Black Networks After Emancipation: Evidence from Reconstruction and the Great Migration

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Abstract

We find that southern blacks responded collectively to political and economic opportunities after the Civil War, but only in places where strong social ties emerged as an unintended consequence of the antebellum organization of production. Black population densities varied substantially across counties in the postbellum South, depending on the crops that were grown during and after slavery. In those counties where black population densities were large, social interactions would have been more frequent, resulting in stronger social ties. These social ties would have supported larger (and more effective) networks, which, in turn, would have supported greater political participation during Reconstruction and the movement to northern cities during the Great Migration. Our theoretical model places additional structure on this relationship: networks will not form and there will be no association between population density and the outcomes of interest up to a threshold density, followed by a positive association above the threshold. This specific nonlinearity, characterized by a slope discontinuity at a threshold, is central to our identification strategy. Voting and migration patterns across counties are consistent with the theory - there is no association with our crop-based measure of black population density up to a threshold point at which a steep, monotonic relationship begins. This finding is robust to rigorous testing, and these tests show that competing hypotheses do not exhibit similar nonlinear patterns. Blacks from southern counties with large population densities accounted for a majority of the northern migrants, and these migrants appear to have benefited from network externalities, as they moved to the same destination cities.


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1 Introduction

Were African-Americans able to overcome centuries of social dislocation and form viable communities once they were free? This question has long been debated by social historians, and is relevant both for contemporary social policy and for understanding the process of social capital formation. The traditional view was that slavery, through forced separation and by restricting social interaction, permanently undermined the black community (Du Bois 1908, Frazier 1939, Stampp 1956). This was replaced by a revisionist history that documented a stable, vibrant African-American family and community, both during and after slavery (Blassingame 1972, Genovese 1974, Gutman 1976). More recently, Fogel (1989) and Kolchin (1993) have taken a position between the traditional and the revisionist view; while other social scientists have brought the literature around full circle by asserting that “[s]lavery was, in fact, a social system designed to destroy social capital among slaves” (Putnam 2000: 294).

Despite the importance of and continuing interest in black social capital after slavery, there has been virtually no quantitative investigation in this area. We cannot examine the impact of slavery on social capital – i.e. the social capital that would have prevailed in the absence of slavery. What we can study is the equally important question of whether (and where) blacks formed networks soon after slavery ended. In the decades following the Civil War, two significant opportunities arose for southern blacks to work together to achieve common objectives. First, blacks were able to vote and elect their own leaders during and just after Reconstruction, 1870-1890. Second, blacks were able to leave the South and find jobs in northern cities during the Great Migration, 1916-1930. We find that southern blacks did form networks in both these events, but only in places where specific historical preconditions existed.

The identification of network effects is a challenging statistical problem. One issue that often arises is that the size or density of the network could be correlated with unobserved variables that directly determine the outcomes of its members. With our historical application, an additional issue is that black networks after Emancipation cannot be directly measured. Our solution to the statistical problem is to identify an exogenous variable that plausibly determines the size and effectiveness of the network, and then to theoretically derive and test the specific relationship between this variable and outcomes such as political participation and migration that we expect to be affected by underlying networks.

The starting point for our analysis is the observation that black population densities varied substantially across counties in the postbellum South, depending on the the crops that were grown in the local area. Where labor intensive crops such as tobacco, cotton, rice, and sugarcane were grown, black population densities tended to be large. Where crops...
such as wheat and corn were grown, blacks were dispersed more widely. These cropping patterns could be traced back to decisions made by white landowners in the antebellum period. Variation in black population densities was an unintended consequence of those decisions. In those counties where black population densities were large, social interactions would naturally have been more frequent, resulting in stronger social ties. These social ties would have supported larger (and more effective) networks, which, in turn, would have supported greater political participation and migration, as described below:

\[ \text{population density} \rightarrow \text{social ties} \rightarrow \text{network size} \rightarrow \text{political participation and migration}. \]

While a positive relationship between population density and particular outcomes during Reconstruction and the Great Migration may be consistent with the presence of underlying black networks, other explanations are available. For example, racial conflict could have been greater in counties with larger black population densities, resulting in greater black voter turnout during Reconstruction and greater movement to northern cities during the Great Migration. Alternatively, economic conditions in more densely populated counties could have encouraged greater political participation and migration. Our strategy to identify a role for networks is to place additional theoretical structure on the relationship derived above.

In the model developed in this paper, a group of blacks work together to provide a service to a local political leader during Reconstruction or a northern firm during the Great Migration, receiving payoffs in return. Social ties allow the network to function more effectively. Nevertheless, under reasonable conditions, networks will not form below a threshold level of social ties. Above this threshold, the size of the largest network that can be supported in equilibrium is increasing in social ties. These prediction are derived in terms of network size and social ties, neither of which are directly observed. If we assume that outcomes such as political participation and migration are increasing in network size and that social ties are increasing in population density, then the predictions of the model can be restated in terms of population density and the outcomes of interest. There should be no association between these outcomes and population density up to a threshold and a positive association thereafter. This specific nonlinearity, characterized by a slope discontinuity at a threshold, is central to our identification strategy.

We derive and apply formal statistical tests of this prediction to the two outcomes of interest. Blacks could vote and elect their own leaders for a brief period during and just after Reconstruction (Morrison 1987, Foner 1988). They would have voted for the Republican Party (the party of the Union) at this time; and so black political participation in each county can be measured by the number of Republican votes. We find that Republican votes in national and state-wide elections during the 1870s match the specific nonlinearity, with a slope discontinuity, implied by the model. Since race-specific voting data are not available, we also examine the relationship between population density and the probability that a
black leader was elected by the county to the State Senate or House. The patterns match
those of Republican votes, consistent with the presumption that black (Republican) voters
would have wanted to elect members of their own race. Southern blacks were gradually
disfranchised from the late 1880s through the 1890s as Jim Crow laws took effect. We find
no association between population density and Republican votes in 1900, which provides
further evidence that the nonlinear voting patterns of the 1870s were primarily driven by
blacks.

Although black disfranchisement was complete by 1900, a new opportunity arose with
the Great Migration. Over 400,000 blacks moved to the North between 1916 and 1918 (ex-
ceeding the total number who moved in the preceding 40 years), and over one million left by
1930 (Marks 1989). The standard explanation for this movement, which varied substantially
across southern counties, is that it was driven by the individual response to external factors
that include the increased demand for labor in the wartime economy (Mandle 1978, Got-
tlieb 1987); the decline in cotton acreage due to the boll weevil invasion (Marks 1983); the
segregation and racial violence that accompanied Jim Crow laws (Tolnay and Beck 1990);
and the arrival of the railroads (Wright 1986). Scant attention has been paid to the internal
forces that would have supported community-based migration. This is surprising given the
voluminous literature on networks in international and internal migration. Providing a new
perspective on the Great Migration, we find that the relationship between population density
and various measures of black migration match the predictions of our network-based model
once again - there is no correlation up to a threshold and a steep, monotonic association
thereafter.

Our primary measure of out-migration is derived from changes in the black population in
southern counties during the Great Migration, adjusting for natural changes due to births and
deaths. We cross-validate this measure with another one constructed from newly-available
data, which contain the city-of-residence in the 1970s (and after) of people born in Mississippi
between 1905 and 1925, as well as the person’s county of birth. While the year of migration
is unknown, these data provide a direct measure of migration at the county level. This
measure is highly correlated with the population change measure, and both variables show
the same nonlinear association with population density across Mississippi counties that we
observe across all southern counties.

Since the Mississippi data contain the (final) destination city of each migrant, we can test
another prediction of the theory. Migrants who are networked will move to the same place,
whereas those who move independently will be spread across the available destinations. If
variation in migration levels across southern counties is driven by underlying networks, then
this implies that the number of black migrants and the spatial concentration of these migrants
across destinations will track together. As predicted, the Herfindahl-Hirschman Index (HHI)
of spatial concentration across destination cities for the Mississippi migrants is uncorrelated with population density up to the same point as the level of migration, and steeply increasing in the density thereafter.

Our measure of black population density is based on the postbellum distribution of crops in the county, taking into account differences in labor intensity (workers per acre) across crops. The crop distribution can be traced back to decisions made by white landowners prior to Emancipation and we verify that the results are robust to using that part of the variation in the postbellum population density that can be explained by antebellum cropping patterns. Having established the presence of a robust nonlinear relationship between (predetermined) population density and both political participation and migration, this paper concludes by considering alternative explanations that do not rely on a role for networks. The first explanation posits that an external agency, such as the Republican Party or a Northern labor recruiter, solved the commitment problem and organized black voters or migrants. A related alternative explanation, which is most relevant during Reconstruction, is that blacks would only turn out to vote when they were sufficiently sure they could elect their own leader. As shown below, both explanations imply that voting and migration levels should shift discontinuously at a threshold population density, which is inconsistent with the data.

Another possibility is that individuals vote and migrate independently in response to external forces that vary across counties. To generate the patterns we observe in the data there must be little variation in these forces up to a threshold density and a positive association with population density thereafter. We find that none of the push factors listed above that are typically associated with the Great Migration exhibit a nonlinear relation with population density; indeed their associations with population density are weak. While these factors may have been important for individual decisions to migrate, they cannot explain why the majority of black migrants came from high population density counties. We cannot rule out the existence of unobserved factors that are correlated with both population density and black migration in a way that would generate the same patterns predicted by our theory. However, such factors would also need to explain the matching patterns in political participation fifty years earlier, as well as those we find for black church congregation size, which is our most direct measure of network size. Even then, they would be hard pressed to account for the nonlinear association between population density and the destination-city HHI of blacks from Mississippi. If blacks’ migration decisions were based on factors that did not include a coordination externality, then the probability of moving to the same destination would not track migration levels so closely.

Our statistical tests consistently find that outcomes associated with black networks – Republican votes, election of black leaders, black church size, black migration – have patterns that match the restrictions of our theory. Variables that should not be associated with black
networks – e.g., railroad density, Republican votes after Reconstruction, white church size, and white migration – do not. The implied magnitudes of the network effects are large - for example, over half of the migrants to the North came from the third of southern blacks who lived in the densest counties, while less than fifteen percent came from the third in the least dense counties. Although anecdotal evidence suggests that networks linking southern communities to northern cities did emerge (Gottlieb 1987, Grossman 1989), we are the first to identify and quantify network effects in the Great Migration, an event of great interest across many disciplines. This paper concludes by discussing the significance of this finding for the subsequent evolution of black communities in northern cities.

2 Postbellum Opportunities and Constraints

This section begins by describing two new opportunities that presented themselves to African-Americans in the postbellum period: (i) the opportunity to vote and elect their own leaders during and just after Reconstruction, 1870-1890 and (ii) the opportunity to migrate to northern cities during the Great Migration, 1916-1930. We subsequently discuss the crop-based variation in black population density (and social ties) that would have constrained the response to these opportunities across southern counties. The discussion concludes by describing the construction of our density measure, together with an initial description of the relationship between this measure and both political participation and migration.

2.1 Political Opportunities

Three amendments to the Constitution, passed in quick succession after the Civil War, gave political representation to African-Americans. The 13th Amendment, passed in 1865, abolished slavery. The 14th Amendment, passed in 1866, granted full rights of citizenship to African-Americans. And the 15th Amendment, passed in 1869, gave them the right to vote. This opportunity coincided with the Reconstruction Act of 1867, which put the Confederate states under military (Federal) rule for the next decade. Blacks voted in large numbers for the Republican party during this period and elected their own leaders. But Southern Democrats began to reassert themselves soon after Reconstruction had ended, and southern states began passing legislation from the early 1890s that effectively eliminated blacks from the electorate by 1900 (Du Bois 1908, Morrison 1987, Valelly 2004).

Although external organizations such as the Freedmen’s Bureau and the Union League were active during Reconstruction, the major impetus for African-American political participation came from within (Stampp 1966, Foner 1988).¹ "In record time they organized,

¹At its peak in 1866, the Freedmen’s Bureau employed only 20 agents in Alabama and 12 in Mississippi. It ceased most of its activities by the end of 1868 and was officially abolished in 1872, before black political
sponsored independent black leaders, and committed themselves to active participation ... 
It was now possible for blacks to not only field candidates for election but to influence the 
outcome of elections by voting” (Morrison 1987: 35). During Reconstruction, as many as 
600 blacks sat in state legislatures throughout the South. While this political success is 
impressive, what is even more impressive is the discipline and courage shown by black voters 
in continuing to vote Republican in large numbers and to elect their own leaders through 
the 1880s and even into the 1890s, after Federal troops had left the South (Kolchin 1993).

Where did the black leaders come from? The church was the center of community life in 
the postbellum period and it was natural that black political leaders would be connected to 
this institution (Du Bois 1908, Woodson 1921, Frazier 1964, Dvorak 1988, Valelly 2004). “... 
preachers came to play a central role in black politics during Reconstruction ... Even those 
preachers who lacked ambition for political position sometimes found it thrust upon them” 
(Foner 1988:93). African-American communities did not passively support these leaders. 
The political support they provided gave them leverage, and benefits in return, until they 
were disfranchised towards the end of the nineteenth century (Morrison 1987).

2.2 Economic Opportunities

The first major movement of blacks out of the South after the Civil War commenced in 
1916. Over the course of the Great Migration, running from 1916 to 1930, over one million 
blacks (one-tenth the black population of the United States) moved to northern cities (Marks 
1983). This movement was driven by both pull and push factors. The increased demand 
for labor in the wartime economy coupled with the closing of European immigration, gave 
blacks new labor market opportunities (Mandle 1978, Gottlieb 1987). Around the same time, 
the boll weevil invasion reduced the demand for labor in southern cotton-growing counties 
(Marks 1989, Lange, Olmstead, and Rhode 2009). Adverse economic conditions in the South, 
together with segregation and racial violence, encouraged many blacks to leave (Tolnay and 
Beck 1990). Their movement was facilitated by the penetration of the railroad into the deep 
South (Wright 1986). A confluence of favorable and unfavorable circumstances thus set the 
stage for one of the largest internal migrations in history.

About 50% of South Carolina’s lower house, 42% of Louisiana’s lower house, and 29% of Mississippi’s 
lower house was black during Reconstruction. The corresponding statistics for the upper house were 19% in 
Louisiana and 15% in Mississippi. Blacks accounted for a sizeable fraction of state legislators even in states 
such as Virginia that did not witness a “radical” phase during Reconstruction (Valelly 2004).

There were three phases in the Great Migration: an initial phase, 1916-1930; a slow down in the 1930s; 
and a subsequent acceleration, 1940-1970 (Carrington, Detragiache, and Vishwanath 1996). We focus on the 
initial phase, as do many historians (e.g. Mandle 1978, Gottlieb 1987, Marks 1989) because we are interested 
in black network formation in the decades after Emancipation. Future work discussed in the Conclusion will 
trace the evolution of these networks in northern cities over the course of the twentieth century, linking our 
project to previous contributions in urban economics (e.g. Cutler, Glaeser, and Vigdor 1999, Boustan 2010).
How did rural blacks hear about new opportunities in northern cities? The first links appear to have been established by recruiting agents acting on behalf of northern railroad and mining companies (Henri 1975, Grossman 1991). Independent recruiters, who charged migrants a fee for placing them in jobs, were soon operating throughout the South (Marks 1989). Apart from these direct connections, potential migrants also heard about jobs through ethnic newspapers. For example, the Chicago Defender, which has received much attention in the literature, increased its circulation from 33,000 in 1916 to 125,000 in 1918. Industries throughout the Midwest sought to attract black southerners through classified advertisements in that newspaper (Grossman 1991).

Although external sources of information such as newspapers and recruiting agents played an important role in jump-starting the migration process, and agencies such as the Urban League provided migrants with housing and job assistance at the destination, networks linking southern communities to specific northern cities, and to neighborhoods within those cities, soon emerged (Gottlieb 1987, Marks 1991, Carrington, Detragiache, and Vishwanath 1996). “[These] networks stimulated, facilitated, and helped shape the migration process at all stages from the dissemination of information through the black South to the settlement of black southerners in northern cities” (Grossman 1991: 67).

Two broad classes of jobs were available to blacks in northern cities: unskilled service and manufacturing jobs and skilled manufacturing jobs. Connections were needed to gain access to the skilled jobs and many migrants did find positions with the help of referrals from their network. However, much of the literature on black labor market networks during the Great Migration focuses on information provision rather than job referrals (eg. Grossman in Chicago and Gottlieb in Pittsburgh). “Unlike the kinship networks among European immigrants ... which powerfully influenced the hiring of foreign-born newcomers, the southern blacks’ family and friends apparently had less leverage inside the workplace” (Gottlieb 1987: 79). A number of explanations are available for the apparent weakness of black networks. First, discrimination by employers and the exclusion of blacks from labor unions could have prevented them from entering skilled occupations in the numbers that were needed for networks to form (Grossman 1991, Collins 1997, Boustan 2009). Second, blacks may have been less socially cohesive (on average) than arriving European migrants (Frazier 1939). A black-white comparison is beyond the scope of this paper. But our analysis, based in the South, will take a first step towards explaining variation in the strength of black networks across northern destinations, as discussed in the Conclusion.

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4Whether networks support or restrict migration will depend on the context. In the postbellum South, new networks would have formed to support migration. However, the same networks could have restricted migration (mobility) many decades later once they were established in northern cities.
2.3 Social Constraints

A distinctive feature of the antebellum South was the unequal size of slaveholdings and the uneven distribution of the slave population across counties (Stampp 1956). One-quarter of U.S. slaves resided in plantations with less than 10 slaves, one-half in plantations with 10-50 slaves, and the remaining in plantations with more than 50 slaves (Genovese 1974). This variation arose as a natural consequence of geographically determined cropping patterns and the organization of production under slavery (Wright 1978, 1986). Where plantation crops such as cotton, tobacco, rice, and sugarcane could be grown, slaveholdings and the slave population density tended to be large. However, a substantial fraction of slaves lived in counties with widely dispersed family farms (Genovese 1974).

Following the Civil War, while many blacks did move, most did not abandon their home plantations and those who did traveled only a few miles (Mandle 1978, Foner 1988, Steckel 2000). The black population distribution remained stable, with the county-level population correlation between 1860 and 1890 as high as 0.85. We will also see that antebellum cropping patterns strongly predict postbellum patterns. This implies that black population densities would have been relatively high in counties where labor intensive plantation crops – cotton, tobacco, rice, and sugarcane – were grown historically and continued to be grown.

Social ties that support collective action and punish deviations from cooperative behavior can only form if individuals interact with one another sufficiently frequently on a regular basis. Forced separation would naturally have weakened social ties in the slave population (Du Bois 1908, Frazier 1939). Nevertheless, the slave quarter and the independent informal church that often formed within the quarter, have been identified as domains within which cooperation, mutual assistance, and black solidarity did emerge (Blassingame 1972, Genovese 1974). “[Large plantations] permitted slaves to live together in close-knit communities – the slave quarters – where they could develop a life of their own” (Fogel 1989: 170). Most slaveholdings were too small to support such communities and interactions across plantations were relatively infrequent (Stampp 1956). Social ties that covered a substantial area

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5While just one or two slaves worked on a family farm growing wheat or corn, approximately 100 slaves worked on a rice or sugarcane plantation, 35 on a cotton plantation, and a somewhat smaller number on tobacco plantations (Fogel 1989).

6Federal assistance to former slaves who sought to acquire land was extremely limited (Kolchin 1993). 40,000 blacks in Georgia and South Carolina were granted land for homesteading by General Sherman in 1865, but the land was returned to their original owners by President Johnson. Similarly, only 4,000 blacks, most of whom resided in Florida, benefited from the Homestead Act of 1866. Apart from these limited opportunities, white landowners could also have actively discouraged black sharecroppers and laborers from moving (Naidu 2010).

7The inter-state slave trade frequently separated families and plantation communities. For example, close to one million slaves moved to southwestern cotton states between 1790 and 1860 as production of that crop boomed (Fogel 1989, Kolchin 1993). Although Fogel and Engerman (1974) estimate that 84 percent of the slaves that moved west migrated with their owners, most other historians assign much greater weight to slave sales (Tadman, 1989, for instance, estimates that sales accounted for 70-80 percent of the slave movement).
and linked a sizeable population could thus have only formed after Emancipation, once the restrictions on social interactions were lifted.

Reconstruction was more radical and persistent in the deep South (Kousser 1974, Kolchin 1993). During the Great Migration, the heaviest black out-migration occurred in an area that had been dominated by the plantation cotton economy. “Some counties were characterized by extremely high out-migration, while others maintained relatively stable black populations ... Such intra-state variation raises interesting questions about the causes of the differential migration ... Was the cotton economy particularly depressed? Were blacks subjected to more brutal treatment by whites in those areas? Did economic competition between blacks and whites restrict economic opportunity, and thereby encourage out-migration?” (Tolnay and Beck 1990: 350). Our explanation for (part of) this variation across counties is based on internal rather than external forces. Following the discussion above, black population densities would have been larger in counties where a greater fraction of land was allocated to the four labor intensive plantation crops (not just cotton). Social interactions would have been more frequent and social ties would have been stronger in those counties, allowing blacks to form larger and more effective networks during Reconstruction and during the Great Migration.

To test this hypothesis, the first step is to construct a measure of black population density. The acreage allocated to crops with different labor intensities in a county would have determined this density and so our crop-based measure is defined as follows:

\[ S_{it} = \sum_j \beta_j \frac{A_{ijt}}{A_{it}}, \]

where \( S_{it} \) is black population density in county \( i \) in year \( t \), \( A_{ijt} \) is the acreage allocated to crop \( j \), \( A_{it} \) is total acreage, and \( \beta_j \) is the labor intensity (workers per acre) for crop \( j \). Although crop acreage at the county level is available from the 1880 census onward, our baseline density measure is constructed in 1890, midway between Reconstruction and the Great Migration. We verify that the results are robust to using the average of this measure over the 1880-1900 period.

The baseline density measure restricts the set of crops to cotton, tobacco, rice, and sugarcane, using labor intensities obtained from previously published farm studies. The implicit assumption is that the labor intensity of black workers for other crops is small enough to be ignored. To validate this assumption and to obtain independent estimates of the labor intensities, we estimated the following equation over the 1880-1900 period:

\[ P_{it} = \sum_j \beta_j A_{ijt} + \alpha (A_{it} - \sum_j A_{ijt}) + f_i + \epsilon_{ijt}, \]

where \( P_{it} \) is black population, \( f_i \) is a county fixed effect, and \( \epsilon_{ijt} \) is a mean-zero disturbance term. The fixed effect accounts for individuals who work off the land, which is relevant for
the few counties that were urban in the postbellum South, as well as for very young and very old individuals outside the labor force. These individuals are not potential members of the network and it is important to exclude them when constructing the population density measure. The labor intensities obtained from previously published farm studies and estimated from the equation above are reported in Table 1. Although the two sets of statistics differ to some extent, we verify that the results are robust to using either set. More importantly, the $\alpha$ coefficient, which measures black labor intensity for other crops, is small enough that it can be reasonably ignored.

Looking back at the $S_d$ expression, the density measure can be reinterpreted as the weighted average of the fraction of cultivated land allocated to each of the labor intensive plantation crops, where the weights are now the labor intensities. This weighted statistic is normalized to have the same mean and standard deviation as the unweighted statistic, $\sum_j A_{ijt}/A_{it}$, in the empirical analysis.\(^8\) Normalization has no effect on the shape of the relationship between our crop-based density measure and the outcomes of interest but it allows us to conveniently interpret this measure as the fraction of land allocated to plantation crops (adjusting for differences in labor intensity across those crops). We will often refer to the density measure as the plantation share in the discussion that follows, emphasizing the connection between black population density and cropping patterns.

Figure 1 describes the crop-based population density measure in the 15 southern states in which slavery existed prior to Emancipation.\(^9\) The message to take away from the figure is that there is substantial variation in this statistic across states and, more importantly, across counties within states. We will take advantage of this variation to include state fixed effects in all the results that we report, although the results are very similar with and without fixed effects. Figure 2A provides preliminary evidence on the relationship between plantation share and both political participation and migration. Political participation is measured by the number of Republican votes in the county in the 1872 presidential election, at which point in time blacks could freely vote and elect their own leaders. Migration is measured by black population change in the county from 1910 to 1930 minus the corresponding change from 1890 to 1910 (to control for natural changes in population across counties, as described below). The nonparametric regressions presented in Figure 2A reveal a highly nonlinear relationship between plantation share and both outcomes.\(^10\) Nonlinearities are commonly

\(^8\)The normalization simply involves multiplying the weighted statistic by a constant and then adding another constant term. After this normalization, observations with values exceeding 0.3 are dropped (these outliers account for 1.5 percent of all counties).

\(^9\)The slave states are Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, Missouri, North Carolina, South Carolina, Tennessee, Texas, and Virginia. Among these states, Kentucky, Missouri, Delaware, and Maryland did not join the Confederacy.

\(^10\)State fixed effects are partialled out nonparametrically using a two-step procedure in Figure 2A and all the figures that follow. In the first step, the outcome under consideration (political participation or migration) and each state dummy is separately regressed nonparametrically on plantation share. The residual from the
generated in models with network effects because there is an externality associated with individual participation. The model that we develop below will provide a simple explanation, based on differences in the size of underlying networks across counties, for the nonlinearity we have uncovered in Figure 2A. It will also generate additional predictions that we can take to the data.

3 Theory with a Test

The model developed in this section places additional structure on the nonlinear relationship between black population density and both political participation and migration. We subsequently proceed to develop statistical tests of the model’s predictions. These tests will be used in Section 4 to formally validate the model and to rule out alternative explanations for the empirical results that are obtained.

3.1 Individual Payoffs

There are many economic environments in which individuals cooperate to achieve a common objective. For example, a group of individuals could form a cooperative to work together and jointly produce a good. Alternatively, a group of individuals could form a mutual insurance arrangement, pooling their incomes to smooth consumption on the basis of a pre-specified sharing rule. In the applications that we consider, a group of blacks from a southern county would have come together to provide a service to a principal, receiving benefits in return. The principal could have been, for example, a local political leader during Reconstruction. Members of the network would have canvassed potential voters and turned out themselves in local, state, and federal elections. Once the leader was elected, the network would have worked on his behalf, helping to provide goods and services to the electorate and increasing his chances of reelection. In return for these services, the network would have received a transfer of some sort. Alternatively, a group of black migrants could have worked diligently as a team for one or more northern firms, and helped each other find jobs, during the Great Migration. In a production environment where effort was unobserved by firms, such diligence and mutual support would have resulted in improved employment prospects and favorable wages for the members of the network.

Consistent with previous empirical results, e.g. Munshi (2003), the payoff \( W \) received by each member of the network is increasing in its size, \( N \). We assume that the size effects are declining at the margin, perhaps due to congestion in the network. Social ties, \( \lambda \) are introduced in the model by assuming that they make the network function more effectively.

\[ \text{first regression is then regressed on the residuals from the state-dummy regressions. Using the estimated coefficients, the state fixed effects can be differenced from the outcome under consideration. This differenced variable is nonparametrically regressed on plantation share in the second step.} \]
This could be because the members of the network work better together or because social ties support collective punishments and *ex post* transfers that encourage them to help each other. For analytical convenience, let \( N \) and \( \lambda \) be real numbers. The payoff each individual receives from participation can then be expressed by the continuous function \( W(N, \lambda) \). Based on the discussion above, \( W_N(N, \lambda) > 0 \), \( W_{NN}(N, \lambda) < 0 \), \( W_{\lambda N}(N, \lambda) > 0 \).

Let \( P \) be the population in the local area, which is defined to be small enough that only a single network is active. Individuals outside the network operate independently and we normalize so that their payoff is zero. Using the payoff in autarky as the benchmark, this implies the following boundary condition:

\[
C1. \lim_{\lambda \to 0} W(N, \lambda) = 0 \quad \forall N
\]

This is just saying that there is no additional payoff from belonging to a group, regardless of its size, when social ties are absent (\( \lambda \to 0 \)).

### 3.2 Maximum Stable Network Size

Given the payoffs described above, we now proceed to derive the maximum stable network size, \( N \), that can be supported in a local area. Social ties, \( \lambda \), vary exogenously across local areas, which are otherwise indistinguishable. Our objective is to derive the relationship between \( \lambda \) and \( N \). During Reconstruction, \( N \) would refer to the number of individuals who would have worked together to support the local political leader. During the Great Migration, \( N \) would refer to the size of the network that could be supported at the destination. Although migration is a dynamic process, we can think of \( N \) as the stock of members at a given point in time.

Since \( W(N, \lambda) \) is increasing in \( N \) and we have normalized so that the payoff in autarky is zero, what prevents the entire population from joining the network? To place bounds on network size, we assume that each member incurs a private effort cost \( c \) when it provides the services described above to the principal. Benefits are received up front by the network, with the expectation that each member will exert effort *ex post*. This could well describe the timing of wage setting and work effort in northern jobs, as well as the sequence of transfers (patronage) and community effort during Reconstruction. The commitment problem that arises here is that a self-interested individual will renege on his obligation in a one-shot game. This problem can be avoided if the network interacts repeatedly with the principal. Based on the standard solution to an infinitely repeated game, cooperation can be sustained if individuals are sufficiently patient, i.e. if the discount factor \( \delta \) is large enough so that the following condition is satisfied:

\[
\frac{W(N, \lambda) - c}{1 - \delta} \geq W(N, \lambda).
\]
The term on the left hand side is the present discounted value of cooperation for each individual. The right hand side describes the payoff from deviating. In the first period, the deviator receives the usual per capita payoff without incurring the effort cost. Although effort is not observed immediately, shirking is ultimately revealed to the principal at the end of the period. A single network operates in each county and the usual assumption is that deviators will be excluded from the group forever after. Since individuals operating independently receive a zero per-period payoff, the continuation payoff is set to zero. Collecting terms, the preceding inequality can be written as,

\[ W(N, \lambda) \geq \frac{c}{\delta}. \]

From condition C1, this inequality cannot be satisfied for \( \lambda \to 0 \) even if the entire population joins the network. This implies that all individuals must operate independently. As \( \lambda \) increases, there will be a threshold \( \lambda^* \) satisfying the condition,

\[ W(P, \lambda^*) = \frac{c}{\delta}. \]

As \( \lambda \) increases above \( \lambda^* \), the condition can be satisfied for smaller networks because \( W_{\lambda N}(N, \lambda) > 0 \). But we are interested in the largest stable network. It follows that the entire population will join the network for all \( \lambda \geq \lambda^* \). This unrealistic result is obtained because the continuation payoff – set to zero – is independent of \( N \). If cooperation can be sustained for a given network size \( N \), it follows that it can be sustained for any network size larger than \( N \). Thus, if cooperation can be sustained at all, the entire population will participate.

Genicot and Ray (2003) face the same problem in their analysis of mutual insurance. If individual incomes are independent, then a larger network does a better job of smoothing risk, and absent other constraints the entire population should join the insurance arrangement. Genicot and Ray consequently turn to an alternative solution concept, the coalition-proof Nash equilibrium of Bernheim, Peleg, and Whinston (1987), to place bounds on the size of the group and we will do the same. An appealing and more realistic feature of this Nash equilibrium refinement in the context of collective arrangements is that it allows sub-groups rather than individuals to deviate. The continuation payoff is no longer constant because deviating sub-groups can form arrangements of their own and we will see that this pins down the maximum size that the network can attain.

The coalition-proof Nash equilibrium places two restrictions on deviating sub-groups: (i) only credible sub-groups, i.e. those that are stable in their own right, are permitted to pose

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11 Because \( N \) is a real number this is more correctly an infinitesimal number of deviators.

12 The canonical efficiency wage model solves the commitment problem by making the employer and the individual worker interact repeatedly and by allowing the wage to adjust so that the gain from shirking in any period is just offset by the loss in future (permanent) income. In our model, the size of the group and, hence, the per capita payoff adjusts so that participants are indifferent between working and shirking.
a threat to the network. (ii) Only subsets of existing networks are permitted to deviate.\textsuperscript{13} The condition for cooperation can now be described by the expression,

\[ \frac{W(N, \lambda) - c}{1 - \delta} \geq W(N, \lambda) + \frac{\delta}{1 - \delta} [W(N', \lambda) - c], \]

where \( N' \) is the size of the deviating sub-group. The implicit assumption is that other principals are available as long as the sub-group is stable. Collecting terms, the preceding condition can be expressed as,

\[ W(N, \lambda) - W(N', \lambda) \geq \frac{1 - \delta}{\delta} c. \]

The greatest threat to a group will be from a sub-group that is almost as large, \( N - N' \to 0 \).

For analytical convenience assume that \( c \) is an infinitesimal number.\textsuperscript{14} If \( c \) is of the same order as \( N - N' \), the ratio \( \tilde{c} \equiv c/(N - N') \) will be a finite number. Dividing both sides of the preceding inequality by \( N - N' \), the condition for cooperation is now obtained as,

\[ W_N(N, \lambda) \geq \frac{1 - \delta}{\delta} \tilde{c}. \]

For a given \( \lambda \), the left hand side of the inequality is \textit{decreasing} in \( N \) since \( W_{NN}(N, \lambda) < 0 \). This implies that there is a \textit{maximum} network size above which cooperation cannot be sustained for each \( \lambda \) (if cooperation can be sustained at all as discussed below). This also ensures that the deviating sub-group of size \( N' \) will be stable, as required by our solution concept.\textsuperscript{15}

Genicot and Ray show that the set of stable insurance arrangements is bounded above once they allow for deviations by sub-groups. Our model, in which the network interacts with an external principal, generates stronger predictions that match Figure 2A.

\textbf{Proposition 1.} \textit{Networks will not form below a threshold level of social ties, }\lambda.\textit{ Above that threshold, the maximum stable network size, }N^*,\textit{ is increasing in social ties, }\lambda.\textit{ }

To prove the first part of the proposition, we take advantage of condition C1, which implies that \( \lim_{\lambda \to 0} W_N(N, \lambda) = 0 \). Cooperation cannot be supported for small \( \lambda \). As \( \lambda \)

\footnotesize
\textsuperscript{13} Members of the deviating sub-group could, in principal, form a new coalition with individuals who were originally operating independently. Bernheim, Peleg, and Whinston justify the restriction they impose on the solution concept by arguing that asymmetric information about past deviations would prevent insiders and outsiders from joining together.

\textsuperscript{14} This assumption, together with the assumption that \( N \) is a real number, allows us to differentiate the \( W \) function below. If we allowed \( c \) to be a finite number and \( N \) to be an integer, we would need to difference instead of differentiating, but it is straightforward to verify that the results that follow would be unchanged.

\textsuperscript{15} Solve recursively to establish this result. Start with the smallest possible network of size \( N'' \). Deviators from this network are individuals and so are stable by definition. From the concavity of the \( W(N, \lambda) \) function, the condition for cooperation will be satisfied for \( N'' \) if it holds for some \( N > N'' \). This establishes that \( N'' \) is stable. Next, consider a network just larger than \( N'' \). Using the same argument establish that it is stable. Continue solving in this way until \( N' \) is reached to establish that it is stable.
increases, \( W_{\lambda N}(N, \lambda) > 0 \) implies that there will be a threshold \( \lambda \) at which cooperation can be supported, but only for groups of infinitesimal size \((N \to 0)\). Above that threshold, since \( N^* \) is the largest group that can be supported in equilibrium for a given \( \lambda \),

\[
W_N(N^*, \lambda) = \frac{1 - \delta}{\delta} \tilde{c}.
\]

Applying the Implicit Function theorem,

\[
\frac{dN^*}{d\lambda} = \frac{-W_{\lambda N}(N, \lambda)}{W_{NN}(N, \lambda)} > 0
\]

to complete the proof. Although Proposition 1 derives the relationship between \( \lambda \) and \( N^* \), both social ties and network size are not directly observed. Let social ties be increasing in black population density, \( S \). And let outcomes such as political participation and migration be increasing in \( N^* \) (support for this assumption will be provided below). Then Proposition 1 can be restated in terms of \( S \): political participation and migration should be *uncorrelated* with \( S \) up to a threshold \( S \) (not necessarily the same threshold) and *increasing* in \( S \) thereafter. This places additional restrictions on the patterns observed in Figure 2A, which we test formally below.

Multiple equilibria evidently exist above the threshold once we characterize individual participation decisions as the solution to a noncooperative game. Apart from the equilibrium derived above, no one participates in another equilibrium.\(^{16}\) We assume in the analysis that follows that blacks were able to solve the coordination problem and so political participation and migration in each local area is based on the maximum stable size \( N^* \) derived above.

Reasonable restrictions on the payoff function \( W(N, \lambda) \) allow the model to generate results that are consistent with Figure 2A. Other assumptions or other models could generate different results, but this is not a concern as long as they do not match the figure. For example, we will see below that models in which blacks vote opportunistically above a threshold or in which an external agency organizes black voters and migrants can generate a *level* discontinuity. However, the *slope* discontinuity that is implied by our model turns out to be more difficult to obtain.\(^{17}\)

\(^{16}\)There are no other equilibria in this noncooperative game. In particular, a network smaller than the largest stable group is not an equilibrium because any individual operating independently would want to deviate and join it, making everyone better off without affecting its stability.

\(^{17}\)A model of information diffusion in which individuals learn about new opportunities from their neighbors could generate a slope discontinuity, although this would still be a story about (information) networks. In counties with low black population densities, individuals who took advantage of the new opportunity for exogenous reasons would be unable to transmit this information to the general population. In counties above a threshold density, information would quickly spread through the population. While diffusion of information about labor markets in distant northern cities could explain some of the results we obtain during the Great Migration, this explanation is less relevant during Reconstruction when information about local leaders and voting opportunities was readily available. Social learning does not require explicit coordination, so this would also not explain variation in black church congregation size, our most direct measure of network size, across counties.
3.3 An Additional Implication of the Model

The model generates predictions for variation in the level of political participation and migration across local areas. The illustrative example presented below extends the model to generate predictions for the distribution of migrants across northern destinations. Based on the description of urban labor markets in Section 2, suppose that two types of jobs are available to blacks in northern cities: skilled jobs with wage $W_S$ and unskilled jobs with wage $W_{NS} < W_S$. Migrants are either educated or uneducated. Educated individuals get skilled jobs with certainty. Uneducated individuals can only get skilled jobs with the support of a network. Because educated individuals can find skilled jobs in northern destinations with certainty, their migration decision will depend on the skilled wage at the destination, their wage at the origin, and the cost of migration. While there is heterogeneity in these costs, for analytical convenience we assume that wages and the distribution of costs do not vary across origin locations. This implies that a fixed number, $N^E$, of educated individuals will migrate from each origin location to $M \geq 2$ destinations.$^{18}$ As educated individuals can migrate without the support of a network, they are randomly assigned across destinations in the model.

Let the wage at the origin for uneducated individuals be the same as the unskilled wage at the destination. It follows that uneducated individuals will only migrate if they receive the skilled job with sufficiently high probability. This will depend on the size of their network, $N^*$, and the number of uneducated individuals who move with them. There is now a strategic aspect to the migration decision and the number of uneducated migrants in equilibrium must be derived as the solution to a fixed point problem. It is straightforward to show that this number, $N^{NE}$, is increasing in $N^*$ and, therefore, in $S$ above the threshold (from Proposition 1).$^{19}$ All of these individuals will move to the same destination, where their network is located. Below the threshold $S$, the network does not form and so uneducated individuals will not migrate.

Having derived the number and distribution of both educated and uneducated migrants at the destination, we now proceed to compute the overall distribution of migrants. The Herfindahl-Hirschman Index, which is defined as the sum of the squared share of migrants

\[ \frac{N^{NE} - N^*}{N^{NE}} W_{NS} + \frac{N^*}{N^{NE}} W_S - C(N^{NE}) = W_{NS}. \]

Collecting terms and simplifying, it is straightforward to show that $N^{NE}$ is increasing in $N^*$.

\[ N^{NE} = \frac{W_S - c(N^E)}{W_{NS}} + \frac{N^*}{N^{NE}} (W_S - c(N^{NE})) = W_{NS}. \]
across all destinations, can be conveniently used to measure this distribution. Below the threshold \( S \), \( N^{NE} = 0 \). This implies that the Herfindahl-Hirschman Index, \( H(S) = M \left[ \frac{N^E}{N^E + N^{NE}(S)} \right]^2 \), is uncorrelated with \( S \). Above the threshold,

\[
H(S) = \left[ \frac{N^E}{N^E + N^{NE}(S)} \right]^2 + (M - 1) \left[ \frac{N^E}{N^E + N^{NE}(S)} \right]^2.
\]

Differentiating this expression with respect to \( S \),

\[
H_S(S) = \frac{2(M - 1) \frac{N^E}{N^E + N^{NE}(S)} N^{NE}(S) N_S^{NE}(S)}{(N^E + N^{NE}(S))^3} > 0,
\]

since \( N_S^{NE}(S) > 0 \) for \( S \geq S \) from the discussion above. The specific nonlinear relationship between the level of migration and plantation share that we derived in Proposition 1 should apply to the distribution of migrants at the destination as well. Although we use an illustrative example to derive this result, it will hold more generally as long as (potential) members of the network cluster more at the destination than individuals who move independently.

Figure 2B describes migration to northern cities from counties in the state of Mississippi as a function of the plantation share. These data are constructed by merging Medicare records with social security records, as described below, allowing migrants from each Mississippi county during the Great Migration to be linked to northern destination cities.\(^20\) Providing independent support for the relationship we uncovered in Figure 2A across all southern counties, there is no association between plantation share and the level of migration up to the same threshold as in that figure, after which a monotonic relationship begins. More importantly, the level of migration and the concentration of migrants in northern cities, measured by the Herfindahl-Hirschman Index (HHI), track very closely together in Figure 2B.\(^21\)

We close this section by justifying the use of the number of voters and the number of migrants as measures of political participation and migration, respectively. The model derives network size as a function of social ties. The extension to the model discussed above goes on to map network size to the number of migrants in equilibrium. This result follows because the expected wage at the destination for uneducated individuals is a function of the number of individuals who move with them. Apart from this theoretical justification, we will also see that the specific nonlinear relationship between plantation share and the number of voters and migrants is matched by the corresponding relationship between plantation share

\(^{20}\)We are grateful to Dan Black, Seth Sanders, and Lowell Taylor for providing us with these data.

\(^{21}\)Although clustering is commonly associated with networks, it could also arise because migrants are restricted to a limited number of destinations. The fact that the number and the concentration of migrants track together, however, is less easy to explain without a role for networks. For this the migrants from counties with access to a relatively small number of destinations would need to have exceptional opportunities at those destinations, resulting in a greater overall level of migration.
and associated outcomes. These outcomes include the probability that a black leader was
elected by the county, the distribution of migrants at the destination (shown above) and
black church congregation size (our most direct measure of network size). This empirical
consistency further increases our confidence in the validity of the measures that have been
chosen.

3.4 Testing the Model

The model indicates that black population density has no association with political partic-
ipation and migration up to a threshold and a positive association thereafter. Following
standard practice when estimating threshold regression models, e.g. Hanson (1999), we esti-
mate a series of piecewise linear regressions that allow for a slope change at different assumed
thresholds. The pattern of coefficients that we estimate, with accompanying t-ratios, will
locate our best estimate of the true threshold and formally test the specific nonlinearity
implied by the model.

Ignoring the state fixed effects to simplify the discussion that follows, the piecewise linear
regression that we estimate for each assumed threshold, $S$, is specified as

$$y_i = \beta_0 + \beta_1 S_i + \beta_2 D_i (S_i - S) + \beta_3 D_i + \epsilon_i$$

where $y_i$ is political participation or migration in county $i$, $S_i$ is the plantation share in that
county, $D_i$ is a binary variable that takes the value one if $S_i \geq S$, and $\epsilon_i$ is a mean-zero
disturbance term. $\beta_1$ is the baseline slope coefficient, $\beta_2$ is the slope change coefficient, and
$\beta_3$ is the level change coefficient (measuring the level discontinuity at the threshold). We
will estimate this regression for a large number of assumed shares, in increments of 0.001,
over the range $[0, 0.3]$.

The slope coefficients, $\beta_1$ and $\beta_2$, can be directly linked to the predictions of the model:
$\beta_1 = 0$ and $\beta_2 > 0$. To derive the pattern of t-ratios on $\beta_1$ and $\beta_2$ that we expect to obtain
across the range of assumed thresholds when the data generating process is consistent with
the model, we generated a data set that consists of two variables: the actual plantation
share in our southern counties, $S_i$, and a hypothetical outcome, $\tilde{y}_i$, that is constructed to
be consistent with the model. The true threshold is specified to be 0.09. The value of
the hypothetical outcome in each county is then obtained by setting $\beta_0 = 670$, $\beta_1 = 0$,
$\beta_2 = 7700$, $\beta_3 = 0$, and $S = 0.09$ in equation (1) and then adding a mean-zero noise term.
These parameter values are derived from a piecewise linear regression of Republican votes in
the 1872 presidential election on plantation share, with state fixed effects and the break at
0.09.\footnote{We set the true threshold at 0.09 to be consistent with our best estimate of that threshold using the
joint-test that will be discussed below. The variance of the mean-zero noise term in the simulation is set to
match the variance of the residuals from this piece-wise linear regression.} To verify that the data we have generated match the model, we nonparametrically
regress \( \hat{y}_i \) on \( S_i \) in Figure 3A. All the nonparametric regressions in this paper are estimated with a narrow bandwidth. Despite the noise that we have added to the outcome, a slope change near the “true” threshold, 0.09, is clearly visible in the figure.

Having generated data that match the model, we next proceed to estimate equation (1) sequentially over a large number of assumed thresholds. The t-ratios for the two slope coefficients, \( \beta_1 \) and \( \beta_2 \), are reported in Figure 3B for each of these assumed thresholds. The t-ratio for the baseline slope coefficient remains close to zero for all assumed thresholds below the true threshold and starts to increase thereafter. The t-ratio for the slope change coefficient starts close to zero, then increases steadily reaching a maximum well above two where the assumed threshold coincides with the true threshold, and then declines thereafter.

To understand why the t-ratios follow this pattern, return to Figure 3A and consider the piecewise linear regression line that would be drawn for an assumed threshold to the left of the true threshold. The best fit to the data at that assumed threshold sets \( \hat{\beta}_1 = \hat{\beta}_3 = 0 \) and \( \hat{\beta}_2 > 0 \). This implies that the t-ratio on the baseline slope coefficient will be zero and the t-ratio on the slope-change coefficient will be positive. Now suppose we shifted the assumed threshold slightly to the right. It is evident that we would continue to have \( \hat{\beta}_1 = \hat{\beta}_3 = 0 \) since there is no change in the slope to the left of the assumed threshold, but \( \hat{\beta}_2 \) would increase and the regression line would do a better job of fitting the data to the right of the threshold. The t-ratio on the baseline slope coefficient would remain at zero, while the t-ratio on the slope-change coefficient would increase. This would continue as the assumed threshold shifted gradually to the right until it reached the true threshold.

Once the assumed threshold crosses to the right of the true threshold, the piecewise linear regression line that best fits the data will set \( \hat{\beta}_1 > 0 \). Although the magnitude of the baseline slope coefficient will increase as the assumed threshold shifts further to the right, the regression line will do an increasingly poor job of fitting the data to the left of the threshold. This implies that the t-ratio on the baseline slope coefficient is not necessarily monotonically increasing to the right of the true threshold, although it must be positive. In practice, this t-ratio will increase monotonically with both political participation and migration.

To derive the corresponding change in the t-ratio for the slope change coefficient, recall that the hypothetical outcome increases linearly to the right of the true threshold. Once the level change coefficient is introduced, which must now be positive, \( \hat{\beta}_3 > 0 \), this implies that the regression line to the right of the assumed threshold will perfectly fit the data, except for the noise we have added to the outcome. This line maintains the same slope, and continues to precisely match the data, as the assumed threshold shifts further to the right. However, since the regression line to the left of the assumed threshold is growing steeper and is less precisely estimated as the assumed threshold shifts to the right, the slope-change coefficient and the t-ratio on that coefficient will unambiguously decline.
The preceding discussion and Figure 3B tell us what to expect when the data are consistent with the model. They also locate our best estimate of the true threshold. This will be the assumed threshold at which the t-ratio on the baseline coefficient starts to systematically increase and the t-ratio on the slope change coefficient reaches its maximum value. Given the noise in the outcome measures, however, it is sometimes difficult to assess whether or not the t-ratios match the predictions of the model. This motivates a joint-test of the model’s predictions, based on the two slope coefficients, which also provides us with a single best estimate of the true threshold’s location.

Following standard practice, the composite null, which we test by estimating equation (1) at each assumed threshold, is set up to be inconsistent with the model:

\[ H_0 : \beta_1 \geq |\epsilon h| \text{ and } \beta_2 = 0, \]

where \( \epsilon \) can be arbitrarily small and \( h \) is a scale parameter. \( \beta_1 \) is thus bounded away from zero under the null, while \( \beta_2 \) is set to zero. \( \hat{\beta}_1 \) will be mechanically further away from zero when the outcome variable has a larger mean or variance. To make the joint-test comparable across outcomes, we thus set \( h \) to be the standard deviation of the outcome under consideration multiplied by a constant.

Given the outcomes that we consider in this paper, the following data generating processes are feasible when the null is rejected:

\[ H_1: \]

\( i \): \( \beta_1 < |\epsilon h| \text{ and } \beta_2 > 0 \)

\( ii \): \( \beta_1 < |\epsilon h| \text{ and } \beta_2 = 0 \)

\( iii \): \( \beta_1 \geq |\epsilon h| \text{ and } \beta_2 > 0 \).

The first data generating process is consistent with our model. With the second data generating process, there is no relationship between the outcome under consideration and plantation share. With the third data generating process, the outcome is increasing monotonically in plantation share (with a slope change at a threshold).

If we replaced the and statement under the null with an or statement, the parameter space would expand and only our model would be feasible if the null were rejected. However, this would introduce a new problem because any test statistic constructed to test the composite hypothesis would have different values under the null, depending on which component was relevant. We consequently retain the and statement, but we will see that our joint-test statistic nevertheless has the power to distinguish between the alternative data generating processes when the null is rejected.

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23 We could alternatively have plotted the baseline and slope change coefficients instead, over the range of assumed thresholds. The advantage of the t-ratios is that they allow us to test and compare the model across multiple outcomes.

24 We are grateful to Yuya Sasaki for his help in deriving the test.
The joint-test statistic is constructed as follows:

\[ T(\beta) = \phi \left( \frac{\beta_1}{h} \right) \beta_2, \]

where \( \phi \) is a symmetric and continuous function that reaches its maximum value at zero and the \( h \) parameter once again ensures that deviations in \( \hat{\beta}_1 \) away from zero are penalized consistently across outcomes. By the delta method,

\[ \sqrt{n} \left( T(\hat{\beta}) - T(\beta) \right) \xrightarrow{d} N \left( 0, DT(\beta)VDT(\beta)' \right) \]

where \( V = \begin{bmatrix} V_{\beta_1} & V_{\beta_1,\beta_2} \\ V_{\beta_1,\beta_2} & V_{\beta_2} \end{bmatrix} \) and \( DT(\beta) = \begin{bmatrix} \frac{1}{h} \phi' \left( \frac{\beta_1}{h} \right) \beta_2 & \phi \left( \frac{\beta_1}{h} \right) \end{bmatrix} \).

\[ T(\beta) = 0, \text{ under the null } H_0 \text{ because } \beta_2 = 0. \] Substituting the expressions for \( V \) and \( DT(\beta) \), under the null

\[ \sqrt{n}T(\hat{\beta}) \xrightarrow{d} N \left( 0, \phi \left( \frac{\beta_1}{h} \right)^2 V_{\beta_2} \right). \]

Dividing by the standard deviation and then squaring,

\[ \frac{n \left[ T(\hat{\beta}) \right]^2}{\phi \left( \frac{\hat{\beta}_1}{h} \right)^2 V_{\beta_2}} \xrightarrow{d} \chi^2_1. \]

Under the null, \( \beta_1 \) has a range of values. We select the “least favorable” null, \( \beta_1 = |\epsilon h| \), which minimizes the value of the preceding statistic. If we do reject the null, this implies that we would reject the null for any \( \beta_1 \geq |\epsilon h| \). Following standard practice when implementing the Wald test, we replace \( V_{\beta_2} \) with \( \hat{V}_{\beta_2} \). Substituting the expression for \( T(\hat{\beta}) \), we arrive at the statistic that is used for the joint test of the model,

\[ \frac{n \left[ \phi \left( \frac{\hat{\beta}_1}{h} \right)^2 \hat{\beta}_2 \right]}{\phi(\epsilon)^2 \hat{V}_{\beta_2}} d \xrightarrow{d} \chi^2_1. \]

Because \( \epsilon \) can be arbitrarily small, we set \( \epsilon \) equal to zero when computing the joint-test statistic. We will reject the null hypothesis if this test statistic exceeds the critical value for the chi-squared distribution with one degree of freedom.

If the data generating process is consistent with the model, \( \hat{\beta}_1 = 0 \) for all assumed thresholds to the left of the true threshold. However, \( \hat{\beta}_2 \) is increasing as we shift closer to the true threshold and is more precisely estimated. This implies that our joint-test statistic will be increasing in magnitude as the assumed threshold moves closer to the true threshold. After reaching its maximum value at the true threshold, where we are most likely to reject the null, the statistic will drop rapidly to zero if the \( \phi \) function and the scale parameter, \( h \), together place sufficient penalty on deviations in \( \hat{\beta}_1 \) away from zero. Recall that \( \hat{\beta}_2 \) is
declining and less precisely estimated as the assumed threshold shifts further to the right of
the true threshold, reinforcing this effect. In contrast, the (multiplicative) joint-test statistic
that we have constructed will be zero when the data generating process is consistent with
model (ii), and we will not reject the null hypothesis, since $\beta_2 = 0$. We will not reject the
null under model (iii) either, if $\beta_1$ is sufficiently large and the $\phi$ function places sufficient
penalty on deviations from zero. Our test statistic thus distinguishes our model from other
data generating processes when the null is rejected. 25

Figure 3C reports the joint-test statistic across the entire range of assumed thresholds,
in increments of 0.0001, with our simulated data. We use the density of the standard normal
distribution to characterize the $\phi$ function and set $h$ equal to three-quarters of the standard
deviation of the outcome under consideration, in the simulation exercise and in the analysis
that follows. 26 The joint-test statistic is increasing in the assumed threshold in Figure 3C
until it reaches its maximum value near the true threshold (0.09), declining steeply thereafter.
The 95 percent critical value for the chi-squared distribution with one degree of freedom is
3.84, which implies that we can reject the null hypothesis at conventional levels for a range
of assumed thresholds around the true threshold. We are nevertheless most likely to reject
the null hypothesis where the joint-test statistic reaches its maximum value, and this will be
our best estimate of the true threshold. 27

4 Empirical Analysis

This section begins by describing the relationship between plantation share and the black
population. We subsequently verify that the response to political and economic opportu-
nities in the postbellum South across counties with different plantation shares matches the
predictions of the model. The empirical analysis concludes by considering alternative models
and establishing that they can match some but not all the patterns observed in the data.

4.1 Black Population

Variation in voting and migration across counties is generated in our model by internal
forces that restrict the size of the largest stable network that can form. Suppose, instead,

25 In the empirical analysis that follows, we will consistently reject the null hypothesis for outcomes asso-
ciated with black networks, where the data generating process based on the t-ratio test is consistent with
model (i). In contrast, we will not reject the null for other outcomes where the t-ratio test indicates that
the data generating process is consistent with model (ii) or model (iii).
26 The results are robust to alternative multipliers (0.5, 1.0).
27 An alternative best-estimate of the true threshold would be the assumed threshold at which the sum of
squared errors of the piecewise linear regression was minimized (Hanson 1999). Our joint test is tied more
closely to the theory, locating the threshold at which the estimated slope coefficients – $\hat{\beta}_1$ and $\hat{\beta}_2$ – match
most closely with the predictions of the model, i.e. $\beta_1 = 0$ and $\beta_2 > 0$. 
that networks are absent, but the relationship between plantation share and black population matches the patterns in Figure 2A; i.e. population is constant up to a threshold and increasing thereafter. If a fixed fraction of the black population votes and migrates, this would explain the patterns in Figure 2A without a role for networks.

To examine this possibility, we nonparametrically regress black population on plantation share in Figure 4A at three points in time: 1860, 1870, and 1890. It is apparent from the figure that black population is monotonically increasing in plantation share. The slope also gets steeper over time, perhaps due to higher fertility in the high plantation share counties, and we will return to this observation when constructing the migration statistics below.

To formally verify that black population is monotonically increasing in plantation share, we report the results of the t-ratio test for 1870 (the other years are the same) in Figure 4B. If the relationship were linear, the t-ratio on the baseline slope coefficient would be greater than two and constant, while the slope change coefficient would be zero. What we see is that the baseline slope coefficient is always greater than two and that it is increasing in plantation share. While this indicates that the relationship is nonlinear, black population is still increasing in plantation share everywhere. The joint test, reported in Figure 4C, confirms this conclusion. We cannot reject the null anywhere, presumably because the φ function places sufficient penalty on deviations in ˆβ1 away from zero.

The increase in voting and migration above a plantation share threshold that we will observe below can be explained by the accompanying increase in the black population. The absence of such an association below the threshold, despite the fact that the black population is getting larger, is less easy to explain without a role for coordination.

4.2 Response to Political Opportunities

Larger black networks in a county during Reconstruction would have generated greater political participation in the population. While political participation by race is not available, voter turnout by party is available from U.S. Historical Election Returns (ICPSR). Because blacks would have voted Republican at this time, our primary measure of political participation is the number of Republican votes in the county. This statistic is reported at three points in time in Figure 5A, for the 1872, 1880, and 1900 presidential elections. The pattern of votes in 1872, which is at the height of black political power, was reported earlier in Figure 2A. Although Southern Democrats started to take control and blacks were gradually disfranchised once Reconstruction ended in 1877, blacks continued to vote and to elect their own leaders, with less and less success, into the 1890s. As expected, the increase in Republican votes past the plantation share threshold is weaker in 1880 than in 1872. However, the specific nonlinearity implied by the model continues to be obtained. This contrasts with the pattern in 1900, by which point in time blacks would have been completely disfranchised.
and where we see no relationship between the number of Republican votes and plantation share.

Figure 5B formally tests whether the nonlinear relationship that we uncovered in 1872 in Figure 5A matches the model. The t-ratio on the baseline slope coefficient is close to zero up to a threshold plantation share and increasing thereafter. The t-ratio on the slope change coefficient increases steadily up to the same threshold, reaching a maximum value of four, and then declines thereafter. Figure 5C reports the joint-test statistic across the range of plantation shares. This statistic reaches its maximum value, well above the 95 percent critical value for the chi-squared distribution with one degree of freedom, close to the threshold in Figure 5B. It declines steeply, on both sides, away from our best estimate of the true threshold (around 0.09). These patterns match the model’s predictions and the simulations in Figures 3B and 3C. This contrasts with what we observed for black population in Figures 4B and 4C.

We next proceed to establish the robustness of this result to alternative measures of the plantation share variable and non-presidential elections. Figure 5D reports nonparametric estimates where (i) the 1890 plantation share is replaced by the average plantation share over the 1880-1900 period, and (ii) labor intensities obtained from previously published farm studies are replaced by our estimates (reported in Table 1). Federal, state, and local elections are synchronized in the American political system and so the voter turnout across counties that we observe for presidential elections should also apply to local elections occurring at the same time, where the implications of the model may be more relevant. Figure 5E regresses Republican votes in gubernatorial and congressional elections (separately) on plantation share, uncovering the same pattern that we obtained with 1872 presidential elections. The relationship between plantation share and Republican votes is robust to the type of election and we expect that the same relationship would be obtained with state and local elections, although those data are unavailable.

Our analysis takes advantage of the fact that cropping patterns in the South were initially put in place by white landowners. Variation in black population density in the antebellum period was an unintended consequence of those decisions. Once blacks were free, however, they could have moved to counties where networks were strongly, changing existing cropping patterns. To account for such endogenous sorting as well as for differential fertility across counties in the postbellum period, we estimate regressions that use that part of the variation in 1890 plantation share that can be explained by 1860 cropping patterns.

The two-step estimation procedure that we implement is based on the nonparametric

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28 Republican votes in gubernatorial and congressional elections are available, by county, from ICPSR. Gubernatorial elections were held at four-year intervals but were not synchronized across states. Figure 5E is thus based on all gubernatorial elections held between 1871 and 1873. Data on congressional elections are obtained for 1872.
instrumental variable procedure suggested by Newey, Powell, and Vella (1999), except that we do not claim that 1860 cropping patterns satisfy the exclusion restriction. Our identification comes from the specific nonlinear relationship between plantation share and the outcomes of interest that we estimate. In the first step, we regress 1890 plantation share on a full set of state dummies and a flexible (polynomial) function of either the size of the median slaveholding in 1860 or production levels of the four plantation crops in 1860. The goodness of fit (R-squared) in both regressions exceeds 0.5, consistent with the view that postbellum cropping patterns could be traced back to antebellum decisions. In the second step, we nonparametrically regress 1872 Republican votes on plantation share, partialling out state fixed effects (as usual) as well as a flexible (fifth-order polynomial) function of the first-stage residuals. By including the first-stage residuals in the second step, we effectively regress political participation on the predicted plantation share (based on 1860 cropping conditions) and we see in Figure 5F that the results are very similar to what we obtained in Figure 5A.

While the robust nonlinear relationship between Republican votes and plantation share we have uncovered is consistent with the model, we do not have direct evidence that the increase in Republican votes above the threshold was driven by black voters. White “carpetbaggers” from the North and white “scalawags” from the South also voted Republican in southern counties at this time. If the number of white Republican votes was correlated with plantation share, this could confound our interpretation of the results in Figure 5A. One observation from that figure that goes against this alternative explanation is that the number of Republican votes and plantation share are unrelated in 1900, by which time blacks were effectively disfranchised. To provide further support for our hypothesis, we take advantage of the fact that an increase in black votes would have generated an increase in black leaders, to the extent that blacks wanted to elect members of their own race.

Foner (1993) provides a complete list of black officeholders during Reconstruction. Almost all of these officeholders were elected to positions in state government. We therefore construct two measures of leadership based on his data: whether a black state representative and whether a black state senator was elected from each county in this period. These measures are regressed nonparametrically on plantation share in Figure 6A. The probability that a black leader, especially a state representative, was elected from a county tracks closely with

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The 1860 population census provides the number of slaveholdings by size-category in each county. These categories are all integers up to 9, 10-14, 15-19, 20-29, 30-39, 40-49, 50-69, 70-99, 100-200, 200-300, 300-500, and greater than 500. A hypothetical ranking of all slaves in a county can be constructed based on the size of the plantation to which they were assigned, which allows us, in turn, to compute the size of the slaveholding associated with the median slave. We regress 1890 plantation share on a quartic function of this median slaveholding in one first-stage specification. Although crop acreage at the county level is not available prior to 1880, crop production data go back to 1840. In a second first-stage specification, we regress 1890 plantation share on a cubic function of 1860 production for each of the four plantation crops, additively and without interaction terms.
the pattern of Republican votes in 1872 and 1880, indicating that voting patterns in those years were indeed being driven by black voters. Figure 6B formally tests the nonlinear relationship with plantation share obtained for state representatives (who accounted for most black leaders). Matching Figure 5B, which tests the corresponding relationship for Republican votes, the t-ratio for the baseline slope coefficient is zero up to the same threshold share and increasing thereafter. The t-ratio on the slope change coefficient increases up to that threshold, reaching a maximum above five, and then declines. We observe two peaks in Figure 6C, which reports the corresponding joint test, perhaps because the probability of election is a noisy measure of leadership. Notice that the location of the peak to the right coincides with our best estimate of the true threshold for 1872 Republican votes in Figure 5C. The single peak that we obtain with the joint test for state senators (not reported) is also located at the same place, and we can comfortably reject the null with 95 percent confidence for both state representatives and state senators. Voting patterns and black leadership during Reconstruction match closely with our model of network formation.

A county can cover a large area. Given the high transportation and communication costs at the time, it would have been difficult for black residents across an entire county to work together in support of a political agenda. Coordination within local communities, with accompanying local political participation, would have aggregated up to the political participation we observe at the county level. As described in Section 2, community life in the postbellum period centered on the church, and African-American churches played an important political role during Reconstruction (Du Bois 1908, Frazier 1964, Dvorak 1988). African-American politicians were often drawn from the clergy and church congregations worked together to support local leaders (Woodson 1921, Foner 1988). The level of local coordination, characterized by the largest stable network in the model, may thus be conveniently measured by black church congregation size. This allows us to test the theory more directly at the local level and also provides micro-foundations for county-level political participation.

While slaves worshipped in biracial churches for the most part, they did appear to have some autonomy in the choice of denomination and most were formally affiliated with either the Baptist or Methodist church (Woodson 1921, Genovese 1974). Once free, they quickly formed independent congregations within those denominations (Boles 1988, Kolchin 1993). Southern blacks could remain part of the mainstream Baptist and Methodist denominations they belonged to as slaves, or they could affiliate with exclusively black sub-denominations, that spread throughout the South after the Civil War. Some of these sub-denominations, such as the African Methodist Episcopalian (AME) Church and the African Methodist Episcopal Zion (AMEZ) Church, were established by freed blacks in northern cities at the beginning of the nineteenth century (Du Bois 1908). Black Baptist sub-denominations coa-
lesced much later (Frazier 1964).

The Census of Religious Bodies (CRB) provides information on the number of churches in each county, by denomination, at roughly ten-year intervals from 1860 onwards. We measure average congregation size in each denomination by the ratio of church members to the number of churches. The 1890 census is the only round in the postbellum period that recorded information on the number of church members in each denomination and that separately identified the black sub-denominations within the Baptists and Methodists. The advantage of having information on these sub-denominations is that the average congregation size we compute for them will be based entirely on black congregations. Southern whites, like southern blacks, were most often Baptist or Methodist (Kolchin 1993). The average congregation size that we compute for the Baptists and the Methodists as a whole will thus be based on black as well as white congregations. For this reason, the analysis of congregation size that follows will be restricted to the 1890 census and will separately consider Baptists and Methodists, black sub-denominations among the Baptists and Methodists, and other non-black denominations such as the Presbyterians, Episcopalians, and Catholics.

Figure 7A nonparametrically regresses average congregation size in each set of denominations described above on plantation share. The pattern for the Baptists and Methodists and for the black sub-denominations matches the corresponding pattern for black political participation and leadership that we obtained earlier, except that it is noisier: there is no association between average congregation size and plantation share up to a threshold and a positive association thereafter. Notice that the increase in congregation size past the threshold is greater for the black sub-denominations than for Baptists and Methodists as a whole. This implies that the results are not being driven by variation in the size of white congregations across counties. Consistent with this interpretation, no particular relationship between congregation size and plantation share is observed for other (non-black) denominations. Figure 7B formally tests whether the nonlinear pattern observed in Figure 7A for the black sub-denominations is consistent with the model. The t-ratios for the baseline slope and slope change coefficients display the familiar pattern, except that the slope change coefficient is less precisely estimated at its peak. Figure 7C reports the corresponding joint test. The joint-test statistic increases steeply in the assumed threshold until it reaches its maximum value and declines steeply thereafter. Although we cannot reject the null hypothesis at conventional levels (we can with 90 percent confidence), our best estimate of the true threshold

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30 The CRB was conducted as part of the population census from 1860 to 1890, with census enumerators collecting information from individual churches in each county. Subsequently, the U.S. Bureau of the Census conducted the CRB separately from the population census in ten-year intervals from 1906 to 1936.

31 The black sub-denominations included in the 1890 CRB are Regular Baptist (colored), African Methodist Episcopal, African Methodist Episcopal Zion, Colored Methodist Episcopal, and Colored Cumberland Presbyterian. Among these sub-denominations, only the Cumberland Presbyterians, who had a small following, fell outside the umbrella of the Baptists and the Methodists.
is close to what we obtained earlier for voting and black leadership.\textsuperscript{32} The analysis of church size thus provides micro-foundations, based on our most direct measure of network size, for variation in political participation and black leadership across counties.

Table 2 completes the analysis of political participation by reporting regression results at our best estimate of the true threshold (from the joint-test). The baseline slope coefficient and the slope change coefficient are both significant in Column 1 with black population in 1870 as the dependent variable. In contrast, the baseline slope coefficient is insignificant in Columns 3-7 for all political outcomes and for church size. The slope change coefficient is large and precisely estimated in Columns 3-7, although it fails to achieve statistical significance at conventional levels for church size. Notice also that the level change coefficient, estimated at the threshold, is always insignificant. This result will be useful below when ruling out alternative explanations.

4.3 Response to Economic Opportunities

We now proceed to examine the relationship between plantation share and the level of migration across southern counties. Since the population census does not provide the county of birth, the birth-location of blacks residing in northern cities in 1920 and 1930 cannot be used to measure the level of migration from each southern county. The census survivor ratio method has been proposed in the historical demography literature to deal with this problem (e.g. Lee et al. 1957, Collins 1997). In our application, this method would predict what a southern county’s population would have been at the end of a given decade in the absence of migration – based on the age and sex distribution, each cohort’s survival ratio (determined by mortality at the national or regional level) and fertility (for the youngest cohort). The difference between this predicted population and the actual population would provide an estimate of intercensal migration. We do not use this procedure for two reasons. First, the age distribution is not available at the county-level for census rounds between 1870 and 1930. Second, even if these data were available, a single survival ratio and fertility rate could not be applied since we saw in Figure 4A that the black population was growing more rapidly in high plantation share counties (than in low share counties) in the postbellum period.

Our approach – which we will validate with an independent migration measure discussed below – uses county-level population changes just prior to the Great Migration to “non-parametrically” predict the changes that would have occurred in the absence of northern migration during that period. The first major movement to the North commenced in 1916. The population change in the preceding decade, $P_{1900} - P_{1910}$, predicts the change that would

\textsuperscript{32}Appendix Figure A1 reports robustness tests with different measures of the plantation share and Appendix Figure A2 reports results using that part of the variation in 1890 plantation share that can be explained by 1860 cropping patterns. As with Republican votes, the results remain at least as strong.
have occurred in the next decade in the absence of migration. The “short” double-difference, 
$$(P_{1910} - P_{1920}) - (P_{1900} - P_{1910})$$, is thus our best estimate of northern migration in each county between 1916 and 1920. The “long” double-difference, 
$$(P_{1910} - P_{1930}) - (P_{1890} - P_{1910})$$, which was used in Figure 1, provides an analogous measure over the course of the Great Migration.

Figure 8A nonparametrically regresses the change in population, $P_{1910} - P_{1920}$ and $P_{1900} - P_{1910}$, separately for black and whites, on plantation share. $P_{1900} - P_{1910}$ for blacks is negative everywhere and mildly declining in plantation share. This implies that the black population was increasing on net throughout the South prior to the Great Migration, particularly in counties with large plantation shares, which is consistent with the changes over time observed in Figure 4A. This relationship is reversed in the subsequent decade. There is no population change up to a threshold plantation share and a large decline in the population thereafter, which we attribute to migration. In contrast, population change for the whites is stable over the two decades, providing a useful benchmark for the results we obtain for the blacks.

Figure 8B adjusts for natural population change by nonparametrically regressing the short double-difference, 
$$(P_{1910} - P_{1920}) - (P_{1900} - P_{1910})$$, and the long double-difference, 
$$(P_{1910} - P_{1930}) - (P_{1890} - P_{1910})$$, on plantation share. The regression with the long double-difference was reported earlier in Figure 2A and we see that the same pattern is obtained with the short double-difference. There is no association between plantation share and our measure of black migration up to a threshold and a positive association thereafter thereafter. This contrasts with white migration, where a monotonically declining relationship with plantation share is observed. Figures 8C and 8D formally test the predictions of the model with the long double-difference. The t-ratios for the baseline slope coefficient and the slope change coefficient are consistent with the model in Figure 8C. As with voting and church size, the joint-test statistic in Figure 8D spikes close to the point where the baseline coefficient starts to increase away from zero and the slope change coefficient reaches its maximum value. The maximum value of the joint-test statistic easily exceeds the 95 percent critical value for the chi-squared distribution with one degree of freedom, providing further support for the model.

Figure 8E validates our migration measure by regressing long double-differences constructed at other points in time on plantation share. One statistic, 
$$(P_{1860} - P_{1880}) - (P_{1840} - P_{1860})$$, provides a measure of migration just after Emancipation. A second statistic, 
$$(P_{1880} - P_{1900}) - (P_{1860} - P_{1880})$$, measures migration around the period of Reconstruction. The relationship between neither of these statistics and plantation share matches what we observe during the Great Migration, 
$$(P_{1910} - P_{1930}) - (P_{1890} - P_{1910})$$, where there is no association up to a threshold and a positive association thereafter.33

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33Appendix Figure A3 reports robustness tests with different measures of the plantation share and Appendix Figure A4 reports results using that part of the variation in 1890 plantation share that can be explained by 1860 cropping patterns. As with Republican votes and black church size, the results remain at least as strong.
Although it does account for natural population change, the double-differenced statistic is still an indirect measure of migration. To verify the robustness of the results in Figure 8 we consequently utilize newly available data from the state of Mississippi that link southern counties to northern destinations. These data include the zip code of residence of all recipients of Medicare Part B between 1976 and 2001. The Medicare records, which are reliably available from the 1905 birth-cohort onward, were merged with social security records (the Numident file), which include the town of birth. Under the assumption that individuals remained in the city (MSA) to which they moved, we can compute the number of migrants and the distribution of migrants across northern cities, by race, for each Mississippi county. These statistics are computed for individuals born between 1905 and 1925 because these are the individuals most likely to have migrated between 1910 and 1930, either as young adults or as children with their parents. While the large number of cohorts allows us to measure migration from each southern county with precision, this also implies that some individuals who moved after the Great Migration will be included in these cohorts. This will not qualitatively change the analysis that follows, because southern counties that channeled their members to particular northern destinations during the Great Migration would have continued to do so thereafter.

Figure 9A nonparametrically regresses the short and long double-difference statistics that we use to indirectly measure migration, and a direct measure based on the 1905-1925 birth cohorts, on plantation share across Mississippi counties. Reassuringly, these measures of migration track closely together and, moreover, match the pattern that was obtained across all southern counties. Although not reported, this pattern is obtained across Mississippi counties for Republican votes in 1872, the probability that a state representative was elected, and black church congregation size. Figure 9B reports nonparametric regressions with the number of migrants and the distribution of migrants, measured by the Herfindahl-Hirschman Index. As observed in Figure 2B, both statistics for blacks are uncorrelated with plantation share up to the same threshold and increasing in plantation share thereafter. In contrast, the number and the distribution of white migrants is uncorrelated with plantation share. The specific nonlinearity we have uncovered appears consistently across multiple outcomes associated with black networks. Notice that it is not obtained with other outcomes such as church size in non-black denominations and white migration.

34 All the nonparametric regressions up to this point in the analysis have included state fixed effects. Since we are now focussing on a single state, the two-step procedure used to partial out the state fixed effects is no longer required.
4.4 Alternative Explanations

The first alternative that we consider assumes that an external agency solves the commitment problem and organizes political participation during Reconstruction and the movement north during the Great Migration. Depending on the context, this agency could be the Republican party or a northern labor recruiter. The value to the agency \( V(N) \) is an increasing function of the number of individuals, \( N \), that it can mobilize. It is reasonable to assume that \( N \) is an increasing function of the black population of the county, which was shown to be increasing in the plantation share \( S \). \( N \) is thus an increasing function of \( S \), \( N(S) \).

The alternative explanation can explain the increase in Republican votes and migration to the right of a plantation share threshold, simply because there is a larger black population to draw from. To explain the absence of such a relationship to the left of the threshold, introduce a fixed cost \( k \). The external agency will only enter counties where it expects to mobilize a sufficiently large number of individuals. Because \( V \) is increasing in \( N \), and \( N \) is increasing in \( S \), there exists a threshold \( S \) below which there is no entry.\(^{35} \) \( N \) is constant (zero) to the left of \( S \) and increasing in \( S \) to the right of \( S \).

This alternative centralized explanation has many features in common with our model of decentralized network formation. What distinguishes the alternative explanation from our model is a level discontinuity at the threshold (a discrete jump to \( N(S) \)) which is needed to just offset the fixed cost and which is not implied by our model. We do not observe a discrete jump at the threshold in any of the figures presented in this paper. What we observe instead is a change in the slope at the threshold. Formal tests of the model at our best estimate of the true threshold, reported in Table 1, are also consistent with this observation. We will see momentarily that the level change coefficient estimated at the threshold is insignificant with migration as well.

A related alternative explanation focuses on the interaction between blacks and whites. Consider a model, which is especially relevant during Reconstruction, in which blacks only mobilize when they expect to win (and elect their own leader) with sufficiently high probability. Because black population and the share of blacks in the population (not reported) are both increasing in plantation share, blacks will not turn out to vote until a threshold share, which is consistent with the voting patterns that we observe. However, this model also implies that there will be a discrete jump in voter turnout (sufficient to win the election) at the threshold. As noted, formal tests reject the presence of a level discontinuity at the threshold.

The second set of alternative explanations that we consider assumes that individuals vote and migrate independently in response to external forces that vary across counties.

\(^{35}\)This threshold must satisfy the condition \( V(N(S)) = k \). \( V(N(S)) < k \) for \( S < S \) since \( V_S(N(S)) > 0 \) and so there is no entry below the threshold.
example, three push factors that have featured prominently in the literature on the Great Migration are the arrival of the railroad, racial intimidation and violence, and the boll weevil invasion in cotton-growing counties. A well documented feature of the Great Migration is positive selection on education (eg. Lieberson 1978, Margo 1990, Tolnay 1998).\textsuperscript{36}

It is entirely possible that the strength of these push factors and other factors such as education that determined the response to new opportunities in the postbellum period varied with plantation share. To generate the migration patterns that we observe in the data, however, there must be little variation in these external forces up to a threshold plantation share and a systematic increase thereafter. Figure 10A nonparametrically regresses the number of miles of railroad in 1911 divided by the area of the county (available in 1880) on plantation share.\textsuperscript{37} Access to railroads is uncorrelated with plantation share. Figure 10B regresses the number of black lynchings in each southern county between 1882 and 1915 (just before the onset of the Great Migration) on plantation share.\textsuperscript{38} Very few lynchings are actually reported in this period, and although the data are quite noisy, no apparent trend is once again detectable. The boll weevil invasion commenced in the cotton south around 1890 (Lange, Olmstead, and Rhode 2009), so Figure 10C regresses the percentage change in cotton acreage from 1890 to 1920, as well as the corresponding change from 1910 to 1920 at the onset of the Great Migration, on plantation share.\textsuperscript{39} There was indeed a massive decline in cotton acreage from 1890 to 1920 and, somewhat surprisingly, a small increase from 1910 to 1920. Leaving aside the sharp change close to zero plantation share, however, there is little variation in these changes with the plantation share. Finally, Figure 10D regresses literacy in 1910, by race, on plantation share. The ability to coordinate would have allowed blacks in counties above the threshold plantation share to set up schools more easily. At the same time, the returns to education might well have been lower in those counties, since agricultural labor was the dominant occupation. What we find is that black literacy is declining mildly in plantation share, while the pattern for white literacy is reversed.

Table 3 tests the significance of the relationship between the push factors we have considered and plantation share. We begin in Columns 1-2 with the short and long double-difference migration measures as the dependents variables. The piecewise linear regression is estimated with the threshold set at the best estimate from the corresponding joint-test. As with the political outcomes, the baseline slope coefficient is small and insignificant, while the slope

\textsuperscript{36} The illustrative example that described the distribution of migrants across destinations in Section 3 allowed educated individuals to get jobs at the destination without the support of a network. Positive selection on education can then be generated under reasonable conditions (as long as the network is not too strong).

\textsuperscript{37} We are grateful to Jeremy Atack and Bob Margo for providing us with these data.

\textsuperscript{38} These data are obtained from the Historical American Lynching (HAL) Data Collection Project. They do not contain observations from Delaware, Maryland, Missouri, Texas, and Virginia.

\textsuperscript{39} An alternative measure, based on the percentage change in cotton production, generates similar results (not reported).
change coefficient is large and precisely estimated. The level change coefficient at the threshold is once again insignificant. Because the push factors we consider are supposed to provide an alternative explanation for the patterns of migration we uncover, Columns 3-7 regress our measures of these push factors on plantation share, with the threshold set to coincide with our best estimate of the threshold for migration (the long double-difference). Matching the figures reported above, the baseline slope coefficient, the slope change coefficient, and the level change coefficient are all insignificant in Columns 3-7. The same absence of significance is obtained (not reported) using the best estimate of the threshold from the joint-test for each push factor. Moreover, as shown in Appendix Figure A5, the joint-test does not locate a statistically significant interior maximum with any of these alternative explanations. Based on the discussion in Section 3, this is what we would expect when the slope change coefficient $\beta_2$ is zero. The same pattern is observed for outcomes such as Republican votes in 1900, church size in other denominations, and white migration, that are not associated with black networks.

While the push factors we consider may have been important for individual decisions to migrate, they cannot explain the specific nonlinear relationship between plantation share and black migration. However, it is possible that our measures do not fully capture the push factors that were relevant during the Great Migration. For example, it has been argued that the loss of economies of scale in agricultural production after slavery resulted in a dramatic decline in productivity (Fogel and Engerman 1974, Goldin and Lewis 1975, Moen 1992, Irwin 1994). This decline may have been particularly severe in the high plantation share counties, resulting in increased black migration to northern cities. It is also possible that white landowners selected particular types of slaves in those counties. An alternative explanation based on independent individual actions or characteristics would need to explain political outcomes many decades earlier. All of the push factors that we consider, for example, would not apply to political participation during Reconstruction. More importantly, external forces that increased the propensity of individuals to migrate (independently) in some counties would not necessarily channel them to a restricted number of northern destinations. The observation that the level of migration and the concentration of migrants across destinations track closely together is difficult to explain without a model of underlying coordination. Variation in the size of the black church congregation is also difficult to explain without a role for local coordination.

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40The boll weevil invasion and the arrival of the railroad occurred after Reconstruction. Although blacks were quick to invest in education after Emancipation, slaves were largely illiterate (Du Bois 1908). We would thus expect little variation in black (adult) literacy rates across southern counties in 1872. Because the South was under Federal rule at that time, we would expect racial violence and intimidation to have been less relevant as well.
5 Conclusion

The development process has historically been characterized, and continues to be characterized, by the movement of entire groups across space and occupations. The analysis in this paper highlights the interaction between historical preconditions and new opportunities in shaping such group mobility. Despite the adverse circumstances that they faced under slavery, blacks were able to solve the coordination problem and respond as a group to new political and economic opportunities when they became available in the postbellum period. It is worth emphasizing, however, that the collective response we uncover is restricted to southern counties where specific preconditions, determined by the organization of agricultural production under slavery and thereafter, were satisfied. Over 50 percent of southern counties and one-third of the black population were situated below the threshold at which networks could form (at a plantation share around 0.09).

Black migrants from counties below the threshold would have moved to northern cities with relatively little social support. Blacks from counties above the threshold would have moved in large groups to a small number of northern destinations. This variation in the pattern of out-migration would have had consequences for the formation and evolution of black communities in northern cities. Relatively weak communities would have formed in destinations that received migrants who moved independently from diverse origin locations. In contrast, the small number of northern destinations that received the bulk of their migrants from southern counties above the threshold would have formed more cohesive communities. This variation in initial conditions would, in turn, have shaped the evolution of African-American communities over the course of the twentieth century.

Differential out-migration could also have had consequences for the evolution of black communities in southern counties. Given the well documented positive selection on education among northern migrants, counties above the threshold would have lost the bulk of their most able residents over the first half of the twentieth century. The resulting social dislocation could then explain Putnam’s observation that those counties have relatively low social capital today. Wilson (1987) famously argued that the exit of educated black professionals from northern neighborhoods after Civil Rights and desegregation resulted in social dislocation and the concentration of poverty in inner-cities. A similar dynamic process may well have occurred in certain southern counties at the beginning of the twentieth century, paradoxically because they were better positioned to support collective migration. Slavery did have long-term effects on individual and institutional outcomes, but this worked through channels that have previously been unexplored and which we will examine in future research.
References


Figure 1: Plantation Share Across Southern Counties in 1890
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B. Migration from Mississippi
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A. Relationship between hypothetical outcome and plantation share

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T-Ratios for Coefficient Estimates

Baseline Slope

Slope Change
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A. Black Population 1860 to 1890

![Graph showing Black Population (1860 to 1890)]

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![Graph showing T-Ratios for Coefficient Estimates]
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B. Differenced Change in Population
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![Graph of T-Ratios for Coefficient Estimates]

D. Joint-Test for Long Double-Difference in Black Population

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B. Level and Distribution of Migrants
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A. Railroads

B. Lynching

C. Boll Weevil

D. Literacy Rates
Table 1: Crop labor intensities

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<td>Estimated</td>
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<td>0.29***</td>
<td>0.10*</td>
<td>0.16***</td>
<td>0.0003</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.11)</td>
<td>(0.06)</td>
<td>(0.02)</td>
<td>(0.0004)</td>
</tr>
</tbody>
</table>

Notes: Labor intensities measured by the number of workers per acre. Statistics from the first row are obtained from Olstead and Rhodes (2010), Niles Weekly Register (1835), House (1954), and Earle (1992), respectively. Estimated standard errors are corrected for heteroskedasticity and clustered residuals within each county.
Table 2: Slope change regression results for outcome variables, thresholds determined by joint test statistic
[absolute value of t-ratios]

<table>
<thead>
<tr>
<th></th>
<th>Black population in 1870</th>
<th>Republican votes for President in 1872</th>
<th>Republican votes for Governor in 1871-1873</th>
<th>Black State Represent.</th>
<th>Black State Senator</th>
<th>Baptist &amp; Methodist church size in 1890</th>
<th>Black Bapt. &amp; Methodist church size in 1890</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7)</td>
</tr>
<tr>
<td>Slope change</td>
<td>21698.6***</td>
<td>7688.4***</td>
<td>7659.8***</td>
<td>3.047***</td>
<td>1.241***</td>
<td>179.48***</td>
<td>193.75*</td>
</tr>
<tr>
<td></td>
<td>[2.70]</td>
<td>[4.10]</td>
<td>[4.25]</td>
<td>[4.32]</td>
<td>[2.60]</td>
<td>[2.59]</td>
<td>[1.76]</td>
</tr>
<tr>
<td>Baseline slope</td>
<td>17372.0***</td>
<td>-135.9</td>
<td>-60.9</td>
<td>0.004</td>
<td>0.020</td>
<td>41.87</td>
<td>9.61</td>
</tr>
<tr>
<td></td>
<td>[3.20]</td>
<td>[0.10]</td>
<td>[0.05]</td>
<td>[0.01]</td>
<td>[0.07]</td>
<td>[0.94]</td>
<td>[0.10]</td>
</tr>
<tr>
<td>Threshold mean shift</td>
<td>530.2</td>
<td>118.8</td>
<td>32.5</td>
<td>-0.033</td>
<td>-0.015</td>
<td>-3.18</td>
<td>6.76</td>
</tr>
<tr>
<td></td>
<td>[0.95]</td>
<td>[1.06]</td>
<td>[0.33]</td>
<td>[0.81]</td>
<td>[0.53]</td>
<td>[0.73]</td>
<td>[1.06]</td>
</tr>
<tr>
<td>Avg. state fixed effect</td>
<td>1896.6</td>
<td>667.58</td>
<td>637.04</td>
<td>0.074</td>
<td>0.034</td>
<td>94.54</td>
<td>99.06</td>
</tr>
<tr>
<td>Threshold location</td>
<td>0.0837</td>
<td>0.0845</td>
<td>0.0843</td>
<td>0.0541</td>
<td>0.0834</td>
<td>0.1323</td>
<td>0.0940</td>
</tr>
<tr>
<td>p-value of joint test</td>
<td>0.999</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
<td>0.057</td>
<td>0.082</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.3650</td>
<td>0.2095</td>
<td>0.1854</td>
<td>0.3356</td>
<td>0.1920</td>
<td>0.1416</td>
<td>0.2215</td>
</tr>
<tr>
<td>Sample size</td>
<td>1022</td>
<td>1040</td>
<td>1005</td>
<td>1135</td>
<td>1135</td>
<td>1104</td>
<td>939</td>
</tr>
</tbody>
</table>

Notes: Threshold locations based on the maximum joint test statistic when fixing the scale parameter to be equal to three-quarters of the standard deviation of the variable of interest. Models include state indicators in the regression, and the estimated standard errors are corrected for heteroskedasticity.
Table 3: Slope change results for competing hypotheses, thresholds fixed at 0.0797
[absolute value of t-ratios]

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope change</td>
<td>11136.0 ***</td>
<td>15579.7 **</td>
<td>0.192</td>
<td>2.52</td>
<td>80.33</td>
<td>2354.1</td>
<td>-0.209</td>
</tr>
<tr>
<td></td>
<td>[2.72]</td>
<td>[2.34]</td>
<td>[0.80]</td>
<td>[0.10]</td>
<td>[1.31]</td>
<td>[1.61]</td>
<td>[1.05]</td>
</tr>
<tr>
<td>Baseline slope</td>
<td>341.8</td>
<td>-54.5</td>
<td>-0.096</td>
<td>4.98</td>
<td>-81.37</td>
<td>-2328.8</td>
<td>0.040</td>
</tr>
<tr>
<td></td>
<td>[0.23]</td>
<td>[0.01]</td>
<td>[0.49]</td>
<td>[0.23]</td>
<td>[1.31]</td>
<td>[1.61]</td>
<td>[0.21]</td>
</tr>
<tr>
<td>Threshold mean shift</td>
<td>-187.8</td>
<td>337.4</td>
<td>0.021</td>
<td>0.84</td>
<td>2.05</td>
<td>49.94</td>
<td>-0.016</td>
</tr>
<tr>
<td></td>
<td>[0.68]</td>
<td>[0.72]</td>
<td>[1.23]</td>
<td>[0.56]</td>
<td>[1.01]</td>
<td>[1.52]</td>
<td>[1.43]</td>
</tr>
<tr>
<td>Avg. state fixed effect</td>
<td>298.77</td>
<td>382.85</td>
<td>0.109</td>
<td>6.84</td>
<td>4.91</td>
<td>124.4</td>
<td>0.698</td>
</tr>
<tr>
<td>Threshold location</td>
<td>0.1235</td>
<td>0.0797</td>
<td>0.0797</td>
<td>0.0797</td>
<td>0.0797</td>
<td>0.0797</td>
<td>0.0797</td>
</tr>
<tr>
<td>p-value of joint test</td>
<td>0.008</td>
<td>0.019</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.1299</td>
<td>0.1434</td>
<td>0.0923</td>
<td>0.0674</td>
<td>0.0182</td>
<td>0.0248</td>
<td>0.2244</td>
</tr>
<tr>
<td>Sample size</td>
<td>1126</td>
<td>1125</td>
<td>1101</td>
<td>434</td>
<td>729</td>
<td>756</td>
<td>1119</td>
</tr>
</tbody>
</table>

Notes: See notes to Table 1. Threshold locations fixed at 0.0797, which is the threshold location for the “long difference” in black population changes between 1890 and 1930.
Appendix

Figure A1: Robustness to Alternative Measures of Plantation Share for Black Baptist and Methodist Church Size

Figure A2: Instrumental Variable Estimates for Black Baptist and Methodist Church Size
Figure A3: Robustness to Alternative Measures of Plantation Share for Long Double-Difference in Black Population

Figure A4: Instrumental Variable Estimates for Long Double-Difference in Black Population
Figure A5: Push Factors and Other Outcomes Not Associated with Black Mobilization

- Railroad density 1911
- Number of Black Lynchings 1882-1915
- Percentage change cotton acreage 1890-1920
- Black Literacy Rate in 1910
- White Literacy Rate in 1910
- Republican Votes in 1900
- Other Denominations Church Size in 1890
- Long Double-Difference in White Population