Persistence in Season of Birth: A New Measure of Intergenerational Mobility*

Mindy S. Marks† A. R. Shariq Mohammed‡

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Abstract

Our understanding of the geography of upward mobility in the historical United States—particularly for Black Americans—remains limited due to data constraints. This paper exploits the fact that individuals born in winter have lower wellbeing to construct novel estimates of intergenerational mobility for the near universe of cohorts born in the post-Reconstruction era. Leveraging season-of-birth data from the 1900 U.S. Decennial census, we first map the geography of intergenerational mobility by race. While state rankings are similar across races, county-level estimates reveal stark differences in the locations that foster upward mobility. We document that counties with stronger human capital indicators, better occupational profiles, and stronger economic attributes exhibit higher upward mobility for both races, whereas higher rates of single motherhood reduce mobility only for Blacks. Our analysis also reveals that Black, but not White, upward mobility was lower in areas where large-slaveholding arrangements were common, underscoring slavery's enduring legacy.

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†Northeastern University. Email:m.marks@northeastern.edu

‡Northeastern University. Email:ab.mohammed@northeastern.edu

1 Introduction

What factors promote upward mobility—and do these factors operate similarly across racial groups, places, and over time? Addressing these fundamental questions requires first documenting the landscape of economic opportunity. Recent advances in census-linked datasets have enabled nationwide analyses of the geography of intergenerational mobility for White populations (e.g., Connor and Storper (2020); Tan (Forthcoming)). However, existing linked samples for Black Americans suffer from low match rates, limited geographic coverage, and small sample sizes—particularly outside the South.[1] As a result, we know relatively little about the landscape of historical mobility for Black individuals. This paper aims to fill that gap by examining the geography of intergenerational mobility by race in the historical United States.

In this paper, we develop a novel measure of socioeconomic mobility based on season of birth and use it to generate the most comprehensive estimates of upward mobility by race in the post-Reconstruction period. Our approach builds on a large body of interdisciplinary research starting from the 1920s, which finds that winter births are associated with lower levels of wellbeing. Similarly, prior studies have shown that parents of lower socioeconomic status (e.g., younger, less educated, and disproportionately from minority groups) are more likely to give birth in the winter. Consistent with this literature, we show that first-quarter births were associated with lower literacy, occupational status, and survival outcomes for both racial groups during our period of analysis. Additionally, illiterate, low-skilled, and Q1-born parents were more likely to have Q1-born children. Taken together, these patterns suggest that season of birth can be used to measure intergenerational mobility.

Our analysis draws on the 1900 Decennial census—the only publicly available U.S. census that records month of birth for the entire population. Leveraging this feature and following the intergenerational mobility literature, we define upward mobility as the likelihood that a child attains a higher socioeconomic status than their parent. Specifically in our primary specification, we classify a parent-child pair as upwardly mobile if a mother born in the first quarter (low socioeconomic status), has a child born outside the first quarter. Based on this

[1] The difference in match rates by race arises from significant difficulties in linking Black individuals across census waves, driven by factors such as the prevalence of common names, spelling errors, and other record-keeping inconsistencies. As a result, commonly used linking datasets yield match rates for Black individuals ranging from 3.4% to 20% with a clear tradeoff between link quality and match rate. See Appendix A for more details.

definition, we estimate national upward mobility at 0.74 for Whites and 0.67 for Blacks, echoing the lower upward mobility for Black Americans documented in other studies (e.g., Collins and Wanamaker (2022); Ward (2023); Jácome et al. (2025); Collins and Holtkamp (2025)).

Next, we turn to a key strength of our approach: its ability to generate estimates of upward mobility at finer levels of geography. For Black individuals, our near-complete coverage of locations where they resided at the start of the twentieth century enables us to provide the most comprehensive geography of intergenerational mobility. We produce estimates for nearly all U.S. states, and at this level, both racial groups exhibit similar regional patterns—mobility was lowest in the South and Southwest, and highest in the Northern Plains and Mountain West. In contrast, our county-level analysis reveals substantial geographic variation in upward mobility—both within and across racial groups—that is obscured in state-level estimates. For White individuals, while state-level data suggest uniformly low mobility in the South, county-level maps uncover pockets of high mobility. We find that the highest rates of upward mobility for Black Americans were concentrated in counties outside the South, highlighting stark regional disparities. The weak correlation between Black and White county-level mobility underscores the importance of examining mobility at finer geographic scales to uncover heterogeneity in access to opportunity in the post-Reconstruction period.

We use county-level estimates of intergenerational mobility for Black and White individuals to explore factors associated with upward mobility. We find that counties with stronger human capital indicators (e.g., literacy rates, school attendance), better occupational profiles (e.g., higher occupational income scores, greater manufacturing employment), and stronger economic attributes (e.g., urbanization, homeownership, railroad access) exhibit higher mobility for both races. However, high rates of single motherhood have little predictive power for White mobility but are negatively associated with Black upward mobility. Additionally, we document that Black, but not White, upward mobility tends to be lower in counties characterized by a higher proportion of slaves held under large slaveholding arrangements, underscoring the enduring legacy of slaveholding arrangements and their disparate impact on Black experiences post-emancipation. All these findings remain robust to alternative samples that address various concerns, including restricting to counties with more observations, adjustments for migration, excluding older children who may no longer be co-residing with their parents, and variations in seasonal definitions.

We contribute to two areas of literature. First, there is a burgeoning literature on novel proxies of socioeconomic status. Going beyond the common proxies of socioeconomic status like income, education, and occupation, researchers have adopted innovative proxies with informational content about socioeconomic status, such as names (Olivetti and Paserman (2015); Güell et al. (2015)), health (Ahlburg (1998); Halliday et al. (2020); Mazumder (2024)), landownership and wealth (Collins and Holtkamp (2025); Black et al. (2020); Adermon et al. (2018); Clark and Cummins (2015)), and lifespan (Black et al. (2023); Monaghan et al. (2020); Minardi et al. (2023)). These novel proxies often help fill gaps where traditional measures are unavailable or complement existing estimates by providing alternative dimensions of intergenerational mobility beyond income. Our contribution to this literature is the use of season of birth as a new proxy for the analysis of intergenerational mobility. This measure offers several advantages, such as being available for the entire population, allowing for large sample analysis of geographic opportunities without the challenges associated with data linking, and being consistently available across all demographic subgroups.

Second, our findings contribute to the literature on the geography of intergenerational mobility in the United States. There is extensive literature on the geography of intergenerational mobility overall (Chetty et al. (2014)) and by race in the modern period (e.g., Davis and Mazumder (2018); Chetty et al. (2020)). It finds that Black children have lower prospects of upward mobility than White children and that the racial gap in upward mobility is lower in geographic areas with relatively lower poverty and racial animus. Advances in data availability have allowed researchers to explore the historical geography of mobility both overall and for Whites (Tan, Forthcoming; Connor and Storper, 2020; Bailey et al., 2025). While the findings differ on some counts, these studies document high mobility in the West and Northeast and low mobility in the South.

Closest to our paper in this literature are two recent studies that map intergenerational mobility by race in historical U.S. contexts. Card et al. (2022) study the 1922–1924 birth cohorts, using education as a proxy for socioeconomic status among the subsample of youth co-residing with parents in the 1940 Decennial census. They document regional and racial disparities in upward educational mobility and find that higher teacher salaries significantly improve mobility, explaining much of the Black-White gap. Collins and Holtkamp (2025) link male cohorts born between 1858–1870 to their future selves in 1900. While coverage for Whites is extensive, the Black linked sample is restricted mostly to Southern counties. Using homeownership as a proxy for socioeconomic status, they show that Black men in cotton-intensive areas faced significantly lower upward mobility in terms of property ownership by 1900.

Our paper differs from these studies in two important ways. First, we focus on cohorts born during the Gilded Age (1885–1899)—a transformative period characterized by rapid wealth accumulation and preceding the Great Migration—thus filling the temporal gap between the cohorts examined in the two prior studies. Second, and more importantly, our proxy for socioeconomic status is observed for the entire population, which allows us to construct a more comprehensive picture of intergenerational mobility. Because this proxy is observed at birth, it applies to both males and females and is less affected by co-residency bias.[2] Additionally, our approach enables analysis even in geographic areas with relatively few Black individuals. This distinction is crucial because the counties where Black populations were concentrated in the nineteenth century strongly overlapped with areas of intensive slaveholding. The spatial distribution of enslaved and free African Americans was far from random and is differentially correlated with historical indicators of economic wellbeing (Allen et al. (2025)). By incorporating all counties—including those with smaller Black populations—our analysis offers the most comprehensive estimates of Black intergenerational mobility in the post-Reconstruction period.

The remainder of the paper is organized as follows. Section 2 discusses the literature on season of birth as a proxy for socioeconomic status. Section 3 presents empirical evidence validating the use of season of birth to measure economic mobility in the historical United States. Section 4 introduces our estimates of the geography of intergenerational mobility. Section 5 examines how mobility correlates with a range of county-level characteristics. Robustness checks are presented in Section 6, and Section 7 concludes.

[2]While Card et al. (2022) address potential selection bias from the co-residency restriction by limiting their sample to children under age 18, their co-residency rates remain highly uneven across groups, exceeding 90% for White males but dropping to as low as 60% for Black females at age 18.

2 Season of Birth and Wellbeing

The relationship between season of birth and wellbeing can be traced back over a century (Faber (1920); Blonsky (1929); Huntington (1938)). Early studies conducted in both the United States and Europe revealed notable patterns, including higher birth weights in spring and summer compared to fall and winter, greater weight loss during the first two weeks of life in winter months versus summer months, lower intelligence quotient, along with higher rates of criminality, insanity, and tuberculosis among individuals born in winter (Bivings (1934); Marshall (1937); Pintner and Forlano (1933); Huntington (1938)). As documented in Appendix Table A1 (Panel A), a large body of contemporary research across the social and natural sciences reinforces this association. While the table presents an illustrative sample of studies, the broader evidence consistently shows that individuals born in winter tend to experience worse outcomes across a range of socioeconomic indicators—including educational attainment, earnings, health, and life expectancy—than those born in other seasons.[3]

There is an ongoing debate as to why winter births are associated with lower socioeconomic status. One explanation is compositional—children born in winter may simply have parents of lower socioeconomic status. However, this relationship persists even in studies with mother fixed effects (Currie and Schwandt (2013)), suggesting that seasonal environmental factors also matter. Winter pregnancies are linked to vitamin D deficiency, reduced maternal physical activity, and higher air pollution, all of which can affect maternal health and fetal growth during a child's critical stages of development (Chodick et al. (2009); Murray et al. (2000); Strand et al. (2011); Lam et al. (1996); Basu et al. (2010); Wilhelm and Ritz (2003)). Elevated maternal cortisol during autumn and winter births may increase risks of later mental health disorders (Garay et al. (2019)). Additionally, studies have shown that the seasonal nature of influenza and other viral infections (e.g., greater influenza prevalence in January and February) is an additional mechanism driving adverse health at birth and very early childhood (e.g., Currie and Schwandt (2013); Payne et al. (1986); Wjst et al. (2005)). Overall, this evidence suggests that as early-life environmental factors can leave

[3] In general, the quarter of the year that corresponds to winter is the one most associated with lower levels of wellbeing. In the Northern Hemisphere, this corresponds to births that occur in the first quarter of the year. In the Southern Hemisphere the pattern is flipped - individuals born in the third quarter (July-September) experience worse outcomes. See Syme and Illingworth (1978); García Hildebrandt (1992) in Appendix Table A1.

lasting scars that shape future socioeconomic outcomes.

Similarly, research dating back to the 1930s has documented that low socioeconomic status parents are disproportionately more likely to give birth in winter months (Pintner and Forlano (1933); Goodenough (1941)). Specifically, research shows that young, minority, and less educated mothers are relatively more likely to give birth in the first quarter, and winter births are more common in households where the father has a lower skilled occupation. Appendix Table A1 (Panel B) describes studies that document an association between winter births and a lower parental socioeconomic background.

The explanations for the documented relationship between parent's socioeconomic status and child's quarter of birth include preference of parents and biological and socioeconomic factors. Goodenough (1941) found that higher-socioeconomic-status families deliberately avoid winter births, favoring later quarters due to health and environmental concerns—summarized by one mother's comment that warmer months offer "sunshine and fresh air" and less risk of illness. More recent studies support this idea. Using data from the National Survey of Families and Growth, Buckles and Hungerman (2013) show that the seasonality in maternal characteristics is driven by women trying to conceive ("wanted births").

Another explanation for seasonal patterns in births is that upper socioeconomic status individuals are more protected from the effects of climate than lower socioeconomic status individuals. For example, summer's high temperatures inhibit sperm production (Centola and Eberly (1999)), and this seems to affect lower socioeconomic status men more adversely, which could account for the fact that there are relatively fewer births to these couples in spring and summer. Finally, for poor households where the mother needs to work there is some evidence of attempting to avoid births during periods of peak labor demand. For agricultural households, this would result in fewer births during the harvest season and more births in the winter when the fields are fallow (Lam et al. (1991); Nurge (1970); Levy (1986)).

Taken together, this evidence—drawn from a large, interdisciplinary literature spanning more than a century—underscores a persistent link between season of birth and wellbeing through biological and socioeconomic channels. In the next section, we examine whether these patterns hold in our historical context.

3 Validity of Season of Birth as an Indicator of Socioeconomic Status

For our approach to be valid, the link between socioeconomic status and season of birth must hold for our cohorts of interest. Table 1 shows the cumulative distribution of births across months of the year, both overall and by race and region. As shown, 26.4% of all children born between 1885-1899 were born in the first quarter (Q1). Importantly, parents who were of low socioeconomic status were disproportionately more likely to have Q1 births. The percentage of Q1 births among parents with low socioeconomic status (when defined as fathers being illiterate) is 28.7% (column 2) or 29% when low socioeconomic status is defined using maternal illiteracy (column 3). In contrast, as shown in column 4, only 25% of births to high socioeconomic status parents (defined as fathers employed in white-collar, semi-skilled, or skilled professions) occurred in Q1.[4] The finding that low socioeconomic status fathers are more likely to have children born in Q1 than their high socioeconomic status counterparts is true across regions and both races (columns 5-16) and aligns with historical and modern studies showing stronger seasonality in births among lower-socioeconomic-status groups (e.g., Goodenough (1941); Pintner and Forlano (1933); Buckles and Hungerman (2013)).

Next, we document a negative relationship between first-quarter birth and socioeconomic status for both parents and children. Using data from the 1900 Decennial census, we test whether socioeconomic outcomes differ by quarter of birth across several measures. Table 2 reports sample averages for individuals born in the first quarter (column 1) and in the second through fourth quarters (column 2), with overall percentage differences shown in column 3. Columns 4–6 and 7–9 present the corresponding statistics separately for the two racial groups. Results for adult males (fathers of our cohorts of interest) appear in Panel A. Take for instance illiteracy: 14% of Q1-born men are illiterate whereas only 11% of non-Q1-born men are illiterate. Thus Q1-born men are 23.9% more likely to be illiterate. For all measures, regardless of race, adult males born in the first quarter have lower measures of socioeconomic status. As shown in Panel B, adult females born in the first quarter are also of lower socioeconomic status. They are more likely to be illiterate, less likely to own a home, more likely to have given birth as a teenager, and more likely to marry at a younger

[4] Under these definitions of socioeconomic status there were 1.8 million births to low socioeconomic fathers, 5.4 million births to high socioeconomic fathers, and 8.1 million births unclassified. Alternatively, if we add non-landowning farmers to the low socioeconomic status classification, this increases the number of low socioeconomic fathers to 3.8 million and the distribution of births across quarters 1 through 4 is 27.7%, 25.6%, 23.7%, and 23%.

age. Panel C contains estimates for the children where fewer measures of socioeconomic status are available. Among children aged 11–15, those born in Q1 were more likely to be illiterate and less likely to attend school. Using 1960 census data, we also find lower survival rates for Q1 births.[5] For example, among children born between 1885 and 1889, survival was 5.6% lower overall and 12.5% lower among Black children. The finding that individuals born in Q1 are of lower socioeconomic status is also true across all four regions (see Appendix Table A2).

In order for quarter of birth to convey information about economic mobility, it must also be true that low socioeconomic status parents according to their quarter of birth (i.e. parents born in the first quarter) are more likely to give birth to low socioeconomic status children as measured by children's quarter of birth. To test this, we estimate a series of regressions in which the outcome of interest is whether a child was born in the first quarter, and the key independent variable is whether the parent(s) were born in the first quarter, along with a set of socioeconomic control variables. The results of this exercise are reported in Table 3. Column 1 contains the results when the father is the focal parent. We find that fathers born in the first quarter are 1.8 percentage points more likely to have children born in the first quarter—a sizable difference, given that the baseline rate among non-Q1 fathers is 25.5%. Fathers who are Black and those who are illiterate, are more likely to have Q1-born children whereas those with higher occupational income score are less likely to have Q1-born children.

A potential concern is that this intergenerational link in season of birth could reflect shared exposure to factors such as local climate or seasonal labor patterns, rather than socioeconomic status. To address this, we re-estimate the model with county fixed effects (column 2), which account for time-invariant local conditions. The results remain virtually unchanged, suggesting that the intergenerational association is not driven by geographic seasonality or local environmental factors, but reflects a deeper socioeconomic pattern.

Focusing on the specification with county fixed effects, column 4 repeats the analysis for mothers. If being born in the first quarter does indeed capture low socioeconomic status that

[5] We use the 1960 Decennial census because it is the next census to record quarter birth for adults. From the 1960 census, we can estimate the number of individuals that were born in each cohort and birth quarter, using 5% sample from IPUMS and weights (slwt) to construct population counts. We compare these estimates to full counts by birth cohort and birth quarter from the 1900 census to compute survival probability. Results are robust to the 1970 census (which also contains quarter of birth).

transmits to the next generation, then it should be true for mothers as well. Reassuringly, findings from this exercise are the same as those in the case of fathers. Mothers who were born in the first quarter are 2.1 percentage points more likely to have children who are born in the first quarter.[6] Furthermore, consistent with contemporary literature, the proxies of low socioeconomic status predict the likelihood that a mother gives birth in the first quarter (e.g., Buckles and Hungerman (2013)). For instance, Black mothers are about 2.2 percentage points more likely to give birth in the first quarter (relative to White mothers). Column 6 shows that both parents' Q1 status jointly predicts child Q1 birth, with nearly identical coefficients for mothers and fathers. The findings that low socioeconomic parents are more likely to give birth to low socioeconomic status children (as proxied by Q1) is also true across regions (Appendix Table A3).[7]

Finally, given the high rates of illiteracy during the study period and the self-reported nature of the birth data, one might be concerned that individuals from lower socioeconomic backgrounds, if unaware of their true birth month, were more likely to report January. While the true month of birth cannot be directly observed, it is possible to assess the reliability of self-reported information under the assumption that individuals could accurately report their birth quarter. To do so, we conduct a validation exercise using publicly available Social Security application records, which required applicants to self-report their month and date of birth. These data allow us to examine patterns of potential misreporting by identifying the likelihood of "rounded" or "made-up" dates (e.g., 1st or 15th). The Social Security application records cover a large subset of our child cohort—specifically, those who survived long enough to apply for Social Security benefits beginning in the mid-1930s.[8]

The Social Security application records are consistent with misreporting of birth information. Appendix Table A4 shows the frequency of various dates both overall and by

[6]A recent study Alcaide et al. (2023) finds similar evidence for the modern period. Using data from Spain and France, they document that mothers and children share a birthday month about 4.6% more often than expected by chance.

[7]As an additional piece of evidence that quarter of birth contains information about socioeconomic status we note that there is assortative mating along this trait. Among all mothers of our cohort of interest that were born in Q1, 31% of the spouses were also born in Q1. For Black mothers this figure is 40%.

[8]The U.S. National Archives and Records Administration version of the public Social Security applications data includes individuals who applied for a Social Security Number at any point. In practice, it offers near-universal coverage of deaths occurring between 1988 and 2007. Coverage rates—measured as the ratio of individuals in the SS-5 records to those in the 1940 census—exceed 30% for birth cohorts born in the 1890s. For our cohorts of interest, the data provide month and day of birth for 2.7 million White Americans and nearly half a million Black Americans. For additional details on this dataset, see Mohammed and Mohnen (2025).

race. Over 5% of the Social Security applicants and 7.4% of Black applicants report being born on the 15^{th} of the month (much greater than chance). The 1^{st}, 10^{th}, and 25^{th} of the month also appear at rates much greater than chance. We call these dates that occur at rates much greater than chance "fishy date". 16.75% of all Social Security applicants and 23.29% of Black applicants in our child cohort report one of these four fishy dates. However, the odds of reporting a birthdate that occurs on a fishy date does not vary by our measure of socioeconomic status. For all individuals, 16.7% of those who reported a birth in quarters 2-4 report a fishy birth date compared to 16.8% for those who report a birth month in Q1. The similarity in the odds of reporting a fishy birth date by quarter of birth holds for both racial groups as well.[9] Overall, while "bunching" occurs around certain dates, reassuringly our investigation finds that this pattern does not differ between individuals with a month of birth in Q1 and those with a month of birth in other quarters.

4 Spatial Variation in Mobility

In this section, we use birth season as a proxy for socioeconomic status to estimate intergenerational mobility at the national, state, and county levels by race. To characterize the geography of upward mobility, information on the economic status of children and their parents is required, from which the degree of intergenerational mobility in each locality can then be estimated.

Let Y_{iCl} denote a measure of socioeconomic status (e.g., income, education) for child C in location l, and Y_{iPl} the corresponding measure for the parent. The intergenerational mobility literature typically defines upward mobility as the likelihood that a child attains a higher socioeconomic status than his/her parent. In our setting, we use birth in the first quarter as a proxy for low socioeconomic status; accordingly, we define upward mobility in a location as the probability that a Q1-born parent has a child born in the second through fourth quarter.

Specifically, for a child-parent pair i containing parent P and child C, we estimate the following empirical model separately for each racial group (Black and White):

[9] If we repeat this exercise adding all the days with frequency of 3.5% or higher (a total of 6 days accounting for 22.5% of White and 31.2% of Black Social Security applicants) to the set of fishy dates, the finding is unchanged.

$$Y_{iCl} = \alpha_l + \beta_l Y_{iPl} + \varepsilon_{il} \quad (1)$$

where Y_{iCl} is an indicator variable that equals 1 when a child residing in location l is not born in the first quarter, α_l is the constant, Y_{iPl} is an indicator variable that equals 1 when a parent residing in location l is born in the first quarter, and ε_{il} is the error term, where l is either a state or a county. The sum of coefficients $\alpha_l + \beta_l$ is the measure of upward mobility in location l, which is equivalent to the probability that a Q1-born parent gives birth to a child in quarter two through four.[10]

Our primary analysis draws on the full count 1900 Decennial Census, which enables us to link parents and their children when they reside in the same dwelling. We restrict the analysis to children who reside with a parent.[11] Our main sample includes children born between 1885 and 1899 and their mothers.[12] We further limit our sample to the subset of parent-child pairs where the child is native-born and was classified by the census enumerator as Black or White. For our child cohort of interest 13.3% are Black, 86.4% are White and the remaining 0.28% are Japanese, Chinese, or American Indian.

Focusing on Black individuals, in 1900 there were 3,435,540 Black children born between 1885-1899 of which 2,968,624 resided with their mother, as such we have information on socioeconomic status for 86.4% of all Black child-parent pairs. Appendix Table A5 compares samples based on our method to those based on commonly used linked samples. We first note that because our approach does not require the child to be linked across census waves we have significantly more child-parent pairs than approaches that require linking. As shown in Appendix Table A5, depending on the methods, linked sample can match 120,000-690,000 Black children belonging to our cohorts of interest to their parents. Additionally, our measure of socioeconomic status is universal where other commonly used measures (occupational income score, literacy) are sometimes missing, further reducing sample size. Smaller sample size is a limitation because sufficiently large sample sizes are needed in a given location in

[10]Note that the measure of upward mobility based on the specification in Equation 1 is equivalent to finding the average Y_{iCl} among parents of race r born in location l in the first quarter, where Y_{iCl} is an indicator variable equal to 1 if a child is not born in the first quarter.

[11]In the 1900 census, 95.5% of children under age of 15 lived with their parents, with 92.8% co-residing with their mothers and 88.1% with their fathers. Thus our main sample uses the mother as the focal parent.

[12]We exclude children born in 1900 because the timing of the census is such that they could only be born in the first two quarters of the year. Results are robust to including these children.

order to generate reliable estimates of the geography of economic mobility. Thus compared to linked samples our approach allows for greater geographic coverage-especially in locations outside of the South where relatively few Blacks were located.[13]

Within the parent-child pairs, our main analysis limits the sample to Q1-born mothers in order to generate estimates of upward mobility. Among all children born in cohorts of interest, 965,639 Black and 5,486,925 White children reside with their Q1-born mothers. Finally, we restrict to counties in which we have at least 20 Q1-born Black mothers. This generates an estimation sample of 961,568 Black children and 3,619,232 White children. We impose a restriction of at least 20 Q1-born Black mothers for both racial groups to ensure that our estimates of upward mobility are derived from the same geographic samples; this results in losing many Western counties with numerous White residents but very few Black households.[14] In terms of geographic coverage, our sample spans 44 states and the District of Columbia, covering a total of 1,418 counties of which 363 are located outside of the US South. The counties in our sample account for 99.16% of all Blacks recorded in the 1900 Decennial census.

We begin with estimates of upward mobility at the national level for each racial group. The national level estimate of upward mobility (probability that a Q1-born mother gives birth in Q2 through Q4) is 0.74 for Whites and the corresponding estimate is only 0.67 for Blacks. Reassuringly, these findings align with recent research on trends in mobility that documents that overall upward mobility rates were significantly lower for Blacks than Whites at the turn of the 20th century (e.g., Collins and Wanamaker (2022); Ward (2023); Jácome et al. (2025)).

Next, we turn to the main strength of our approach that allows us to generate estimates of upward mobility at finer levels of geography. Figure 1 presents our findings of upward mobility for the full sample by child's state of residence with the mother as the focal parent.

[13]As documented in Appendix Table A5, if we require at least 50 Black child-parent pairs without missing proxies of socioeconomic status in a county, there are 416 such counties outside of the south when quarter of birth is the measure of socioeconomic status. For the linked samples with occupational income score as the measure of socioeconomic status, coverage ranges from 24-178 counties. We note that 50 Black parent-child pairs is arbitrary but each measure of socioeconomic status imposes its own sample restrictions. For instance we limit our analysis to counties with at least 20 Q1-born Black mother-child pairs, whereas others may restrict to 10 parent-child pairs (or parent-son pairs) where the parent is low socioeconomic status.

[14]5,486,776 White children reside in counties with at least 20 Q1-born White mothers. Appendix Figure A1 presents a county-level map of upward mobility for White individuals, restricting the analysis to counties with at least 20 Q1-born White mothers. Corresponding correlational estimates are reported in Figure A1.

Darker shades in each map denote states with lower upward mobility. We start by discussing estimates for Whites (Panel A) for comparability with the recent literature. There are some clear and distinct regional patterns that stand out from state-level maps. Specifically, we find that mobility was lowest in the Southern region and parts of the Southwest, and we find high rates of upward mobility in the New England, West, and Midwest regions.

The existing historical literature largely focuses on the geography of White intergenerational mobility. By and large our maps are similar to the existing estimates for Whites that use linked samples and occupation as the measure of socioeconomic status. Connor and Storper (2020) and Tan (Forthcoming) document high rates of upward mobility in the West and Northeast. Their results suggest that upward mobility was lowest in the South. Using a different sample and a different measure of socioeconomic status we find the same.

Because our method does not require linking we have a large enough sample to be able to offer the most comprehensive look at the geography of upward mobility for Blacks during the post-Reconstruction era. Figure 1 (Panel B) presents our findings of upward mobility by child's state of residence among Blacks. Upward mobility is highest for Blacks in New England, the Mountain region, and it is lowest in the South. Our estimates of upward mobility for all three Southern divisions lie between 0.66 and 0.67. Perhaps surprisingly, the geography of upward mobility appears similar for Black and White populations. For both racial groups, rates of upward mobility are lowest in the South and high in New England and the Mountain West. The rank correlation between the Black and White maps is 0.75 when we compare estimates at the state level. This suggests that whatever historical factors were driving spatial difference in upward mobility across states likely impacted both racial groups. Notably, this would rule out factors such as differential access to quality schooling, which varied widely across racial groups during this period (e.g., Anderson (1988)).

Figure 2 shows the geography of upward mobility using the child's county of residence as the unit of geography.[15] The county-level maps unmask a great deal of heterogeneity

[15] Appendix Figures A2, A3, A4 and A5 show the maps using two alternative mobility measures: downward mobility (the likelihood that a non-Q1-born mother has a Q1-born child) and relative mobility (the slope from regressing a child's Q1 birth on the mother's Q1 birth). Relative mobility is strongly negatively correlated with upward mobility for both groups (–0.65 for White individuals and –0.86 for Black individuals for the state level maps, and –0.67 for Whites and –0.79 for Blacks for the county-level maps), while downward mobility is negatively correlated with upward mobility only for Whites (–0.76 for Whites and –0.05 for Blacks for the state level maps, and –0.52 for Whites and –0.14 for Blacks for the county-level maps).

within states, and show the advantage of generating maps at finer levels of geography. While the analysis at the state level suggests that the geography of upward mobility is similar across racial groups, this is not the case when county is the level of geography. The rank correlation between the Black and White maps is only 0.28 when we compare estimates at the county level.[16]

For the White population, the state map and the existing estimates in the literature suggest that the South is uniformly bad, whereas our analysis at the county level suggests that many counties in the South have very high rates of upward mobility for Whites. For instance, counties with some of the highest and lowest rates of economic mobility are located within Alabama. On the other hand, both the state and county maps suggest that the Midwest has high rates of upward mobility for Whites.

The key advantage of our approach is that it leverages the near-universe of Black population in 1900, enabling us to include all counties where Black populations resided outside the South. Thus ours is the first study to map the complete landscape of Black intergenerational mobility in the late nineteenth century. The only existing estimate of Black upward mobility in this time period is Collins and Holtkamp (2025) which is mostly limited to Southern counties. Within the South, they find upward mobility for Black men is higher in parts of Virginia and North Carolina, and lowest in parts of Alabama and South Carolina, a pattern we replicate. However, looking at the entirety of counties where Blacks resided in that time period reveals a new insight: the vast majority of counties with highest rates of upward mobility were located outside of the South. For instance, Ohio, Indiana, Michigan, and much of New England contain counties with high rates of Black upward mobility.

Finally, our baseline results used children co-residing with their mothers, as relatively more children can be found co-residing with their mothers than their fathers in the 1900 Decennial census. However, a benefit of using quarter of birth as a proxy for socioeconomic status is that unlike most proxies this measure is available with large samples for either parent. As such, we can also generate estimates of upward mobility using the father's quarter of birth as the proxy for parent's socioeconomic status. Specifically, we limit the sample to children co-residing with their fathers and define upward mobility as the probability

[16]A valid concern is whether the low correlation stems from noise in county-level estimates due to small sample sizes. However, narrowing the analysis to counties with at least 50 or 100 Black Q1-born mothers (compared to 20 in the baseline) increases the correlation only slightly, to 0.33 and 0.36, respectively.

of a child being born in the second through fourth quarters given their *father* was born in the first quarter. The results of this exercise are shown in Figure 3. The patterns are strikingly similar to those seen when the mother's season of birth is the proxy for parent's socioeconomic status. When focusing on locations common to both mother and father maps, the rank correlation at the state level is 0.96 for Whites and 0.91 for Blacks. Overall, the similarity in findings regardless of focal parent is reassuring.

Taken together, these findings highlight both the depth of regional inequality and the importance of examining mobility at finer geographic levels and across a fuller national landscape—including areas outside the South—to uncover the true heterogeneity of opportunity in post-Reconstruction America.

5 Correlates of Intergenerational Mobility

Why did some areas of the United States exhibit much higher rates of upward mobility than others? Given the differences in the geography of upward mobility by race, why were some areas relatively worse for Black upward mobility?

To begin addressing these questions, we examine how our race-specific measures of upward mobility correlate with county-level attributes commonly studied in the literature on economic mobility and growth. While these correlations are not intended to identify causal effects, our objective is to document a set of stylized facts about the factors associated with upward mobility in the post-Reconstruction era. Because our estimates of intergenerational income mobility are available for only a single birth cohort, we focus on cross-sectional patterns rather than changes over time. We compile socioeconomic indicators spanning 1860 to 1900 from a variety of historical sources.[17] Appendix Table A6 provides descriptive statistics for the county-level attributes used in this analysis along with the data source and decades for which each socioeconomic attribute is available.

Following the literature (e.g., Connor and Storper (2020); Chetty et al. (2020)), for each attribute X we estimate the following equation separately for each racial group:

[17]Recall that a child's season of birth provides information about his/her future socioeconomic status as well as the socioeconomic status of his/her parents. Our focal children were born between 1885 and 1899 and their parents were born in the mid 1860s (the median birth year for this generation is 1865). As such we have opted to include county-level attributes starting 1860.

$$UM_l = \eta X_l + \varepsilon_l \tag{2}$$

where UM_l is the race-specific measure of upward mobility estimate from equation 1, where l is county and X is a county-level attribute. Both UM_l and X_l are standardized having a mean of 0 and a variance of 1. The coefficient of interest η reflects correlation between the two measures, and it can also be interpreted as an increase of one standard deviation in the county-level attribute, on average, is associated with η standard deviation change in upward mobility for a given racial group.

Figure 4 presents the findings from the correlation analysis. It shows the unweighted, univariate correlations between upward mobility and a range of county-level characteristics, using all counties with available data for each variable. We include several measures within five broad domains: human capital, occupational structure, demographic and economic attributes, race and discrimination, and slaveholding arrangements.[18] The symbols mark the correlation estimates, and the horizontal lines represent 95 percent confidence intervals. Different symbol shapes represent years corresponding to the data sources for county-level attributes. The top panel displays results for Black individuals, and the bottom panel shows results for White individuals. The remainder of this section discusses the correlations between upward mobility and each of the county-level attributes shown in Figure 4.

5.1 Human Capital

In the left most section of Figure 4, we show the associations between various county-level measures of human capital and our estimate of intergenerational mobility. We have four different measures of human capital. For multiple census waves we can compute the illiteracy rate (the fraction of individuals over the age of 16 in the county that can neither read nor write), the literacy rate (the fraction of individuals over the age of 16 in the county that can both read and write), the school-going rate (the fraction of individuals aged 5-20 who attend school), and the teacher-pupil ratio (the number of teachers divided by the population aged

[18] As mentioned earlier, a key advantage of our approach is its broad coverage, encompassing counties representing over 99% of the Black population. Appendix Figure A6 reports results separately for Southern and non-Southern counties. Interestingly, the factors we examine—such as human capital and demographic characteristics—sometimes exhibit a weaker association with upward mobility for Blacks in non-Southern counties, whereas for Whites, human capital variables are more strongly predictive of upward mobility outside the South.

5-20). Regardless of the measure of human capital for both Blacks and Whites, there is a positive relationship between human capital and upward mobility with the relationship being stronger for Blacks. For instance, a one standard deviation increase in the literacy rate is associated with a 0.21 to 0.23 standard deviation increase in upward mobility for Whites depending on the census wave. The corresponding estimates for Blacks are 0.29 to 0.34. The finding that human capital inputs are positively correlated with intergenerational mobility has been documented by various scholars for Whites during our time period (e.g., Connor and Storper (2020)) and for Blacks in the 1940s (e.g., Card et al. (2022)). It is reassuring that we observe similar results based on our estimates of intergenerational mobility which use a new proxy for socioeconomic status.

5.2 Occupational Structure

Next we examine the relationship between occupational structure and intergenerational mobility. This analysis builds on the literature in social stratification linking intergenerational mobility occupations and industrial activity which finds that intergenerational mobility is positively associated with industrial activity and negatively associated with agricultural employment (e.g., Lipset and Bendix (1959); Torche and Costa Ribeiro (2010)). Using county-level occupational data from the 1870, 1880, and 1900 censuses, we find that counties with higher occupational score show greater upward mobility for both racial groups.[19] Higher levels of manufacturing is also associated with upward mobility irrespective of census waves. Both of these findings are consistent with those for Whites in Connor and Storper (2020). We calculate the share of working-age adults (16–65) employed as farmers or unskilled laborers. A higher proportion of unskilled workers predicts lower upward mobility for Black individuals, whereas a greater farmer share is negatively associated with mobility for Whites.

5.3 Demographic and Economic Attributes

The middle section of Figure 4 illustrates the relationship between intergenerational mobility and various demographic and economic attributes. Prior work in the historical US has shown that upward mobility tends to be higher in areas with a larger foreign-born share (e.g., Connor and Storper (2020); Bailey et al. (2025)). We find similar patterns using our

[19] This finding is robust to using occupational income scores based on Collins and Wanamaker (2022).

measure of socioeconomic status: for both Black and White individuals, upward mobility is positively correlated with the foreign-born share.

Recent research highlights the importance of family structure in shaping intergenerational mobility, showing that the share of two-parent families in a community is strongly associated with upward mobility (Chetty et al. (2014)). Moreover, evidence suggests that family structure has a greater impact on Black mobility than on White mobility in the contemporary U.S. (Chetty et al. (2020)). Whether these patterns held historically is less well understood. In our period of study, we construct two measures of family structure for mothers with co-residing children: (1) the share who have never married, and (2) the share who are currently married (i.e., not "never married, widowed, or divorced").[20]

Among White families, we find little evidence of a relationship between county-level family stability and upward mobility. In contrast, for Black families, living in counties with a higher share of never-married mothers is associated with significantly lower upward mobility, while a higher share of currently married mothers is positively associated with mobility. For example, the correlation between the proportion of never-married mothers and Black upward mobility is –0.21. Although this estimate is smaller than that reported by Chetty et al. (2014) using contemporary data, the direction and interpretation remain consistent.

Next we explore the relationship between commonly used measures of economic conditions and economic progress (e.g., Donaldson and Hornbeck (2016); Bond (1934); Berger (2018)). Specifically, we look at the home ownership rate, access to railroad and water transportation, churches per capita, the urban share, and the share of farm acres that are improved. With an exception of water access for Whites, all other proxies of economic progress (i.e the home ownership rate, the urban share, the share of farm acres that are improved, access to railroads) are positively related to intergenerational mobility for both racial groups regardless of census wave. We do not find any association between churches per capita and economic mobility. These findings of positive association with proxies of wealth align with the historical literature on the geography of upward mobility among Whites (e.g., Connor and Storper (2020)).

[20]Even though divorce status is reported in the 1880 and 1890 census, we do not include it as a proxy of unstable families because divorce was very uncommon during our time period. The median county had a divorce rate of 0.1% in both census years.

5.4 Race and Discrimination

In this section, we focus on various proxies related to race and discrimination, and examine how they are associated with intergenerational mobility. We begin our analysis by examining the percentage of Black residents in a county and a measure of county-level racial residential segregation taken from Logan and Parman (2017). Previous research has shown that these factors were negatively associated with economic progress of both racial groups (Chetty et al. (2014); Andrews et al. (2017); Connor and Storper (2020); Logan and Parman (Forthcoming)). In line with these findings, we observe that higher percentages of Black residents and greater racial segregation are associated with lower upward mobility for both racial groups.

Next, following recent work by Collins and Holtkamp (2025), we turn to Reconstruction-era political dynamics and agricultural conditions as additional historical factors that may have shaped long-run mobility patterns. Specifically, we associate our estimates of intergenerational mobility with the share of votes cast for the Republican presidential candidate, Ulysses S. Grant, in the 1872 election (Clubb et al. (2006)). Grant, a former Union general, was generally unpopular among Southern Whites. As such, Republican vote shares in this context are often interpreted as a reflection of Black political strength (e.g., Collins and Holtkamp (2025)). Despite this, like Collins and Holtkamp (2025), we find no evidence that counties with higher Republican vote shares in 1872 experienced greater upward mobility for Black residents by 1900.

Finally, we explore the role of cotton production in shaping economic opportunity. Cotton-intensive areas were marked by a high prevalence of sharecropping and tenant farming among Black residents (Wright (1986)) which could impede economic mobility. Our findings indicate that upward mobility for Black individuals was substantially lower in counties with higher per capita cotton production. Notably, this negative relationship is stronger for Black residents than for Whites. Our findings of a negative relationship between cotton intensity and upward mobility for Blacks mirror recent work by Collins and Holtkamp (2025). Collectively, the evidence presented in this panel suggests that the social and economic conditions of the late-nineteenth-century may have played a lasting role in shaping racial disparities in economic opportunity across generations.

5.5 Slaveholding Arrangements

Finally, we leverage the fact that we have upward mobility estimates for the near-universe of Southern counties to provide the first empirical insights into the relationship between slaveholding arrangements and intergenerational mobility. The significance of this investigation lies in the lack of consensus among scholars concerning how the scale of slaveholding arrangements has influenced the economic outcomes of enslaved individuals and their descendants.

One perspective, advanced by Du Bois (1908), argues that large plantations subjected slaves to extreme conditions with "no family life, no meals, no marriages, no decency, only an endless round of toil", implying that such environments eroded social structures and led to persistent familial and social dysfunction. The greater numbers and higher density of people on large holdings probably promoted the spread of communicable diseases (Genovese (1976)). Additionally, the labor demands on slaves were likely greater on larger units (Fogel and Engerman (1995)).

However, another strand of scholarship points to the instability of small slaveholders, where slave families in smaller holdings were more frequently separated due to sales or the absence of enough laborers to support a stable family unit that resulted in single-parent or divided families (e.g., Blassingame (1972); Dunaway (2003); Miller (2018)). Additionally, given the significant economic vulnerability of cash crops grown, small slaveholders were more susceptible to financial insolvency than their larger and wealthier counterparts which could also result in family separation given that enslaved individuals were used as collateral for loans (Kolchin (1993); Johnson (2001); Kilbourne and Wright (2014)). Additionally, based on his interactions with enslaved individuals, Olmsted (1860) noted that they rarely wanted to be sold to small farms, partly because they understood that their own access to food and care depended upon their owner's solvency (Genovese (1976)).

To address the legacy of the size of slaveholding arrangements on the future economic mobility of descendants of slaves, we turn to the 1860 census, where slaveholders were asked to report the size of their slaveholdings. We have information on slaveholding size in 19 distinct groups, starting with individual counts from 1 to 9 and then larger holdings (e.g., 10–14, 15–19, up to 300 or more) (Haines et al. (2010)). We use this data to generate an estimate of the number of slaves that resided in a county overall in 1860 assuming the midpoint for each bin and 300 slaves for those that are categorized in the largest bin. Then for each slaveholding category we define slaveholding share based on the total number of slaves held by owners in that category divided by the total slave population in each county. We restrict this analysis to counties with at-least 300 slaves in 1860.[21] For these counties, Appendix Figure A7 shows the spatial variation in the distribution of larger slaveholdings (40+ slaves).

The right most panel of Figure 4 highlights the striking relationship between historical slaveholding arrangements and intergenerational mobility by race. For White individuals, we find no meaningful association between a county's historical distribution of slaves and upward mobility. In contrast, for Black individuals, upward mobility is significantly lower in counties where a larger share of enslaved people were held in large-scale slaveholding operations.[22] For example, consider two neighboring counties in South Carolina: Kershaw County, which had 7,841 enslaved individuals with an average of 21 slaves per slaveholder, and Chesterfield County, with 4,348 enslaved individuals and an average of 10 slaves per slaveholder (based on the 1860 census). The corresponding upward mobility measures for these counties are 0.59 and 0.75, respectively, illustrating how more concentrated slaveholding arrangements are associated with lower upward mobility for Blacks. The fact that the size of the slaveholding arrangements correlates with Black but not White upward mobility suggests that the disparities observed for Blacks are not solely attributable to economic conditions commonly affecting both racial groups, such as wealth and economic opportunities associated with locations with smaller slaveholding arrangements.

Our finding aligns closely with the accounts of Black intellectuals and formerly enslaved individuals such as W. E. B. Du Bois, Frederick Douglass, Booker T. Washington, and Harriet Jacobs (Du Bois (1908); Douglass (1845); Jacobs (1861); Washington (1965)). These prominent figures consistently documented the dehumanizing conditions on large plantations, highlighting not only the brutal physical labor but also the severe deprivation that enslaved

[21] These results are robust to including all counties or restricting the sample to those within former Confederate states.

[22] The finding that Black upward mobility tends to be lower in counties characterized by a higher proportion of slaves held under large slaveholding arrangements aligns with results from Margo and Steckel (1982). Using Civil War military records, they show that the stature of Black Americans declined as the median size of holding in the county of residence increased. The decline in stature with increasing plantation size may partly reflect reduced access to essential nutrients on larger holdings. On smaller farms, food was often prepared in a common kitchen for both slaveholders and the enslaved, resulting in relatively better-quality meals (Stampp (1956); Genovese (1976)).

people, especially field hands, endured. Our empirical results support this historical evidence by demonstrating that the legacy of large-scale slavery continued to shape economic outcomes across generations.

6 Robustness Checks

In this section, we check the robustness of the descriptive findings in section 5. Specifically we alter the samples to address potential concerns and compare the correlation estimates to our baseline estimates shown by blue Xs from Figure 4.[23] We first assess the robustness of our results by re-estimating equations 1 and 2 restricting the sample to counties with larger Black populations. In the baseline analysis, counties were included as long as there were 20 Black mothers born in the first quarter. It is possible that in our county-level estimates of upward mobility are mismeasured in counties with few Black households. As such, we generate new correlation estimates where the threshold for a county to be included in the sample is increased to 50 Q1-born Black mothers. This removes 235 counties from the sample. These results are shown in the black open square in Figure 5. Figure 5 also shows the correlates of upward mobility if we further restrict to counties with at least 100 Q1-born Black mothers; dropping an additional 165 counties. These estimates are illustrated by black open circles. As illustrated by the open squares and circles, the relationship between the human capital variables and upward mobility is slightly attenuated for the White sample. For the Black sample, regardless of the attribute, the correlation estimates remain basically unchanged.

Many of the county-level variables of interest, including the slavery measures, are only available prior to 1890. Thus far we are assigning these variables to the mother's (and child's) county of residence in 1900. However for migrants the assignment of county-level variables is likely incorrect since the mother and/or child were exposed to a different county that we cannot observe in the data. Measuring migration in historical censuses is fraught with challenges, as the 1900 Decennial census only reports state of birth and current county of residence for each individual. Given this data limitation, we account for in-migration by labeling each mother as a migrant if her current state of residence differs from her birth state.

[23] For the baseline estimates we take attributes from the 1880 census when available. Slaveholding arrangements, rail and water access are from the 1860 census, and the number of churches, homeownership and 1872 republican candidate's vote share is from 1870.

We then re-estimate equations 1 and 2 excluding all migrant mothers from the sample.[24] The association of the estimates of intergenerational mobility based on this sample and county-level correlates is shown as solid circles in Figure 5. Excluding migrants from the sample slightly attenuates the correlations for the Black sample for the human capital and demographic structure variables. The estimates for the White sample are very similar to our baseline estimates when we exclude migrants from the sample.

Next, we describe how we address out-migration. We cannot add back individuals who previously lived in the county, thus we employ the following approach. Conceptually, a county whose population for a given cohort shrinks over time either has out-migration or an abnormally high mortality rate. We consider the cohort of women born between 1860 and 1870 since this cohort had significant overlap with mothers in our analysis. To generate a county-level proxy for out-migration, we use data from the 1870 and 1900 censuses to count U.S.-born women—born between 1860 and 1869—living in each county, separately by race. We compute the ratio of the number of 1860-1869 born individuals in 1900 compared to 1870. For Whites in the median county we can locate 67% of women. The corresponding figure for Blacks is 54%. We exclude from the sample the counties with the highest rates of out-migration, defined as the bottom quartile in population retention (i.e., counties where fewer than 54% of the 1870 White population and fewer than 36% of the 1870 Black population could be located in 1900). Removing counties with high rates of out-migration strengthens the correlation between the county-level variables and upward mobility as shown by the solid diamonds in Figure 5.

Our sample requires children to be co-residents with their mothers so that we can observe quarter of birth for both members of the dyad. A potential concern with using the 1885–1899 birth cohorts in the 1900 census is that older children may have left the household by the time of observation, potentially introducing selection bias. To address this concern, we restrict our sample to children under age 10—specifically those born between 1890 and 1899—which increases the rate of co-residence with mothers from 92.75% to 94.64%. Importantly, the overall patterns in our analysis (represented by solid triangles) remain unchanged under this restriction.

[24]This analysis excludes 476,172 out of a total of 2,952,938 Black and 5,688,575 out of 13,512,857 White mother-child pairs. During this period, nearly all excluded migrant mother-child pairs are distributed relatively evenly across the non-Western regions.

Next, a valid concern is that individuals with lower socioeconomic status, who cannot recall their exact birth month, may disproportionately report births as occurring in January. To address this, we exclude January from our sample. For this robustness exercise we compute upward mobility estimates, defined as the probability of a child being born in Q2-Q4 to mothers born in February or March. As shown by the solid squares, omitting January from the sample slightly attenuates the correlational estimates but the overall patterns are unchanged.

Lastly, the negative impact of being born in winter does not start or end abruptly on January 1^{st} or March 31^{st}, as the process is likely more continuous. To address this, we adjust our definition of a winter birth by adding December and April births to our proxy of low socioeconomic status and define upward mobility as cases where mothers born in December through April have children born outside these months (i.e., between May and November). Reassuringly, the relationship between county-level attributes and these alternative upward mobility estimates (indicated by plus signs) closely mirrors the baseline results, suggesting that our findings are not sensitive to changes in how we define a winter birth.

In sum, correlations between county attributes and upward mobility estimates remain stable across various sample restrictions, underscoring the robustness of our findings to alternative definitions of winter birth, co-residence criteria, sample size thresholds, and migration-related concerns.

7 Conclusion

In this paper we develop a novel measure of upward mobility using season of birth as a proxy for socioeconomic status. A key advantage of this proxy is that it enables linkage-free mobility estimates for all individuals co-residing with a parent. Using this approach, we produce estimates of upward mobility by race in the post-Reconstruction United States. At the state level, mobility patterns are broadly similar across races, but at the county level, sharp racial disparities emerge: while some Southern counties show high mobility for Whites, mobility for Blacks remains uniformly low across the region.

We then explore the determinants of intergenerational mobility using our new measure. In our analysis of county-level correlates, we find that better human capital indicators (e.g., literacy rates, school attendance, teacher-student ratios), occupational characteristics (e.g., higher occupational income scores, greater manufacturing employment), and better economic attributes (e.g., urbanization, homeownership rates) are positively associated with upward mobility for both Black and White individuals.

However, notable racial differences emerge. Attributes associated with family structure—such as higher shares of non-marital births or lower rates of mothers being currently married—and markers of racialized institutions—cotton intensity—have little predictive power for White mobility but are negatively associated with Black upward mobility. Finally, we contribute new evidence to the historical debate on slaveholding arrangements by showing that counties with large slaveholdings were linked to lower upward mobility for Blacks, but have no effect on Whites.

While the primary focus of this paper is to introduce a new proxy for socioeconomic status, demonstrate its validity, and use it to explore upward mobility for Blacks in the post-Reconstruction era, future research can extend this approach to other underrepresented demographic groups (e.g., Native Americans) or apply it to other nations or time periods where more commonly used measures of socioeconomic status are unavailable. By opening new avenues for the study of intergenerational mobility in data poor settings, this work contributes both a methodological innovation and a deeper understanding of intergenerational mobility in the United States for Black Americans.

References

Adermon, Adrian, Mikael Lindahl, and Daniel Waldenström, "Intergenerational Wealth Mobility and the Role of Inheritance: Evidence from Multiple Generations," *The Economic Journal*, 2018, *128* (612), F482–F513.

Ahlburg, Dennis, "Intergenerational Transmission of Health," *The American Economic Review*, 1998, *88* (2), 265–270.

Alcaide, Adela Recio, César Pérez López, Miguel Ángel Ortega, Luisa N. Borrell, and Francisco Bolúmar, "Is There an Association Between Family Members' Season of Birth That Could Influence Birth Seasonality? Evidence from Spain and France," *Population Studies*, 2023, pp. 1–16.

Allen, Treb, Winston Chen, and Suresh Naidu, "The Economic Geography of American Slavery," Technical Report w34356, National Bureau of Economic Research 2025.

Anderson, James D., *The Education of Blacks in the South, 1860–1935*, University of North Carolina Press, 1988.

Andrews, Rodney, Marcus Casey, Bradley L. Hardy, and Trevon D. Logan, "Location Matters: Historical Racial Segregation and Intergenerational Mobility," *Economics Letters*, 2017, *158*, 67–72.

Bailey, Martha J., A. R. Shariq Mohammed, and Paul Mohnen, "Changes in Educational Mobility in the U.S. over the Twentieth Century," 2025. Working Paper.

Basu, Rupa, Brenna Malig, and Bart Ostro, "High Ambient Temperature and the Risk of Preterm Delivery," *American Journal of Epidemiology*, 2010, *172* (10), 1108–1117.

Berger, Thor, "Places of Persistence: Slavery and the Geography of Intergenerational Mobility in the United States," *Demography*, 2018, *55* (4), 1547–1565.

Bivings, Lee, "Racial, Geographic, Annual, and Seasonal Variations in Birth Weights," *American Journal of Obstetrics and Gynecology*, 1934, *27* (5), 725–728.

Black, Sandra E., Neil Duzett, Adriana Lleras-Muney, Nolan G. Pope, and Joseph Price, "Intergenerational Correlations in Longevity," Technical Report w31034, National Bureau of Economic Research 2023.

_ , Paul J. Devereux, Petter Lundborg, and Kaveh Majlesi, "Poor Little Rich Kids? The Role of Nature versus Nurture in Wealth and Other Economic Outcomes and Behaviours," *The Review of Economic Studies*, 2020, *87* (4), 1683–1725.

Blassingame, John W., *The Slave Community: Plantation Life in the Antebellum South*, Oxford University Press, 1972.

Blonsky, Pavel Petrovich, "Friih- und Spatjahrkinder," *Jb. Kinderheilk.*, 1929, *124*, 115–120.

Bond, Horace Mann, *The Education of the Negro in the American Social Order*, Octagon, 1934.

Buckles, Kasey and Daniel Hungerman, "Season of Birth and Later Outcomes: Old Questions, New Answers," *Review of Economics and Statistics*, 2013, *95* (3), 711–724.

Card, David, Ciprian Domnisoru, and Lowell Taylor, "The Intergenerational Transmission of Human Capital: Evidence from the Golden Age of Upward Mobility," *Journal of Labor Economics*, 2022, *40* (S1), S39–S95.

Centola, Grace M. and Shirley Eberly, "Seasonal Variations and Age-Related Changes in Human Sperm Count, Motility, Motion Parameters, Morphology, and White Blood Cell Concentration," *Fertility and Sterility*, 1999, *72* (5), 803–808.

Chetty, Raj, Nathaniel Hendren, Maggie R. Jones, and Sonya R. Porter, "Race and Economic Opportunity in the United States: An Intergenerational Perspective," *The Quarterly Journal of Economics*, 2020, *135* (2), 711–783.

_ , _ , Patrick Kline, and Emmanuel Saez, "Where Is the Land of Opportunity? The Geography of Intergenerational Mobility in the United States," *The Quarterly Journal of Economics*, 2014, *129* (4), 1553–1623.

Chodick, Gabriel, Shira Flash, Yonit Deoitch, and Varda Shalev, "Seasonality in Birth Weight: Review of Global Patterns and Potential Causes," *Human Biology*, 2009, *81* (4), 463–477.

Clark, Gregory and Neil Cummins, "Intergenerational Wealth Mobility in England, 1858–2012: Surnames and Social Mobility," *The Economic Journal*, 2015, *125* (582), 61–85.

Collins, William J. and Marianne H. Wanamaker, "African American Intergenerational Economic Mobility since 1880," *American Economic Journal: Applied Economics*, 2022, *14* (3), 84–117.

_ and Nicholas C. Holtkamp, "The Geography of Opportunity after the Civil War: Black and White Americans' Intra-and Intergenerational Mobility into Property Ownership," Technical Report w33860, National Bureau of Economic Research 2025.

Connor, Dylan Shane and Michael Storper, "The Changing Geography of Social Mobility in the United States," *Proceedings of the National Academy of Sciences*, 2020, *117*, 30309–30317.

Currie, Janet M. and Hannes Schwandt, "Within-Mother Analysis of Seasonal Patterns in Health at Birth," *Proceedings of the National Academy of Sciences*, 2013, *110*, 12265–12270.

Davis, Jonathan and Bhashkar Mazumder, "Racial and Ethnic Differences in the Geography of Intergenerational Mobility," 2018. Available at SSRN 3138979.

Donaldson, Dave and Richard Hornbeck, "Railroads and American Economic Growth: A 'Market Access' Approach," *The Quarterly Journal of Economics*, 2016, *131* (2), 799–858.

Douglass, Frederick, *Narrative of the Life of Frederick Douglass, an American Slave*, Boston: Anti-Slavery Office, 1845.

Du Bois, W.E.B., *The Souls of Black Folk*, Chicago: A.C. McClurg & Co., 1908.

Dunaway, Wilma A., *The African-American Family in Slavery and Emancipation*, Cambridge University Press, 2003.

Faber, Harold, "A Study of Growth of Infants in San Francisco with a New Form Weight Chart," *Arch Pediatr*, 1920, *37* (1), 244–254.

Fogel, Robert William and Stanley Lewis Engerman, *Time on the Cross: The Economics of American Negro Slavery*, Vol. 1, WW Norton & Company, 1995.

Garay, Samantha M., Katrina A. Savory, Lorna A. Sumption, Richard J.A. Penketh, Ian R. Jones, Anna B. Janssen, and Rosalind M. John, "Seasonal Variation in Salivary Cortisol but Not Symptoms of Depression and Trait Anxiety in Pregnant Women Undergoing an Elective Caesarean Section," *Psychoneuroendocrinology*, 2019, *108*, 14–19.

Genovese, Eugene D., *Roll, Jordan, Roll: The World the Slaves Made*, New York: Vintage Books, 1976.

Goodenough, Florence Laura, "Month of Birth as Related to Socio-Economic Status of Parents," *The Pedagogical Seminary and Journal of Genetic Psychology*, 1941, *59*, 65–76.

Güell, Mai, José V. Rodríguez Mora, and Christopher I. Telmer, "The Informational Content of Surnames, the Evolution of Intergenerational Mobility, and Assortative Mating," *The Review of Economic Studies*, 2015, *82* (2), 693–735.

Halliday, Timothy J., Bhashkar Mazumder, and Ashley Wong, "The Intergenerational Transmission of Health in the United States: A Latent Variables Analysis," *Health Economics*, 2020, *29* (3), 367–381.

Hildebrandt, Jorge O García, "Estacionalidad del Nacimiento en Esquizofrénicos de Lima y Callao (Peru) – Un Estudio en el Hemisferio Sur," *An. salud ment*, 1992, pp. 69–100.

Huntington, Ellsworth, *Season of Birth: Its Relation to Human Abilities*, New York, NY: Wiley, 1938.

Jacobs, Harriet, *Incidents in the Life of a Slave Girl. Written by Herself*, Boston: Published for the Author, 1861.

Johnson, Walter, *Soul by Soul: Life Inside the Antebellum Slave Market*, Harvard University Press, 2001.

Jácome, Elisa, Ilyana Kuziemko, and Suresh Naidu, "Mobility for All: Representative Intergenerational Mobility Estimates Over the Twentieth Century," *Journal of Political Economy*, 2025, *133* (1), 306–354.

Kilbourne, Richard Holcombe Jr. and Gavin Wright, *Debt, Investment, Slaves: Credit Relations in East Feliciana Parish, Louisiana, 1825-1885*, Tuscaloosa: The University of Alabama Press, 2014.

Kolchin, Peter, *American Slavery, 1619-1877*, New York: Hill and Wang, 1993.

Lam, David, Jeffery Miron, and Ann Riley, "Seasonality of Births in Human Populations," *Social Biology*, 1991, *38* (1-2), 51–78.

_ , _ , and _ , "The Effects of Temperature on Human Fertility," *Demography*, 1996, *33* (3), 291–305.

Levy, Victor, "Seasonal Fertility Cycles in Rural Egypt: Behavioral and Biological Linkages," *Demography*, 1986, *23*, 13–30.

Lipset, Seymour Martin and Reinhard Bendix, *Social Mobility in Industrial Society*, Berkeley: University of California Press, 1959.

Logan, Trevon D. and John M. Parman, "The National Rise in Residential Segregation," *The Journal of Economic History*, 2017, *77* (1), 127–170.

_ and _ , "Racial Residential Segregation in the United States," *Journal of Economic Literature*, Forthcoming.

Luukkonen, Juha, Heta Moustgaard, Hanna Remes, and Pekka Martikainen, "Month of Birth and Outdoor Temperature After Birth Predict Childhood Atopic Diseases in Finland," *Pediatric Allergy and Immunology*, 2025, *36* (6), e70118.

Margo, Robert A. and Richard H. Steckel, "The Heights of American Slaves: New Evidence on Slave Nutrition and Health," *Social Science History*, 1982, *6* (4), 516–538.

Marshall, Everett L., "A Review of American Research on Seasonal Variation in Stature and Body Weight," *The Journal of Pediatrics*, 1937, *10* (6), 819–831.

Mazumder, Bhashkar, "What Do We Know About the Intergenerational Transmission of Health," in "Research Handbook on Intergenerational Inequality" 2024, pp. 150–163.

Miller, Melinda C., "Destroyed by Slavery? Slavery and African American Family Formation Following Emancipation," *Demography*, 2018, *55* (5), 1587–1609.

Minardi, Saverio, Giulia Corti, and Nicola Barban, "Historical Patterns in the Intergenerational Transmission of Lifespan and Longevity: Evidence From the United States, 1700-1900," 2023.

Mohammed, A. R. Shariq and Paul Mohnen, "Black Economic Progress in the Jim Crow South: Evidence from Rosenwald Schools," *Journal of Economic History*, 2025, *85* (1), 72–109.

Monaghan, Pat, Alexei A. Maklakov, and Neil B. Metcalfe, "Intergenerational Transfer of Ageing: Parental Age and Offspring Lifespan," *Trends in Ecology & Evolution*, 2020, *35* (10), 927–937.

Murray, Liam J., D. Patrick J. O'Reilly, Neil Betts, Chris C. Patterson, George Davey Smith, and A. Elizabeth Evans, "Season and Outdoor Ambient Temperature: Effects on Birth Weight," *Obstetrics & Gynecology*, 2000, *96* (5), 689–695.

Nurge, Eero, "Birth Rate and Work Load," *American Anthropologist*, 1970, *72* (6), 1434–1439.

Olivetti, Claudia and Daniele Paserman, "In the Name of the Son (and the Daughter): Intergenerational Mobility in the United States, 1850-1940," *American Economic Review*, 2015, *105* (8), 2695–2724.

Olmsted, Frederick Law, *A Journey in the Back Country* 1860.

Payne, Claire M., C. George Ray, Virginia Borduin, Linda L. Minnich, and Michael D. Lebowitz, "An Eight-Year Study of the Viral Agents of Acute Gastroenteritis in Humans: Ultrastructural Observations and Seasonal Distribution With a Major Emphasis on Coronavirus-Like Particles," *Diagnostic Microbiology and Infectious Disease*, 1986, *5* (1), 39–54.

Pintner, Rudolf and George Forlano, "The Influence of Month of Birth on Intelligence Quotients," *Journal of Educational Psychology*, 1933, *24* (8), 561.

Stampp, Kenneth M., *The Peculiar Institution: Slavery in the Ante-Bellum South*, New York: Alfred A. Knopf, 1956.

Strand, Lise B., Adrian G. Barnett, and Sophie Tong, "The Influence of Season and Ambient Temperature on Birth Outcomes: A Review of the Epidemiological Literature," *Environmental Research*, 2011, *111* (3), 451–462.

Syme, GJ and DJ Illingworth, "Sex Differences in Birth Patterns of Schizophrenics," *Journal of Clinical Psychology*, 1978, *34* (3), 633–635.

Tan, Hui Ren, "A Different Land of Opportunity: The Geography of Intergenerational Mobility in the Early 20th-Century US," *Journal of Labor Economics*, Forthcoming.

Torche, Florencia and Carlos Costa Ribeiro, "Pathways of Change in Social Mobility: Industrialization, Education and Growing Fluidity in Brazil," *Research in Social Stratification and Mobility*, 2010, *28* (3), 291–307.

Ward, Zach, "Intergenerational Mobility in American History: Accounting for Race and Measurement Error," *American Economic Review*, 2023, *113* (12), 3213–3248.

Washington, Booker T., *Up from Slavery*, New York: Dover Publications, 1965.

Wilhelm, Michelle and Beate Ritz, "Residential Proximity to Traffic and Adverse Birth Outcomes in Los Angeles County, California, 1994-1996," *Environmental Health Perspectives*, 2003, *111* (2), 207–216.

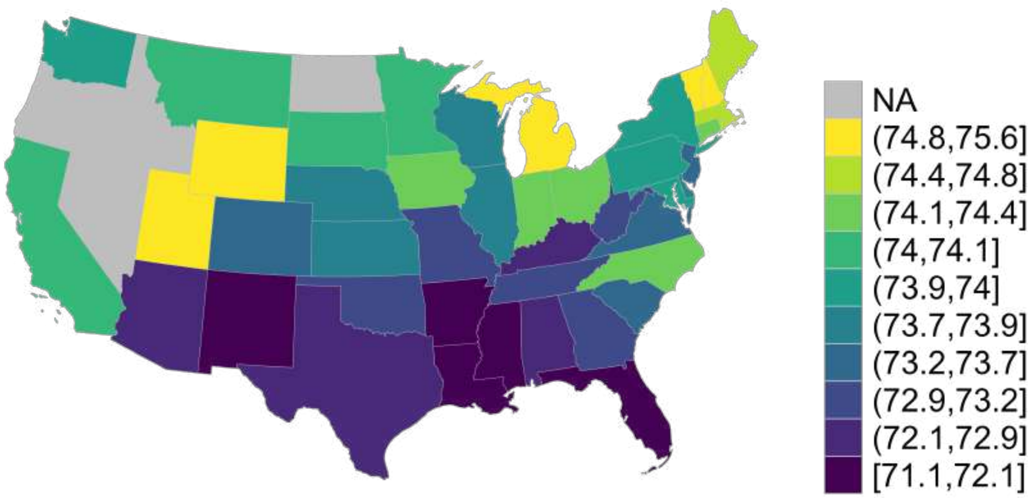
Wjst, Matthias, Shyamali Dharmage, Elisabeth André, Dan Norbäck, Chantal Raherison, Simona Villani, Jure Manfreda, Jordi Sunyer, Deborah Jarvis, Peter Burney, and Cecilie Svanes, "Latitude, Birth Date, and Allergy," *PLoS Medicine*, 2005, *2* (10), e294.

Wright, Gavin, *Old South, New South: Revolutions in the Southern Economy since the Civil War*, New York: Basic Books, 1986.

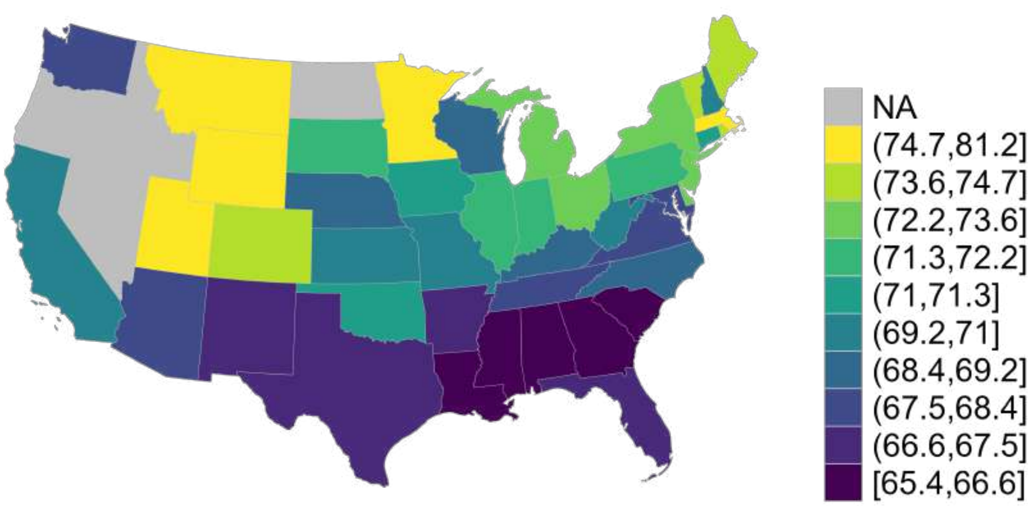
Figures and Tables

Figure 1. The Historical Geography of Upward Mobility (State-Level)

(A) Whites



(B) Blacks

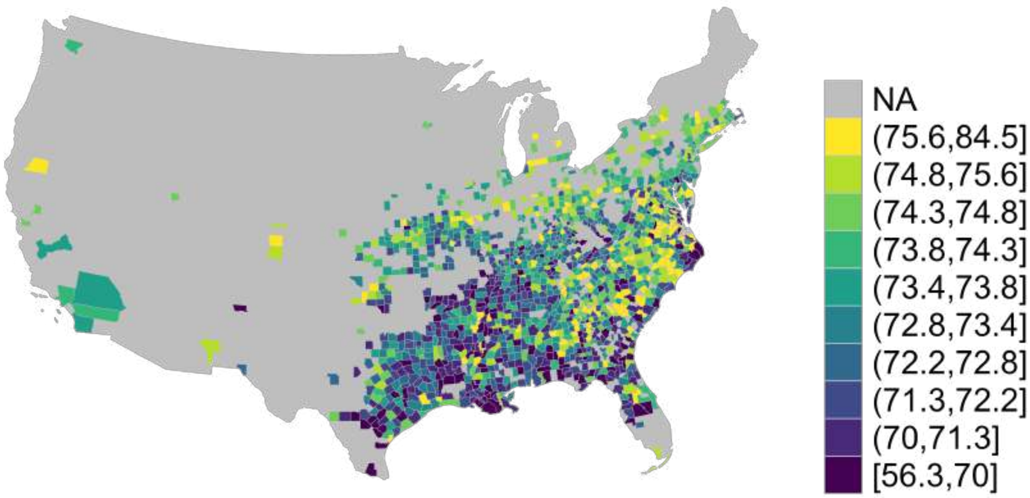


Correlation: 0.75

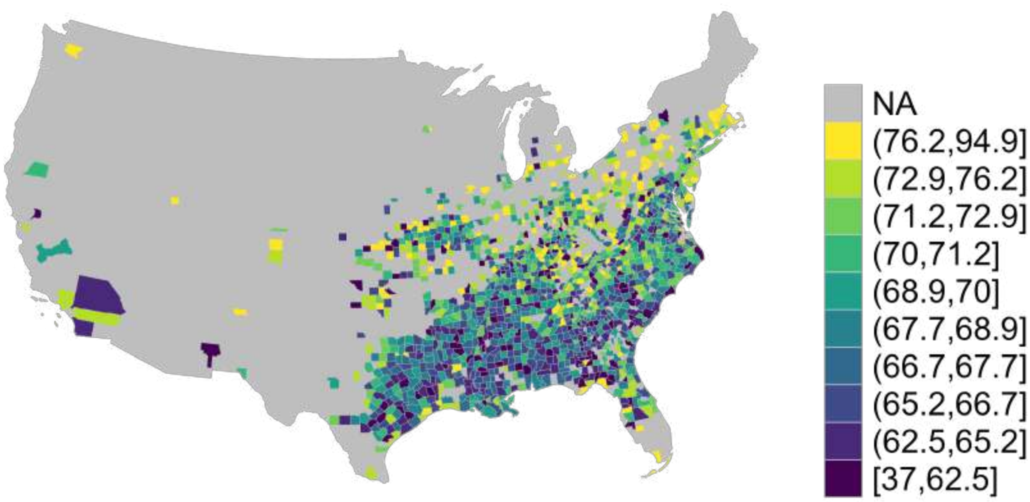
Note: Data come from 1900 Decennial census. Each map plots the probability that a Q1-born mother gives birth to a child in Q2-Q4 by race and a mother's state of residence. All samples include children born between 1885-1899 and co-reside with their mother in the 1900 census. Each color shade represents a decile of locations; lighter shades indicate higher upward mobility. Locations denoted in gray have fewer than 20 Q1-born Black mothers and are excluded from the sample. The reported correlation is the Spearman rank correlation between Black and White maps at the state-level.

Figure 2. The Historical Geography of Upward Mobility (County-Level)

(A) Whites



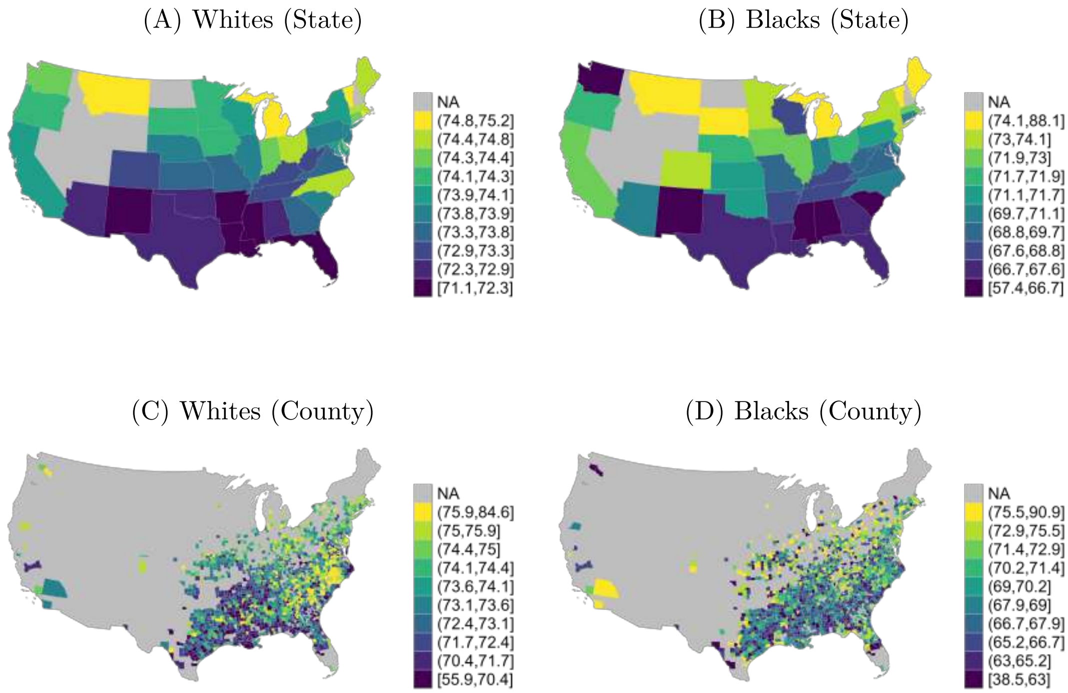
(B) Blacks



Correlation: 0.28

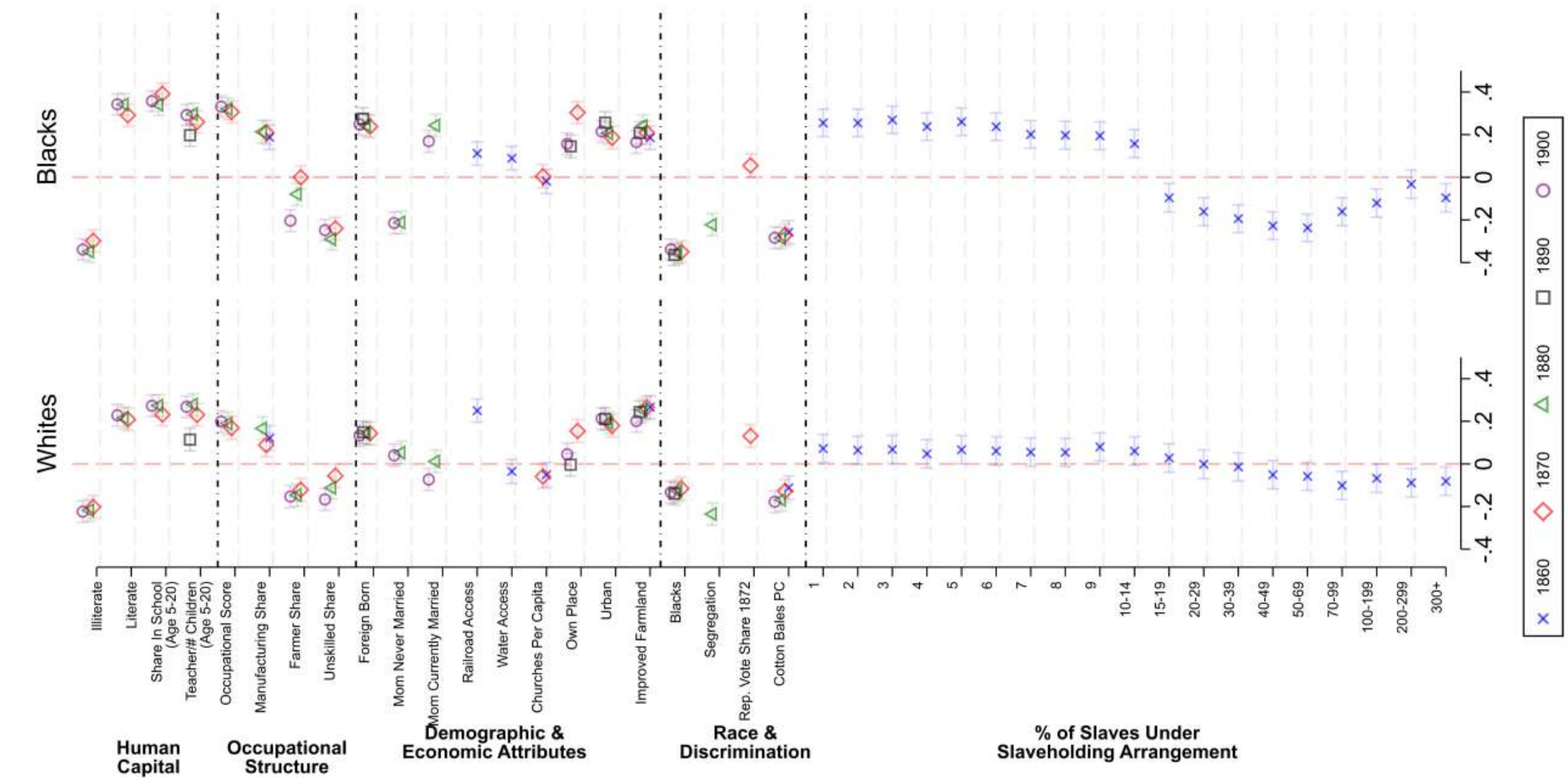
Note: Data come from 1900 Decennial census. Each map plots the probability that a Q1-born mother gives birth to a child in Q2-Q4 by race and a mother's county of residence. All samples include children born between 1885-1899 and co-reside with their mother in the 1900 census. Each color shade represents a decile of locations; lighter shades indicate higher upward mobility. Counties denoted in gray have fewer than 20 Q1-born Black mothers and are excluded from the sample. The resulting sample includes 1,418 counties. The reported correlation is the Spearman rank correlation between Black and White maps at the county-level.

Figure 3. The Historical Geography of Upward Mobility: Fathers as Focal Parent



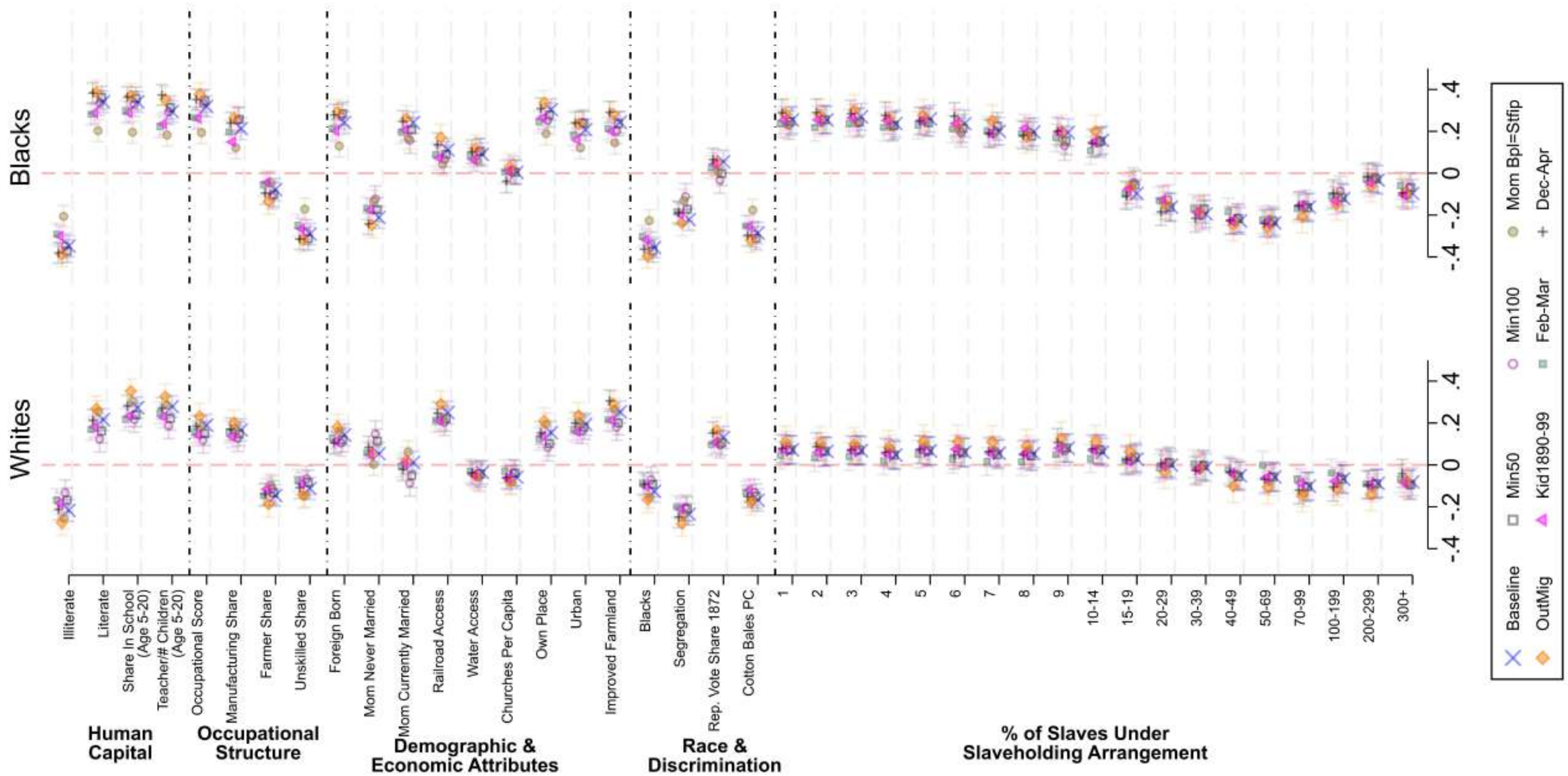
Note: Data come from 1900 Decennial census. Each map plots the probability of a child being born in the second through fourth quarters given their father was born in the first quarter. We estimate this probability separately by race and a father's state (Panels A and B) or county (Panels C and D) of residence. All samples include children born between 1885-1899 and co-reside with their father in the 1900 census. Each color shade represents a decile of locations; lighter shades indicate higher upward mobility. Locations denoted in gray have fewer than 20 Q1-born Black fathers and are excluded from the sample. The resulting sample includes 1,394 counties. The Spearman rank correlation between Black and White maps at the state-level is 0.62 and at the county-level is 0.21.

Figure 4. Correlates of Intergenerational Mobility



Note: Each estimate shows the correlation between county-level attributes and estimates of upward mobility. For attributes available in multiple years, the correlation estimates are arranged in ascending order from earliest to latest available census year. Vertical bars indicate the 95% confidence interval. See Appendix Table A6 for the sources and variable definitions.

Figure 5. Correlates of Intergenerational Mobility: Robustness



Note: Each estimate reflects the correlation between county-level characteristics and upward mobility. "Min50" and "Min100" require a minimum of 50 or 100 Black mothers born in Q1 for a county to be included. Mom bpl = stfip restricts the sample to mothers whose state of birth is the same as their state of residence. "OutMig" excludes counties where the 1900-to-1870 ratio of females born in the 1860s falls below the 25th percentile for that racial group. "Kid1890to1899" limits the sample to children born between 1890 and 1899. The Feb-Mar excludes Jan for the sample. Dec-Apr redefines Q1 births as occurring in December–April. For variables available across multiple Decennial census waves, 1880 is used whenever data exist, and variables without 1880 coverage are drawn from the latest earlier census: rail and water access (1860), churches per capita (1870), own place (1870), and Republican presidential vote share (1872). Vertical bars denote 95% confidence intervals.

Table 1. Cumulative Distribution of Birth by Parental Socioeconomic Status

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	All	Fathers	Mothers	Fathers	Northeast		Midwest		South		West		White		Black	
		ses=0	ses=0	ses=1	ses=0	ses=1	ses=0	ses=1	ses=0	ses=1	ses=0	ses=1	ses=0	ses=1	ses=0	ses=1
Jan	8.9	9.6	9.8	8.5	9.0	8.5	8.8	8.4	9.8	8.6	9.2	8.4	8.9	8.5	10.2	9.1
Feb	17.2	18.5	18.7	16.4	16.7	16.3	17.4	16.4	18.9	16.6	17.7	16.0	17.3	16.4	19.5	17.5
Mar	26.4	28.7	29.0	25.0	26.1	24.9	27.1	25.1	29.2	25.2	27.6	24.4	26.9	24.9	30.2	26.8
Apr	34.7	37.9	38.3	32.9	34.7	32.9	35.6	32.9	38.5	32.8	36.5	32.5	35.5	32.8	39.8	35.1
May	43.7	48.7	49.3	41.2	44.9	41.5	44.4	41.1	49.6	40.9	46.7	41.1	45.2	41.1	51.5	44.5
Jun	51.2	55.8	56.4	49.0	52.5	49.4	51.9	48.9	56.6	48.3	55.4	49.1	52.7	48.9	58.2	51.9
Jul	59.1	62.8	63.3	57.5	60.5	58.0	60.0	57.5	63.3	56.7	62.3	57.5	60.4	57.5	64.7	59.6
Aug	67.7	70.7	71.2	66.5	68.8	66.9	68.4	66.6	71.2	65.8	70.3	66.4	68.8	66.5	72.2	68.2
Sep	76.2	78.4	78.7	75.3	76.7	75.5	76.8	75.4	78.8	74.9	77.6	74.9	77.1	75.2	79.4	76.7
Oct	84.5	86.0	86.1	83.8	84.4	83.9	84.9	83.9	86.3	83.7	85.0	83.6	85.2	83.8	86.6	84.6
Nov	91.9	92.2	92.1	91.7	91.5	91.7	92.1	91.8	92.3	91.6	91.9	91.5	92.1	91.7	92.3	91.7
Dec	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
N	17,630,310	1,782,161	2,184,844	5,375,875	192,233	2,377,474	128,532	1,570,002	1,451,636	1,277,098	9,760	151,301	790,849	5,192,622	991,312	183,253

Note: The data are drawn from the 1900 Decennial census. All columns report the monthly distribution of births for cohorts born between 1885 and 1899. For fathers, socioeconomic status is defined as 1 if their occupation falls into the white-collar or skilled/semi-skilled categories, and 0 if the father is illiterate. For mothers, socioeconomic status is coded as 0 if the mother is illiterate. Regional and racial distributions are based on the father's socioeconomic status.

Table 2. Season of Birth and Individual-Level Attributes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		All			Whites			Blacks	
	Q1	Not-Q1	% Diff.	Q1	Not-Q1	% Diff.	Q1	Not-Q1	% Diff.
					Panel A: Men				
Illiterate	0.135	0.109	-23.9	0.068	0.060	-13.3	0.412	0.380	-8.4
Occupational Income Score	19.043	19.393	1.8	20.120	20.240	0.6	14.624	14.720	0.7
Farmer (owns housing unit)	0.198	0.201	1.5	0.212	0.211	-0.5	0.142	0.147	3.4
Farmer (rents housing unit)	0.195	0.180	-8.3	0.136	0.135	-0.74†	0.435	0.426	-2.1
Unskilled	0.196	0.182	-7.7	0.167	0.158	-5.7	0.315	0.311	-1.3
Skilled or Semi-skilled	0.242	0.252	4.0	0.283	0.285	0.4	0.069	0.073	5.5
White Collar	0.119	0.131	9.2	0.144	0.151	4.6	0.019	0.022	13.6
Owns Housing Unit	0.394	0.406	3.0	0.430	0.433	0.7	0.248	0.257	3.9
Father Currently Married	0.972	0.974	0.2	0.975	0.976	0.1	0.959	0.961	0.2
Teenage Father	0.023	0.018	-27.8	0.016	0.013	-23.1	0.053	0.047	-12.8
Age at Marriage	25.763	26.104	1.3	25.748	26.127	1.5	25.831	25.973	0.6
					Panel B: Women				
Illiterate	0.153	0.127	-20.5	0.073	0.065	-12.3	0.455	0.427	-6.6
Children Ever Born	5.550	5.452	-1.8	5.283	5.240	-0.8	6.562	6.487	-1.2
Mother Currently Married	0.922	0.930	0.9	0.943	0.945	0.2	0.844	0.854	1.2
Age at Marriage	21.056	21.504	2.1	21.245	21.678	2.0	20.244	20.541	1.5
Teenage Mother	0.113	0.094	-20.2	0.092	0.076	-19.7	0.196	0.182	-7.7
Owns Housing Unit	0.392	0.399	1.8	0.433	0.431	-0.5	0.238	0.247	3.2
					Panel C: Children				
In School in 1900 (1885-89)	0.692	0.737	6.1	0.753	0.788	4.4	0.477	0.515	7.4
Illiterate in 1900 (1885-89)	0.104	0.091	-14.3	0.042	0.040	-5.0	0.321	0.313	-2.6
Survival Odds 1960 (1885-89)	0.449	0.475	5.6	0.484	0.502	3.6	0.261	0.299	12.5
Survival Odds 1960 (1890-94)	0.559	0.584	4.4	0.597	0.612	2.4	0.355	0.406	12.7
Survival Odds 1960 (1895-99)	0.637	0.655	2.7	0.679	0.689	1.4	0.404	0.430	5.9

Note: Panels A and B include father and mother of individuals born between 1885 and 1899. The attributes are drawn from the 1900 Decennial census. Panel C includes all children born between 1885 and 1899. The estimates report outcomes for individuals born in the first quarter (Q1) versus those born in quarters 2–4 (Not Q1). % Diff refers to [((NotQ1 - Q1)/NotQ1)*100]. Survival odds are calculated as the ratio of weighted counts of individuals from a given cohort observed in 1960 Decennial census to the corresponding counts in 1900 Decennial census. Numbers for Q1 and Not-Q1 birth samples are rounded to three decimal places; as a result, percentage differences may not always precisely reflect the differences calculated from the rounded figures. Percentage differences are statistically significant at the 1% level, except where marked with a single dagger (†), which indicates significance at the 5% level.

Table 3. Persistence in Season of Birth

	(1)	(2)	(3)	(4)	(5)	(6)
	Outcome: Child Born in Quarter 1 (Q1)					
	Father	Father	Mother	Mother	Father+Mother	Father+Mother
Father: Born in Q1	0.018***	0.018***			0.017***	0.016***
	(0.000)	(0.000)			(0.000)	(0.000)
Mother: Born in Q1			0.021***	0.020***	0.019***	0.018***
			(0.000)	(0.000)	(0.000)	(0.000)
Father: Black	0.027***	0.025***			0.010**	0.010**
	(0.000)	(0.000)			(0.005)	(0.005)
Father: Illiterate	0.014***	0.013***			0.006***	0.006***
	(0.000)	(0.000)			(0.000)	(0.000)
Father: Occupational Score	-0.007***	-0.006***			-0.005***	-0.004***
	(0.000)	(0.000)			(0.000)	(0.000)
Father: Currently Married	-0.016***	-0.015***			0.001	0.001
	(0.001)	(0.001)			(0.005)	(0.005)
Father: Age at Marriage	0.000	0.000***			0.000***	0.000***
	(0.000)	(0.000)			(0.000)	(0.000)
Own House	0.002***	0.002***	-0.000**	-0.001***	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Farm Household	0.006***	0.003***	0.005***	0.002***	0.003***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mother: Black			0.024***	0.022***	0.011**	0.010**
			(0.000)	(0.000)	(0.005)	(0.005)
Mother: Illiterate			0.012***	0.011***	0.008***	0.008***
			(0.000)	(0.000)	(0.000)	(0.000)
Mother: Currently Married			-0.015***	-0.015***	-0.027	-0.028
			(0.001)	(0.001)	(0.018)	(0.018)
Mother: Age at Marriage			0.000***	0.000***	0.000	0.000***
			(0.000)	(0.000)	(0.000)	(0.000)
Mother: Children Ever Born			0.004***	0.004***	0.004***	0.004***
			(0.000)	(0.000)	(0.000)	(0.000)
R-Sq	0.002	0.002	0.003	0.003	0.003	0.003
N	15296176	15296176	16264795	16264795	14804868	14804868
County Fixed Effects	N	Y	N	Y	N	Y
Mean of dep. variable	0.261	0.261	0.262	0.262	0.261	0.261

Note: Data are from the 1900 census. Columns 1–2 include children under age 15 with a father present; columns 3–4 include those with a mother present; and columns 5–6 include children with both parents present. Occupational income scores are in log units. We create separate categories of indicator variables for missing observations (race, occupational income score, age at marriage, and children ever born) and do not omit these observations from the analysis. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Online Appendix

A Sample Attributes: Our Approach Relative to Linked Datasets

Recent advances in historical record linkage have yielded publicly available datasets that link individuals across Decennial U.S. censuses. A natural question, then, is why not use these datasets to estimate intergenerational mobility using conventional socioeconomic status proxies, such as occupational income score or literacy, by linking Black individuals across censuses. In Table A5, we examine the feasibility of linked datasets for our cohorts of interest—Black children born between 1885 and 1899 and their parents. Specifically, we show the samples available using three widely used linked datasets which have been previously used to study intergenerational mobility: IPUMS Multigenerational Longitudinal Panel (MLP) (Helgertz et al. (2020)), Census Linking Project (CLP) (Abramitzky et al. (2020)), and Census Tree (Price et al. (2023)). Each of the three datasets we consider employs a distinct linkage strategy.

For the analysis in this section, we focus on links between the 1900 and 1920 Decennial censuses for children born between 1885 and 1899. This period aligns with a commonly used strategy in intergenerational mobility research: observing children co-residing with their parents in the earlier census, measuring parental socioeconomic status in that year, and then tracking the children's adult outcomes two or three decades later. Match rates and sample sizes would be lower across all methods we consider, with the notable exception of our approach, if we instead used the 1930 census to observe the child outcome.

For each linked dataset (Columns 2-6), we compute the following key metrics: the number of 1885–1899 Black children observed in 1900, the number of matched Black parent-child pairs (i.e. the child was co-residing with their parent in 1900 and the child can be matched to the 1920 census) and the match rate (defined as the percentage of all children in 1900 that are part of the matched parent-child pair). We also compute the percentage of parent-child pairs with missing socioeconomic status proxies for at least one member of the dyad. This measure is informative because the missing SES proxy is likely non-random.

To provide information on geographic coverage and the reliability of the estimates we compute the number of counties with at least 50 Black parent-child pairs with non-missing socioeconomic status information, the number of non-Southern counties with at least 50 Black parent-child pairs with non-missing socioeconomic status information, and the number of Black parent-child pairs with non-missing socioeconomic status information in the median county.[1] These results are reported in Table A5.

Column 1 of Table A5 contains our approach. For our approach the focal parent is a mother whereas for the linked approaches the focal parent is the father. In Panel A, we consider both sons and daughters in child generation to maximize sample size. Additionally, the socioeconomic status proxy is occupational income score for the linked samples whereas our socioeconomic status proxy is birth season. Our approach generates almost 3 million matched parent-child pairs with a match rate of 86.4%. This approach generates estimates for 1,494 counties with at least 50 Black parents-child pairs with non-missing socioeconomic status information of which 416 are located outside of the South.

Column 2 shows sample characteristics using the IPUMS Multigenerational Longitudinal Panel (MLP). MLP uses a two-step supervised machine learning approach—first linking men with high confidence, then extending matches to other household members, thereby improving coverage for children and other household members. This approach results in many times fewer matches. There are 196,506 matched parent-child pairs with a match rate of 5.7%. Information about occupation is unavailable for about 1 in 4 matched-pairs. Thus for our cohorts of interest MLP would generates a sample of 757 counties with at least 50 Black parents-child pairs with non-missing socioeconomic status information of which only 68 are located outside of the South.

Sample characteristics for the Census Linking Project (CLP) are shown in columns 3 and 4. CLP uses unsupervised matching algorithms based on names, birth years, and birthplaces, and we focus on the NYSIIS-based links that standardize names phonetically and yield relatively high match rates (NYSIIS std) in column 3 and the CLP algorithm that adds race as a matching variable to NYSIIS std (race NYSIIS std) in column 4. The match rate for CLP is similar to MLP, but CLP has fewer pairs with missing socioeconomic status proxies. Depending on the particular algorithm CLP produces a sample where the median country has between 161 and 169 Black parents-child pairs with non-missing socioeconomic status information compared to 914 in our approach.

Columns 5 and 6 show samples using Census Tree. For the Census Tree dataset, we

[1] Having a cutoff of 50 parent-child pairs is somewhat arbitrary. In practice, depending on the socioeconomic status measure, different estimates of upward mobility will end up using a much smaller subsample of all matched pairs. For instance our approach will only include pairs where the parent was born in the first quarter; other estimates might restrict to those pairs where the parent is illiterate or the parent has a low occupational income score.

consider two sets of links: one that includes all available linkage methods (MLP, CLP, XGBoost, Family Tree, Direct Hint, Indirect Hint, and Implied), and a more conservative subset that includes only the genealogical links created through the Family Tree platform (Buckles et al. (2023)). While the full dataset incorporates links of varying quality, the links derived from the Family Tree are likely less prone to false matches (Kalsi and Ward (2025)). For instance, Buckles et al. (2023) report that, in a sample of 1,000 individuals from the 1910 census, the precision of 759 matched links to the 1900 census—verified by trained research assistants—ranged from 0.89 to 0.98. Additionally, links identified by only one source were correct 69–82% of the time, with precision increasing when multiple sources confirmed the match.

As shown in column 5 when all available links are allowed there are almost 700,000 matched parent-child pairs for a match rate of 20.0% these numbers fall to 117,920 and 3.4% when only Family Tree links are allowed. Both columns 5 and 6 show high rates of missing socioeconomic status proxies. For our cohorts of interest, Census Tree generates a sample of 178 non-Southern counties with at least 50 Black parents-child pairs when all links are allowed which falls to 24 counties when only Family Tree links are allowed.

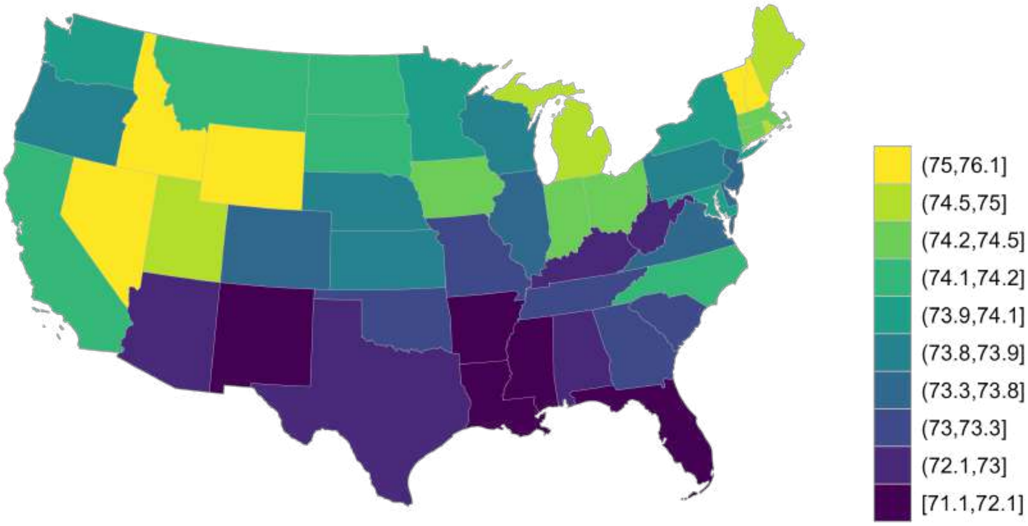
In Panel B we conduct the same analysis except we limit the children's generation to sons. In general this restriction improves the match rates for the linked approach since sons do not change names upon marriage, and thus are easier to link. Note that under our approach we can match as many daughters as sons since both genders have birthdays so this restriction does not influence our match rate. Limiting to sons also reduces the number of pairs where the socioeconomic status proxy is missing. Nevertheless even if we limit our estimates of intergenerational mobility to sons our approach generates a sample that is over three times the sample of the largest of the linked datasets. Additionally unlike the other approaches there are no pairs with missing socioeconomic status proxies whereas in the linked samples 12-15% of pairs are missing the socioeconomic status proxy: occupational income score.

In Panel C we again consider both sons and daughters in child generation. We alter socioeconomic status proxy to be literacy instead of occupation. Unlike occupation, literacy is commonly available for daughters as well as sons. As shown by comparing Panels A and C using literacy as the socioeconomic status proxy greatly reduces the number of pairs where the socioeconomic status proxy is missing. As such more counties can be included in the sample under this proxy. Despite this, our approach has between 300 to 850 more counties with at least 50 Black parents-child pairs.

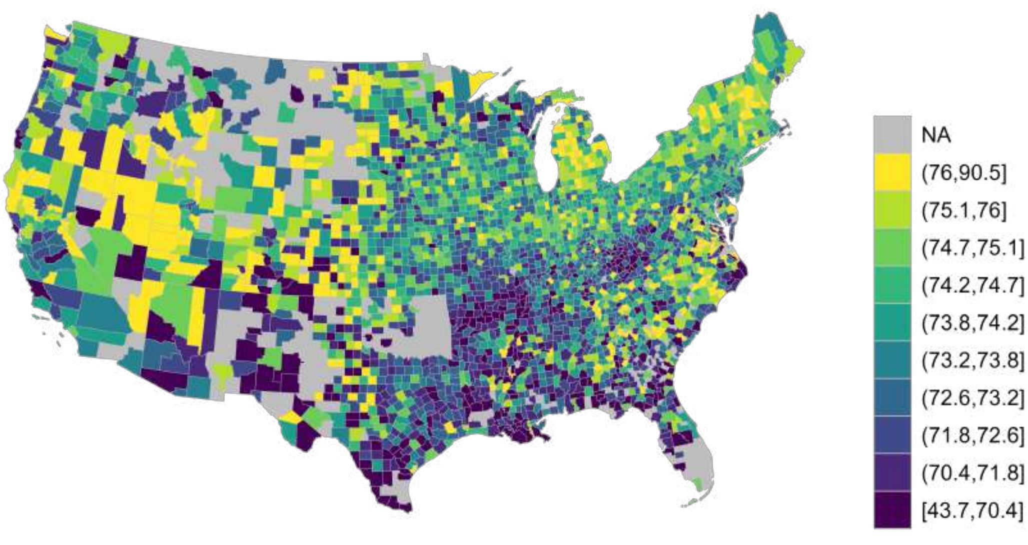
Overall, estimates presented in Table A5 show that census-linked samples for Black individuals in our cohorts face challenges such as low match rates, limited geographic coverage, and fewer observations, especially outside the South. It shows that there is a tradeoff between link quality and match rate. For instance, for Black individuals, relying exclusively on higher-quality Family Tree links (Kalsi and Ward (2025); Buckles et al. (2023)) results in a 3.4% match rate limiting coverage to just 24 counties outside the South, whereas a less conservative variant of the Census Linking Project's approach—using NYSIIS-standardized names and omitting race as a linking variable results in a 6.1% match rate with 82 counties outside the South. Under the same restrictions, our approach has 86.4% match rate and allows coverage for 416 counties outside the South. These limitations underscore the difficulty of using census-linked datasets to produce comprehensive maps of intergenerational mobility for Black individuals in the post-Reconstruction era.

Appendix Figure A1. The Historical Geography of White Upward Mobility

(A) State



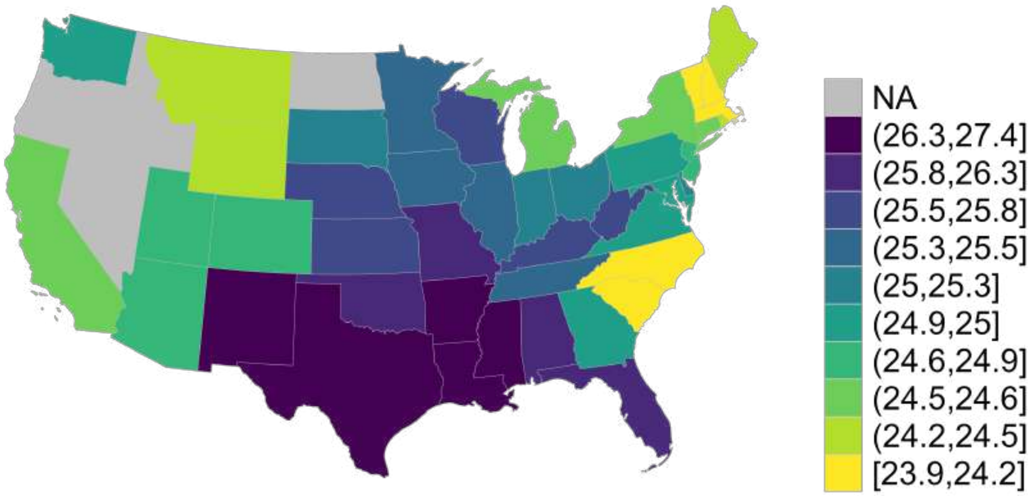
(B) County



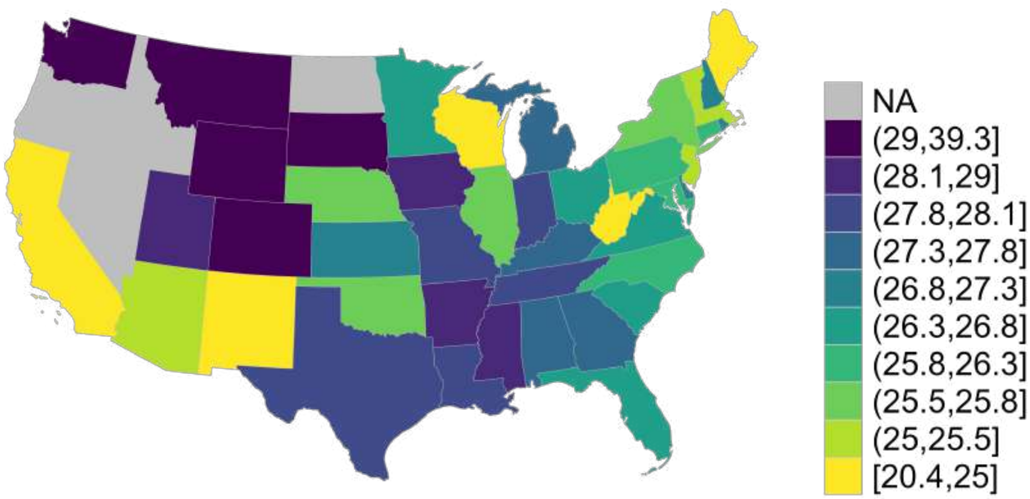
Note: Data come from 1900 Decennial census. Each map plots the probability that a Q1-born white mother gives birth to a child in Q2-Q4 by a mother's state or county of residence. All samples include children born between 1885-1899 and co-reside with their mother in the 1900 census. Each color shade represents a decile of locations; lighter shades indicate higher upward mobility. Locations denoted in gray have fewer than 20 Q1-born White mothers and are excluded from the sample. The resulting sample includes 2,806 counties.

Appendix Figure A2. The Historical Geography of Downward Mobility (State-Level)

(A) Whites



(B) Blacks

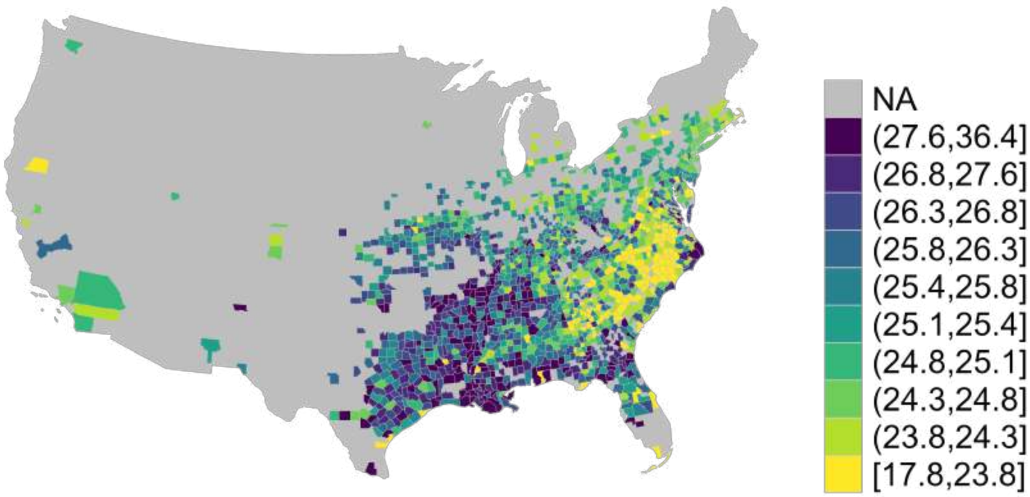


Correlation: 0.17

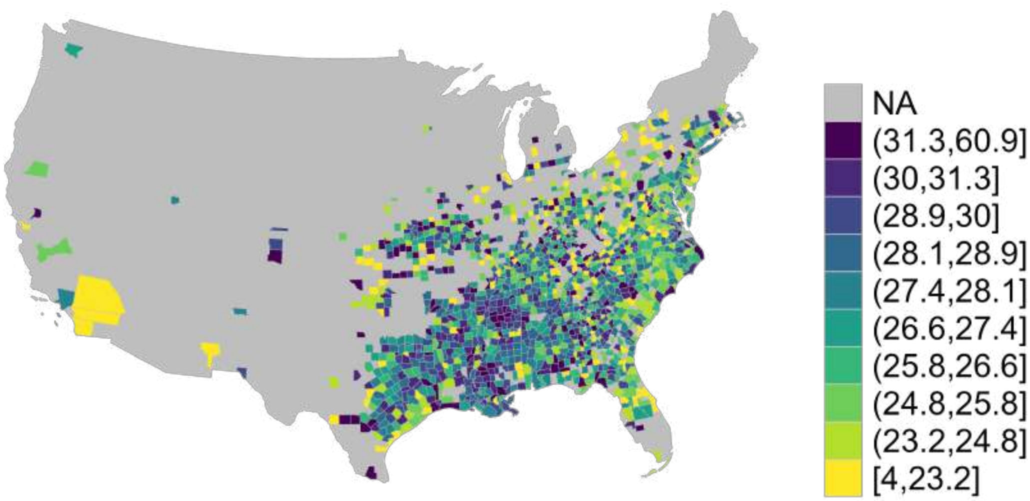
Note: Each map plots the probability that a Non-Q1-born mother gives birth to a child in Q1 by a mother's state of residence. All samples include children born between 1885-1899 and co-reside with their mother in the 1900 census. Each color shade represents a decile of locations; lighter shades indicate lower rates of downward mobility. Locations denoted in gray have fewer than 20 Q1-born Black mothers and are excluded from the sample. The reported correlation is the Spearman rank correlation between Black and White maps at the state-level.

Appendix Figure A3. The Historical Geography of Downward Mobility (County-Level)

(A) Whites



(B) Blacks

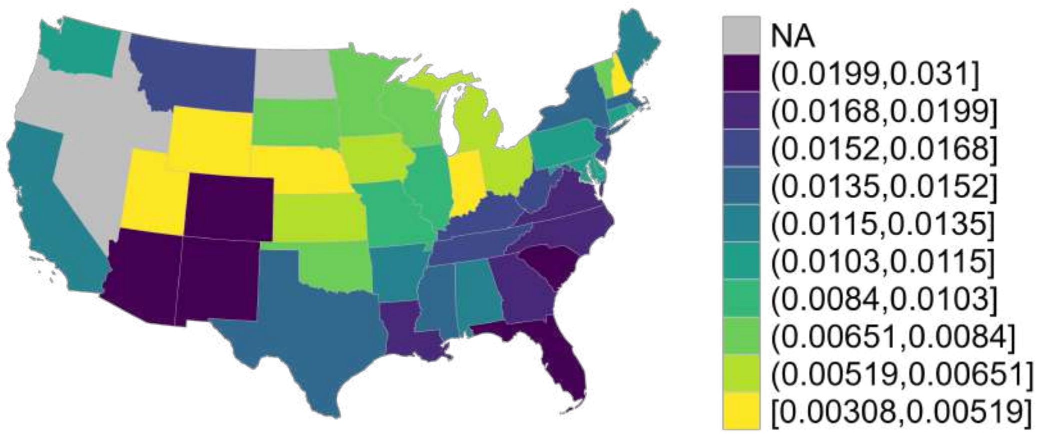


Correlation: 0.30

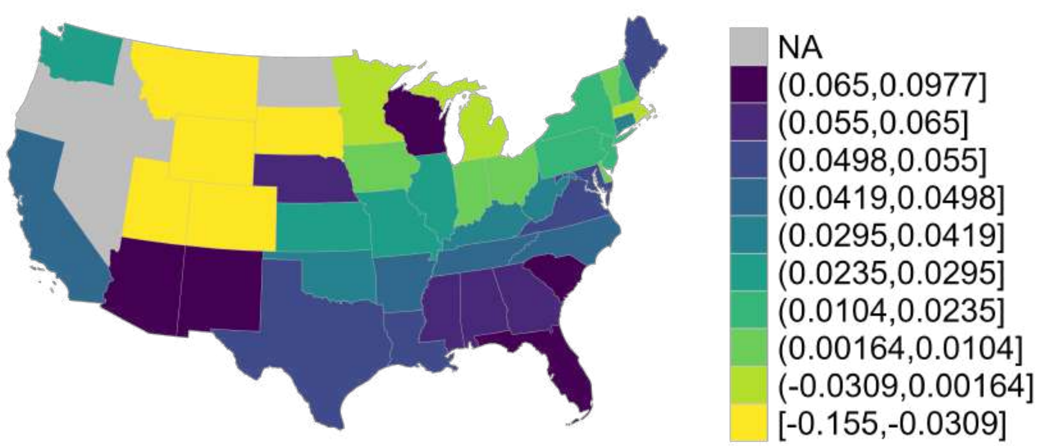
Note: Each map plots the probability that a Non-Q1-born mother gives birth to a child in Q1 by a mother's county of residence. All samples include children born between 1885-1899 and co-reside with their mother in the 1900 census. Each color shade represents a decile of locations; lighter shades indicate lower rates of downward mobility. Locations denoted in gray have fewer than 20 Q1-born Black mothers and are excluded from the sample. The reported correlation is the Spearman rank correlation between Black and White maps at the county-level.

Appendix Figure A4. The Historical Geography of Relative Mobility (State-Level)

(A) Whites



(B) Blacks

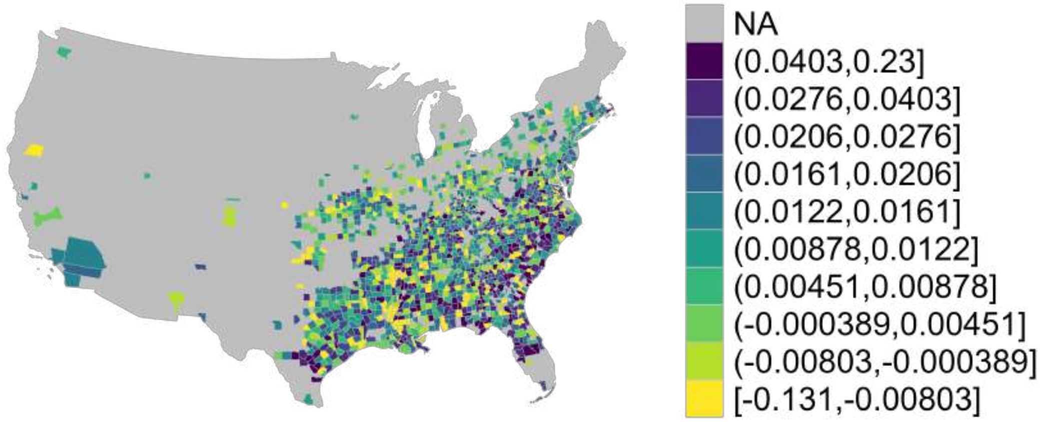


Correlation: 0.53

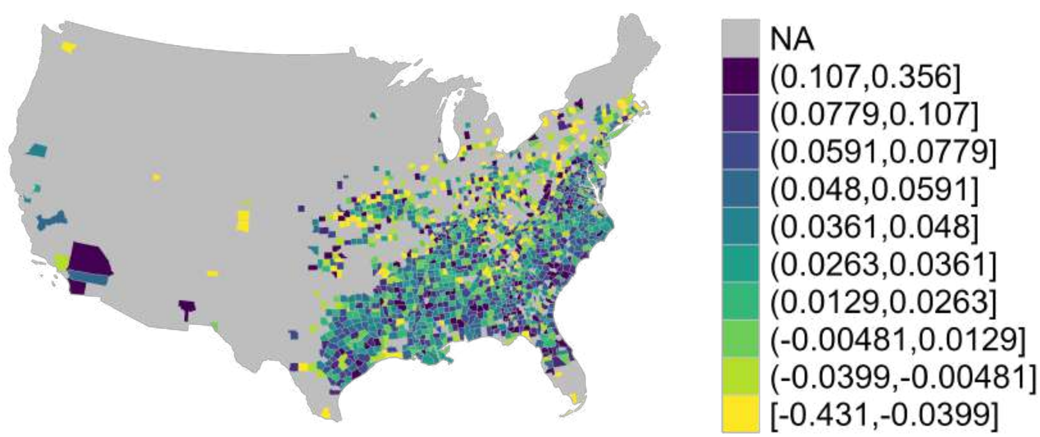
Note: Data come from 1900 Decennial census. Each map shows the estimated coefficient where the dependent variable is an indicator set to 1 if a child is born in Q1, and the independent variable is an indicator set to 1 if the mother is born in Q1. These estimates are estimated separately by race and a mother's state of residence. All samples include children born between 1885-1899 and co-reside with their mother in the 1900 census. Each color shade represents a decile of locations; lighter shades indicate higher rates of relative mobility (less persistence in season of birth). Locations denoted in gray have fewer than 20 Q1-born Black mothers and are excluded from the sample. The reported correlation is the Spearman rank correlation between Black and White maps at the state-level.

Appendix Figure A5. The Historical Geography of Relative Mobility (County-Level)

(A) Whites



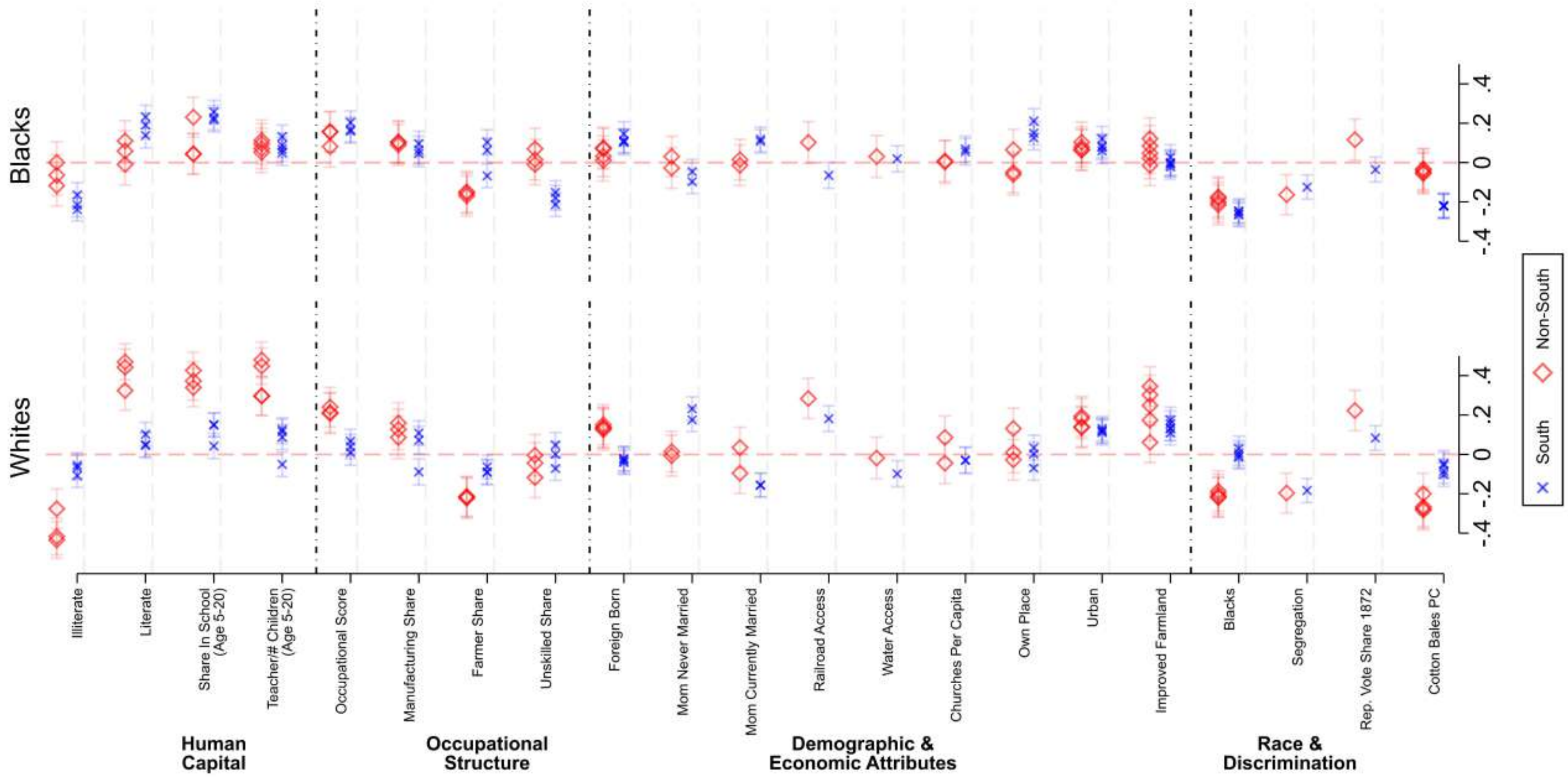
(B) Blacks



Correlation: 0.16

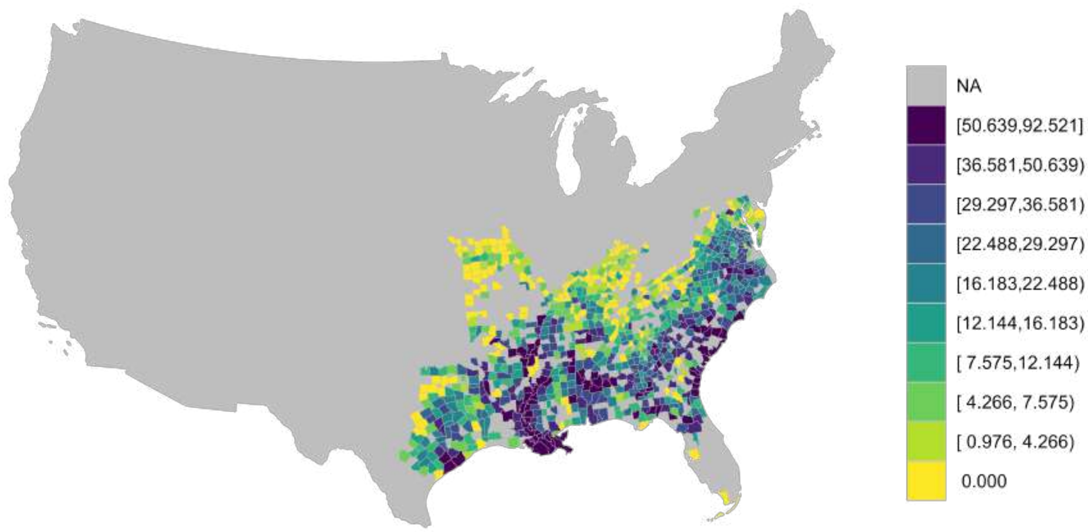
Note: Data come from 1900 Decennial census. Each map shows the estimated coefficient where the dependent variable is an indicator set to 1 if a child is born in Q1, and the independent variable is an indicator set to 1 if the mother is born in Q1. These estimates are estimated separately by race and a mother's county of residence. All samples include children born between 1885-1899 and co-reside with their mother in the 1900 census. Each color shade represents a decile of locations; lighter shades indicate higher rates of relative mobility (less persistence in season of birth). Locations denoted in gray have fewer than 20 Q1-born Black mothers and are excluded from the sample. The reported correlation is the Spearman rank correlation between Black and White maps at the county-level.

Appendix Figure A6. Correlates of Intergenerational Mobility: South and Non-South



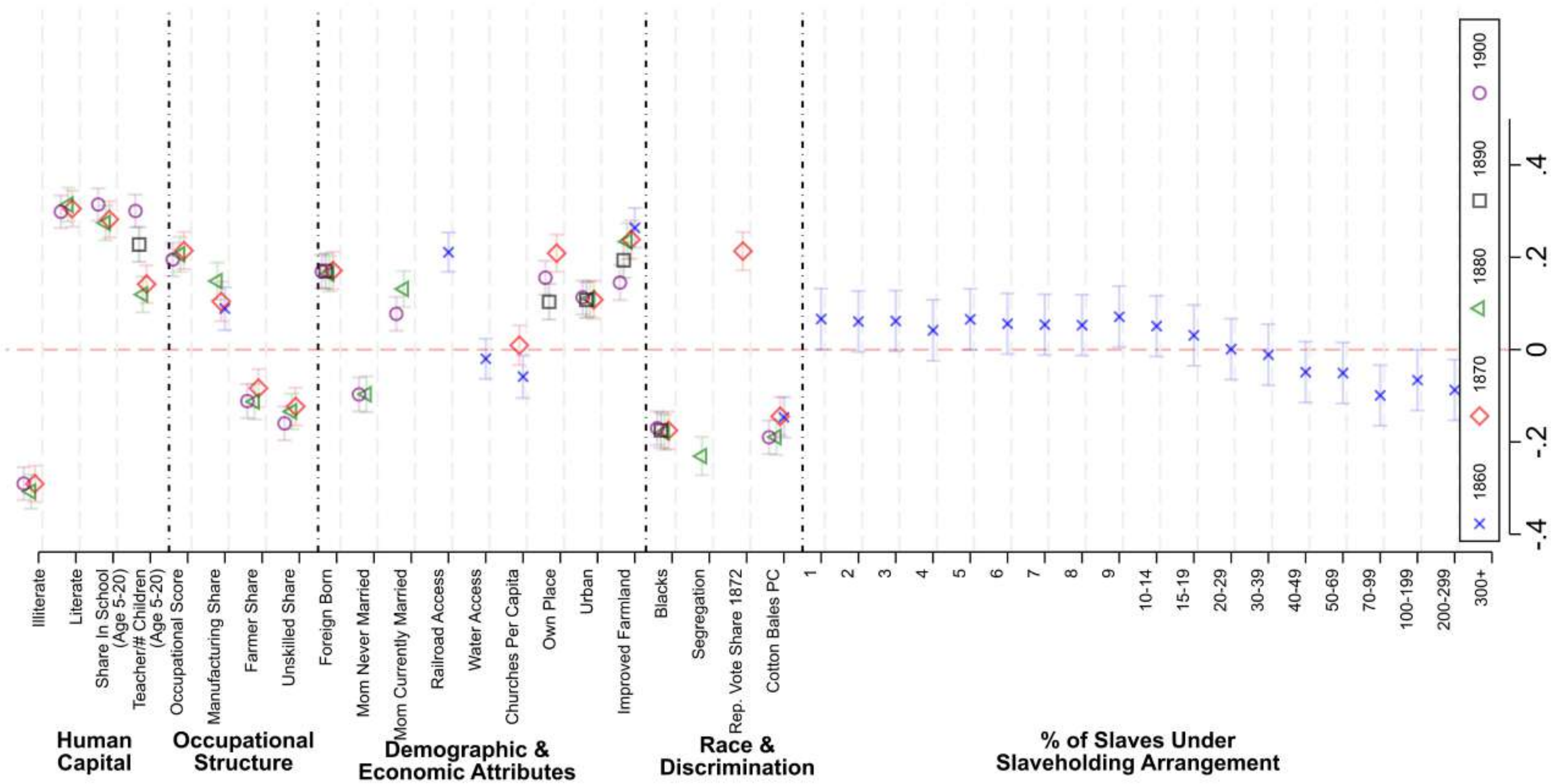
Note: Each estimate shows the correlation between county-level attributes and upward mobility. Estimates for the South and Non-South are distinguished by different symbols, as indicated in the legend. For variables available across multiple Decennial Census waves, we report estimates from all available waves. See Appendix Table A6 for sources, variable definitions, and details on availability across census waves.

Appendix Figure A7. Percentage of Slaves under 40+ Slaveholding Arrangements in 1860



Note: Data are drawn from the 1860 Decennial census. Among counties with more than 300 enslaved individuals, the graph classifies counties into deciles based on the share of slaves held in large-scale holdings—defined as arrangements involving 40 or more individuals. Counties that either did not report slave data or reported fewer than 300 slaves are excluded.

Appendix Figure A8. Correlates of Intergenerational Mobility: Whites (Counties with at least 20 Q1-Born White Mothers)



Note: Each estimate shows the correlation between county-level attributes and estimates of upward mobility for counties with at least 20 Q1-born White mothers. The resulting sample includes 2,806 counties. For attributes available in multiple years, the correlation estimates are arranged in ascending order from earliest to latest available census year. Vertical bars indicate the 95% confidence interval. See Appendix Table A6 for the sources and variable definitions.

Appendix Table A1. Quarter of Birth, Outcomes, and Parental Socioeconomic Status

Authors	(1) **Location**	(2) **Time Period**	(3) **SES Measure**	(4) **Finding**
Panel A: Quarter of Birth and SES Outcomes				
Pintner and Forlano (1933)	NYC	1915–1928	IQ	Lower IQ among winter-born (Dec–Feb).
Bivings (1934)	USA (multiple cities)	Early 1930s	Birth weight	Lower birth weight in fall/winter, higher in spring/summer.
Eastman (1945)	USA	1935–1937	Infant mortality	Higher mortality among winter-born (Dec–Feb).
Pasamanick and Knobloch (1958)	NYC	1956	Pregnancy complications (eclampsia, preeclampsia, uterine bleeding, heart disease)	More pregnancy complications in Q1 births.
Knobloch and Pasamanick (1958)	Ohio	1913–1948	Mental disability	Higher first admissions for winter-born.
Hare (1975)	England & Wales	1921–1955	Manic depression	More Q1 births among cases.
Syme and Illingworth (1978)	Australia	1920–1950	Schizophrenia	Among Schizophrenics, males showed excess births in June; females in September
Kendell and Kemp (1987)	Scotland	1931–1968	Schizophrenia	More Q1 births diagnosed.
Angrist and Krueger (1991)	USA	1930–1949	Education, earnings	Q1-born men have less schooling and lower earnings.
Torrey et al. (1996)	USA (4 states)	1925–1975	Schizophrenia	Higher risk for Q1-born.
Breschi and Livi Bacci (1997)	Europe (multiple countries)	1828–1888	Infant mortality	Highest for Q1 births (except Russia: summer).
Bound and Jaeger (2000)	USA	1840–1875, 1972–1998	Earnings, employment, happiness	Q1-born had lower imputed earnings, more farm work, and reported less happiness.
Gavrilov and Gavrilova (2011)	USA	1880–1895	Longevity	March-born least likely to reach age 100.
Currie and Schwandt (2013)	NJ, NYC, PA	1994–2010	Gestation	May conceptions (Q1 births) more likely preterm.
Day et al. (2015)	UK	1937–1970	Growth, puberty	Winter-born: lower birth weight, earlier puberty, shorter stature; summer-born opposite.
Boland et al. (2015)	NYC	1900–2000	Cardiovascular disease	Higher risk for Q1-born.
Dorélien (2015)	Sub-Saharan Africa	1980s–2000s	Child height	Q1-born more stunted.
Maitra et al. (2022)	China	1995–2016	Height-for-age	Winter-born girls in farm households shorter at age 5.
Luukkonen et al. (2025)	Finland	1995-2004	atopic diseases (asthma, eczema, allergic rhinitis)	Autumn or winter births exposed to cold in early months faced higher risk of atopic medication use than those with warm conditions.
Panel B: Parent Socioeconomic Status and Timing of Birth				
Goodenough (1941)	NYC, MI	1920–1930	Occupation	Higher-status parents less likely to have winter births.
Warren and Tyler (1979)	Georgia	1967–1977	Census tract income level	Low-socioeconomic status: births peak Aug & Jan; High-socioeconomic status: Sept–Oct.
Bound et al. (1995)	USA	1977–1980	Income	Lower income among households with Q1-born children.
Darrow et al. (2009)	Atlanta	1994–2004	Education, marital status, age	Q1 births more common among less educated, unmarried, and younger mothers.
Buckles and Hungerman (2013)	USA	1989–2001	Age, race, education, marital status	Q1 births more common among younger, less educated, unmarried, and minority mothers.

Appendix Table A2. Season of Birth and Individual-Level Attributes by Region

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		Northeast			Midwest			South			West	
	Q1	Not-Q1	% Diff.	Q1	Not-Q1	% Diff.	Q1	Not-Q1	% Diff.	Q1	Not-Q1	% Diff.
Panel A: Men												
Illiterate	0.05	0.05	-17.78	0.04	0.03	-17.65	0.22	0.19	-20.54	0.05	0.03	-40.63
Occupational Income Score	22.87	22.90	0.13†	20.76	20.85	0.45	16.21	16.55	2.07	22.46	22.88	1.84
Farmer (owns housing unit)	0.05	0.05	6.00	0.17	0.17	-0.58†	0.29	0.31	4.92	0.10	0.10	-1.03‡
Farmer (rents housing unit)	0.03	0.03	8.82	0.11	0.11	-0.89†	0.32	0.30	-5.94	0.04	0.04	-5.00†
Unskilled	0.22	0.20	-6.86	0.20	0.19	-4.28	0.18	0.17	-10.84	0.20	0.18	-10.38
Skilled or Semi-skilled	0.44	0.44	-0.23†	0.31	0.31	0.65	0.11	0.11	7.02	0.32	0.33	1.82
White Collar	0.18	0.19	3.76	0.15	0.16	4.46	0.07	0.08	14.63	0.25	0.26	4.67
Owns Housing Unit	0.29	0.30	2.68	0.45	0.45	0.22	0.42	0.44	4.95	0.44	0.44	-0.45‡
Father Currently Married	0.98	0.98	0.20	0.98	0.98	0.20	0.97	0.97	0.21	0.98	0.98	-0.10‡
Teenage Father	0.02	0.01	-15.38	0.01	0.01	-18.18	0.03	0.03	-23.08	0.01	0.01	-30.00
Age at Marriage	25.45	25.88	1.65	26.11	26.48	1.41	25.72	25.98	1.01	27.41	27.80	1.43
Panel B: Women												
Illiterate	0.07	0.06	-12.90	0.04	0.04	-11.11	0.25	0.21	-17.22	0.05	0.04	-19.51
Children Ever Born	4.99	4.95	-0.63	5.03	4.99	-0.80	6.08	5.99	-1.50	4.59	4.51	-1.73
Mother Currently Married	0.95	0.95	0.21	0.95	0.95	0.32	0.90	0.91	1.10	0.93	0.93	0.00
Age at Marriage	21.76	22.17	1.85	21.57	21.99	1.91	20.44	20.83	1.92	21.91	22.40	2.20
Teenage Mother	0.07	0.06	-19.30	0.08	0.07	-22.39	0.15	0.13	-16.28	0.08	0.07	-22.39
Owns Housing Unit	0.29	0.30	1.35	0.45	0.45	-0.45	0.41	0.43	4.18	0.44	0.43	-1.85
Panel C: Children												
In School in 1900 (1885-89)	0.79	0.83	5.06	0.82	0.85	4.00	0.59	0.63	6.17	0.83	0.86	3.03
Illiterate in 1900 (1885-89)	0.01	0.01	0.00	0.01	0.01	-11.11	0.19	0.18	-7.39	0.01	0.01	-42.86
Survival Odds 1960 (1885-89)	0.44	0.44	1.95	0.42	0.42	1.68	0.38	0.42	10.18	1.40	1.45	3.34
Survival Odds 1960 (1890-94)	0.54	0.56	2.65	0.52	0.53	1.60	0.47	0.51	8.07	1.68	1.68	0.00
Survival Odds 1960 (1895-99)	0.63	0.64	1.07	0.61	0.61	0.39	0.51	0.55	5.75	1.96	1.95	-0.83

Note: The data are drawn from the 1900 and 1960 Decennial censuses. Panels A and B include parents of the cohorts of interest observed in the 1900 census. Panel C includes all individuals born between 1885 and 1899, observed in both the 1900 and 1960 censuses (IPUMS 5% sample). The estimates report adult outcomes for individuals born in the first quarter (Q1) versus those born in quarters 2–4 (Not Q1). Survival odds are calculated as the ratio of weighted counts of individuals from a given cohort observed in 1960 to the corresponding counts in 1900. "% Diff" refers to [(NotQ1 - Q1)/NotQ1]. All values are rounded to two decimal places; as a result, percentage differences may not always precisely reflect the differences calculated from the rounded figures. Percentage differences in Panels A and B are statistically significant at the 1% level, except where marked with a single dagger, which indicates significance at the 5% level. Estimates marked with a double dagger have p-values greater than 5% and are not statistically significant.

Appendix Table A3. Persistence in Season of Birth by Region

	(1)	(2)	(3)	(4)
	Outcome: Child Born in Quarter 1 (Q1)			
	Northeast	Midwest	South	West
Father: Born in Q1	0.012***	0.007***	0.023***	0.012***
	(0.000)	(0.001)	(0.000)	(0.002)
Mother: Born in Q1	0.013***	0.008***	0.026***	0.008***
	(0.000)	(0.001)	(0.000)	(0.002)
Father: Black	0.009	0.017	0.006	0.020
	(0.010)	(0.012)	(0.007)	(0.041)
Father: Illiterate	0.004***	0.003**	0.006***	0.015***
	(0.001)	(0.001)	(0.000)	(0.005)
Father: Occupational Score	-0.001	-0.004***	-0.007***	-0.001
	(0.001)	(0.001)	(0.001)	(0.002)
Father: Currently Married	-0.006	0.010	0.000	0.046
	(0.010)	(0.013)	(0.008)	(0.038)
Father: Age at Marriage	0.000*	0.000***	0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Own House	0.001	0.001*	-0.001**	0.002
	(0.001)	(0.000)	(0.000)	(0.002)
Farm Household	0.001	-0.001	0.001	-0.001
	(0.001)	(0.001)	(0.000)	(0.003)
Mother: Black	-0.001	-0.003	0.013*	0.004
	(0.010)	(0.012)	(0.007)	(0.042)
Mother: Illiterate	0.006***	0.004***	0.008***	0.004
	(0.001)	(0.001)	(0.000)	(0.005)
Mother: Currently Married	-0.020	-0.087	-0.029	0.123
	(0.026)	(0.062)	(0.026)	(0.120)
Mother: Age at Marriage	0.000	0.000	0.000***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Mother: Children Ever Born	0.003***	0.004***	0.004***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)
R-Sq	0.001	0.001	0.005	0.001
N	3950620	3470071	7117962	266215
County Fixed Effects	Y	Y	Y	Y
Mean of dep. variable	0.251	0.255	0.270	0.248

Note: Data are from the 1900 census. All columns include children with both parents present. Occupational income scores are in log units. We create separate categories of indicator variables for missing observations (race, occupational income score, age at marriage, and children ever born) and do not omit these observations from the analysis. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table A4. Distribution of Days of Birth: Overall and by Race

(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All		Whites		Blacks	
	Panel A: Distribution of Births					
Day	Freq.	Percent	Freq.	Percent	Freq.	Percent
1 ‡ *	136,149	3.93	101,311	3.72	22,366	5.1
2	114,744	3.31	89,755	3.3	14,757	3.37
3	107,889	3.11	84,773	3.12	13,396	3.06
4 ‡	122,042	3.52	93,400	3.43	18,233	4.16
5	113,566	3.28	88,194	3.24	15,004	3.42
6	114,396	3.3	89,802	3.3	14,699	3.35
7	108,509	3.13	85,774	3.15	13,119	2.99
8	115,548	3.33	91,097	3.35	13,989	3.19
9	105,615	3.05	83,842	3.08	12,657	2.89
10 ‡ *	134,925	3.89	101,071	3.71	21,366	4.88
11	105,504	3.04	83,891	3.08	12,463	2.84
12 ‡	121,211	3.5	93,854	3.45	16,671	3.8
13	100,739	2.91	81,944	3.01	9,539	2.18
14	113,624	3.28	90,774	3.34	12,993	2.96
15 ‡ *	173,041	4.99	124,751	4.58	32,471	7.41
16	112,447	3.24	88,420	3.25	14,201	3.24
17	111,526	3.22	89,421	3.29	12,357	2.82
18	116,843	3.37	92,667	3.41	14,070	3.21
19	102,657	2.96	84,186	3.09	9,035	2.06
20	115,722	3.34	90,072	3.31	14,957	3.41
21	94,918	2.74	78,922	2.9	7,456	1.7
22	118,698	3.42	93,755	3.45	14,972	3.42
23	101,763	2.94	82,534	3.03	10,329	2.36
24	108,318	3.12	86,952	3.2	11,394	2.6
25 ‡ *	136,426	3.94	99,327	3.65	25,856	5.9
26	102,897	2.97	82,406	3.03	11,480	2.62
27	104,978	3.03	84,461	3.1	11,456	2.61
28	110,610	3.19	88,405	3.25	12,512	2.85
29	97,143	2.8	78,921	2.9	9,514	2.17
30	86,963	2.51	70,041	2.57	9,026	2.06
31	57,519	1.66	46,543	1.71	5,919	1.35
	Panel B: Whether born on (1, 10, 15, 25)?					
	Not Born in Q1	Born in Q1	Not Born in Q1	Born in Q1	Not Born in Q1	Born in Q1
No	2136911 (83.28%)	749478 (83.18%)	1702686 (84.33%)	592120 (84.32%)	243438 (76.66%)	92760 (76.84%)
Yes	428979 (16.72%)	151562 (16.82%)	316334 (15.67%)	110126 (15.68%)	74103 (23.34%)	27956 (23.16%)
	Panel C: Whether born on (1, 4, 10, 12, 15, 25)?					
	Not Born in Q1	Born in Q1	Not Born in Q1	Born in Q1	Not Born in Q1	Born in Q1
No	1955950 (76.23%)	687186 (76.27%)	1563487 (77.44%)	544065 (77.47%)	217640 (68.54%)	83654 (69.3%)
Yes	609940 (23.77%)	213854 (23.73%)	455533 (22.56%)	158181 (22.53%)	99901 (31.46%)	37062 (30.7%)

Note: Data pertains to individuals born between 1885 and 1899 in the National Archives and Records Administration version of the public Social Security Applications data. This dataset includes individuals who applied for a Social Security Number at any point. Breakdown by quarter of birth for dates marked with a * is shown in Panel B and those marked with a double dagger is shown in Panel C.

Appendix Table A5. Comparison to Linked Datasets

	(1)	(2)	(3)	(4)	(5)	(6)
			CLP		Census Tree	
	Our Approach	MLP	NYS Std	Race NYS Std	All	Family Tree
Panel A: Parent*; Child: Sons and Daughters†						
SES proxy	birth season	occupation	occupation	occupation	occupation	occupation
# of 1885-99 Black children alive in 1900	3,435,549	3,435,549	3,435,549	3,435,549	3,435,549	3,435,549
# of matched Black parent-child pairs	2,968,624	196,506	208,965	232,655	686,092	117,920
Match rate	86.4%	5.7%	6.1%	6.8%	20%	3.4%
% of pairs: SES proxy is missing	0%	23.40%	12.2%	11.7%	24.8%	39.4%
# of counties: 50+ Blacks	1,494	757	823	874	1,077	439
# of Non-Southern counties: 50+ Blacks	416	68	82	104	178	24
# of parent-child pairs in median county	914	138	161	169	317	93
Panel B: Parent*; Child: Sons						
SES proxy	birth season	occupation	occupation	occupation	occupation	occupation
# of 1885-99 Black children alive in 1900	1,716,389	1,716,389	1,716,389	1,716,389	1,716,389	1,716,389
# of matched Black parent-child pairs	1,479,885	148,666	208,951	232,642	486,878	60,716
Match rate	86.2%	8.7%	12.2%	13.6%	28.4%	3.5%
% of pairs: SES proxy is missing	0%	14.60%	12.2%	11.7%	12.5%	14.9%
# of counties: 50+ Blacks	1,306	701	823	874	1,036	328
# of Non-Southern counties: 50+ Blacks	287	60	82	104	161	18
# of parent-child pairs in median county	638	128	161	169	277	81
Panel C: Parent*; Child: Sons and Daughters†						
SES proxy	birth season	literacy	literacy	literacy	literacy	literacy
# of 1885-99 Black children alive in 1900	3,435,549	3,435,549	3,435,549	3,435,549	3,435,549	3,435,549
# of matched Black parent-child pairs	2,968,624	196,506	208,965	232,655	686,092	117,920
Match rate	86.4%	5.7%	6.1%	6.8%	20%	3.4%
% of pairs: SES proxy is missing	0%	0.12%	0.12%	0.10%	0.23%	0.26%
# of counties: 50+ Blacks	1,494	860	869	913	1,177	639
# of Non-Southern counties: 50+ Blacks	416	101	89	116	230	58
# of parent-child pairs in median county	914	165	175	186	370	112

Note: Data are from the 1900 Decennial census (for birth season approach) and the 1900–1920 linked samples (for all other approaches). * In the birth season approach, "parent" refers to mothers; in all other approaches, "parent" refers to fathers. The match rate is the ratio of matched Black parent–child pairs to the number of Black children born between 1885 and 1899 and alive in the 1900 census. † Columns based on linked samples from the Census Linking Project are restricted to male links, and minor discrepancies arise from a small number of observations with missing or miscoded sex. See Appendix A for more details.

Appendix Table A6. Descriptive Statistics: County-Level Correlates in Correlation Graphs

	(1) 1860 Mean (SD) [Counties]	(2) 1870 Mean (SD) [Counties]	(3) 1880 Mean (SD) [Counties]	(4) 1890 Mean (SD) [Counties]	(5) 1900 Mean (SD) [Counties]	(6) Source
Illiterate (Cannot Read and Write)		0.32 (0.22) [1300]	0.27 (0.18) [1363]		0.16 (0.11) [1418]	Ruggles et al. (2025)
Literate (Can Read and Write)		0.62 (0.22) [1300]	0.68 (0.19) [1363]		0.78 (0.14) [1418]	Ruggles et al. (2025)
In School (Age 5-20) Ratio		0.29 (0.20) [1300]	0.36 (0.16) [1363]		0.46 (0.12) [1418]	Ruggles et al. (2025)
Teacher-Children Age 5-20) Ratio		0.01 (0.004) [1300]	0.01 (0.01) [1363]		0.01 (0.01) [1418]	Ruggles et al. (2025)
Occupational Income Score		15.35 (2.97) [1297]	16.13 (2.55) [1363]		16.99 (2.89) [1418]	Ruggles et al. (2025)
Manufacturing Employment Per Capita	0.02 (0.03) [1100]	0.03 (0.04) [1225]	0.02 (0.04) [1329]			Donaldson and Hornbeck (2016)
Farmer Share		0.35 (0.19) [1297]	0.36 (0.16) [1363]		0.34 (0.15) [1418]	Ruggles et al. (2025)
Unskilled Share		0.47 (0.19) [1297]	0.44 (0.13) [1363]		0.42 (0.10) [1418]	Ruggles et al. (2025)
Foreign Born Share		0.05 (0.09) [1300]	0.04 (0.07) [1363]	0.04 (0.08) [1348]	0.04 (0.07) [1418]	Ruggles et al. (2025); Haines et al. (2010)
Mother Never Married Share			0.03 (0.02) [1363]		0.02 (0.02) [1418]	Ruggles et al. (2025)
Mother Currently Married Share			0.81 (0.04) [1363]		0.82 (0.04) [1418]	Ruggles et al. (2025)
Railroad Access	0.39 (0.49) [1221]					Haines et al. (2010)
Water Access	0.46 (0.50) [1221]					Haines et al. (2010)
Churches Per 1,000 people	2.07(1.08)[1175]	2.31(1.34)[1266]				Haines et al. (2010)
Own Place		0.45 (0.17) [1300]		0.50(0.15)[1348]	0.47 (0.14) [1418]	Ruggles et al. (2025); Haines et al. (2010)
Urban Population (2,500+) Share		0.08 (0.19) [1300]	0.10 (0.20) [1363]	0.14 (0.23) [1348]	0.16 (0.25) [1418]	Ruggles et al. (2025); Haines et al. (2010)
Improved Acres Farmland	0.37 (0.20) [1212]	0.40 (0.21) [1269]	0.46 (0.21) [1333]	0.51 (0.21) [1348]	0.53 (0.21) [1372]	Haines et al. (2010)
Black Population Share		0.25 (0.23) [1300]	0.27 (0.24) [1334]	0.27 (0.24) [1348]	0.26 (0.24) [1418]	Ruggles et al. (2025); Haines et al. (2010)
Segregation Index			0.29 (0.13) [1360]			Logan and Parman (2017)
Republican Presidential Candidate Vote Share 1872		0.49 (.12) [1321]				Clubb et al. (2006)
Cotton Bales Per Capita	0.35 (0.71) [1212]	0.19 (0.33) [1297]	0.27 (0.39) [1363]	0.29(0.43) [1381]	0.29 (0.43) [1417]	Haines et al. (2018)

Descriptive Statistics (continued)

	(1) 1860 Mean (SD) [Counties]	(2) 1870 Mean (SD) [Counties]	(3) 1880 Mean (SD) [Counties]	(4) 1890 Mean (SD) [Counties]	(5) 1900 Mean (SD) [Counties]	(6) Source
1-Slave Holdings	0.03 (0.03) [870]					Haines et al. (2010)
2-Slaves Holdings	0.04 (0.03) [870]					Haines et al. (2010)
3-Slaves Holdings	0.04 (0.03) [870]					Haines et al. (2010)
4-Slaves Holdings	0.04 (0.03) [870]					Haines et al. (2010)
5-Slaves Holdings	0.04 (0.03) [870]					Haines et al. (2010)
6-Slaves Holdings	0.04 (0.02) [870]					Haines et al. (2010)
7-Slaves Holdings	0.04(0.02) [870]					Haines et al. (2010)
8-Slaves Holdings	0.04 (0.02) [870]					Haines et al. (2010)
9-Slaves Holdings	0.04 (0.02) [870]					Haines et al. (2010)
10-14-Slaves Holdings	0.14 (0.05) [870]					Haines et al. (2010)
15-19-Slaves Holdings	0.10 (0.04) [870]					Haines et al. (2010)
20-29-Slaves Holdings	0.12 (0.05) [870]					Haines et al. (2010)
30-39-Slaves Holdings	0.07 (0.05) [870]					Haines et al. (2010)
40-49-Slaves Holdings	0.05 (0.04) [870]					Haines et al. (2010)
50-69-Slaves Holdings	0.06 (0.06) [870]					Haines et al. (2010)
70-99-Slaves Holdings	0.04 (0.06) [870]					Haines et al. (2010)
100-199-Slaves Holdings	0.04 (0.08) [870]					Haines et al. (2010)
200-299-Slaves Holdings	0.01 (0.02) [870]					Haines et al. (2010)
300plus-Slaves Holdings	0.01 (0.03) [870]					Haines et al. (2010)

Note: Data sources are listed in the last column. Illiteracy and literacy rates are calculated over individuals older than 15. Teacher–child ratio and in-school ratio are computed for individuals aged 5–20. Average occupational income score, as well as farmer and unskilled worker shares, are based on adults aged 16–65 with non-missing occupational codes. Shares of “mother never married” and “mother currently married” are calculated among mothers aged 13 and older co-residing with a child. Black population share, foreign-born share, urban share, and homeownership share are computed over total population. homeownership in 1870 is defined as the share of non-group-quarter individuals (gq < 3) reporting any positive real estate value. Manufacturing employment per capita equals the sum of male and female hands employed in manufacturing divided by total population. Improved acreage farmland share is calculated as improved acreage divided by the sum of improved and unimproved acreage. Slaveholding shares are defined as the total number of slaves held by owners in each category divided by the total slave population in the county.

Appendix References

Abramitzky, Ran, Leah Boustan, and Myera Rashid, "Census Linking Project: Version 1.0," dataset 2020.

Angrist, Joshua D. and Alan B. Krueger, "Does Compulsory School Attendance Affect Schooling and Earnings?," *The Quarterly Journal of Economics*, 1991, *106* (4), 979–1014.

Bivings, Lee, "Racial, Geographic, Annual, and Seasonal Variations in Birth Weights," *American Journal of Obstetrics and Gynecology*, 1934, *27* (5), 725–728.

Boland, Mary Regina, Zachary Shahn, David Madigan, George Hripcsak, and Nicholas P. Tatonetti, "Birth Month Affects Lifetime Disease Risk: A Phenome-Wide Method," *Journal of the American Medical Informatics Association*, 2015, *22* (5), 1042–1053.

Bound, John and David A. Jaeger, "Do Compulsory School Attendance Laws Alone Explain the Association Between Quarter of Birth and Earnings?," in "Research in Labor Economics" 2000, pp. 83–108.

_ , _ , and Regina M. Baker, "Problems With Instrumental Variables Estimation When the Correlation Between the Instruments and the Endogenous Explanatory Variable Is Weak," *Journal of the American Statistical Association*, 1995, *90* (430), 443–450.

Breschi, Marco and Massimo Livi Bacci, "Month of Birth as a Factor in Children's Survival," in Lucia Pozzi and Diego Ramiro Fariñas, eds., *Infant and Child Mortality in the Past*, Paris: Belin, 1997, pp. 157–173.

Buckles, Kasey, Adrian Haws, Joseph Price, and Haley EB Wilbert, "Breakthroughs in Historical Record Linking Using Genealogy Data: The Census Tree Project," Technical Report w31671, National Bureau of Economic Research 2023.

_ and Daniel Hungerman, "Season of Birth and Later Outcomes: Old Questions, New Answers," *Review of Economics and Statistics*, 2013, *95* (3), 711–724.

Clubb, Jerome M., William H. Flanigan, and Nancy H. Zingale, "Electoral Data for Counties in the United States: Presidential and Congressional Races, 1840-1972," Inter-university Consortium for Political and Social Research [distributor] 2006.

Collins, William J. and Marianne H. Wanamaker, "African American Intergenerational Economic Mobility since 1880," *American Economic Journal: Applied Economics*, 2022, *14* (3), 84–117.

Currie, Janet M. and Hannes Schwandt, "Within-Mother Analysis of Seasonal Patterns in Health at Birth," *Proceedings of the National Academy of Sciences*, 2013, *110*, 12265–12270.

Darrow, Lyndsey A., Matthew J. Strickland, Mitchel Klein, Lance A. Waller, W. Dana Flanders, Adolfo Correa, Michele Marcus, and Paige E. Tolbert, "Seasonality of Birth and Implications for Temporal Studies of Preterm Birth," *Epidemiology*, 2009, *20* (5), 699–706.

Day, Felix R., Nita G. Forouhi, Ken K. Ong, and John RB Perry, "Season of Birth Is Associated With Birth Weight, Pubertal Timing, Adult Body Size and Educational Attainment: A UK Biobank Study," *Heliyon*, 2015, *1* (2).

Donaldson, Dave and Richard Hornbeck, "Railroads and American Economic Growth: A 'Market Access' Approach," *The Quarterly Journal of Economics*, 2016, *131* (2), 799–858.

Dorélien, Audrey M., "Effects of Birth Month on Child Health and Survival in Sub-Saharan Africa," *Biodemography and Social Biology*, 2015, *61* (2), 209–230.

Eastman, Paris R., "Infant Mortality in Relation to Month of Birth," *American Journal of Public Health and the Nations Health*, 1945, *35* (9), 913–922.

Gavrilov, Leonid A. and Natalia S. Gavrilova, "Season of Birth and Exceptional Longevity: Comparative Study of American Centenarians, Their Siblings, and Spouses," *Journal of Aging Research*, 2011, *2011*, 104616.

Goodenough, Florence Laura, "Month of Birth as Related to Socio-Economic Status of Parents," *The Pedagogical Seminary and Journal of Genetic Psychology*, 1941, *59*, 65–76.

Haines, Michael, Price Fishback, and Paul Rhode, "United States Agriculture Data, 1840 - 2012," 2018.

Haines, Michael R., Inter university Consortium for Political, and Social Research, "Historical, Demographic, Economic, and Social Data: The United States, 1790-2002," Inter-university Consortium for Political and Social Research [distributor] 2010.

Hare, E. H., "Manic-Depressive Psychosis and Season of Birth," *Acta Psychiatrica Scandinavica*, 1975, *52* (1), 69–79.

Helgertz, Jonas, Steven Ruggles, John Robert Warren, Catherine A. Fitch, Ronald Goeken, J. David Hacker, Matt A. Nelson, Joseph P. Price, Evan Roberts, and Matthew Sobek, "IPUMS Multigenerational Longitudinal Panel: Version 1.0," dataset 2020.

Kalsi, Priti and Zachary Ward, "The Gilded Age and Beyond: The Persistence of Elite Wealth in American History," Technical Report w33355, National Bureau of Economic Research 2025.

Kendell, R. E. and I. W. Kemp, "Winter-Born v Summer-Born Schizophrenics," *The British Journal of Psychiatry*, 1987, *151* (4), 499–505.

Knobloch, Hilda and Benjamin Pasamanick, "Seasonal Variation in the Births of the Mentally Deficient," *American Journal of Public Health and the Nations Health*, 1958, *48* (9), 1201–1208.

Logan, Trevon D. and John M. Parman, "The National Rise in Residential Segregation," *The Journal of Economic History*, 2017, *77* (1), 127–170.

Maitra, Pushkar, Nidhiya Menon, and Chau Tran, "The Winter's Tale: Season of Birth Impacts on Children in China," *Economic Development and Cultural Change*, 2022, *70* (2), 671–728.

Pasamanick, Benjamin and Hilda Knobloch, "Seasonal Variation in Complications of Pregnancy," *Obstetrics Gynecology*, 1958, *12* (1), 110–112.

Pintner, Rudolf and George Forlano, "The Influence of Month of Birth on Intelligence Quotients," *Journal of Educational Psychology*, 1933, *24* (8), 561.

Price, Joseph, Kasey Buckles, Adrian Haws, and Haley Wilbert, "The Census Tree: Machine Learning Models," Inter-university Consortium for Political and Social Research [distributor] 2023.

Ruggles, Steven, Sarah Flood, Matthew Sobek, Daniel Backman, Grace Cooper, Julia A. Rivera Drew, Stephanie Richards, Renae Rogers, Jonathan Schroeder, and Kari C.W. Williams, "IPUMS USA: Version 16.0," dataset 2025.

Torrey, E. Fuller, Robert R. Rawlings, Jacqueline M. Ennis, Deborah Dickerson Merrill, and Donn S. Flores, "Birth Seasonality in Bipolar Disorder, Schizophrenia, Schizoaffective Disorder and Stillbirths," *Schizophrenia Research*, 1996, *21* (3), 141–149.

Warren, Charles W. and Carl W. Tyler, "Social Status and Season of Birth: A Study of a Metropolitan Area in the Southeastern United States," *Social Biology*, 1979, *26* (4), 275–288.