either exaggerated or rely on scanty evidence. Kenneth Stampp aptly explains the controversy by noting that at the time Aptheker began his research in 1927, the dominant view of the American slave was one of docility, dependence and submission. In fact, over thirty years later slaves were described as such:

> Sambo, the typical plantation slave, was docile but irresponsible, loyal but lazy, humble but chronically given to lying and stealing; his behavior was full of infantile silliness and his talk inflated with childish exaggeration. His relationship with his master was one of utter dependence and childlike attachment: it was indeed his childlike quality that was the very key to his being.[55]

[53] See, for example, the recent exchange between George L. Fishman and Carl N. Degler in the *Journal of American History* (1990).

[54] Rodriguez (2007)

[55] Elkins (1976, p. 82), reprinted. The inherent laziness of slaves has also been used as evidence the long-standing debate over the viability and profitability of American slavery, *cf.* Cairnes(1969), Ruffin(1857) and Genovese(1965).

Thus it is sometimes argued (by Stampp included) that Aptheker's book exaggerates instances of militant action on the part of slaves in order to repudiate the paternalistic view of him as "Sambo." To mitigate this tendency, and in line with Wilson's (1964) scholarship, the following analysis distinguishes between "insurrections" and "conspiracies", to be defined presently.

An "insurrection" is defined as any event in which multiple slaves resorted to violent action to obtain their freedom; this includes instances of "opportunistic" or "vandalistic" rebellion referred to by Kilson. A typical entry in Aptheker which would be classified as an insurrection is as follows:

> In August 1858, about 55 slaves on a plantation...near Coffeesville, Mississippi, decided they would no longer submit to whippings, and became unmanageable. The overseer obtained assistance from his neighbors, but the slaves, armed with axes, hatchets, clubs, scythes and stones, barricaded themselves...One white man was severely injured in attempting to get at the rebellious Negroes. It was only when, after a few days, some seventy-five armed men came to the plantation from surrounding communities that the slaves were overpowered.[56]

A discovered "conspiracy" is defined as any event in which multiple slaves were tried and convicted in a court of law for crimes related to the planning and execution of a revolt. Court records documenting instances of these trials are in large part from the work of Catterall (1998). A typical conspiracy entry, take from the Governor's Papers of Raleigh, NC, is as follows:

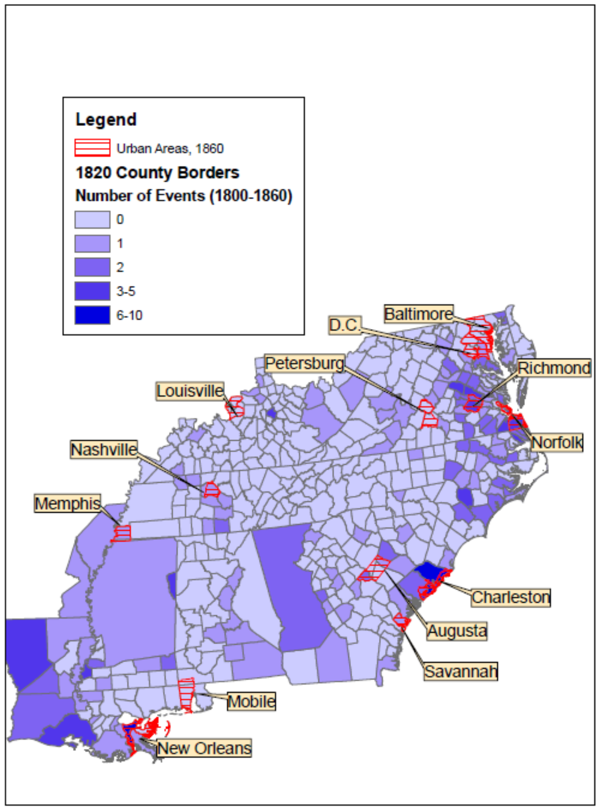
> Sir the inhabitants of Sampson have been alarmed with the insurrection of the Negroes - We have ten or fifteen negroes in Jail, and we have such proof that most of them will be bound over to our Supreme Court. We have testimony that will implicate most of the negroes in the county...the people of Duplin County have examined ten or fifteen negroes & found two guilty, and have put them to death...[57]

An "insurrection event" is defined as one in which either an insurrection, discovered conspiracy or panic occurred. Instances of such events has been cross-referenced with Rodriguez (2007) and Carroll (1968), and linked with county-level census data to be described below. In the entire period under investigation, 1800-1859, there were 52 recorded insurrections, 103 conspiracies and 63 panics. Due to a paucity of reliable

[56] Aptheker (1993, p. 351).
[57] *Ibid.*, p. 309.

records, it is likely that in each time period the number of events is grossly underestimated.[58] Figure 1 below gives an illustration of the geographic distribution of insurrection events from 1800-1860.

Figure 2: Geographic Distribution of Insurrection Events



Source: Aptheker (1993)

For the purposes of the empirical analysis in Section 4, insurrection and conspiracy outcomes for a given county are expressed as simply an indicator for whether such an event was observed during the period of study. That is, $EvInsurrect_i$ and $EvConsp_i$ are indicators for whether an insurrection or discovered conspiracy was observed in county i between 1800-1860.

3.2 GAEZ Data

The most novel component of my dataset is that garnered from the Food and Agriculture Organization of the United Nations (FAO), which created the Global Agro-Ecological Zones (GAEZ) data beginning in 2000. This micro-level dataset is extremely rich in its detail and applications, and as a result is becoming an increasingly utilized

[58]Moreover, Wade (1964, p. 194) and Aptheker (1993) note that incidents of slave unrest often went unreported in order to quell widespread panic. "Even at moments of great tension, as in Charleston during the Vesey affair or in St. Louis after the burning of McIntosh, a free black little was revealed, because city officials drew a veil over the vents and secured a news blackout from local editors."

tool among economists.[59] The overarching goal of the GAEZ project is to provide farmers and government agencies with accurate information regarding the optimal crop choice. To this end, the GAEZ project first collected data on the characteristics of 154 crops to determine the required environmental conditions for their cultivation. The FAO then employed a team of researchers to compile climatic data for the global climatic database of the Climate Research Unit (CRU) at the University of East Anglia; the data extracted from this database include variables such as precipitation, frequency of wet days, mean temperature, diurnal temperature range, vapor pressure, cloud cover, sunshine, ground-frost frequency, and wind speed. A second set of data collected refer to land-specific characteristics (e.g. soil type) which are taken from the FAO's Digital Soil Map of the World (DSMW), and information on the slope of soils from the GTOPO30 Database developed at the U.S. Geological Survey (USGS) EROS Data Center. Together these data provide detailed information for 2.2 million grid-cells spanning the entire globe, where each grid-cell is .5 degrees by .5 degrees, and therefore comprises an area of 56 km^2 at the equator.

These data are then fed into state-of-the-art agronomic models, in which hundreds of parameters have been calibrated using extant research from the agronomic literature and field experiments from agricultural research stations, to predict potential yields (tons per hectare) for 17 different crops. These predictions consider "agro-climatic" constraints such as variability in water supply and existence of pests and weeds, as well as "agro-edaphic" suitability (i.e., soil erosion) for each grid-cell. In order to remove the effect of aberrant weather in any particular year while still taking climate conditions into account, the final GAEZ output used in my analysis is an average of runs of the GAEZ models using daily weather records observed in each year from 1961 to 1990. Lastly, in order to control for varying levels of complementary inputs such as irrigation, fertilizers, machinery and labor, the GAEZ models allow for the user to choose the level of sophistication in the production process, which I set to "intermediate" to mirror the realities of the antebellum South.[60]

The end result of this procedure is a GIS raster file containing high-resolution data on the potential yield of tobacco and cotton for each grid-cell. These data are then linked with geo-referenced county border files available from the Minnesota Population Center's National Historical Geographic Information System (NHGIS). Multiple grid-cells fall within the borders of each county; for example, the median county contains 108 grid-cells. As a result, to glean a county level measure of tobacco and cotton productivity, I simply average over all the grid-cells within a given county. Visual

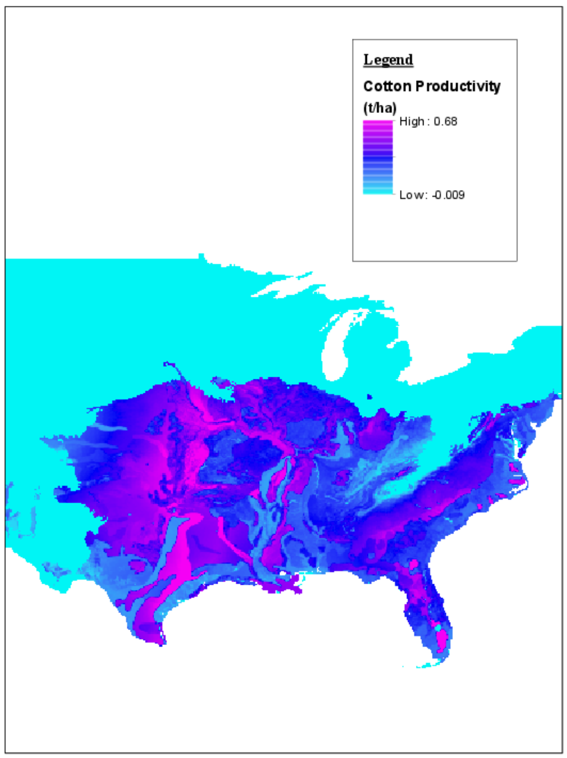
[59] *cf.* Costinot et al. (2014), Marden (2014), Nunn and Qian (2009), Costinot and Donaldson (2011).

[60] These are also the settings chosen by Nunn and Qian (2009) in their study of the contribution of the potato to European population growth and urbanization, which covers a similar time period. The results below are robust to this specification.

illustrations of the GAEZ output in tons per hectare are illustrated in Figures 3 and 4.

It should once again be reiterated that because the GAEZ output is a model-based measure of productivity, as opposed to directly observable yields, productivities at a given location are plausibly exogenous to other economic activity. This exogeneity is preserved by the fact that, although the GAEZ project meticulously tests its predictions, for example under controlled experiments at agricultural research stations, it does not form these predictions by estimating any statistical relationship between observed inputs and outputs.

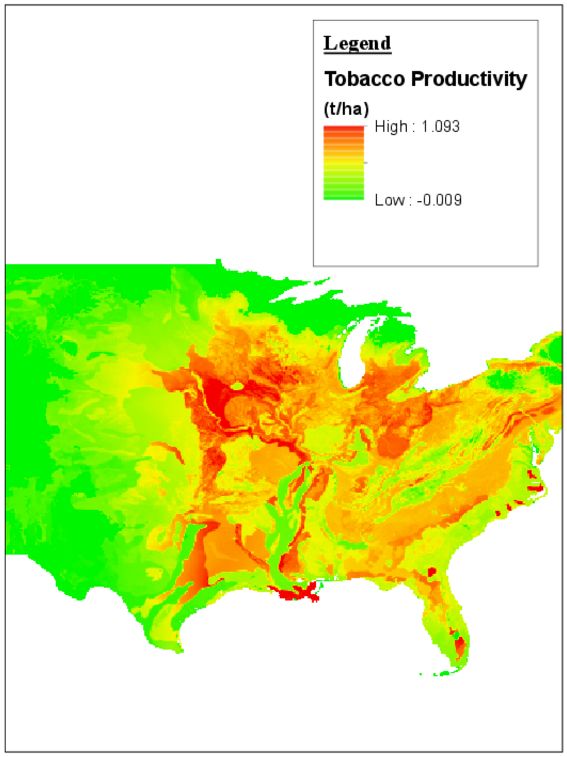
Figure 3: GAEZ Cotton Productivity Output



Source: GAEZ Database

Figure 3 aids in explaining the general westward expansion of cotton production from the Old South to the New South witnessed in the antebellum period. As Olmstead and Rhodes (2010) note, in the early 1790s production of cotton was concentrated along the coastal tidewaters of Georgia and South Carolina, but by 1839 the geographic center of upland cotton had shifted to west-central Alabama, and by 1859 shifted westward beyond the Mississippi-Alabama border. As the fertile lands of Texas, Louisiana and Mississippi were incorporated into the Union, so the dominion of King Cotton expanded. Similarly, Figure 4 helps illuminate the preeminence of tobacco production in the piedmont region of Virginia and North Carolina, particularly in the colonial period; as a swath of high-productivity land sweeping southwest from the Chesapeake is clearly noticeable. Summary statistics of these data can be found in Table 11 in Appendix Section 6.1.

Figure 4: GAEZ Tobacco Productivity Output



Source: GAEZ Database

3.3 Additional Geographic and Census Data

Additional geographic data for each county has also been compiled, and these variables include the Euclidean distance in miles to the nearest river, nearest Southern city and nearest free state, calculated using arcGIS software. In this procedure, if a river or Southern city falls within a given county, the distance variable is automatically assigned a zero, otherwise the Euclidean distance from the midpoint of the county to the nearest city or river is retained. Geo-referenced data on U.S. rivers is obtained from Esri (2014). The Southern cities used in the analysis are those which had at least a population of 3000 in 1810 (the first year in which reliable data can be obtained), and at least a population of 10,000 in 1860. The cities which met both of these criteria are: New Orleans, LA, Mobile, AL, Savannah, GA, Augusta, GA, Charleston, SC, Memphis, TN, Nashville, TN, St. Louis, MO, Louisville, KY, Petersburg, VA, Richmond, VA, Norfolk, VA, Washington D.C. and Baltimore, MD.

County-level census data used in the empirical analysis below is from two sources: Haines (2010) and the Minnesota Population Center. Up until 1900 censuses in the United States were conducted only on a decennial basis. Beginning in 1840 these decennial censuses become much more detailed, both in spatial scope and the variety of variables available. Demographic variables such as total population (*TotPop*), urban population (*UrbPop*), slave population (*SlavePop*), white population (*WhtPop*) and an indicator for whether a county had access to a navigable waterway (*NavWater*) are included. The independent variable of interest in examining the merits of the Wade hypothesis is county-level urban population, which should be positively correlated with the probability of an event if the theory is correct. In addition, these censuses contain information on the value of agricultural output (*ValAgProd*), value of manufacturing output (*ValManProd*), and manufacturing employment (*ManEmpl)* and investment (*ManInvest*). Moreover, and importantly for the instrument variable strategy employed below, educational variables such as the number of private (*PrivSchl*) and public schools, enrollment and literacy rates are included in theses censuses as well. Tables 12, 13 and 14 of the Appendix displays the summary statistics for these data.

A perennial issue which trammels this analysis, or any other attempting to investigate 19th century United States history, is the fact that county boundaries were in a constant state of flux during this period. Persistent territorial expansion in the pursuit of manifest destiny, via the purchase of new lands from foreign governments (Louisiana Purchase) or the dislocation of Native Americans (Creek cessions of 1805,1806,1821 and 1826), made county borders in the period 1800-1860 (and onward) far more fluid than rigid. If the over-riding goal in compiling these data is to create a panel of observations which are consistent through time, then data for a given county in, say, 1840 is effectively useless if its borders were re-organized in 1835.

As a result, following the method outlined in Hornbeck (2010) and Perlman (2013), county borders are adjusted to hold geographical units constant through time for the 1840-1860 panel. Using historical U.S. county boundary files,[61] county borders in later decades are intersected with those of a base year using ArcView GIS software. When later counties fall within more than one base year county, data for each piece are calculated by multiplying the later county data by the share of its area in the base year county. For those later decades, each base year county is then assigned the sum of all the pieces falling within its area. Of course, this procedure relies on the assumption that data are uniformly distributed across a given county, though I do not view this to be particularly unrealistic.

[61]Carville, Hepen, and Otterstrom (1999).

3.4 IPUMS Data

In order to gauge the relative size of police forces in Southern versus Northern cities, and thus make inferences regarding the cost of slave supervision, I collected data from the Integrated Public Use Microdata Series (IPUMS) at the Minnesota Population Center, University of Minnesota, for the years 1850 and 1860. These detailed data were originally collected from individual households, and I aggregated them to the level of minor civil division (MCD) while taking into account disparate weights for each sample. Using the 1950 Census Bureau occupational classification system, I created an MCD-level measure for the number of households reporting a member whose occupation was either "patrol, watchman, or doorkeeper" (code 763), "marshal or constable" (code 771), "policeman or detective" (code 773), or "sheriff or bailiff" (code 782). In line with the analysis of Jayadev and Bowles (2006), I define this variable *GuardLabor*. In addition, in order to control for potential omitted variable bias, I also created an MCD-level measure (*Foreign*) for the number of foreign-born residents in a given MCD, as well as a measure for the number of urban residents (*UrbPop*).[62] Lastly, I also created a number of MCD-level measures for economic activity, including mean income (*Income*), proportion of labor force in manufacturing (*Prpmanu*), proportion of labor force employed in finance (*Prpfinance*) and total real estate value (*Prop*). Taking these data together, I created a balanced panel of 13,808 cross-sectional units observed in 1850 and 1860, with 395 urban MCD's in 1860. Summary statistics for these data are provided in Appendix Table 15.

4 Empirical Results

4.1 Geography, Slave Insurrections and Conspiracies

As a first step in empirically validating the theoretical predictions of Proposition 1, it must first be verified that the counties which the GAEZ data predict are the most productive in tobacco and cotton did in fact produce these crops. It could be the case, for example, that the general upward trend in cotton prices during the pre-war era incentivized cotton production even in areas which were not particularly suited for it. To alleviate this concern, I determine the correlations between the GAEZ predicted productivity for a given crop and its actual production in 1860, by conducting a simple regression of the form:

[62] In this panel urban status is based on the IPUMS' classification criterion, in which a person is counted as part of an urban population if they live in a city or incorporated place with more than 2,500 inhabitants.

$$Y_i = \alpha + \beta GAEZ_i + \varepsilon_i \tag{8}$$

where Y_i is actual production of tobacco or cotton in county i in 1860, α is an intercept term, β is the coefficient of interest, $GAEZ_i$ represents the predicted productivity of cotton or tobacco in county i as predicted by the GAEZ database, and ε_i is a randomly distributed error term.

Table 1: GAEZ Data and Actual Production in 1860

	Cotton Production, 1860	Tobacco Production, 1860
GAEZ Cotton (predicted)	13680.4*** (10.81)	
GAEZ Tobacco (predicted)		371448.4*** (5.78)

Note: dependent variable is actual cotton or tobacco production in 1860. Results are reported for the coefficient estimates of GAEZ-predicted cotton and tobacco productivity, in metric tonnes per hectare. See Data Section 3.2 for a discussion of the construction of these variables. T-statistics are reported in parentheses, with heteroskedasticity-robust standard errors employed in the estimation. Significance levels reported are as follows: * p<0.10, ** p<0.05, and *** p<0.01.

Table 1 illustrates the coefficient of interest and the t-statistics in parentheses from regressions in which robust standard errors are employed to mitigate any effects of heteroskedasticity. As is clear from the table, the coefficients on the predicted tobacco and cotton productivities are large, positive, and highly significant, which suggests that the naturally-determined productivity of a crop within a given area was an important factor in determining whether or not it would be grown. The strength of these first-stage results also suggests that the predicted productivities garnered from the GAEZ database can serve as viable instruments for actual production.

It should once again be reiterated that because the independent variables employed below are of a purely geographic nature, and because technological limitations of the day hindered drastic improvements to agricultural lands,[63] each of the right-hand-side variables in equation (9) are plausibly exogenous, and thus causal inferences can be made from the empirical analysis. The following exercise will delineate the results of a Linear Probability Model (LPM), as well as from probit and rare-event logit regressions of the form:

$$Pr(Y_i = 1|X) = F(X'\beta), \tag{9}$$

where Y_i is either $EvConsp_i$ or $EvInsurrect_i$, β is a vector of coefficients of interest,

[63] *cf.* Rubin (1975).

and X is a matrix of geographic independent variables, as well as a control for the number of years a given county existed during the period of investigation,[64] and F is a link function. Tables 2-4 below illustrates the results, in which *EvConsp* and *EvInsurrect* represent indicators for whether such an event was observed in a given county between 1800-1860, *CotProd* and *TobacProd* represent the predicted productivities for these crops gleaned from the GAEZ database, and *DistCity*, *DistNorth*, *DistRiver* represent the Euclidean distance to the nearest city, free state and river, respectively. Lastly, $NumYears$ represents the number of years a given county fell within the time period of study.

Table 2: GAEZ-Predicted Productivity and Insurrections

	LPM		Probit		R.E. Logit	
	EvConsp	EvInsurrect	EvConsp	EvInsurrect	EvConsp	EvInsurrect
CotProd	1.63***	.490***	5.76***	3.63**	9.88***	6.43***
	(5.77)	(3.65)	(5.10)	(2.39)	(4.64)	(3.45)
TobacProd	-1.154***	-.211*	-3.84***	-1.52*	-6.50***	-2.82*
	(-6.04)	(-1.74)	(5.74)	(-1.75)	(-5.45)	(-1.93)
NumYears	.002	.002**	.007	.014	.012	.025
	(1.21)	(2.10)	(1.23)	(1.78)	(1.22)	(1.55)

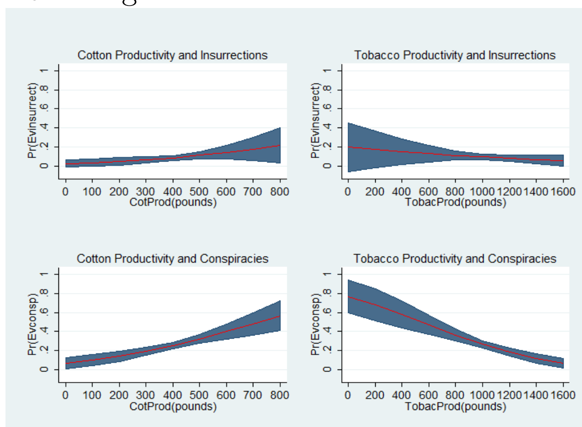
Dependent variable is an indicator for whether an insurrection or discovered conspiracy occurred within a given county in the period 1800-1860. Coefficient estimates are reported for Linear Probability Model (LPM), probit and rare-event logit specifications. See King and Zeng (2001) for a discussion of the advantages and drawbacks of rare-event logit models. T-statistics are reported in parentheses, with heteroskedasticity-robust standard errors employed in the estimation. Significance levels reported are as follows: * p<0.10, ** p<0.05, and *** p<0.01.

A plausible detraction from the estimates in Table 2 is that there exists a high degree of multicollinearity between the geographic independent variables. Appendix Table 16 presents the variance inflation factor (VIF), $\sqrt{VIF}$ tolerance, and R-Squared statistics for these variables, all of which are within an acceptable range, and therefore multicollinearity should not present problems for the coefficient and t-statistic estimates. It could also reasonably be argued that the coefficient estimates in Table 2 give a misleading picture of the actual marginal effects of predicted cotton and tobacco productivities on the probability of discovered conspiracies and insurrections. It could be the case that for certain ranges of cotton productivity, for example, there exists a

[64] This is included in order to control for potential biases that might arise simply because counties in Virginia, for example, are observed over the entire period 1800-1860, while counties in Alabama are only observed upon entering the union in 1819.

negative relationship between productivity and the probability of an insurrection or discovered conspiracy, even though the net effect is positive. To alleviate this fear, Figure 5 plots the predicted probabilities of insurrection events as a function of the predicted cotton and tobacco productivities. It is immediately clear from the plots that a monotonic, and largely linear, relationship exists between these probabilities and the predicted productivities garnered from the GAEZ database.

Figure 5: Marginal Effects of Predicted Productivities



The results of Table 2 suggest that counties which were inherently more productive in cotton were more likely to experience discovered conspiracies and insurrections, while counties inherently more productive in tobacco were less likely to experience discovered experiences. This accords well with the prediction of Proposition 1. Due to the fact that cotton production was more laborious for slaves *vis-a-vis* tobacco, it was more likely that the utility garnered from toiling in the service of their slaveowner was less than the w necessary to prevent them from rebelling. Moreover, perspicacious and profit-oriented cotton planters, aware of the taxing nature of cotton production and the desire of their chattels to rebel, put forth greater efforts to uncover such plots, leading to more discovered conspiracies. Conversely, slaves on tobacco plantations enjoyed a relatively less arduous work regime, and were therefore less inclined to risk the severe punishment that was doled out in the wake of a failed rebellion. As a result, tobacco planters presiding over a relatively less militant pool of slaves were less likely to voluntarily incur the costs associated with greater surveillance, and therefore discovered conspiracies were less likely in those areas where tobacco was most productive.

A plausible detraction from the preliminary results presented in Table 2 is that the coefficient estimates suffer from an omitted variable bias. It could be the case, for example, that counties in the Upper South were simply less productive in tobacco and cotton than those in the Lower South, and it is this correlation that is driving the results. Figure 4 lends potential support to this claim, as the areas of Southern

Table 3: GAEZ-Predicted Productivity and Insurrections

	LPM		Probit		R.E. Logit	
	EvConsp	EvInsurrect	EvConsp	EvInsurrect	EvConsp	EvInsurrect
CotProd	1.49***	.524***	5.34***	4.02**	9.18***	7.07***
	(4.27)	(3.17)	(4.39)	(2.38)	(3.71)	(3.05)
TobacProd	-1.07***	-.232*	-3.59***	-1.75*	-6.11***	-3.17**
	(-4.61)	(-1.76)	(-5.00)	(-1.82)	(-4.43)	(-2.00)
DistNorth	.001	-.003	.003	-.002	.001	-.001
	(.72)	(-.29)	(.89)	(-.54)	(0.65)	(-0.37)
NumYears	.003	.002	.009	.013	.014	.023
	(1.28)	(1.45)	(1.46)	(1.56)	(1.27)	(1.21)

Dependent variable is an indicator for whether an insurrection or discovered conspiracy occurred within a given county in the period 1800-1860. Coefficient estimates are reported for Linear Probability Model (LPM), probit and rare-event logit specifications. See King and Zeng (2001) for a discussion of the advantages and drawbacks of rare-event logit models. T-statistics are reported in parentheses, with heteroskedasticity-robust standard errors employed in the estimation. Significance levels reported are as follows: * $p<0.10$, ** $p<0.05$, and *** $p<0.01$.

Louisiana and Eastern Texas exhibit a greater predicted productivity in tobacco than Kentucky, Tennessee or Virginia. To control for this potentiality, Table 3 presents estimates in which the Euclidean distance of each county to the nearest free state (*DistNorth*), has been included. As is clear from the table, the addition of this variable does not qualitatively alter the coefficient estimates.

Table 4 presents coefficient estimates in which geographic independent variables *DistRiver* and *DistCity*, described in Section 3.3, have been included. Once again, the inclusion of these additional variables does not qualitatively alter the relationship between cotton and tobacco productivity and insurrections and discovered conspiracies. Table 4 also accords well with the predictions of Proposition 1, which argued that as the costs associated with evading capture decrease, surveillance effort by slaveowners increases and the propensity for slaves to rebel increases. The variables *DistCity* and *DistRiver* may be considered proxies for such costs. As was argued above, often times cities served as a convenient embarkation point for more distant destinations, but also as a place for temporary refuge. By virtue of being near a Southern city rebel slaves were able to reach distant destinations, and evade capture in the meantime, at a lower cost than slaves whose plantations were in the hinterlands. In line with the prediction of Proposition 1, this smaller cost incentivized slaveowners to put forth a greater degree of surveillance effort, which led to greater success in uncovering slave plots.

Perhaps counter intuitively, a nearness to navigable rivers also imposed greater costs associated with evading capture, as river depots often served as sites of intense,

Table 4: Productivity, Geography and Insurrections

	LPM		Probit		R.E. Logit	
	EvConsp	EvInsurrect	EvConsp	EvInsurrect	EvConsp	EvInsurrect
CotProd	1.09***	.340*	4.832***	3.215*	7.87***	5.52**
	(2.91)	(1.94)	(3.71)	(1.78)	(3.07)	(2.17)
TobacProd	-.831***	-.083	-3.153***	-1.002	-5.17***	-1.75
	(-3.33)	(-0.60)	(-4.21)	(-.099)	(-3.59)	(-1.03)
DistCity	-.001**	-.003	-.00377***	-.000825	-.006**	-.002
	(-2.31)	(-.16)	(-2.80)	(-.47)	(2.53)	(-0.43)
DistNorth	.002	.0003	.000713*	.000145	.012	.0004
	(1.25)	(0.32)	(1.74)	(.26)	(1.39)	(0.29)
DistRiver	.0014**	.001***	.00450***	.00665***	.007***	.012***
	(2.35)	(2.97)	(2.81)	(3.49)	(2.61)	(3.54)
NumYears	.0017	.001	.00478	.00952	.008	.014
	(0.78)	(0.90)	(.79)	(1.09)	(0.72)	(0.76)

Dependent variable is an indicator for whether an insurrection or discovered conspiracy occurred within a given county in the period 1800-1860. Coefficient estimates are reported for Linear Probability Model (LPM), probit and rare-event logit specifications. See King and Zeng (2001) for a discussion of the advantages and drawbacks of rare-event logit models. T-statistics are reported in parentheses, with heteroskedasticity-robust standard errors employed in the estimation. Significance levels reported are as follows: * p<0.10, ** p<0.05, and *** p<0.01.

concentrated slave supervision. As Schweninger (1999, p. 118) states, "in later years, steamboats proved no better means for escape than poling skiffs. With the aid of strict state laws, local authorities searched steamboats regularly for stowaways. In New Orleans, Natchez, Vicksburg, and other ports, departing steamers were inspected, and those who could not prove their status as a freeman or hired slave were subject to arrest." In Virginia, for example, the General Assembly passed a law mandating that no more than one third of the crew of any rivercraft could consist of slaves.[65]

The difficulty of escape along inland waterways was exacerbated by the fact that many slave catchers devoted themselves to patrolling these areas, as expertise in navigating waterways and a network of acquaintances could ensure greater profits than that afforded by hunting down slaves on foot.[66] In addition, impropriety on the part of compassionate steamboat captains was mitigated by legal mandates making them personally responsible, with the threat of fines and criminal prosecution, if they were found to be harboring slaves, even unwittingly. As a result, runaway slaves near such waterways often took circuitous routes into the countryside, and took great pains to avoid rivers in the future, in order to avoid detection and confuse potential captors.[67]

[65] See Egerton (1991).

[66] *Ibid.*, p. 158.

[67] "...Western Virginia and Kentucky slaves found the Ohio River a formidable barrier. Authorities

Such detours would have imposed considerable costs on runaway slaves, who were often forced to traverse rugged terrains in order to bypass river checkpoints. This lends an interpretation to the positive coefficients on *DistRiver* in each of the regressions listed in Table 4 that is in line with the predictions of Proposition 1. Greater distance from navigable waterways ensured that rebellious slaves did not have to bear the additional cost of avoiding river patrols and inspection points, thus incentivizing insurrection. As a result, slaveowners in the open countryside, without the benefit of river slave catchers and patrols, put forth greater private surveillance efforts, leading to a higher incidence of discovered conspiracies.

4.2 Southern Cities, Slave Insurrections and Conspiracies

In order to more comprehensively evaluate the Wade hypothesis described in the Introduction, and take advantage of the dynamic census data available, this section will illustrate the results of panel regressions from the period 1840-1859. Estimation in a panel setting has the distinct advantage that biases due to county-level time-invariant omitted variables may be removed and, under a fixed effect regime, no assumption about the arbitrary correlation between covariates and these omitted variables is required. As noted above, however, regardless of how the fixed effects estimator is implemented, either through county dummies or de-meaning observations from a given county, coefficients on time-invariant covariates cannot be identified. To sidestep this issue, *NavWater* is interacted with year dummies so that its effect in a given time period may still be estimated. In addition, our panel data allows year indicators to be included in each of the regressions below, thus accounting for time-dependent shocks that might bias coefficient estimates.[68]

The model estimated in Tables 5 and 6 below is characterized by Equation (10):

$$I_{i,t\in[t,t+9]} = \alpha + \beta' X_{it} + \gamma\delta_t + \sigma NavWater_i * \delta_t + \Gamma_i + \varepsilon_{it} \tag{10}$$

where $I_{i,t\in[t,t+9]} \in \{EvInsurrect, EvConsp_{i,t\in[t,t+9]}, EvEvent_{i,t\in[t,t+9]}\}$

is an indicator for whether an insurrection, discovered conspiracy or either occurred

in counties along the river were on the lookout for those who might be trying to pass themselves off as hired hands or free persons. At certain jumping off points and portage locations, sheriffs were particularly vigilant." As a result, "when it might be suspected that they would take to the river, some slaves who lived along the Mississippi deliberately struck out across the countryside, away from the river..." (*Ibid.*, p. 112).

[68]Aptheker argues that economic depression brought on by adverse climate conditions placed a greater work burden on slaves, and thus may have been a precipitate of rebellion. Lingering effects of the disastrous rains which struck Louisiana in 1829, for example, will be controlled for in the specification described in Equation (10)

in county i in period $[t, t+9]$, X_{it} is a vector of independent variables of interest, δ_t is a year indicator and Γ_i is a vector of county-level time-invariant omitted variables (fixed effects). As such, a linear probability model (LPM) is utilized in each of the regressions described below, with robust standard errors accounting for the inherent heteroskedasticity that results from these specifications. It should be noted that the coefficient and standard error estimates presented below are not substantially altered when Probit or Logit estimators are employed instead. In the panel regressions county-level fixed effects are utilized unless otherwise stated, as this specification requires less stringent exogeneity assumptions than a random effects analysis, and because a Hausman test points to the former as the preferred model.[69] As a precaution standard errors are also clustered at the county level to control for serial correlation, although the 10-year gap between cross-sections in a given panel should also ameliorate this issue.

One immediate result from Tables 5 and 6, in direct contradiction to the Wade hypothesis described above, is that in the period 1840-1859 the degree of urbanization in a given county appears to have no statistically significant impact on the probability of an insurrection or discovered conspiracy. Moreover, Table 5 illustrates that this result is robust to the inclusion of non-linear terms. In fact, the correlation actually appears to be *negative* in some cases, and this accords with the alternative view of Claudia Goldin that fears of insurrection were not the deciding factor in the decline of urban slavery in the South.

However, a valid criticism that may be leveled at much of the foregoing analysis is that the urban population within a given county is not strictly exogenous in the manner articulated by Wooldridge (2010). It is certainly plausible that omitted variables correlated with a county's urban population have an independent impact on the probability of an insurrection event, therefore biasing each of the results presented thus far. Perhaps laws regulating manumission in a particular county were made more stringent in response to a growing urban population, and this led to greater unrest and outbursts of violence among the slave population.[70] To counter the adverse effects of this potentiality in the private school enrollment is instrumented for the urban population, and the first and second stage results from these regressions are presented in Tables 7-9 below.

Any instrument must satisfy two conditions in order to be valid, namely relevance and excludability. The first of these conditions mandates that the instrument, conditional on any included control variables, must be strongly correlated with the endoge-

[69] Wooldridge (2010, p. 288), however, argues that the Hausman test requires strict exogeneity of regressors under both the null and alternative hypotheses, which rules out any feedback from the dependent variable to future values of the independent variables.

[70] Wade (1964) provides some evidence for this claim.

Table 5: Urbanization and the Probability of an Insurrection Event

	EvInsurrect	EvConsp	EvEvent
UrbPop	-0.00000369	-0.0000329	-0.0000160
	(-0.45)	(-1.99)	(-0.65)
UrbPop^2	1.38e-11	5.02e-10	1.33e-10
	(0.11)	(1.91)	(0.35)
UrbPop^3	7.23e-18	-1.81e-15	-3.49e-16
	(0.02)	(-1.87)	(-0.24)
SlavePop	0.0000106	-0.00000161	0.0000126
	(1.24)	(-0.19)	(1.09)
1850 Indicator	-0.000886	0.0309***	0.0216
	(-0.10)	(3.43)	(1.67)
NavWater*1850	-0.00470	-0.00693	-0.00383
	(-0.38)	(-0.36)	(-0.16)

Dependent variable is an indicator for whether an insurrection, conspiracy or either occurred in a given county in the period 1840-1859. Standard errors are clustered at the county level and county fixed effects are included for all regressions shown. T-statistics are reported in parentheses, with significance levels reported as follows: * p<0.10, ** p<0.05, and *** p<0.01.

nous variable, in this case a county's urban population.[71] Table 7 displays results from the first-stage regression of urban population on private school enrollment (*PrivSchl*). As is evident, the instrument is highly correlated with *UrbPop* indicating, as one might expect, that in the years 1840 and 1850 private schools were far more rare in rural areas. It should also be noted that the F-statistic from this regression is 22.87, well above the widely accepted lower-bound of 10.

In order for this instrument to satisfy its exclusion restriction, it must be the case that, conditional on any included controls, private school enrollment does not have any *independent* impact on the probability of an insurrection. As a first step in arguing for the excludability of private school enrollment, it should be noted that laws banning the literacy of slaves in many states precluded their association with any schools, private or otherwise. One might argue that high private school enrollment in a given county may be indicative of relatively abundant income, which may have a partial effect on the probability of an insurrection event. To counter this possibility, the value of manufacturing output, agricultural output, manufacturing investment and manufacturing employment are included as controls, the idea being that these serve as reasonable proxies for income. Lastly, as a further precaution any effects that higher private school

[71]Indeed if this is not the case, the cure may be worse than the disease. See Stock et al. (2002) for a discussion of the adverse effects of "weak" instruments.

Table 6: Free blacks, slave density and Insurrection Events

	EvInsurrect	EvConsp	EvEvent
UrbPop	-0.000000611	0.00000381	-0.00000116
	(-0.41)	(1.25)	(-0.33)
Freeblk	-0.00000885	-0.0000943***	-0.0000398
	(-1.33)	(-4.47)	(-1.26)
Slvdensity	0.163	0.202	0.530*
	(1.24)	(0.81)	(1.90)
1850 Indicator	0.00463	0.0256***	0.0227*
	(0.71)	(2.75)	(1.95)
NavWater*1850	-0.00529	-0.0139	-0.00602
	(-0.42)	(-0.72)	(-0.25)

Dependent variable is an indicator for whether an insurrection, conspiracy or either occurred in a given county in the period 1840-1859. Standard errors are clustered at the county level and county fixed effects are included for all regressions shown. T-statistics are reported in parentheses, with significance levels reported as follows: * $p<0.10$, ** $p<0.05$, and *** $p<0.01$.

enrollment may have on literacy rates among the white population is also controlled for, although it is not immediately clear why this would affect the incidence of slave rebellion.

The results presented in Tables 8 and 9, differentiated by the inclusion of either fixed or random effects, offer further evidence against the hypothesis that slave insurrections and discovered conspiracies were more prevalent in urban versus rural counties in the period 1840-1859. In the fixed-effects regression the sign on UrbPop is positive when the dependent variable is *EvConsp*, but the coefficient is not statistically significant. Moreover, the random effects specification in Table 9 implies that discovered conspiracies were more likely the larger the urban population.

These results appear to be in direct contradiction to the results presented in Section 4.1. How is it possible that in the period 1800-1859 distance to the nearest city is positively correlated with discovered conspiracies, while the incidence of these events is not significantly greater in Southern cities in the period 1840-1859? An explanation which accords with Proposition 1, and offers a more nuanced interpretation of the Wade hypothesis, is that Southern cities put forth greater efforts to police and surveil their slave populations during this period. According to Wade (1964, p. 227), the liberties granted to slaves as a result of their urban environs kept slaveholders in a perpetual state of suspicion and fear, and as a result "papers continued to demand increased police vigilance, municipal officials sought wider powers and additional arms from state government, and

Table 7: First Stage Regression

	UrbPop
PrivSchl	3.475***
	(4.01)
ManProduct	0.00175***
	(3.45)
ValAgProduction	-0.000148
	(-0.81)
ManEmpl	0.660
	(1.48)
WhtIllitPop	0.334**
	(2.58)
SlavePop	-0.0506
	(-0.69)
_cons	143.2
	(0.57)

Dependent variable in this regression is urban population in county i in period t. Independent variable of interest is private school enrollment, with controls for slave population, literacy, manufacturing employment, manufacturing production and agricultural production. Standard errors are clustered at the county level, and county fixed effects are included. T-statistics are reported in parentheses, with significance levels as follows: * p<0.10, ** p<0.05, and *** p<0.01.

vigilante committees stood ready to quash the colored rebels."[72] These factors led to an inherent and incontrovertible incompatibility between urbanization and slavery that ultimately led to the decline of Southern industry, as urban slaveowners took great pains to mitigate the rebelliousness that city life instigated among their chattels slaves.[73] To this end, Radford (1976) notes the elaborate fortifications built by slaveowners in Charleston in an attempt to maintain the isolation, segregation and subservience of slaves.[74] Moreover, Wade (1964, p. 100) and Hadden (2001) highlight the prevalence

[72]In addition Wade (1964, p. 242) writes, "Rumors of plots and imminent uprising marked the ordinary routine of every city. If whites learned to live with this anxiety, they could not long forget it. Just as the patrols, whipping posts, and auction blockes reminded Negroes of their servitude, so these symbols made the townspeople aware of their own insecurity." Sheldon (1979, p. 36) makes a similar point when describing the reaction of Richmond, VA citizens to a discovered conspiracy during the War of 1812. It should be reiterated that Wade was not the first to highlight the problem of slave control in Southern cities, as this observation is found in the work of Cairnes (1862), Wesley (1927) and Eaton (1960).

[73]"Newspapers and tracts, the gossip around town, even the conversation in the master's house, indicated that many Americans believed slavery to be evil, or at least unjust. This perception resulted in constant unrest among a significant number of urban slaves, an unrest that manifested itself not only in persistent pressure to widen the latitude within slavery but also in sporadic attempts to get outside it by escape or mutiny." *Ibid.*, p. 209.

[74]Radford also argues that this system of control was the precursor to state-instituted segregation

Table 8: Two-Stage Least Squares with County Fixed Effects

	EvInsurrect	EvConsp	EvEvent
UrbPop	-0.0000127	0.0000269	0.0000136
	(-0.68)	(1.90)	(0.51)
Slvdensity	-0.109	0.256	0.242
	(-0.76)	(0.86)	(0.76)
Freeblk	-0.0000289	-0.0000999***	-0.0000531*
	(-1.92)	(-5.67)	(-1.96)
ValManufactProduct	2.97e-08	-3.61e-08	-5.67e-08
	(0.67)	(-0.98)	(-0.80)
ValAgProduction	-2.57e-08	4.06e-08	2.26e-09
	(-0.80)	(0.89)	(0.04)
ManEmpl	0.0000257	-0.0000107	0.0000512
	(1.05)	(-0.59)	(1.19)
WhtIllitPop	-0.0000184	-0.0000412	-0.0000661
	(-0.88)	(-1.54)	(-1.89)
SlavePop	0.0000134	-0.00000948	0.00000692
	(1.37)	(-0.79)	(0.37)
1850 Indicator	0.0101	0.0262*	0.0386*
	(1.16)	(2.13)	(2.36)
NavWater*1850	-0.00916	-0.0118	-0.00689
	(-0.65)	(-0.58)	(-0.26)

Dependent variable is an indicator for whether an insurrection, discovered conspiracy or either occurred in county i in period t. Standard errors are clustered at the county level, and county fixed effects are included for all regressions. T-statistics are reported in parentheses, with significance levels as follows: * p<0.10, ** p<0.05, and *** p<0.01.

of volunteer slave patrols, or night watches, among the slaveowning community, particularly in the wake of slave unrest.[75] Indeed, travelers to the antebellum South such as Frederick Law Olmsted noted that beyond the outwardly amenable relations between slave and slaveowner "you come to police machinery such as you never find in towns under free governments: citadels, sentries, passports, grape-shotted cannon, and daily public whippings...for accidental infractions of police ceremonies."[76]

witnessed in the postbellum period.

[75]"In St. Louis the police seemed so inadequate that in the midst of rumored slave unrest, a public meeting urged the establishment of a vigilante network in each ward to enforce the Negro statues. In 1835 a public meeting in Mobile, also reacting to presumed colored agitation, set up 'volunteer companies' in each neighborhood...Such sentiment was sporadic, but is recurrence reflected both the extent of the anxieties of the white and the inability to find really effective means to control the colored population."

[76]Olmsted (2010, p. 444).

Table 9: Two-Stage Least Squares with County Random Effects

	EvInsurrect	EvConsp	EvEvent
UrbPop	-0.00000370	0.0000214*	0.00000898
	(-0.31)	(1.87)	(0.57)
Slvdensity	-0.00360	0.0574**	0.0696*
	(-0.20)	(2.12)	(1.77)
Freeblk	-0.00000137	-0.0000339	-0.00000187
	(-0.08)	(-1.17)	(-0.07)
ValManufactProduct	-1.23e-09	-3.25e-08	-2.60e-08
	(-0.04)	(-0.84)	(-0.66)
ValAgProduction	-2.56e-08	8.01e-08	3.28e-08
	(-0.60)	(1.35)	(0.46)
ManEmpl	-0.000000265	-0.0000281	-0.0000295
	(-0.01)	(-0.98)	(-0.58)
WhtIllitPop	-0.0000237**	0.0000192	-0.0000159
	(-2.27)	(1.42)	(-0.90)
NavWaterway	0.0149*	0.0364***	0.0514***
	(1.80)	(3.23)	(3.73)
TotPop	0.00000414	-0.00000702	0.000000459
	(0.92)	(-1.34)	(0.07)
1850 Indicator	0.00976	0.0216**	0.0275**
	(1.60)	(2.01)	(2.04)
NavWater*1850	-0.00956	-0.0138	-0.0124
	(-0.79)	(-0.64)	(-0.58)

Dependent variable is an indicator for whether an insurrection, discovered conspiracy or either occurred in county i in period t. Standard errors are clustered at the county level, and county random effects are included for all regressions. T-statistics are reported in parentheses, with significance levels as follows: * p<0.10, ** p<0.05, and *** p<0.01.

The increased police presence in Southern cities can be empirically verified through the use of occupational data garnered from the Integrated Public Use Microdata Series (IPUMS) at the Minnesota Population Center, University of Minnesota, described in Data Section 3.4. The first column of Table 10 presents results from a random-effects[77] panel regression of the form:

$$GuardLabor_{it} = \alpha + \beta_1 SlaveState_i + \Pi_{it} + \gamma\delta_t + \Gamma_i + \varepsilon_{it}, \tag{11}$$

where $GuardLabor_{it}$ refers to the number of policemen, sheriffs, constables, etc. in urban minor civil division (MCD) i in period t, $SlaveState_i$ is an indicator for whether a given MCD falls within a slave state, δ_t is a year indicator, Γ_i is a vector of county-level

[77]Once again, a fixed-effects specification cannot be employed because the independent variable of interest, *SlaveState*, does not vary over time.

time-invariant omitted variables (random effects) and Π_{it} is a vector of controls. Included in Π_{it} in are measures for total urban population, total foreign-born population, income, proportion of the labor force in manufacturing and proportion of the labor force in finance.

Table 10: Police Occupations and Urbanization, Random Effects Regressions

	(1) GLS Estimator	(2) Between Estimator
SlaveState	83.36***	76.848***
	(4.13)	(4.26)
UrbPop	-0.093	0.003
	(-1.18)	(0.00)
Foreign	0.072***	0.005***
	(4.02)	(2.11)
Income	0.0132	0.0595
	(0.26)	(1.14)
Prp. In Manufacturing	-126.150	-50.129
	(-1.49)	(-0.53)
Prp. in Finance	4290.39	2797.247
	(1.49)	(1.22)
1860 Indicator	0.947	7.866
	(0.24)	(1.38)

Dependent variable is guard labor in MCD i in period t. Column 1 implements a generalized least squares estimator with standard errors clustered at the MCD level, while column 2 implements the Between estimator with bootstrapped standard errors.T-statistics are reported in parentheses, with significance levels as follows: * $p<0.10$, ** $p<0.05$, and *** $p<0.01$.

β_1 is the coefficient of interest in this regression, and the results of Table 10 suggest that urban MCD's in slave states, on average, employed between 77 to 83 more policemen, patrolmen, marshals, etc., than MCD's in northern states, while controlling for demographic and economic factors. Moreover, this regression controls for the possibility that police forces were larger in Southern cities simply because their immigrant populations were larger. A potential detraction from the estimates in Table 10, however, is that factors associated with whether a given MCD belonged in a slave state bias the coefficient estimates. Or it could be the case that economies of scale in slave supervision, coupled with the fact that northern cities were, on average, much larger than southern cities, lead to a misleading picture of policing in the urban South. To alleviate these concerns, I implement a matching estimator as proposed by Abadie et al. (2004). This procedure benefits from an ability to correct for the bias in coefficient estimates and inconsistent standard error estimation that often hinder standard propensity score

Table 11: Police Occupations and Urbanization, Matching Estimator

	1850	1860
Guard Labor	24.74***	21.30
	(2.28)	(1.79)

Dependent variables are guard labor in MCD i in 1850 and 1860. Reported results are the coefficient on *SlaveState* from the implementation of a matching estimator as described by Abadie et al. (2004). Northern and Southern MCD's were matched using economic and demographic data. Z-scores are reported in parentheses, with significance levels as follows: * p<0.10, ** p<0.05, and *** p<0.01.

matching methods.[78] Using aggregated IPUMS data from 1850 and 1860, southern and northern urban MCD's are matched according to economic characteristics such as average income, proportion of labor force in manufacturing, proportion of labor force in finance and total real estate property and demographic characteristics such as total population and share of population identified as immigrant. Table 11 presents the coefficient estimates, or the average treatment effect of being in a slave state, using 1850 and 1860 occupational data. As can be seen from the table, the impact of being in a Southern MCD on the size of police forces is qualitatively similar to that presented in Table 10. In 1850, southern MCD's had on average roughly 25 more policemen, patrolmen, marshals, etc. than those in northern MCD's, and the difference is significant at the 5% level. The coefficient estimate from 1860 is qualitatively similar, although a larger standard error detracts from the significance.

These results suggest an explanation for the absence of correlation between urbanization and slave unrest that accords both with Proposition 1, and a more subtle reading of Wade (1964). The difficultuy of slave supervision in Southern cities was overcome through the use of larger, more organized police forces, whose genesis had yet to occur in the North. As such, to the extent that problems of slave management in Southern cities led to geater costs being borne among the slaveholding community, a more nuanced reading of Wade's (1964) fundamental argument remains valid.

5 Conclusion

This paper investigates the relationship between various factors, such as geography and urbanization, and the incidence of slave unrest in the antebellum South. I develop a novel, theoretical model of slave rebellion to determine how the arduousness of the work

[78]See Abadie and Imbens (2006), for example.

regime, and the costs associated with a successful revolt, impact the calculus of slaves as well as that of their owners in determining the optimal level of surveillance. The model predicts that as the work regime becomes more strenuous, and the costs borne by slaves in the event of a successful rebellion become less severe, insurrection becomes more likely. As a result, these same parameter deviations incentivize greater surveillance on the part of slaveowners attempting to stymie such plots before they can be brought to fruition. To test these assertions, I compiled a novel dataset using predicted cotton and tobacco productivities from the FAO's GAEZ database, geographic variables calculated using arcGIS software, records of slave unrest compiled by Aptheker (1993), county-level census data and MCD-level occupation data. Various regressions utilizing incidences of slave unrest in the period 1800-1860 imply that slave insurrections and discovered conspiracies were in fact more likely in cotton producing counties, as predicted by the model. In addition, proxies for the costs borne by slaves in the wake of a rebellion, such as distance to the nearest river or Southern city, were shown to have a significant impact on the prevalence of insurrections and discovered conspiracies. Counties that were closer to Southern cities and farther away from navigable rivers were shown to be significantly more likely to experience a discovered conspiracy in the period 1800-1859. However, this relationship between urbanization and discovered conspiracies disappears in the period 1840-1860. This evidence, coupled with the occupational data supplied in the IPUMS, suggests a greater degree of surveillance on the part of slaveowners in these areas, as predicted by my theoretical model.

6 Appendix

6.1 Geographic Data Summary Statistics

Table 12: Summary Statistics for GAEZ and Geographic Data

	CotProd (t/ha)	TobacProd (t/ha)	DistRiver (mi)	DistCity (mi)	DistNorth (mi)
mean	.2123	.4915	32.828	75.5635	258.5748
s.d.	.0917	.1443	40.8814	53.5020	186.6176
min	0	0	0	0	0
max	.4212	.8369	201.5633	305.0933	785.953

"CotProd and "TobacProd" refer to predicted productivities in tons per hectare obtained from the GAEZ database, and the method for arriving at these estimates is described in detail in Section 3. "DistRiver", "DistCity" and "DistNorth" variables refer to the Euclidean distance, in miles, from the midpoint of each county to that feature, respectively.

6.2 Census Data Summary Statistics

Table 13: Population Statistics for 1840-1859 Panel, by Year

	UrbPop	SlavePop	WhtPop	TotPop
1840				
mean	637.2774	3326.502	6210.327	9824.855
standard deviation	5753.379	4086.69	5812.114	8936.076
min	0	3	384	821
max	102313	58539	105331	134379
1850				
mean	1093.656	4079.889	7581.049	11975.83
standard deviation	8743.838	4512.572	8931.344	11719.13
min	0	29	395	1314
max	169054	44376	174853	210646
Total				
mean	865.4668	3703.196	6895.688	10900.34
standard deviation	7402.233	4319.91	7563.49	10472.8
min	0	3	384	821
max	169054	58539	174853	210646

Table 14: Agricultural, Manufacturing and Education Statistics for 1840-1859, by Year

	ValManProd	ManInvest	ManEmpl	ValAgProd	PrivSchl
1840					
mean	65549.84	70585.42	247.264	469382.9	74.80758
standard deviation	282374.9	225823.1	593.3811	459252	151.2863
min	0	0	0	0	0
max	5881778	4294702	11229	2845941	2372
1850					
mean	234003.4	126430	213.8188	634524.2	131.5627
standard deviation	1361218	520948	1087.001	513602.6	367.7554
min	0	0	0	34561	0
max	2.45e+07	9929332	23863	4069086	7244
Total					
mean	151058.1	98932.52	230.287	553209.8	103.6169
standard deviation	993102.2	404397.8	879.1472	494377.7	284.0282
min	0	0	0	0	0
max	2.45e+07	9929332	23863	4069086	7244

Table 15: 1860 Agricultural Summary Statistics

	CotProd (tons)	TobacProd (tons)	More100	More500
mean	742.13	129.61	184.37	15.79
standard deviation	1944.10	500.13	186.846	27.71
min	0	0	0	0
max	28298.6	6723.28	1325	197

6.3 IPUMS Data Summary Statistics

Table 16: Occupational and Foreign-Born Statistics, By Year

	GuardLabor	ForeignBorn
1850		
mean	3.82	2.39
standard deviation	67.11	28.76
min	0	0
max	5155	2387
1860		
mean	4.48	2.88
standard deviation	96.44	40.91
min	0	0
max	8056	3880

Data are taken from the IPUMS 1850 and 1860 occupational data, and 1950 occupational classification guidelines are utilized. *GuardLabor* is defined as the number of households in a given MCD reporting a member whose occupation was either “patrol, watchman, or doorkeeper” (code 763), “marshal or constable” (code 771), “policeman or detective” (code 773), or “sheriff or bailiff” (code 782).

6.4 Multicollinearity of Geographic Variables

Table 17: Multicollinearity Diagnostics for Independent Variables

	VIF	$\sqrt{\text{VIF}}$	Tolerance	R-Squared
CotProd	2.75	1.66	0.367	0.6363
TobacProd	2.65	1.63	0.3767	0.6233
DistCity	1.14	1.07	0.8742	0.1258
DistNorth	1.65	1.28	0.6070	0.3930
DistRiver	1.18	1.08	0.8506	0.1494

This table presents multicollinearity diagnostics for the variables utilized in estimating equation (9). See Data section for description of the construction of each of these variables.

7 Acknowledgements

I would like to thank Stergios Skaperdas, Dan Bogart and Michael McBride for their invaluable comments. I also thank the Center for Citizen Peacebuilding at the University of California, Irvine, as well as the Institute on Global Conflict and Cooperation at the University of California, San Diego for their generous support.

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