NBER WORKING PAPER SERIES

THE NATIONAL RISE IN RESIDENTIAL SEGREGATION

Trevon Logan
John Parman

Working Paper 20934
http://www.nber.org/papers/w20934

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
February 2015

We thank Rodney Andrews, David Blau, Shari Eli, Joe Ferrie, Judge Glock, Daeho Kim, Alison Schertzer and Richard Steckel. Seminar audiences at Michigan, Occidental, UC-Riverside, UC-Irvine, Yale, American University, Pomona College, UT-Dallas, Virginia Commonwealth University, Dalhousie University, The Ohio State University, ASSA Annual Meetings, and NBER Summer Institute provided welcome suggestions. William D. Biscarri, Nicholas J. Deis, Jackson L. Frazier, Adaeze Okoli, Terry L. Pack, Stephen Prifti and Colin Weinshenker provided excellent research assistance. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

The National Rise in Residential Segregation
Trevon Logan and John Parman
NBER Working Paper No. 20934
February 2015
JEL No. J1,N3,N9,N91,N92

ABSTRACT

This paper introduces a new measure of residential segregation based on individual-level data. We exploit complete census manuscript files to derive a measure of segregation based upon the racial similarity of next-door neighbors. Our measure allows us to analyze segregation consistently and comprehensively for all areas in the United States and allows for a richer view of the variation in segregation across time and space. We show that the fineness of our measure reveals aspects of racial sorting that cannot be captured by traditional segregation indices. Our measure can distinguish between the effects of increasing racial homogeneity of a location and the tendency to segregate within a location given a particular racial composition. Analysis of neighbor-based segregation over time establishes several new facts about segregation. First, segregation doubled nationally from 1880 to 1940. Second, contrary to previous estimates, we find that urban areas in the South were the most segregated in the country and remained so over time. Third, the dramatic increase in segregation in the twentieth century was not driven by urbanization, black migratory patterns, or white flight to suburban areas, but rather resulted from a national increase in racial sorting at the household level. The likelihood that an African American household had a non-African American neighbor declined by more than 15 percentage points (more than a 25% decrease) through the mid-twentieth century. In all areas of the United States -- North and South, urban and rural -- racial segregation increased dramatically.

Trevon Logan
The Ohio State University
410 Arps Hall
1945 N. High Street
Columbus, OH 43210
and NBER
logan.155@osu.edu

John Parman
Department of Economics
P.O. Box 8795
College of William and Mary
Williamsburg, VA 23187
and NBER
jmparman@wm.edu

"We make our friends; we make our enemies; but God makes our next-door neighbor."

- Gilbert K. Chesterton, *Heretics* (1905)

1 Introduction

This paper introduces a new measure of residential segregation. Our measure uses the complete manuscript pages of the federal census to identify the races of next-door neighbors. We measure segregation by comparing the number of households in an area living next to neighbors of a different race to the expected number under complete segregation and under no segregation (random assignment). The resulting statistic provides a measure of how much residents segregate themselves given the particular racial composition of the area. The measure allows us to distinguish between the effects of differences in racial composition and the tendency to segregate *given* a particular racial composition. A particular advantage is that neighbor-based segregation can be aggregated to any boundary without losing the underlying properties since it is defined at the individual level.

To our knowledge, this measure of segregation is the first to exploit actual residential living patterns of households and the first to be equally applicable to rural and urban areas. Equally important, our measure can be consistently applied over time. Previous advances in the measurement of segregation have attempted to use smaller geographic units (Reardon & Sullivan, 2004; Echenique & Fryer, 2007; Reardon et al., 2008), but none have comprehensively exploited the actual pattern of household location as we do here. While analysis of segregation has primarily been focused on cities, there are few theoretical reasons to believe that rural segregation is unimportant or unrelated to socioeconomic outcomes for rural residents (Lichter et al., 2007). As such, our measure is the first to give a complete picture of segregation for the entire United States.

This project fills a large gap in our knowledge of segregation and its change over time. We not only answer the question of how segregation changed, but also the question of how persistent segregation was as a national phenomenon. Questions regarding the strength of the relationship between segregation and racial inequality hinge on issues of selection into segregated areas that require a comprehensive measure of segregation that can apply to both urban and rural areas. Existing segregation measures inherently obscure the effects of sub-district segregation, making empirical progress on this issue difficult. The debate over the effect of neighborhood-level mechanisms and social networks on socioeconomic outcomes has shown that neighborhood effects may or may not be strong and persistent (Kling et al., 2007; Bayer et al., 2007). Progress in this area requires a measure of neighborhood segregation that moves beyond tract-level population shares and exploits a more accurate description of residential dispersion. Our measure exploits the finest level of detail available for residential location.

In what follows we derive our measure of segregation, which is based on the similarity of residential neighbors. (The measure has the additional advantage of being flexible to any definition of neighbor.) Next, we perform a simulation exercise to verify the properties of the measure. The simulation establishes that our measure captures residential housing patterns and performs as predicted as the dispersion of households by race and the underlying racial composition of the area vary. In particular, we show that our measure works well in areas with very small numbers of black households and in the presence of missing households in enumeration while traditional measures falter under the same conditions. A key result in our comparison is that traditional measures are quite sensitive to geographic boundaries while our measure is not.

We apply our measure to the full, 100% federal census for both 1880 and 1940, exploiting the census takers' sequenced alignment of households to identify the race of household heads and their next-door neighbors and estimating segregation levels for all counties and cities in the United States. This comprehensive approach to segregation makes it possible, for the first time, to rigorously analyze the accepted history of residential segregation. The traditional narrative of segregation in the United States supposes that migration of African Americans from the rural South to urban communities, especially in the North, gave rise to segregated cities that persist to this day. Missing from this narrative is any analysis of the national trend in segregation. If segregation was equally likely to exist in rural communities as in urban ones, the focus on urban segregation has told a partial story about segregation in the United States. Moreover, migratory patterns and geographic dispersion are equilibrium processes, and we must have information on all areas to properly analyze national economic change and its impact on incentives to migrate, population flows, urbanization, agglomeration, and resulting segregation patterns in rural and urban communities. Our results provide the first truly national estimates of segregation and its change over time.

Our neighbor-based measure establishes several new facts about segregation in the United States. First, we find that segregation, as measured by our neighbor-based index, doubled nationally from 1880 to 1940. This is the first evidence of a national increase in segregation. Second, contrary to previous estimates which implied that northern cities were the most segregated areas (Cutler et al., 1999), we find that cities in the South were the most segregated in the country and remained so over time. While blacks and whites occupied the same wards and districts in southern cities, they were the least likely to be neighbors. This finding is a direct result of a measure of segregation that builds from household position as opposed to ward population shares. Third, we find that increasing segregation over time was not confined to cities, nor was urbanization the driving force behind increasing segregation. While previous work has viewed increasing segregation as the result of black migratory flows to cities, we find that segregation increased substantially in rural communities as well. Our neighbor-based measure of segregation shows that population sorting by race changed just as dramatically in rural areas as in urban areas. The broad, national increase in racial sorting we document is a new historical fact which complicates the existing segregation narrative and points to a more general trend in residential racial separation than has been previously suggested.

Our measure allows us to look at a key factor behind that trend– racial sorting at the household level. We find that the likelihood of a black family having an opposite-race neighbor declined by more than 15 percentage points from 1880 to 1940, more than a 25% decline in the likelihood of opposite-race neighbors. Rather than being the product of black migratory patterns, regional differences in black location patterns, or white population flows out of central cities, the increase in racial sorting was quite general. Areas that both gained and lost African American residents saw substantial increases in racial segregation at the household level. We conclude by noting how our new measure of segregation calls for a reinterpretation of segregation trends over time and how our measure can be used to answer a broader range of questions about both the historical and contemporary effects of segregation.

2 A New Measure of Segregation

Our measure is an intuitive approach to residential segregation. We use the location of households in adjacent units in census enumeration to measure the degree of integration or segregation in a community, similar to Schelling's classic model of household alignment. At its core, the Schelling concept of segregation is based on next-door neighbors.[1] The popular discussions of segregation and preferences for racial integration, particularly in survey data, use neighbors as the criteria. A standard approach is Bobo & Zubrinsky (1996) and Zubrinsky & Bobo (1996), which elicit preferences for same race neighbors, or Farley et al. (1997), which shows examples of a neighborhood layout and a reference household.[2] As such, our measure of segregation is well-aligned to the conceptual definition of residential segregation.

We take the Schelling model to census enumeration, where households are aligned on a line with neighbors, to its comparative conclusion. Areas that are well integrated will have a greater likelihood of opposite-race neighbors that corresponds to the underlying racial proportion of households in the area. The opposite is also true— segregated areas will have a lower likelihood of opposite-race neighbors than racial proportions would predict.

We calculate the predicted number of black households with white neighbors given the number of black and white households in the area assuming that households are randomly located by race and the predicted number assuming that households are completely segregated (only the households on the edge of the all black community have white neighbors and vice versa). The segregation measure is simply an estimate of how far the actual number of black households with white neighbors is between these two extremes. We ask a fundamentally different question about segregation than traditional measures, one that aligns more closely to existing models of segregation and the intuition of residential segregation.

This measure uses census enumeration ordering of households to define neighbors, exploiting the fact that adjacent households appear next to each other on the census manuscript page. This is a

[1] In the classic formulation, segregation is the product of household preferences over the race of their neighbor and their neighbor's neighbor (Schelling, 1971, 1969). For a model which includes preferences over schools see Bayer et al. (2007). For a recent example of a test of Schelling's tipping model see Card et al. (2008).

[2] Studies such as Clark (1991) ask respondents about racial proportions, but these are rare.

one-dimensional approach to neighbors given the limitations of the data; the census manuscript pages do not identify neighbors living behind or across the street from a household. Whether one has an opposite-race neighbor across the street or across a back alley, however, is highly correlated with the segregation of the community. There is not a reason to believe that this measure, based on a one-dimensional sample of the full set of next-door neighbors, would be biased by not including the neighbors in front or behind of the household, especially since those neighbors are still included as next-door neighbors of another household in the same community.[3] Most important, our measure improves on existing segregation measures by capturing a dimension of household specific segregation while traditional measures, which are inherently aspatial within subunits, capture no micro-dimension at all.

2.1 The Limitations of Traditional Segregation Measures

The advantages of our approach are most apparent when comparing them to the most popular existing measures of segregation– the index of dissimilarity (a measure of eveness) and the index of isolation (a measure of exposure).[4] The index of dissimilarity is a measure of how similar the distribution of minority residents among geographical units is to the distribution of non-minority residents among those same units.[5] The index compares the percentage of the overall black population living in each geographical unit to the percentage of white residents living in that same area. As the black population becomes less evenly spread across geographical units, black residents will begin to constitute a disproportionately large share of residents in some areas and a disproportionately low share in others, increasing the index of dissimilarity. The index of isolation provides a measure of the exposure of

[3]In many rural areas neighbors are situated along a line. For example, a row of homes along a road may not have neighbors in any other dimension.

[4]See Massey & Denton (1988) for a complete list of traditional segregation measures.

[5]Formally, if i is an index for the N census tracts within a city, B_i is the number of black residents in tract i, B_{total} is the total number of black residents in the city, W_i is the number of white residents in tract i, and W_{total} is the total number of white residents, the index of dissimilarity for the city is:

$$\text{Dissimilarity} = \frac{1}{2}\sum_{i=1}^{N}\left|\frac{B_i}{B_{\text{total}}} - \frac{W_i}{W_{\text{total}}}\right|$$

minority residents to other individuals outside of their group.[6] This is a measure of the racial composition of the census tract for the average black resident, where racial composition is measured as the percentage of the residents in the tract who are black. If there is little segregation, this measure will approach the percent black for the city as a whole. If there is extensive segregation (blacks are highly isolated), this measure will get larger as the tracts containing black residents become more and more homogeneous.

These traditional segregation measures, given their reliance on geographic subunits, are typically applied to cities which have a natural subunit of wards. With this focus on cities, these measures are ill-suited to describe the evolution of segregation over time. For example, between Reconstruction and World War II there was dramatic change in urban locations. In 1870 roughly 90 percent of blacks lived outside of cities and by 1940 more than half lived in urban areas (see Figure 1). We do not know if increasing segregation in urban areas was related to increases or decreases in rural segregation. Segregation measures focused on cities will fail to capture the experiences of the majority of the Americans in the early twentieth century or the conditions that drove many of them to cities by the mid-twentieth century.

An additional problem with these traditional measures is that they are inherently aspatial within the geographic subunits. While our measure exploits the alignment of individual households along a line, the traditional measures only use population shares within a given area. This is particularly problematic for segregation as a proxy for social interactions, social networks, and interpersonal exchange. As the level of aggregation increases, within-area segregation is inherently obscured in traditional measures. This is particularly problematic for rural areas which have less dense populations that may require larger geographical subunits that are less meaningful proxies for social interactions.[7]

[6]Using the same notation, the index of isolation for a city is given by:

$$\text{Isolation} = \sum_{i=1}^{N} \left(\frac{B_i}{B_{\text{total}}} \cdot \frac{B_i}{B_i + W_i} \right)$$

[7]Rhode & Strumpf (2003) analyze inequality in rural counties, but they do not calculate traditional segregation measures for all counties. Lichter et al. (2007) calculate dissimilarity for rural areas using 1990 and 2000 census data using census blocks. They find that the pattern of segregation is rural communities is very similar to the pattern in urban communities. African Americans are the most segregated racial group in both rural and urban areas. They note that the highly aggregated nature of the census block in rural communities limits their ability to speak to the forces shaping the segregation patterns they observe due to the aspatial nature of the measure.

Furthermore, if the size of these geographical subunits or the economic implications of living in a particular subunit differ across rural and urban communities, it becomes difficult to make meaningful comparisons of the traditional segregation indices between rural and urban areas.

There is a final critique of using these traditional measures that has special importance when considering the history and evolution of segregation. Echenique & Fryer (2007) and Lee et al. (2008) note that these measures are highly dependent on the way the boundaries of the geographical subunits are drawn. It is an issue that Cutler et al. must deal within estimating city segregation when the available data switches from ward-level data to census tract-level data in 1950. In the cases where Cutler et al. have data at both the ward and census tract levels, the correlation between the index of dissimilarity for southern cities using wards and the same index using census tracts is only 0.59—0.35 with one outlier removed.

What makes this particularly problematic for historical segregation is that political motivations when drawing ward boundaries can have dramatic effects on segregation measures and the inference we draw from those measures. A city in which wards are drawn to minimize the voting power of black residents by dispersing their votes across wards may appear to be highly integrated. If the same city had wards drawn to make it easier to discriminate in the provision of public services by placing black residents in a small number of wards it would appear completely segregated according to the segregation measures. The endogenous nature of political boundaries makes it difficult to analyze segregation as the cause or consequence of institutional development using traditional measures.[8] Regardless of the motivations for drawing boundaries, existing measures tell us little about proximity or sorting within any boundary, arbitrary or not.

[8]For example, consider the case of Richmond, in the which the ward lines were drawn to include over one third of the city's black population within the Jackson Ward, making that ward 80 percent black in 1880 (Rabinowitz, 1996, page 98). This resulted in a segregated pattern by gerrymandering. The efforts to minimize black voting power through gerrymandering were publicly discussed in cases such as Raleigh, where the Republican leaders advised black residents to move to the Fifth Ward which had not been gerrymandered. The local newspaper noted that blacks attempting this would find it "difficult to get houses when it is known they move only to carry the election and keep control of a much plundered city" (from the *Daily Sun* as quoted in Rabinowitz (1996, page 105)). This would result in the opposite of Richmond, a city that was more "integrated" simple due to the incomplete gerrymandering process.

2.2 Advantages of a Household Level Measure of Segregation

Our new measure does not suffer from the limitations of using political boundaries for geographical subunits and in fact does not require geographical subunits at all, making it possible to look at segregation in *any* geographical area, a key innovation of our approach. At the same time, our measure is inherently spatial in that it uses sequenced enumeration and the nearest household to define neighbors. Rather than asking whether an individual lives in a ward or tract with many black residents, a question that hinges on how wards or tracts are defined, we can ask whether an individual's nearest neighbor is of the same race, a question that can be consistently and universally applied to all households.[9]

Our approach has a number of additional advantages. First, we focus on households as opposed to the population. If members of one group have larger household sizes or different household structure (as was the case historically, Ruggles et al. (2009)) there will be a difference between the population share and the household share. Another advantage is that this measure is an intuitive proxy for social interactions. Neighbors are quite likely to have some sustained interactions with each other, and an increasing likelihood of opposite-race neighbors implies that the average level of interactions across racial lines would be higher. Social interaction models of segregation are inherently spatial and assume that close proximity is related to social interactions both directly and indirectly (Echenique & Fryer, 2007; Reardon et al., 2008).[10] Our next-door neighbor approach guarantees this proximity, relying on population shares in geographical subunits such as wards does not. At the same time, while we exploit the ordered fashion of census enumeration, we do not assume that entire enumeration districts

[9]Grigoryeva & Ruef (2014) build on the method of Agresti (1980) and calculate a sequenced index of segregation that counts "runs" (sequences) of households by race. While related to our measure, their measure requires the strong assumption that the entire enumeration district was surveyed in a linear fashion. As described below, our measure deals directly with this issue and the simulation results described later show that our measure is robust to measurement error due to the mapping of non-linear geographic locations into linear rosters.

[10]We are careful to stress that our approach to segregation is focused on a measure of residential segregation. We do not propose a model of optimal household location choice as household location decisions are a function of their own preferences and the location of neighbors of preferred type (Bayer et al., 2007). The problems of aggregating such measures over a community are further compounded by inherent geographic differences in locations that may be related to household location decisions. Here, our concern is deriving an intuitive measure that captures a key feature of residential living patterns by race. Models which apply a network approach to segregation assume that a person's social network is closely tied to their residential living pattern, and without direct information on the actual social network such measures may not capture actual exposure to more or less segregated individuals. Similarly, any model proposed with preferences over racial composition would need to account for changing preferences over time, which themselves could vary by racial group and geographic location (Card et al., 2008).

were surveyed in a linear fashion. One could derive the optimal path for an enumerator if one were interested in the path that should be traversed over a large area, such as which roads should be selected first. Since we restrict ourselves to next-door neighbors the optimal path is trivial– neighbors would enumerated in order. Lastly, our measure can be decomposed to analyze the determinants of changes in segregation. For example, one can calculate how much of the change in segregation is due to changes in the tendency to segregate given a particular racial composition for a county and how much is due to changes in the overall racial composition of counties influencing the likelihood of opposite-race neighbors holding the tendency to segregate constant.

2.3 Next Door Neighbors and Census Enumeration

We exploit a feature of historical census enumeration to derive our segregation measure. Census enumerators went door-to-door to survey households until 1960, when the Census Bureau first began mailing questionnaires. The position on the manuscript census form therefore provides a measure of the actual location and composition of households as one would "walk down the street" from residence to residence. Proximity in the manuscript census form is, by design, a measure of residential proximity because enumeration was recorded in sequenced order. Figure 2 shows an example of where household race and the race of adjacent households are identified on the manuscript census form. We assume that adjacent appearance on the manuscript census form is evidence of being neighbors.

There are several historical facts which support our assumption (Magnuson & King, 1995; Grigoryeva & Ruef, 2014; Agresti, 1980). First, enumerators were expected to be from the districts they were enumerating and to be familiar with the area and its residents. Second, the official training of enumerators specifically required an accurate accounting of dwellings containing persons in order of enumeration. A personal visit to each household was required. Third, enumeration instructions explicitly directed enumerators to leave blank spaces for households who could not be surveyed upon the first visit, filling in those entries in a subsequent visit. Fourth, enumeration was publicly checked– after enumeration, census law required the public posting of each enumeration for several days for public comment and correction. Fifth, enumeration was often cross-checked with external sources such as voting records and other municipal information that would be recorded in sequenced household order. Sixth, the accuracy of the records had to be ascertained before the enumerator received payment. Census officials adopted a rough tracking system that allowed them to detect gross over- or under-counting of households.

Grigoryeva & Ruef (2014) provide confirmation of this assessment, documenting that the census enumeration of Washington, D.C. in 1880 followed an ordered process. However, the linear path cannot be verified for other locations due to data limitations and the incomplete records pertaining to the specifics of enumeration in each locality.[11] Census enumeration does not typically contain addresses, even for urban areas. In general, however, the policies and procedures of enumeration since 1880 give us confidence that our approach is the best available proxy for household adjacency.

An obvious concern for rural communities would be the distance between neighbors identified in census manuscript files. Since enumeration districts were quite compact, even for rural areas, these adjacent households were closer than one may be led to believe. Those at quite a distance would be placed in a different enumeration district for practical purposes. A second consideration is that African Americans were far less likely to be landowners and therefore distant from their opposite race neighbors. Differences in land ownership greatly impacted the residential location of the average African American family– they were usually not living on independent farms but rather more likely to live in compact tenant farming communities (Litwack, 1998; Ransom & Sutch, 2001).

It is important to note that rural communities had recognized neighborhoods. The federal government used rural neighborhood location and ethnic population shares in determining farm value in early twentieth century mortgage underwriting, which implies that neighborhoods were clearly defined in rural communities and that their racial and ethnic distributions were important.[12] Similarly, Parman (2012) shows that human capital spillovers worked through neighboring farms in the early twentieth century, suggesting that interactions in sparsely populated areas are significant and measurable. In short, living in a rural community with less dense population did not necessarily imply that neighbors were more distant than those in urban areas nor that social and economic interactions between neighbors were any less important.

[11]We deal with this issue of how this impacts the segregation measure directly in our simulation results below.

[12]These criteria date back to Federal Land Banks, established by the Federal Farm Loan Act of 1916.

3 Deriving the Segregation Measure

Construction of the measure begins by identifying neighbors in manuscript census records.[13] Our method requires the complete, 100% census since all households are needed. The complete set of household heads in the census is sorted by reel number, microfilm sequence number, page number and line number. This orders the household heads by the order in which they appear on the original census manuscript pages, meaning that next-door neighbors appear next to one another (see Figure 2). Institutions, boarding houses and other non-households (dormitories, etc.) are excluded from the calculation. Households in apartments or other multi-family units are recorded as separate households in the census and are retained. We focus our analysis on black households, assessing whether they have a neighbor of a different race. All racial groups other than blacks or whites constituted less than 0.5% of the total population from 1870 to 1940 in census returns. As such, a black household with a neighbor of a different race is equivalent to saying they have a white neighbor.[14] Given the extremely low levels of interracial marriage in the past (fewer than 0.2% of households had opposite race spouses from 1870 to 1940), we assume the race of the household head applies to all household members.

There are two different methods for identifying each household's next-door neighbors. The first is to define the next-door neighbors as the households appearing before and after the individual on the census manuscript page. An individual that is either the first or last household head on a particular census page will only have one next-door neighbor identified using this method. To allow for the next-door neighbor appearing on either the previous or next census page, and to account for the possibility that two different streets are covered on the same census manuscript page, an alternative method for identifying neighbors is also used that relies on street name rather than census manuscript page. In this alternative measure, next-door neighbors are identified by looking at the observations directly before and after the household in question and declaring them next-door neighbors if and only if the street name matches the street name of the individual of interest (and the street name must be given, two blank street names are not considered a match). This approach has the advantage of finding the last household on the previous page if an individual is the first household on his census

[13]The full derivation of the segregation measure is given in the appendix.

[14]For our purposes people with their race given as 'mulatto' are considered to be in the same category as people with their race given as 'black'.

manuscript page (or the first household on the next page if the individual was the last household on a manuscript page). However, the number of observations is reduced substantially relative to the first method because many individuals have no street name given in the manuscript census files. Few roads were identified in historical census records.

Once next-door neighbors are identified, an indicator variable is constructed that equals one if the individual has a next-door neighbor of a different race and zero if all observed next-door neighbors are of the same race as the household based on the race assigned at enumeration. As such, the measure of opposite-race neighbors is measured at the extensive margin. This is measured for each household in the manuscript census.

Summing this indicator variable across all black households for the entire county gives us the number of black households with a next-door neighbor of the opposite race, x_b. The segregation measure compares this number of black households with opposite-race neighbors to the expected number under complete segregation, $E(\underline{x_b})$, and the expected number under complete integration (random assignment of neighbors), $E(\overline{x_b})$. These two values are calculated based on the total number of black households and white households in a county. $E(\underline{x_b})$ is calculated assuming that only the two households on either end of the black neighborhood have white neighbors.[15] $E(\overline{x_b})$ is calculated assuming that households are randomly assigned by race: the probability of a next-door neighbor being of the opposite race is given by the fraction of the households in the county of that race.[16]

The degree of segregation in an area is defined as the distance between these two extremes,

[15] This value is a function of the probability of observing one or both of the two black households with white neighbors (a non-trivial number of households in the census do not have races given for their neighbors). Defining the number of black households with both neighbors' races observed as n_b and the total number of black households in the county as b_{all}, the value of $E(\underline{x_b})$ is calculated as $\frac{1}{\frac{1}{2}(n_b+1)}\left(1-\prod_{i=0}^{n_b-1}\frac{b_{all}-i-2}{b_{all}-i}\right)+2\left(1-\frac{1}{\frac{1}{2}(n_b+1)}\right)\left(1-\prod_{i=0}^{n_b-1}\frac{b_{all}-i-2}{b_{all}-i}\right)$. In the case of including households with only one observed neighbor, this equation must be modified somewhat to account for the possibility of observing one of the black households with a white neighbor but not observing the white neighbor. Full details are provided in the appendix.

[16] Following the same notation as the previous footnote and defining the total number of white households in the county as w_{all}, the value of $E(\overline{x_b})$ is calculated as $n_b\left(1-\frac{b_{all}-1}{b_{all}-1+w_{all}}\cdot\frac{b_{all}-2}{b_{all}-2+w_{all}}\right)$. As with $E(\underline{x_b})$, the equation must be modified when including households with only one observed neighbor. Details are provided in the appendix.

measured from the case of no segregation:[17]

$$\eta = \frac{E(\overline{x_b}) - x_b}{E(\overline{x_b}) - E(\underline{x_b})} \tag{1}$$

This segregation measure increases as black residents become more segregated within an area. The measure equals zero in the case of random assignment of neighbors (no segregation) and equals one in the case of complete segregation.[18] The measure is only defined for racially heterogeneous communities, as racially homogeneous communities are neither segregated nor integrated. The segregation measure is normalized by the population size and the percent of African Americans in the community, which allows for comparison of segregation across communities with different population sizes and racial compositions.

We have derived the segregation measure for analysis of neighbors situated along a line in order to match the way in which neighbors can be identified in the census manuscript pages. However, it should be noted that the measure can be easily extended to considering two-dimensional residential patterns rather than simply household sequences along a line. Expanding the definition of next-door neighbors to include those living behind a household or across the street from the household simply requires adjusting the probability terms in the definition of $E(\overline{x_b})$ to account for the probability that any one of the four next-door neighbors is white and adjusting $E(\underline{x_b})$ to account for all of the black households on the perimeter of the two-dimensional black neighborhood having white neighbors rather than simply the two households on the ends of the one-dimensional neighborhood. This highlights the advantages

[17] There are a total of four versions of the segregation measure. Each of these versions corresponds to one of the two different methods of defining next-door neighbors (whether or not specific street of residence is used in addition to adjacency on the census manuscript page) and whether all individuals with a neighbor present are included or only those individuals with both neighbors identified are used. Throughout, we use the measure that defines neighbors based on adjacency on the census manuscript form and where all individuals with a neighbor present are included. All four measures are highly correlated with one another and the results of all analyses are the same regardless of the measure chosen.

[18] In the derivation section of the appendix, we show that in the case of large black and white populations, our measure can be expressed in a form similar to measures of evenness that compare the average racial diversity within a subunit to the racial diversity of the larger geographic area as a whole. Our measure is essentially the limiting case where the geographic subunit is each individual black household and the measure of diversity is whether or not that black household has a white neighbor. However, this equivalence to an evenness measure is dependent on the assumption what $E(\overline{x_b})$ is substantially larger than $E(\underline{x_b})$, an assumption that fails when either the overall population is small or there are particularly small numbers of black households. The form of our expression provided in Equation 1 does not rely on this assumption and, as we demonstrate in simulations section, performs better than traditional measures including evenness measures when dealing with small communities.

of constructing a household-level measure of segregation; unlike traditional segregation measures based on geographic subunits or runs in the sequence of households, our measure can accommodate any definition of next-door neighbors fully exploiting available information on household location. While existing federal census information limits us to considering neighbors to the right and left of a household, our measure can accommodate less restrictive definitions of next-door neighbors as richer household-level spatial data become available.

4 Simulations of the Segregation Measure

In order to assess the sensitivity of our measure to missing information in the census, to compare our measure to traditional segregation indices, and to investigate how sensitive our measure is to areas of different population sizes, we perform a series of simulations calculating our measure. We simulate both completely integrated and completely segregated areas, varying the size and racial composition of the areas as well as the number of missing neighbors. These simulations confirm that our measure accurately identifies the level of segregation even in the presence of missing data and that it does so more precisely than traditional measures based on geographic subunits.

4.1 Simulating Segregated and Integrated Communities

We begin by constructing a line of households with the appropriate number of black households followed by the appropriate number of white households, a completely segregated community. To simulate completely integrated areas, we assign a random number to each household and reorder the households along the line on the basis of this number. This produces household locations that are independent of race by design.

We take two approaches to constructing the simulated areas. The first is to hold the relative proportion of black and white households fixed while varying the overall area size from twenty households to 4000 households. The second is to hold the area size fixed at 2000 households and vary the percentage of black households from one to 99 percent. For each area size and racial composition of the population, we simulate 1000 different areas, each based on a different draw of random numbers, and calculate our neighbor-based segregation index. To assess how sensitive the measures are to missing individuals, five percent of the households are randomly selected to be 'missing' and therefore not included in the segregation measure calculations.[19]

Our measure begins from a fundamentally different unit of analysis than existing measures, making it difficult to perform a direct empirical comparison of the methods. Analytically, aggregating our measure to the level of the census tract and block reveals different information about segregation in the subunit than the population shares used in traditional measures. The traditional measures, at their base, require only population shares by race, while our measure uses alignment and is not hierarchical. Subunit differences in the neighbor-based segregation measure reflect subtle, but potentially important, differences in spatial distribution.[20]

To gauge the importance of these effects we also simulate the two most popular measures of segregation, dissimilarity and isolation.[21] For the purposes of calculating the dissimilarity index and isolation index, we divide the line into wards of equal size. We simulate ward boundaries that are drawn independent of race by randomly choosing the starting position of the block of black households along the line of households.[22] Thus the completely segregated area has a single neighborhood of all black households that may or may not cross ward boundaries with a neighborhood of all white households to the right and/or left of it along the line. We also simulate gerrymandered wards, for which the black population is concentrated in as few wards as possible. The neighborhood of black households is placed at the beginning of the line to ensure that the black neighborhood is restricted to the first ward until it exceeds the ward size, at which point it is restricted to the first and second wards and so on. To be clear, we estimate neighbor-based segregation, dissimilarity, and isolation for the same simulated areas.

[19] The results are the same when increasing the number of missing households to twenty percent.

[20] One critique of traditional segregation measures is that they may fail to capture the emergence of separate neighborhoods housing members of the same race but of different socioeconomic status. For example, Bayer et al. (2005) argue that increasing wealth among African Americans led to the development of middle-class black communities which increased measures of segregation.

[21] When calculating isolation, we follow the approach of Cutler et al. (1999) and rescale and normalize the isolation index such that it is independent of the overall size of the black population and ranges between zero and one.

[22] Note that the community is still completely segregated as only the two black households at the edge of the white communities have opposite race neighbors.

4.2 Simulation Results

Figure 3 shows the results of these simulations for a representative set of cases.[23] For each graph, the upper curve marked with X's gives the mean value of the segregation index for the completely segregated areas while the lower curve marked with circles gives the mean value of the segregation index for the completely integrated areas. The shaded regions correspond to the range between the 5th and 95th percentiles of the simulated segregation indices, offering a sense of how reliably the segregation indices capture complete segregation or integration.

There are several features in Figure 3 worth noting. First, our neighbor-based segregation index precisely identifies the completely segregated and completely integrated areas for any area with more than a handful of black households despite the presence of a significant number of 'missing' households. Specifically, once an area has more than ten black households, the neighbor-based measure is consistently equal to one for the completely segregated area and zero for the completely integrated area. This is true both when varying the racial composition of the area, as in panel (a), or when varying the size of the area, as in panel (b).

In stark contrast to our neighbor-based measure, the traditional segregation measures do not consistently or precisely identify complete segregation or integration. Their performance relative to the neighbor-based measure is quite poor. For segregated areas, the means of dissimilarity and isolation never approach one. For integrated areas, the mean of dissimilarity never approaches zero and is quite large at low levels of black households, indicating fairly high levels of segregation. The dissimilarity measure remains relatively large even as the number of black households approaches 100, as seen in panel (d). This overstatement of segregation at smaller numbers of black households is extremely problematic when considering the historical racial composition of US counties: the median county in 1880 had 59 black households with this number only increasing to 66 black households by 1940. The results of the simulation imply that dissimilarity would be imprecisely estimated for a large number of rural areas.

The isolation index approaches zero more quickly than the dissimilarity index for integrated areas

[23] Complete simulation results for all measures when varying area size, area racial composition, ward size and ward boundary location are available from the authors.

as the number of black households increases, but it exhibits its own problems in segregated areas. At any given area size, the simulated values of the isolation index vary substantially for completely segregated areas. In the case of areas divided into ten wards, panel (e), the 5th percentile of the isolation index for completely segregated wards is just over 0.4 while the 95th percentile is close to 0.9, numbers that have dramatically different interpretations in terms of how segregated an area is. Increasing the number of wards to twenty in panel (f) both increases the average value of the isolation index and reduces the variation in the estimates, demonstrating how sensitive traditional measures are to the choice of geographic subunits. While previous analysis of traditional measures has suggested that they perform poorly in small units or when population shares of blacks are extremely low (Carrington & Troske, 1997; Cortese et al., 1976; Winship, 1978), the results in Figure 3 show that traditional segregation measures perform poorly in comparison to our measure even when units are large and population shares are large.

The traditional measures are also dependent on the number of wards in several important ways. Note the periodicity of the dissimilarity index in panels (c) and (g) when varying the percentage of black households. This is the product of how concentrated the black population can be. With ten wards, the black population can be placed in all-black wards when the overall percentage of the population that is black is near a multiple of ten. At these points, the black population will be at its most segregated according to the traditional measures. When the overall percentage is not a multiple of ten, there must be a ward with both black and white households in it, leading to less segregation as measured by the traditional measures. However, there is nothing different about where black individuals live or who their neighbors are, only how their households are fit into wards. Areas that have arbitrary differences in the number of wards may have different segregation measures for reasons unrelated to residential sorting.

It is not only the number of wards that affects the dissimilarity and isolation values, it is also how they are drawn. When gerrymandering the ward boundaries to concentrate the black population in as few wards as possible, the variation in the traditional measures disappears and both isolation and dissimilarity approach one. However, nothing has actually changed in terms of the residential living patterns or the probability of a black household having a white neighbor. The difference in segregation moving from panels (c) and (e) to panels (g) and (h) is purely an artifact of how boundaries are drawn. The underlying residential locations are unchanged. The simulation shows the extreme sensitivity of traditional segregation measures to boundaries.

The simulations demonstrate that our measure reliably identifies segregation and integration in communities, even at very low numbers of black households and in the presence of missing data. Dissimilarity and isolation, with their dependence on how subunit boundaries are drawn and how many subunits are used, produce widely varying estimates of the level of segregation even for our simulated areas with completely segregated or completely integrated black populations. Moreover, the simulations show that the differences between our measure and traditional measures is not due to differences in underlying population sizes, unit size, or the respective sizes of the black and white populations in a given area. Since we allow for the areas to be sampled the differences between our measure and traditional measures are not likely to be due to idiosyncratic differences in enumeration. Indeed, the simulation results show that we can relax the assumption of strict adjacency to nearest neighbor. The simulations demonstrate the distinct advantages of having a measure based on individual household location rather than the racial composition of geographic subunits. By doing away with the need for these geographic subunits and concentrating on the finest level of racial sorting, our neighbor-based measure is not subject to these artificial fluctuations in estimated segregation levels.

5 Empirical Comparison of Segregation Measures

We begin with estimates of the segregation measure using the 100 percent sample of the 1880 US federal census.[24] The next section will examine changes in segregation from 1880 to 1940.[25] The geographic unit of analysis of primary interest is the county though we also produce city-level estimates for comparison to the prior literature on segregation. Counties allow us to analyze the differences in segregation between urban and rural areas, they are well-defined civil jurisdictions and a wealth of additional information is available at the county level which allows us to analyze the correlates of

[24]The 1880 federal census is the first to use professional enumerators and also has the advantage of being the only federal census to have a fully cleaned and coded 100 percent sample available through the Integrated Public Use Microdata Series.

[25]We choose 1940 as the end point since it is the most recent federal census which is publicly available.

segregation using our measure in addition to traditional measures.[26] We assess how our segregation measure compares to traditional measures empirically by calculating our segregation measure, the index of dissimilarity and the index of isolation using the federal census. To our knowledge, this produces the first estimates of dissimilarity and isolation for every county in the United States.

As noted earlier, dissimilarity and isolation are typically only calculated at the city level using wards as the geographic subunit for the calculation. Given our interest in applying our measure to both urban and rural counties, we cannot take this approach. Rural areas do not have such subdivisions. We need a geographic subunit that will be available for both urban and rural areas for comparison. One of the few candidates for such a unit is the census enumeration district. The enumeration district is typically a smaller unit in terms of population than a ward but still contains several hundred households, on average.[27] The typical rural enumeration district in the 1880 census contains 350 households while the typical urban enumeration district contains 450 households.[28] The mean number of enumeration districts in a rural county is 10 while the mean for urban counties is 39. Given that ward-level data is not available for rural counties and that the values of the traditional segregation measures vary with the fineness of the geographical subunit, we calculate the traditional segregation measures using the enumeration district as the subunit for both urban and rural counties in order to make meaningful comparisons across counties. A key advantage of enumeration districts is that they were designed to maintain the boundaries of civil divisions (towns, election districts, wards, precincts, etc.). The use of enumeration districts helps guard against finding differences between the measures that are simply the product of a higher level of aggregation (calculating dissimilarity and isolation over a larger area) as opposed to actual differences in living arrangements by race.[29]

Figure 4 depicts the variation in our segregation measure and the traditional measures for both

[26]Note that the urban-rural designation in the federal census is not done at the county level. Counties can include both individuals living in urban places and living in rural places. We designate a county as urban if more than one quarter of the households from that county live in an urban area and rural if less than one quarter of the households live in an urban area. Our city-level estimates suggest that the patterns we observe for urban counties are indeed being driven by the individuals residing in the urban areas of those counties.

[27]An enumeration district is actually more comparable in size to a census block, the geographical subunit used by Echenique & Fryer (2007), than a ward or census tract.

[28]Enumeration districts averaged roughly 1,500 persons.

[29]Note that on average, since the enumeration districts are smaller units than wards, our estimates of dissimilarity and isolation in urban counties will tend to be higher than those of Cutler et al. (1999) and Troesken (2002).

rural and urban counties across regions.[30] The figure depicts the means and ranges of the measures with the end points of the range being one standard deviation above and below the mean. When calculating the means and standard deviations, counties are weighted by the number of black household heads to provide a more accurate picture of the experience of the typical black household and to minimize the effects of outlier counties with few black households. The figure focuses on only those regions in which over one percent of the population is black.

These figures reveal a substantial amount of heterogeneity in segregation within regions, across regions and between urban and rural areas. However, the data also reveal that the patterns of segregation depend heavily on the chosen measure of segregation. To get a better sense of how the measures relate to one another, correlations between the measures are provided in Table 1. Our measure is positively correlated with the percentage of households who are black and with the index of isolation in urban counties. Surprisingly, our measure is negatively correlated with the index of dissimilarity for both rural and urban counties and with isolation in rural counties. However, after weighting by the number of black households in each county these correlations turn positive.

In general, the correlations in Table 1 show that our measure is weakly correlated with traditional measures of segregation. This is likely due to the fineness of our measure as opposed to the groupings required of traditional measures. For example, Echenique & Fryer propose a spectral index of segregation that is well correlated with the percent black (.90) and isolation (.93), but less well correlated with dissimilarity (.42). Our measure is substantially less well correlated with any of these measures (.43, .55 and .29 for percent black, isolation and dissimilarity respectively) but does share the same general pattern of correlations.[31]

For a more detailed view of how the geographical distribution of segregation varies by measure, maps of the eastern and midwestern United States are given in Figure 5.[32] The most striking feature

[30]To make the sample used for calculating the index of isolation and the index of dissimilarity comparable to the sample used in the calculation of our segregation measure, we drop all household heads for which race is not observed and neighbor's race is not observed. When calculating the index of isolation, we follow the approach of Cutler et al. (1999) and rescale the isolation index by subtracting the percent black for the county and then normalize the statistic by dividing by the maximum theoretical value of this rescaled isolation index for the county, resulting in an index that is normalized to range between zero and one and is independent of the overall size of the black population.

[31]Measures such as the sequence index of segregation, described in Grigoryeva & Ruef (2014) and Agresti (1980) are well correlated with dissimilarity in all regions except the South. Our measure is weakly correlated with dissimilarity and isolation over all regions.

[32]Black households constitute less than one percent of the population in the mountain and pacific regions of the

is that the index of dissimilarity shows the North and, more generally, areas with a low percentage of black residents as more segregated on average while our measure identifies the South as more segregated (but not necessarily the areas of the South with dense populations). That is, the percent black and the index of dissimilarity do not reveal the same spatial pattern of segregation as our neighbor-measure does.

5.1 Segregation in American Cities

One striking feature of our segregation measure is the fact that it yields stark differences in regional segregation patterns. When looking at dissimilarity, the results suggest that urban areas in the North were more segregated than those in the South. This is consistent with the city-level segregation estimates in Cutler et al. (1999). Our segregation measure, however, reveals the opposite pattern. While blacks and whites may have lived in the same wards in southern cities, they were less likely to live in close proximity to one another. This different regional pattern in urban segregation is consistent with the simulation results, where a finer level of detail reveals a segregation pattern that is obscured in traditional measures. Southern urban counties appear to have a substantial amount of within-district racial sorting that is not captured by traditional measures.

This finding is not an artifact of using counties rather than cities; city-level estimates produce the same patterns. Means and standard deviations of our segregation measure and traditional measures at the city level weighted by number of black households are given in Table 2. Southern cities are the most segregated on the basis of next-door neighbors despite Northern cities appearing more segregated on the basis of traditional measures. The set of cities we use for this calculations is larger than the set used by Cutler et al. (1999) because they were limited to cities with populations greater than 25,000. Since we use the complete 100 percent sample of the census, we are able to look at all cities in the United States. Restricting our sample to the cities with populations greater than 25,000 produces the same patterns across regions as those in Table 2. As such, the finding for regional differences in segregation between Southern and Northern cities holds for all cities and for larger cities.

The city estimates reinforce our finding that traditional measures obscure a substantial amount

United States at this time. Consequently, we focus our attention on the East and the Midwest. Maps for the entire country are provided in the appendix and yield the same conclusion.

of within-district segregation that is particularly pronounced in the South. The traditional measures of segregation, with their reliance on geographic boundaries and population shares, paint a portrait of regional differences in segregation that is not consistent with residential location patterns by race. Southern cities were the most segregated. This finding leads to a reinterpretation of the narrative of segregation– regional differences in segregation were not due to black population inflows to Northern cities but rather to an existing segregated pattern in the South. Given the maps for the traditional measures, one could make the argument that *de jure* racial restrictions in the South led to low levels of racial segregation. That is, if blacks were systematically restricted from access to public spaces, schools, and other public accommodations the residential pattern would not need to be segregated. The results show that this was not the case.

Related to this fact is that there is a distinct, discontinuous change in the index of dissimilarity when moving from the South to the North; the southern borders of Pennsylvania, Ohio and Indiana in particular stand out in Figure 5. These patterns are likely due to differences across states in the way enumeration districts are drawn, which occurred at the state level. The index of dissimilarity is particularly sensitive to the way these subunits are defined, which is consistent with the simulation results. Our measure, based on individual-level data, does not depend on these definitions of enumeration districts and shows a much more gradual transition in levels of segregation across space. This highlights the importance of having a measure that is not dependent on the boundaries of geographic subunits. Residential segregation just north of the Mason-Dixon line is quite similar to residential segregation just south of the line. While it would be tempting to conclude from the index of dissimilarity that institutional or cultural differences led to dramatic differences in residential segregation between the North and South, our measure shows that no such discontinuity exists.

5.2 Segregation and Population Shares

Until now, segregation in rural communities could only be approximated by the percent black in a county. In Figure 6, we show that the percent of a county that is black is a relatively poor approximation of the level of segregation in the community. At each level of percent black in a county, shown in panel (a) of Figure 6, there is significant heterogeneity in the neighbor-based measure of segregation. In fact, the relationship is just as heterogeneous at each level of percent black in a county. Given the wide variation in segregation levels by percent black, counties with small and large black population shares could be equally segregated or more/less integrated than the other. We view this as a function of the fineness of our measure, which allows us to distinguish between population shares and the propensity to segregate in an area.

Moving beyond county-level estimates, our segregation measure can be calculated at the enumeration district level. This measure of sub-county segregation is not possible with traditional segregation measures– the enumeration population shares are the input into traditional segregation measures, which cannot be further disaggregated. In panel (b) of Figure 6 we show the segregation measure and the percent black in each enumeration district in the United States. The dispersion in the relationship is even more significant, suggesting that a focus on percent black in rural and urban areas obscures a great deal of heterogeneity, and that this obscurity increases with the fineness of detail. The correlation of the segregation measure and percent black for enumeration districts is only 0.13, even less than the county correlation of 0.43. These relatively weak correlations suggest that sorting within counties and especially enumeration districts is an important dimension of segregation, and one that traditional segregation measures cannot capture.

The results of the comparison show that our new measure of segregation is not redundant, but rather yields new information about spatial sorting by race. The relatively low correlation of our measure of segregation with other indices of segregation and the population share by race shows that knowledge of dissimilarity, isolation, or racial composition would not predict our segregation measure. The simulation results show that our measure does reflect underlying segregation patterns even in the presence of measurement error or missing enumeration. Both of these results imply that our measure captures a dimension of segregation not reflected in traditional segregation indices.

6 Segregation Over Time

The 1940 census offers a fascinating time period to bookend our study of residential segregation. The time period between the two census measures is particularly important. The 1880 census comes after the Civil War and before the nation moved to Jim Crow. For example, at the time of the 1880 census the Civil Rights Act of 1875, which guaranteed equal protection in public accommodation, was still enforced. The 1940 census, however, depicts residential patterns after the rise of Jim Crow, the Great Migration, and the influx of European immigrants. Importantly, the 1940 census comes largely before the rise of significant suburbanization seen in the post-war years. It is this period from the late-nineteenth century to 1940 that Cutler, Glaeser and Vigdor cite as the rise of the American ghetto. Cutler et al. (1999), Collins & Margo (2000) and Troesken (2002) demonstrate that traditional measures of segregation can be applied to historical data for cities. Cutler et al. and Collins & Margo use these measures to consider the changes in urban residential patterns over the twentieth century. These patterns across cities tended to persist over time, with the most segregated cities at the turn of the century also being the most segregated cities at the end of the century.[33] The complete census returns for 1880 and 1940 allow us to see whether our neighbor-based segregation index shows a similar rise in urban segregation and whether a comparable change in segregation occurred in rural areas.

6.1 The National Rise of Residential Segregation

Table 3 shows the variation in our segregation index by census region in both 1880 and 1940.[34] All statistics are weighted by the number of black households in the county so they should be interpreted as representing the level of segregation experienced by the average black household. Counties are divided between rural and urban to distinguish between the segregation patterns described by Cutler, Glaeser and Vigdor specific to cities and more general patterns affecting the rest of the population. For our purposes, we designate a county as urban if more than one quarter of the households from that county live in an urban area and rural if less than one quarter of the households live in an urban

[33] It is this variation in segregation across cities that Troesken (2002) exploits when looking at the health improvements resulting from the provision of water and sewerage service during the Jim Crow era. Cities that were more segregated as measured by the index of isolation saw smaller health improvements for black residents relative to white residents.

[34] Table 3 shows results weighted by black population. The patterns described for the changes over time in our segregation index hold for dissimilarity and isolation as well (results are provided in the appendix). All regions saw a pronounced increase in the levels of segregation as measured by dissimilarity and isolation. The only exceptions are decreases in the index of isolation for the Mountain and Pacific regions. However, these regions had incredibly small numbers of black residents in 1880, making it very difficult to draw any strong inferences related to the segregation statistics in 1880 or the change in those statistics from 1880 to 1940.

area. For 1880, this leads to 88 percent of counties being classified as rural. For 1940, 60 percent of counties are classified as rural.[35]

The table shows several stark time trends. First, segregation varied substantially across regions. Southern regions, in particular the East South Central and West South Central regions, were substantially more segregated than the North or the Midwest. This is true in both 1880 and 1940 and for both rural and urban counties. As described before, the finding that urban areas in the South were more segregated than Northern cities is a new finding and runs counter to the conclusions reached using traditional measures (Cutler et al., 1999). The higher level of segregation in Southern cities persisted over time despite the dramatic increases in segregation in other areas of the country.

The truly striking feature of Table 3 is the difference between the 1880 and 1940 segregation levels, given in columns (5) and (10) for rural and urban counties, respectively. In all regions, there is a substantial increase in segregation in urban areas. These increases are particularly large in those regions that were receiving large inflows of black residents during the Great Migration; the largest changes in segregation are for the urban areas in the East North Central and West North Central regions.[36] However, the table suggests that the story of rising segregation levels is not strictly an urban story. While the first decades of the twentieth century may have seen the rise of the American ghetto, they also witnessed a substantial rise in rural segregation levels as well. All of the regions show substantial increases in segregation comparable in size to one to two standard deviations of the county-level segregation index distribution. Between 1880 and 1940 the United States became more segregated overall— urban and rural, North and South.

It is worth noting that this rise in segregation across all regions is not simply a story of black households becoming concentrated in selected counties. Table 4 shows the variation in percent black by region and over time. Once again, the counties are weighted by the number of black households and correspond to the experience of the average black household, not the average county. Table 4 shows that there were modest increases in the percentage of households with black household heads

[35]Note that the urban-rural distinction in the census data is not defined at the county level. Some residents in a county may be living in an urban area while other residents in the same county may be considered to be living in a rural area.

[36]It is important to note that this rise in segregation precedes the larger outflows of whites from central cities in the postwar era. Boustan (2010) estimates that each black migrant after WWII resulted in more than one white exodus from the central city.

by county in the Northeast and Midwest but there were actually declines in the percentage of black households for the South. These patterns hold for both rural and urban counties and are consistent with mass migration. Despite the North and the South experiencing very different demographic change in terms of the distribution of black households across counties, *all* regions experienced an increase in segregation within counties whether those counties were urban or rural.

6.2 Increasing Segregation in American Cities

Looking at segregation at the city level reinforces the findings that rising segregation is not strictly a northern phenomenon and that segregation in Southern cities was more pronounced than in Northern cities. Table 5 shows the mean level of segregation in 1940 for cities by region. As with the results in Table 2, Northern cities are less segregated than Southern cities. The level of segregation in cities in all regions, however, is much higher in 1940 than in 1880.

Figure 7 plots the neighbor-based segregation index for 1940 against the index for 1880 for cities in the Northeast, South and Midwest. Consistent with the county-level results, nearly every city across all regions lies above the 45 degree line, with higher levels of segregation in 1940 than in 1880. However, the striking feature of the graph is that the Southern cities exhibited the highest levels of segregation in both 1880 and 1940 and Midwestern cities that experienced the largest increases in segregation. While there is a wide range of segregation levels for Northeastern cities, the rise in neighbor-based segregation for these cities is less pronounced than the rise for the Midwest and the South. This regional variation in Figure 7 coupled with the changes in segregation over time for rural counties in Table 3 suggest that the rise of the American ghetto described by Cutler, Glaeser and Vigdor is one piece of a much larger and more complex story of increasing residential segregation in the United States over the first half of the twentieth century.

6.3 The Persistence of Segregation

A simple time series regression of the change in segregation over time reveals the strong persistence of segregation. We show a series of time series regressions in Table 6. The baseline regression of 1940 segregation on 1880 segregation yields

$$
\begin{aligned}
\eta_{1940} &= 0.242 + 0.800\eta_{1880} + \epsilon \\
& (0.009)^{***}\ (0.030)^{***}\ R^2 = 0.27
\end{aligned}
$$

Given that the average level of segregation measured in 1880 was 0.215, the intercept suggest that county-level segregation essentially doubled from 1880 to 1940.[37] Regional controls do not alter the substantive implications. Even when adding changes in the percent black, regional controls and urban population to the regression above, the point estimates for segregation remains the same (0.555 (0.035 s.e.)), which is consistent with the results in Table 3. In short, time series results in Table 6 suggest a doubling of neighbor-based segregation from 1880 to 1940. Even more, the increase in segregation over time was not restricted to urban areas but was rather a national phenomena.[38]

While the level change in segregation is noteworthy, it is important to establish that the increase in segregation is not simply a mechanical function of population growth or driven by outliers where either the population or racial composition changed dramatically. For example, the measure could increase (decrease) as more counties gained (lost) black residents with the Great Migration. This is best seen graphically, as regression analysis can obscure the influence of outliers. We address these concerns in Figure 8 and Figure 9. In Figure 8 we show that the change in segregation was quite general. The level changes in neighbor-based segregation are not concentrated in a small number of counties nor one region of the country. Consistent with the results of Table 6, the vast majority of counties in every region saw substantial increases in segregation.

In Figure 9 we show the distribution of the change in the neighbor-based segregation measure against other measures of population change. In panel (a) of Figure 9 we show that the change in the segregation measure is not driven mechanically by increases in the number of black households. When we plot the change in the segregation measure by the change in the log of the number of black households the relationship shows a muted upward trend but there are still substantial increases in segregation in counties that experienced significant declines in the black population as well. This is consistent with segregation being driven by sorting as opposed to population flows. In panel (b) of

[37] This regression is unweighted by black population shares. Although there is strong persistence, tests of a unit root in the segregation measure were rejected at all conventional levels. A basic Dickey Fuller test of the change in the segregation measure on the 1880 segregation measure yields a slope coefficient of -0.199 (0.030 s.e.).

[38] This is not to suggest that regional and urban/rural controls have no impact, but the persistence of segregation itself is not driven by these controls.

Figure 9 we plot the change in the segregation measure against the log of the number of households in 1880. The figure shows that the change in segregation was observed for both large and small counties. In panel (c) we plot the change against the percent black in 1880, and the figure shows that counties with small and large proportions of black households experienced similar changes in segregation. In panel (d) we plot the change in segregation against the change in the percent of black from 1880-1940. The figure shows that the result is not driven by counties where African American population share grew or declined substantially.[39]

Our analysis also allows us to investigate changes in segregation using traditional measures. While our neighbor-based measure of segregation shows that both rural and urban segregation increased by roughly the same amount (62 percent for rural areas and 68 percent for urban areas), dissimilarity and isolation measures imply that the change in segregation was concentrated in urban areas. Using dissimilarity, rural segregation increased 48 percent while urban segregation increased by 86 percent. Using isolation, rural segregation increased 112 percent while urban segregation increased by more than 300 percent. Using either the dissimilarity or isolation results, one would be left with the false inference that segregation increased much faster in urban communities than rural communities. As shown in Figure 9, the increase in neighbor-based segregation was not driven by urbanization. The comparison of the measures reveals that segregation increased broadly. While urban areas became more segregated, rural residents sorted by race as well in a way that is not easily captured in existing segregation measures.[40]

6.4 The Likelihood of Opposite-Race Neighbors Over Time

An important advantage of our segregation measure is that it allows us to directly investigate the likelihood of opposite-race interaction and its change over time: the probability of an African American household having an opposite-race neighbor is a component of our segregation measure, a novel

[39]The results in Figure 9 are for all counties, but the results hold when looking at Northern and Southern counties separately.

[40]The time series of the traditional segregation measures are also consistent with these results in that they show much less persistence of the traditional segregation measures over time and suggest that segregation increased faster in urban areas than rural areas. See the appendix for those results.

advance in the measurement of segregation and interracial social interactions.[41] Overall, in the median county in 1880 a black household had roughly a 50% chance of having a white neighbor. By 1940, however, this likelihood declined by more than 15 percentage points, a decrease of more than 25% in the likelihood of an opposite-race neighbor. Using only areas where blacks were greater than 1% of the population in 1880 results in more than a 25 percentage point decline in the likelihood, a decrease of more than 35%.[42] In Table 7 we present a series of regressions where the dependent variable is the change in the likelihood of opposite-race neighbors for black households. The first set of results shows that the change in the likelihood of opposite-race neighbors declined both in regions that received black migratory flows from 1880 to 1940 and those that experienced declines. The East North Central, Mid Atlantic, South Atlantic and East South Central saw significant declines in opposite-race neighbors relative to the omitted region of New England. However, given the large and negative constant, New England also experienced significant declines in opposite-race neighbors. These regional declines hold when changes in the percent black, being in an urban county, urban population, and the number of enumeration districts are added to the specification.

This significant change in the degree of opposite-race neighbors holds across regions that saw relative declines and increases in the black population, across urban and rural areas, and across large and small populations. These findings add a new dimension to the changing residential patterns of the late nineteenth and early twentieth centuries. At a minimum, the results suggest that increasing racial isolation was not driven by urbanization or the Great Migration, but was rather a national phenomena. This is evidence that racial sorting in the population was a national trend in the twentieth century.

Overall, the results show that segregation was both persistent and increasing from the late nineteenth to early twentieth centuries. The result was not restricted to urban counties nor was the increase only seen in counties that changed significantly in the proportion black. These results are consistent with a general, national increase in racial segregation in the United States. Even more, we show that the result of changing segregation led to substantial declines in the likelihood of opposite-race interaction. The decline was national and did not concentrate in particular regions of the country.

[41] The probability of opposite-race neighbors is simply the number of black households with opposite-race neighbors, x_b, divided by the total number of black households, b_{all}.

[42] The result also holds when using larger cutoffs for the percentage of the black population in 1880. In general, the increase in racial isolation is not driven by black migration to areas where the black population was small in 1880.

As with the the change in segregation, the decline in opposite-race neighbors was nationwide. Our results show that racial residential sorting increased dramatically in the United States from 1880 to 1940.

7 Conclusion

In this paper we have derived a new measure of segregation from the complete federal census manuscripts using the simple criteria of the race of an individual's next-door neighbors. Our measure gives a direct assessment of the likelihood of interracial interaction in residential communities. If neighbors are less likely to be of a different race than random assignment would predict then that location is more segregated than another that is closer to random assignment. We have demonstrated that this measure has distinct advantages over the most commonly used measures of segregation in the literature and captures dimensions of segregation missed by traditional measures both in simulations and when applied to census data. Our neighbor-based measure reveals substantial heterogeneity in segregation across regions, within regions and between rural and urban areas that could not be captured with existing measures focused on sorting across political units.

When using our new measure to assess change in segregation over time, we find that the United States became a more segregated society from 1880 to 1940 and that this increase in segregation was far more general than previously thought. Our findings show that the likelihood of opposite-race neighbors declined precipitously in every region of the United States. The substantial rise in segregation occurred in areas with small black population shares, areas with large black population shares, areas that experienced net inflows of black residents, areas that experienced net outflows of black residents, urban areas with large populations and rural areas with smaller populations. The traditional story of increasing segregation in urban areas in response to black migration to urban centers must be augmented with a discussion of the increasing racial segregation of rural areas and other areas that lost black residents.

Our findings complicate traditional explanations for increasing segregation as being due to blacks clustering in small areas abutting white communities (Kellogg, 1977), the use of restrictive covenants

(Gotham, 2000), the presence of large manufacturing firms which employed blacks, or differences in transportation infrastructure, as these were all urban phenomena. The increase in rural segregation also complicates historical narratives which view population dynamics in rural areas as stagnant. The focus on urban segregation has neglected the fact that rural areas were segregated and, as we have discovered, became increasingly segregated over time. While there are studies which seek to look at the causal effect of black social networks in rural areas on outcomes (Chay & Munshi, 2013), they use county proportions which we show are relatively poorly correlated with residential segregation. Overall, the national trend in increasing segregation in the twentieth century adds a new chapter to American history.

Our finding that segregation and its rise over the first half of the twentieth century was a truly national phenomenon occurring in both the cities people were moving to and the rural areas they left also opens new, important lines of inquiry. Understanding the relationship between segregation and urbanization and population flows will help us understand the dynamics of segregation in cities and rural communities in the twentieth century. These links have important implications for the skill mix of cities, public finance, education, inequality, health and other measures of social well-being. The strong persistence of our segregation measure suggests that the roots of contemporary segregation may be more varied that previously thought. Both rural and urban areas had different levels of segregation that were highly persistent over time. This finding also poses a range of questions about the impact of Jim Crow, racial violence, European immigration, internal migration and the differences and similarities between racial segregation in rural and urban areas in the United States. The scope of segregation research is now broader with this neighbor-based measure.

While this paper estimates segregation patterns from the post-bellum era to 1940, the importance of the results is not limited to historical analysis. Our measure can be applied to more modern data to examine nuanced aspects of modern residential segregation that traditional measures fail to capture. This will offer a better understanding of the modern impacts of segregation on schooling and labor market outcomes (Kain, 1968; Cutler et al., 1999; Cutler & Glaeser, 1997; Collins & Margo, 2000), health outcomes (Almond et al., 2006; Chay et al., 2009), and the neighborhood effects and social networks that influence a range of socioeconomic outcomes (Case & Katz, 1991; Brooks-Gunn et al., 1993; Borjas, 1995; Cutler et al., 2008; Ananat, 2011; Ananat & Washington, 2009; Echenique & Fryer, 2007; Sethi & Somanathan, 2004; Ramcharan, 2010). Furthermore, given the persistence we find in segregation levels, the historical estimates themselves offer important insight into modern segregation levels and their correlates. A comprehensive assessment of the evolution of residential segregation will give us the tools to outline its full impact in the past and, most important, the roots of segregation's effect on contemporary racial disparities.

References

Agresti, B. (1980). Measuring Residential Segregation in Nineteenth Century American Cities. *Sociological Methods and Research*, *8*(4), 389–399.

Almond, D., Chay, K., & Greenstone, M. (2006). Civil Rights, the War on Poverty, and Black-White Convergence in Infant Mortality in the Rural South and Mississippi. *MIT Department of Economics working paper*.

Ananat, E. O. (2011). The Wrong side(s) of the Tracks: The Causal Effects of Racial Segregation on Urban Poverty and Inequality. *American Economic Journal: Applied Economics*, *3*(2), 34–66.

Ananat, E. O., & Washington, E. (2009). Segregation and Black Political Efficacy. *Journal of Public Economics*, *93*(5), 807–822.

Bayer, P., Fang, H., & McMillan, R. (2005). Separate When Equal? Racial Inequality and Residential Segregation. Tech. rep., National Bureau of Economic Research.

Bayer, P., Ferreira, F., & McMillan, R. (2007). A Unified Framework for Measuring Preferences for Schools and Neighborhoods. *Journal of Political Economy*, *115*(4), 588–638.

Bobo, L., & Zubrinsky, C. L. (1996). Attitudes on Residential Integration: Perceived Status Differences, Mere In-group Preference, or Racial Prejudice? *Social Forces*, *74*(3), 883–909.

Borjas, G. J. (1995). Ethnicity, Neighborhoods, and Human-Capital Externalities. *The American Economic Review*, *85*(3), 365–390.

Boustan, L. P. (2010). Was Postwar suburbanization White Flight? Evidence from the Black Migration. *The Quarterly Journal of Economics*, *125*(1), 417–443.

Brooks-Gunn, J., Duncan, G. J., Klebanov, P. K., & Sealand, N. (1993). Do Neighborhoods Influence Child and Adolescent Development? *American journal of sociology*, (pp. 353–395).

Card, D., Mas, A., & Rothstein, J. (2008). Tipping and the Dynamics of Segregation. *The Quarterly Journal of Economics*, *123*(1), 177–218.

Carrington, W., & Troske, K. (1997). On Measuring Segregation in Samples with Small Units. *Journal of Business and Economic Statistics*, *15*(4), 402–409.

Case, A. C., & Katz, L. F. (1991). The Company You Keep: The Effects of Family and Neighborhood on Disadvantaged Youths. *NBER Working Papers*.

Chay, K., & Munshi, K. (2013). Black Networks After Emancipation. Tech. rep., Brown University.

Chay, K. Y., Guryan, J., & Mazumder, B. (2009). Birth Cohort and the Black-White Achievement Gap: The Roles of Access and Health Soon After Birth. Tech. rep., National Bureau of Economic Research.

Clark, W. A. (1991). Residential Preferences and Neighborhood Racial Segregation: A Test of the

Schelling Segregation Model. *Demography*, *28*(1), 1–19.

Coale, A., & Rives, N. (1973). A Statistical Reconstruction of the Black Population of the United States, 1880-1970: Estimates of True Numbers by Age and Sex, Birth Rates, and Total Fertility. *Population Index*, *39*(1), 3–36.

Collins, W. J., & Margo, R. A. (2000). Residential Segregation and Socioeconomic Outcomes: When did Ghettos Go Bad? *Economics Letters*, *69*(2), 239–243.

Cortese, C., Falk, R., & Cohen, J. (1976). Further Considerations on the Methodological Analysis of Segregation Indices. *American Sociological Review*, *41*(4), 630–637.

Cutler, D. M., & Glaeser, E. L. (1997). Are Ghettos Good or Bad? *Quarterly Journal of Economics*, *112*(3), 827–872.

Cutler, D. M., Glaeser, E. L., & Vigdor, J. L. (1999). The Rise and Decline of the American Ghetto. *Journal of Political Economy*, *107*(3), 455–506.

Cutler, D. M., Glaeser, E. L., & Vigdor, J. L. (2008). When are Ghettos Bad? Lessons from Immigrant Segregation in the United States. *Journal of Urban Economics*, *63*(3), 759–774.

Eblen, J. (1974). New Estimates of Vital Rates of United States Black Population During the Nineteenth Century. *Demography*, *11*(2), 301–319.

Echenique, F., & Fryer, R. G. (2007). A measure of segregation based on social interactions. *The Quarterly Journal of Economics*, *122*(2), 441–485.

Farley, R., Fielding, E. L., & Krysan, M. (1997). The Residential Preferences of Blacks and Whites: A Four-Metropolis Analysis. *Housing Policy Debate*, *8*(4), 763–800.

Gotham, K. F. (2000). Urban Space, Restrictive Covenants and the Origins of Racial Residential Segregation in a US City, 1900-1950. *International Journal of Urban and Regional Research*, *24*(3), 616–633.

Grigoryeva, A., & Ruef, M. (2014). The Historical Demography of Racial Segregation. Tech. rep., Princeton University and Duke University.

Kain, J. F. (1968). Housing Segregation, Negro Employment, and Metropolitan Decentralization. *The Quarterly Journal of Economics*, *82*(2), 175–197.

Kellogg, J. (1977). Negro Urban Clusters in the Postbellum South. *Geographical Review*, *67*(2), 310–321.

Kling, J. R., Liebman, J. B., & Katz, L. F. (2007). Experimental Analysis of Neighborhood Effects. *Econometrica*, *75*(1), 83–119.

Lee, B. A., Reardon, S. F., Firebaugh, G., Farrell, C. R., Matthews, S. A., & O'Sullivan, D. (2008). Beyond the Census Tract: Patterns and Determinants of Racial Segregation at Multiple Geographic Scales. *American Sociological Review*, *73*(4), 761–791.

Lichter, D. T., Parisi, D., Grice, S. M., & Taquino, M. C. (2007). National Estimates of Racial Segregation in Rural and Small-Town America. *Demography*, *44*(3), 563–581.

Litwack, L. F. (1998). *Trouble in Mind: Black Southerners in the Age of Jim Crow*. Alfred K Knopf.

Magnuson, D. L., & King, M. L. (1995). Comparability of the Public Use Microdata Samples: Enumeration Procedures. *Historical Methods: A Journal of Quantitative and Interdisciplinary History*, *28*(1), 27–32.

Massey, D. S., & Denton, N. A. (1988). The Dimensions of Residential Segregation. *Social forces*, *67*(2), 281–315.

Parman, J. M. (2012). Good Schools Make Good Neighbors: Human Capital Spillovers in Early 20th Century Agriculture. *Explorations in Economic History*, *49*(3), 316–334.

Preston, S., Elo, I., Foster, A., & Fu, H. (1998). Reconstructing the Size of the African American Population by Age and Sex, 1930-1990. *Demography*, *35*(1), 1–21.

Rabinowitz, H. N. (1996). *Race Relations in the Urban South, 1865-1890*. University of Georgia Press Athens, GA.

Ramcharan, R. (2010). Inequality and Redistribution: Evidence from U.S. Counties and States, 1890-1930. *Review of Economics and Statistics*, *92*(4), 729–744.

Ransom, R. L., & Sutch, R. (2001). *One Kind of Freedom: The Economic Consequences of Emancipation*. Cambridge University Press.

Reardon, S. F., Matthews, S. A., OSullivan, D., Lee, B. A., Firebaugh, G., Farrell, C. R., & Bischoff, K. (2008). The Geographic Scale of Metropolitan Racial Segregation. *Demography*, *45*(3), 489–514.

Reardon, S. F., & Sullivan, D. (2004). Measures of Spatial Segregation. *Sociological Methodology*, *34*(1), 121–162.

Rhode, P. W., & Strumpf, K. S. (2003). Assessing the Importance of Tiebout Sorting: Local Heterogeneity from 1850 to 1900. *American Economic Review*, *93*(4), 1648–1677.

Ruggles, S., Sobek, M., Alexander, T., Fitch, C., Goeken, R., Hall, P., King, M., & Ronnander, C. (2009). Integrated Public Use Microdata Series Sample of the 1880 Federal Census. Accessed throgh usa.ipums.org/usa/.

Schelling, T. C. (1969). Models of Segregation. *American Economic Review*, *59*(2), 488–493.

Schelling, T. C. (1971). Dynamic Models of Segregation. *Journal of Mathematical Sociology*, *1*(2), 143–186.

Sethi, R., & Somanathan, R. (2004). Inequality and Segregation. *Journal of Political Economy*, *112*(6), 1296–1321.

Troesken, W. (2002). The Limits of Jim Crow: Race and the Provision of Water and Sewerage Services in American Cities, 1880-1925. *The Journal of Economic History*, *62*(3), 734–772.

Winship, C. (1978). The Desirability of Using the Index of Dissimilarity or Any Adjustment of it for Measuring Segregation. *Social Forces*, *57*(2), 717–720.

Zubrinsky, C. L., & Bobo, L. (1996). Prismatic Metropolis: Race and Residential Segregation in the City of the Angels. *Social Science Research*, *25*(4), 335–374.

Table 1: Correlations in segregation measures for rural and urban counties, 1880.

Rural counties									
	Unweighted					Weighted by number of black households			
	Neighbor-based segregation	Percent black	Dissimilarity	Isolation		Neighbor-based segregation	Percent black	Dissimilarity	Isolation
Neighbor-based segregation	1				Neighbor-based segregation	1			
Percent black	0.61	1			Percent black	0.43	1		
Dissimilarity	-0.36	-0.5199	1		Dissimilarity	0.29	-0.21	1	
Isolation	-0.02	-0.16	0.53	1	Isolation	0.55	0.08	0.76	1
Urban counties									
	Unweighted					Weighted by number of black households			
	Neighbor-based segregation	Percent black	Dissimilarity	Isolation		Neighbor-based segregation	Percent black	Dissimilarity	Isolation
Neighbor-based segregation	1				Neighbor-based segregation	1			
Percent black	0.68	1			Percent black	0.28	1		
Dissimilarity	-0.44	-0.5503	1		Dissimilarity	0.14	-0.53	1	
Isolation	0.50	0.35	0.18	1	Isolation	0.69	0.06	0.50	1

Source: Authors' own calculations based on the IPUMS 100 percent sample of the 1880 federal census.

Table 2: City-level segregation by region weighted by number of black households, 1880.

Region	Number of cities	Neighbor-based segregation index		Dissimilarity index		Isolation index	
		Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
New England	60	0.384	0.140	0.529	0.140	0.111	0.064
Middle Atlantic	49	0.464	0.142	0.623	0.126	0.151	0.085
East North Central	51	0.302	0.114	0.460	0.172	0.086	0.048
West North Central	19	0.418	0.127	0.368	0.145	0.083	0.044
South Atlantic	18	0.566	0.104	0.307	0.118	0.122	0.063
East South Central	10	0.482	0.051	0.253	0.114	0.093	0.048
West South Central	6	0.359	0.043	0.283	0.062	0.099	0.033

Source: Authors' own calculations based on the IPUMS 100 percent sample of the 1880 federal census. Dissimilarity and isolation are calculated using enumeration district as the geographic subunit.

Table 3: Changes in the county-level segregation index from 1880 to 1940 by region, counties weighted by number of black households.

	Rural counties					Urban counties				
	Mean, 1880	Standard deviation, 1880	Mean, 1940	Standard deviation, 1940	1940 - 1880, (3)-(1)	Mean, 1880	Standard deviation, 1880	Mean, 1940	Standard deviation, 1940	1940 - 1880, (8)-(6)
Region	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
New England	0.12	0.10	0.33	0.17	0.21	0.33	0.12	0.56	0.18	0.22
Middle Atlantic	0.23	0.13	0.39	0.11	0.16	0.40	0.17	0.75	0.15	0.35
East North Central	0.23	0.13	0.43	0.23	0.20	0.28	0.12	0.80	0.17	0.51
West North Central	0.25	0.10	0.43	0.13	0.18	0.37	0.14	0.73	0.20	0.36
South Atlantic	0.30	0.10	0.54	0.16	0.24	0.51	0.11	0.74	0.13	0.23
East South Central	0.37	0.09	0.57	0.09	0.20	0.44	0.05	0.78	0.10	0.34
West South Central	0.44	0.09	0.61	0.09	0.18	0.39	0.08	0.71	0.12	0.33
Mountain	0.28	0.29	0.40	0.31	0.12	0.26	0.15	0.53	0.18	0.27
Pacific	0.07	0.12	0.40	0.31	0.33	0.06	0.05	0.59	0.19	0.53
Entire country	0.35	0.11	0.57	0.13	0.22	0.44	0.13	0.75	0.15	0.30

Notes: All means and standard deviations are weighted by the number of black households in the county. The urban-rural distinction is based on the year the statistic corresponds to, so some of the counties in the 1880 rural calculations appear in the 1940 urban calculations.

Table 4: Changes in county-level percent black from 1880 to 1940 by region, counties weighted by number of black households.

	Rural counties					Urban counties				
Region	Mean, 1880 (1)	Standard deviation, 1880 (2)	Mean, 1940 (3)	Standard deviation, 1940 (4)	1940 - 1880, (3)-(1) (5)	Mean, 1880 (6)	Standard deviation, 1880 (7)	Mean, 1940 (8)	Standard deviation, 1940 (9)	1940 - 1880, (8)-(6) (10)
New England	0.01	0.01	0.03	0.02	0.02	0.02	0.01	0.02	0.01	0.00
Middle Atlantic	0.04	0.03	0.04	0.02	0.00	0.03	0.02	0.09	0.05	0.06
East North Central	0.05	0.07	0.13	0.15	0.08	0.06	0.07	0.07	0.04	0.01
West North Central	0.10	0.07	0.11	0.09	0.02	0.10	0.06	0.18	0.19	0.07
South Atlantic	0.52	0.18	0.38	0.18	-0.14	0.50	0.18	0.34	0.13	-0.17
East South Central	0.53	0.24	0.50	0.24	-0.03	0.53	0.20	0.39	0.18	-0.14
West South Central	0.54	0.21	0.41	0.18	-0.13	0.35	0.15	0.28	0.14	-0.07
Mountain	0.07	0.09	0.03	0.03	-0.03	0.04	0.03	0.10	0.06	0.05
Pacific	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.03	0.05	0.02
Entire country	0.51	0.23	0.42	0.21	-0.08	0.37	0.25	0.23	0.18	-0.14

Notes: All means and standard deviations are weighted by the number of black households in the county. The urban-rural distinction is based on the year the statistic corresponds to, so some of the counties in the 1880 rural calculations appear in the 1940 urban calculations.

Table 5: City-level segregation by region weighted by number of black households, 1940.

Region	Number of cities	Neighbor-based segregation index: Mean	Neighbor-based segregation index: Standard deviation	Dissimilarity index: Mean	Dissimilarity index: Standard deviation	Isolation index: Mean	Isolation index: Standard deviation
New England	54	0.607	0.187	0.789	0.095	0.349	0.198
Middle Atlantic	44	0.794	0.087	0.852	0.064	0.616	0.142
East North Central	47	0.845	0.128	0.893	0.084	0.714	0.199
West North Central	19	0.809	0.150	0.847	0.101	0.641	0.211
South Atlantic	16	0.904	0.042	0.772	0.111	0.641	0.136
East South Central	10	0.872	0.033	0.720	0.102	0.574	0.121
West South Central	6	0.801	0.062	0.698	0.062	0.542	0.104

Source: Authors' own calculations based on the 100 percent sample of the 1940 federal census.
Dissimilarity and isolation are calculated using enumeration district as the geographic subunit.

Table 6: The time series of segregation, 1880-1940, segregation in 1940 as dependent variable.

Segregation in 1880	0.800***	0.561***	0.590***	0.566***	0.545***
	(0.0305)	(0.0340)	(0.0348)	(0.0346)	(0.0349)
Change in Percent Black, 1880-1940			0.219***	0.241***	0.215***
			(0.0609)	(0.0602)	(0.0603)
Urban County in 1880				0.113***	0.0934***
				(0.0164)	(0.0170)
Urban Population					4.52e-05***
					(1.15e-05)
Constant	0.242***	0.153***	0.149***	0.132***	0.134***
	(0.00864)	(0.0271)	(0.0270)	(0.0268)	(0.0267)
Census Region Fixed Effects		X	X	X	X
Observations	1,876	1,876	1,876	1,876	1,876
R-squared	0.269	0.348	0.352	0.368	0.373

OLS estimates with standard errors given in parentheses. The unit of observation is a county.
Counties are defined as urban if greater than 25% of the county population lives in an urban area.
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Changes in the likelihood of opposite-race neighbors for black households, 1880-1940, change in probability of having an opposite-race neighbor as dependent variable.

Middle Atlantic	-0.0732**	-0.0711**	-0.0653**	-0.0628**	-0.0679**
	(0.0318)	(0.0300)	(0.0297)	(0.0297)	(0.0297)
East North Central	-0.0788***	-0.0801***	-0.0789***	-0.0796***	-0.104***
	(0.0293)	(0.0276)	(0.0274)	(0.0274)	(0.0283)
West North Central	-0.0242	-0.0267	-0.0316	-0.0323	-0.0619**
	(0.0298)	(0.0281)	(0.0279)	(0.0279)	(0.0291)
South Atlantic	-0.0787***	-0.146***	-0.160***	-0.160***	-0.198***
	(0.0284)	(0.0271)	(0.0270)	(0.0270)	(0.0291)
East South Central	-0.0980***	-0.148***	-0.163***	-0.163***	-0.198***
	(0.0289)	(0.0275)	(0.0274)	(0.0274)	(0.0292)
West South Central	-0.0569*	-0.114***	-0.129***	-0.129***	-0.169***
	(0.0295)	(0.0281)	(0.0280)	(0.0279)	(0.0302)
Mountain	0.0375	0.0351	0.0208	0.0205	-0.0194
	(0.0400)	(0.0378)	(0.0375)	(0.0375)	(0.0392)
Pacific	-0.0575	-0.0583*	-0.0609*	-0.0613*	-0.0954***
	(0.0372)	(0.0351)	(0.0348)	(0.0348)	(0.0361)
Change in Percent Black, 1880-1940		-0.852***	-0.877***	-0.870***	-0.885***
		(0.0561)	(0.0557)	(0.0559)	(0.0559)
Urban County in 1880			-0.0924***	-0.0842***	-0.0880***
			(0.0155)	(0.0162)	(0.0162)
Urban Population				-1.81e-05*	6.09e-05**
				(1.08e-05)	(2.57e-05)
Number of Enumeration Districts					-0.00138***
					(0.000407)
Constant	-0.0992***	-0.1003***	-0.0841***	-0.0839***	-0.0372
	(0.0267)	(0.0252)	(0.0252)	(0.0251)	(0.0286)
Observations	1,876	1,876	1,876	1,876	1,876
R-squared	0.021	0.129	0.145	0.146	0.152

OLS regression results with standard errors given in parentheses. The unit of observation is a county. The omitted region is New England. Counties are defined as urban if greater than 25% of the county population lives in an urban area. *** p<0.01, ** p<0.05, * p<0.1

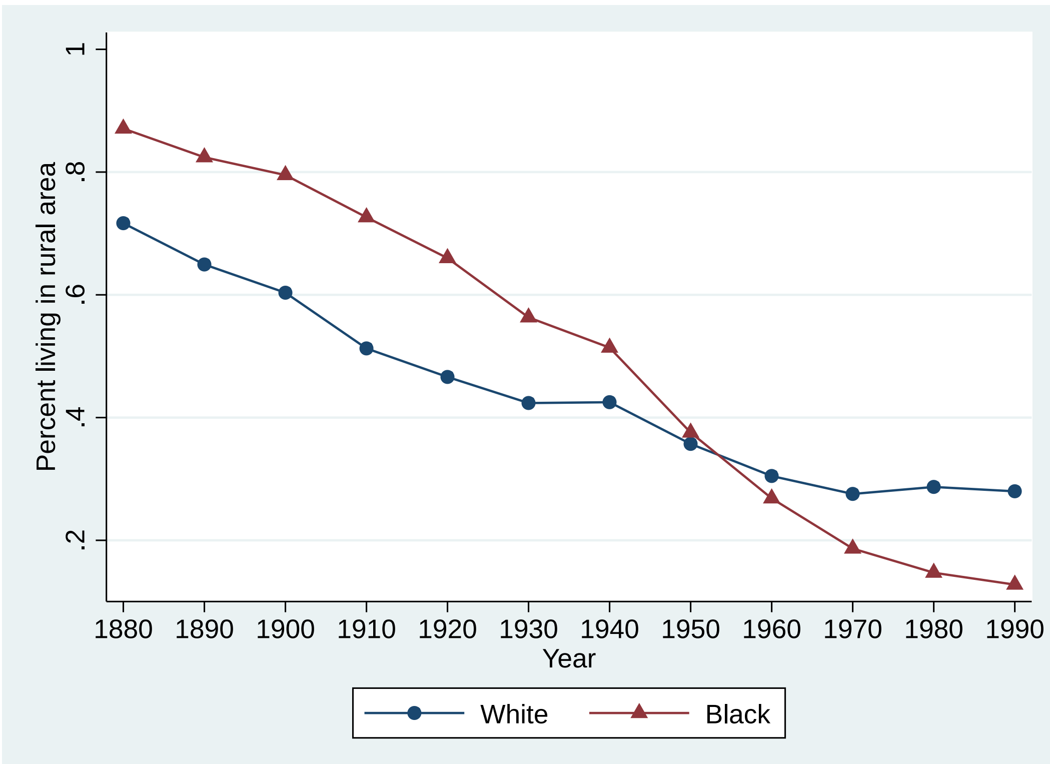

Figure 1: Percentage of population living in rural areas, 1880-1990. Source: Historical Statistics of the United States, Table Aa716-775.

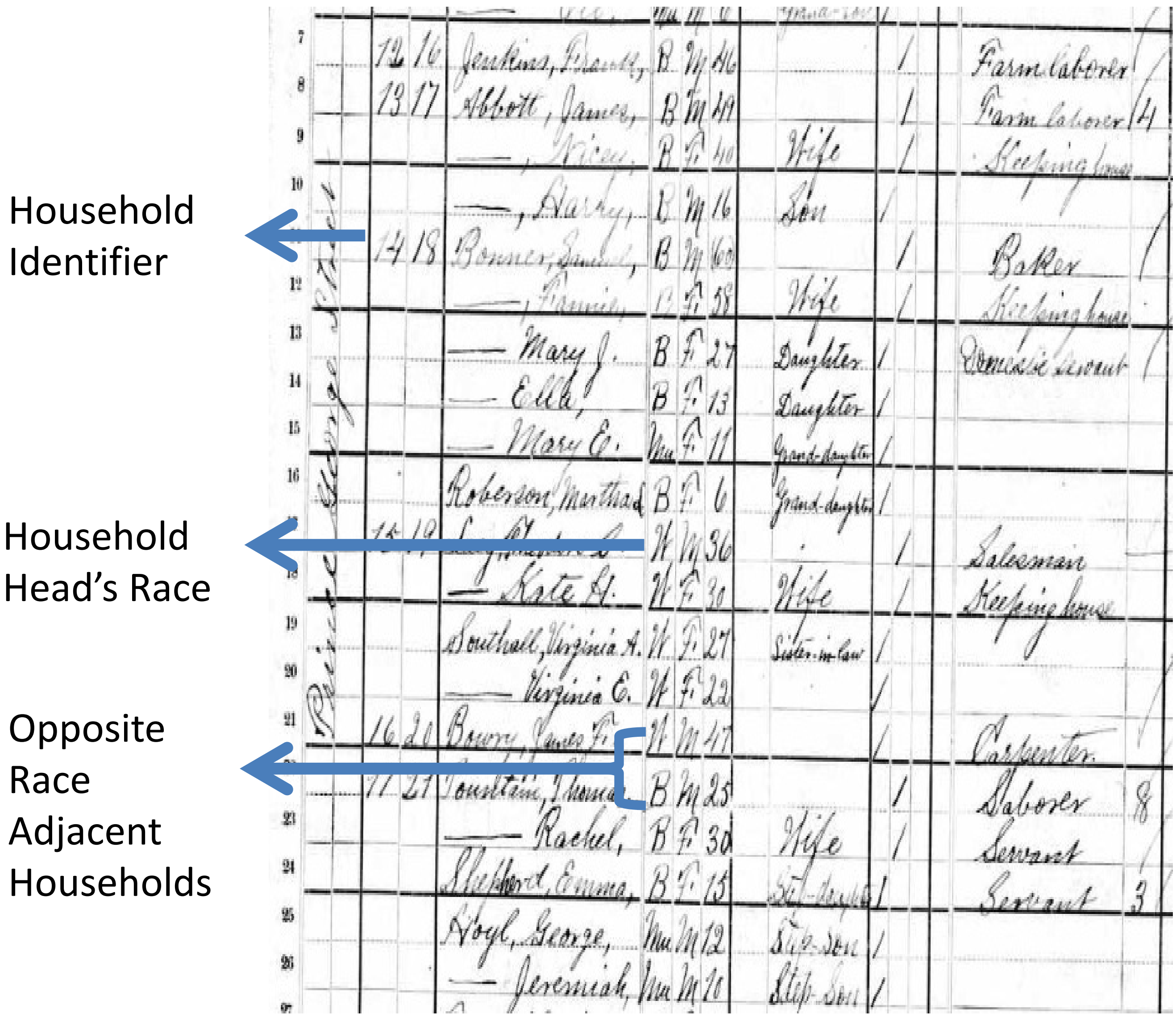

Figure 2: Manuscript census page, 1880 federal census.

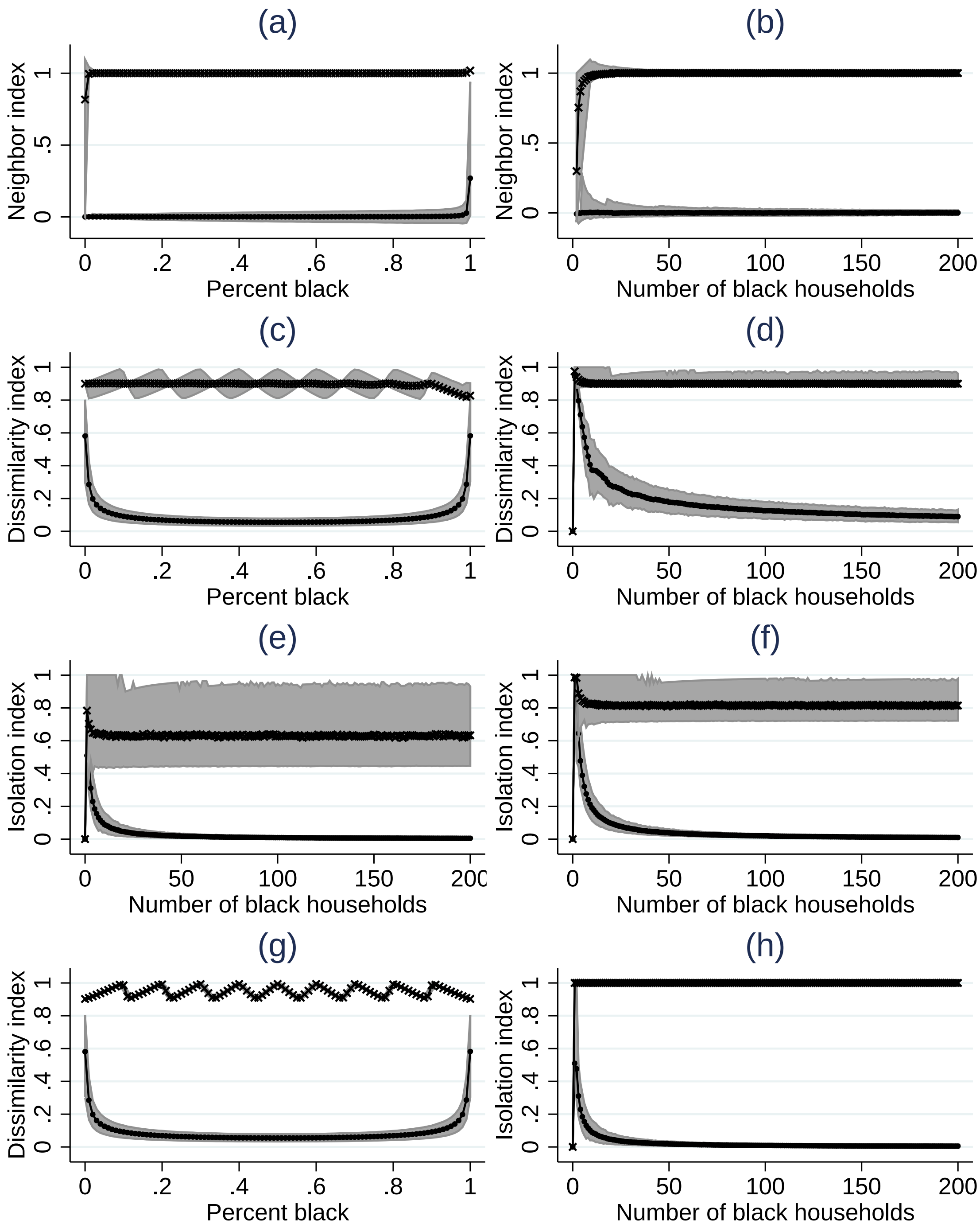

Figure 3: Simulated values of segregation indices by county size and county racial composition under complete segregation (upper curve marked with X's) and complete integration (lower curve marked with circles). Points give the mean value while the shaded regions give the range between the 5th and 95th percentiles of the value. Dissimilarity and isolation are calculated using ten wards in all panels except (f) which uses twenty wards. Wards are gerrymandered to concentrate the black population in as few wards as possible in panels (g) and (h). Panels with percent black on the horizontal axis use county population sizes of 2020 households. Panels with number of black households on the horizontal axis have the percent black for the county fixed at ten percent.

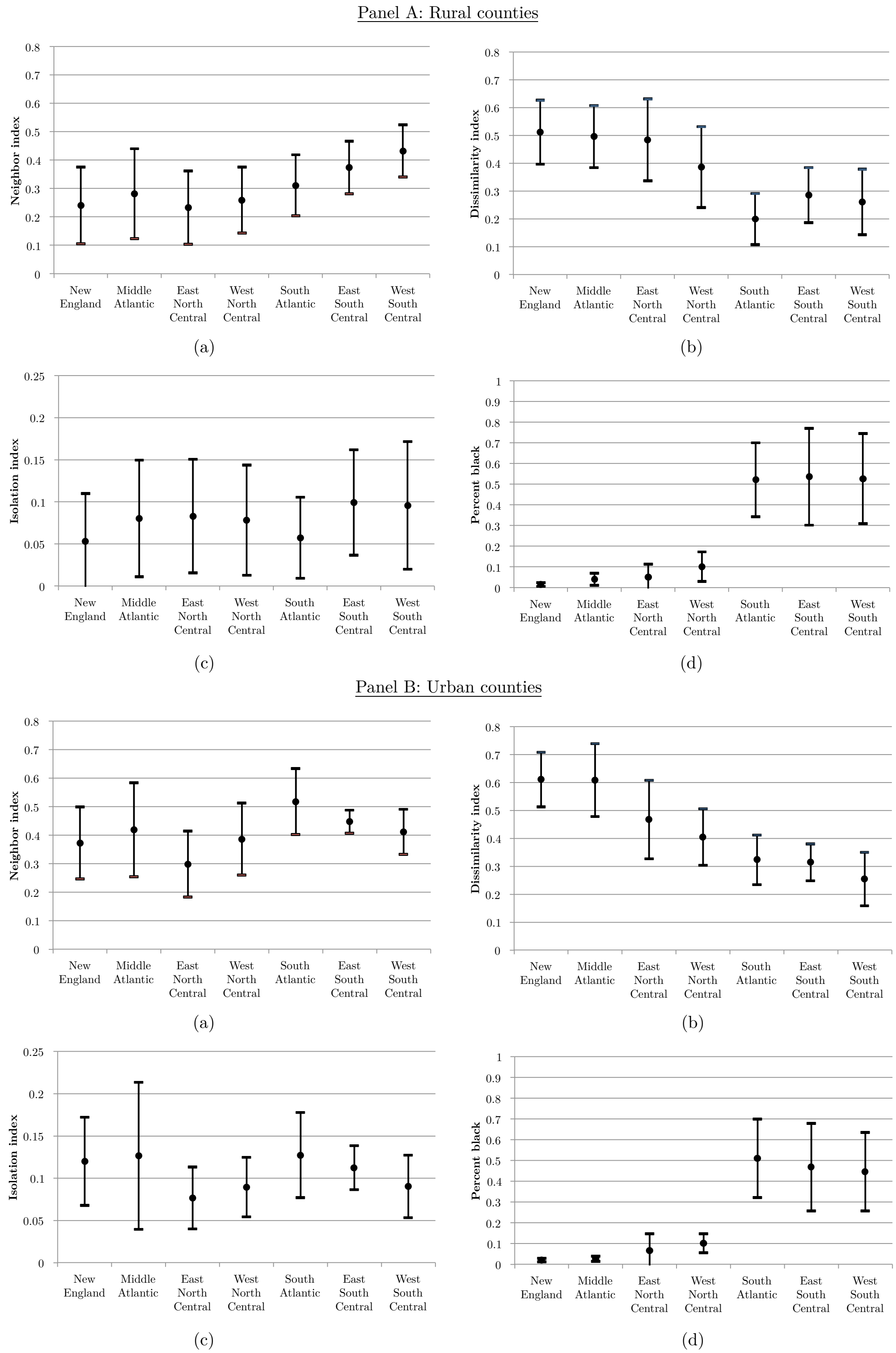

Figure 4: Black household-weighted measures of segregation for rural counties (Panel A) and urban counties (Panel B) by region. Upper and lower endpoints of bars correspond to one standard deviation above and below the mean, respectively. The measures in each panel are: (a) our neighbor-based measure, (b) the index of dissimilarlity, (c) the index of isolation, and (d) the percentage of household heads who are black. Source: Authors' calculations based on the IPUMS 100 percent sample of the 1880 federal census.

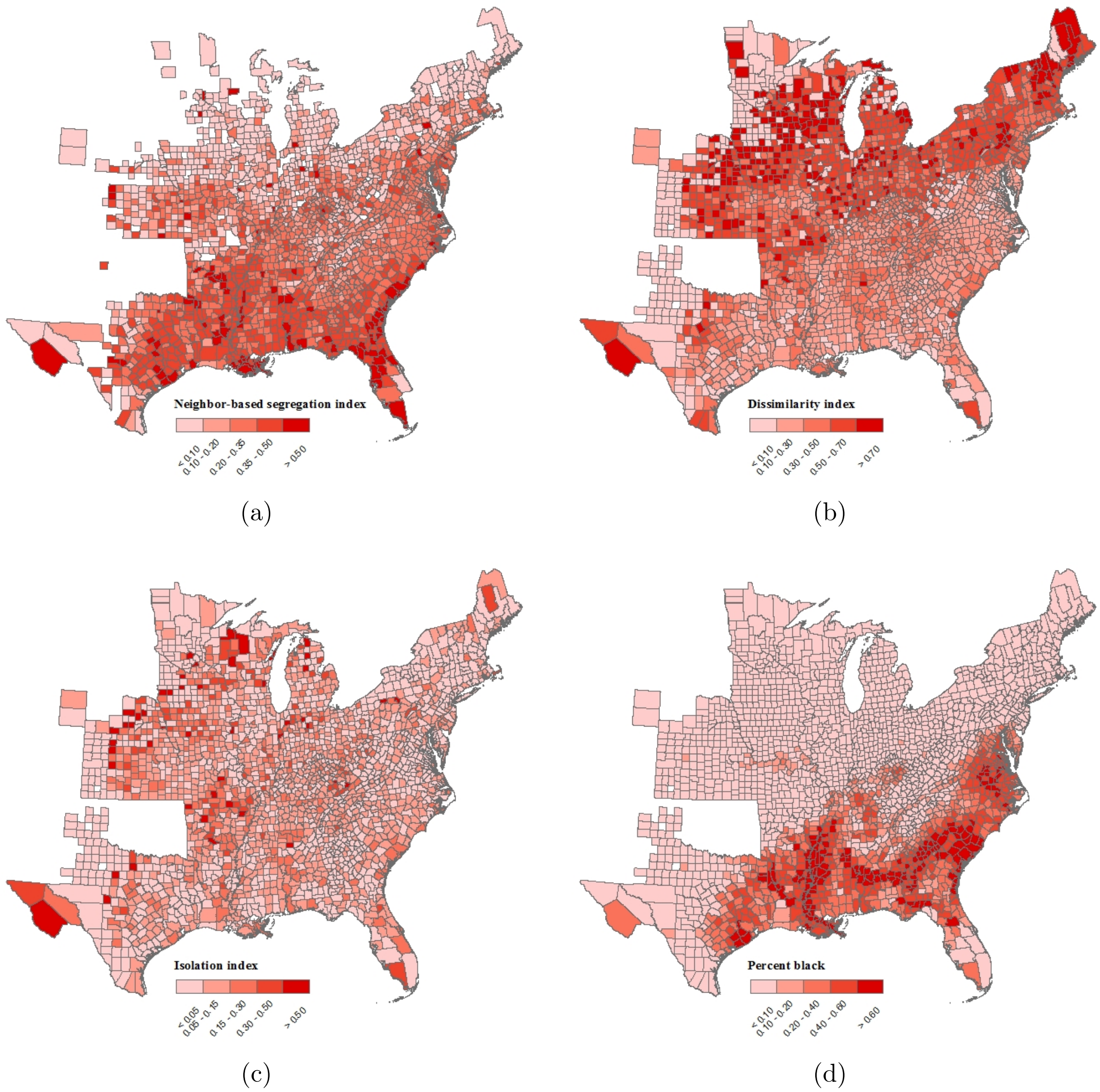

Figure 5: Segregation measures by county, 1880: (a) our neighbor-based measure; (b) index of dissimilarity; (c) index of isolation; and, (d) percent black. Source: Authors' calculations based on IPUMS 100 percent sample of the 1880 federal census.

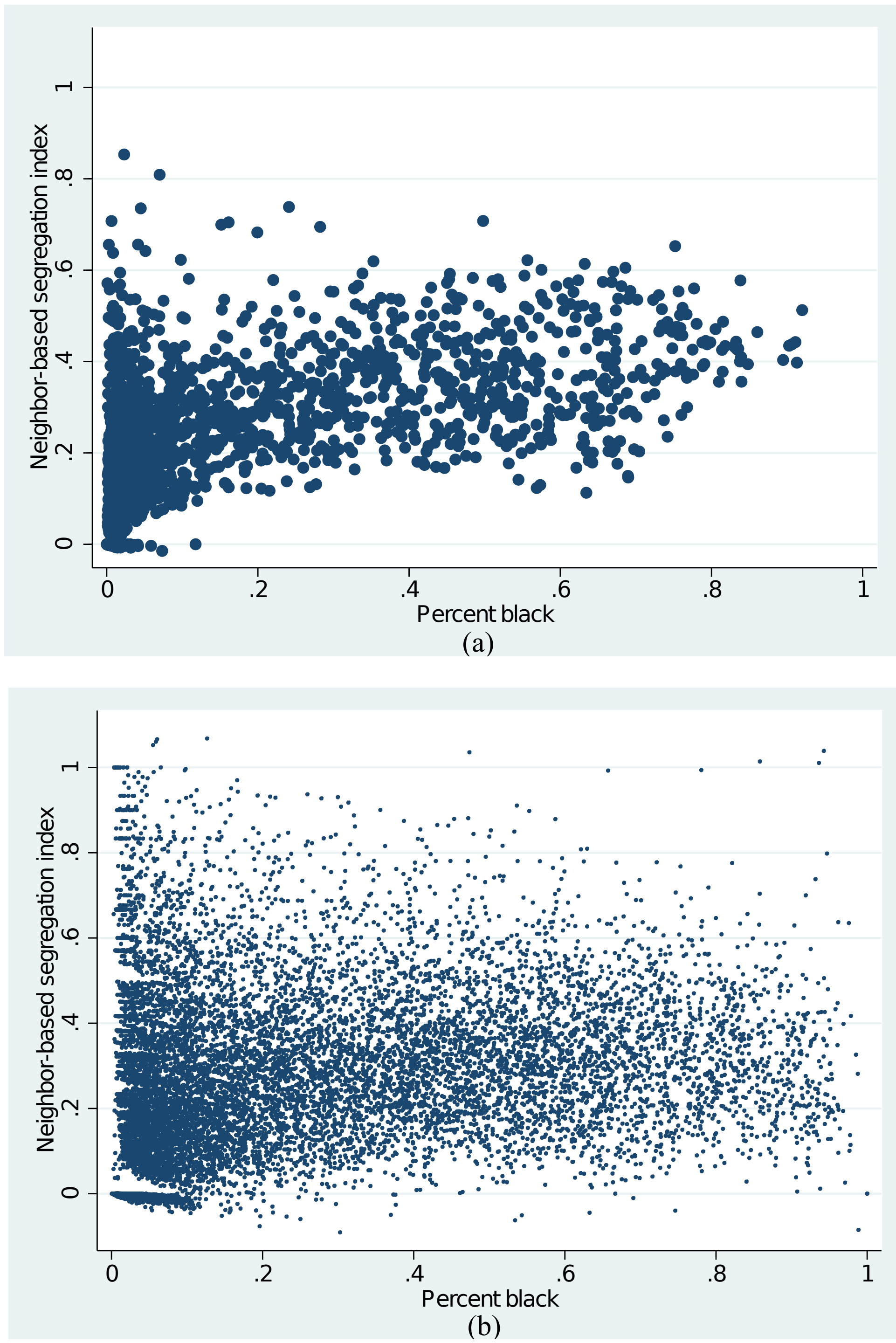

Figure 6: Segregation and the percentage black, by: (a) all counties in the United States; (b) all census enumeration districts in the United States. Source: Authors' calculations based on the IPUMS 100 percent sample of the 1880 federal census.

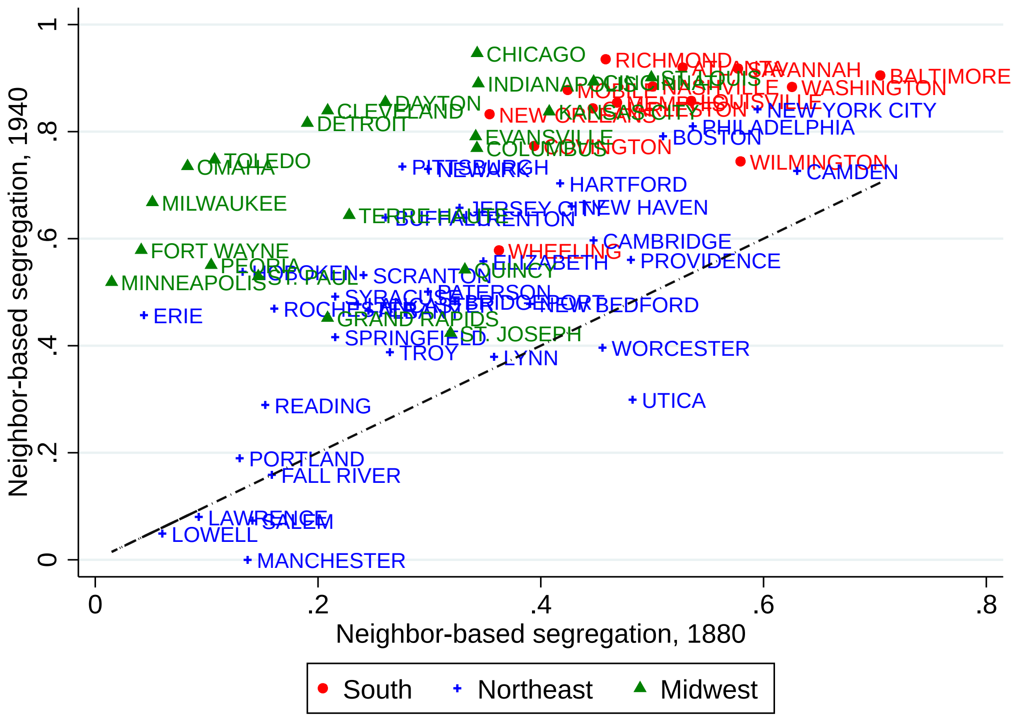

Figure 7: City-level segregation in 1880 and 1940

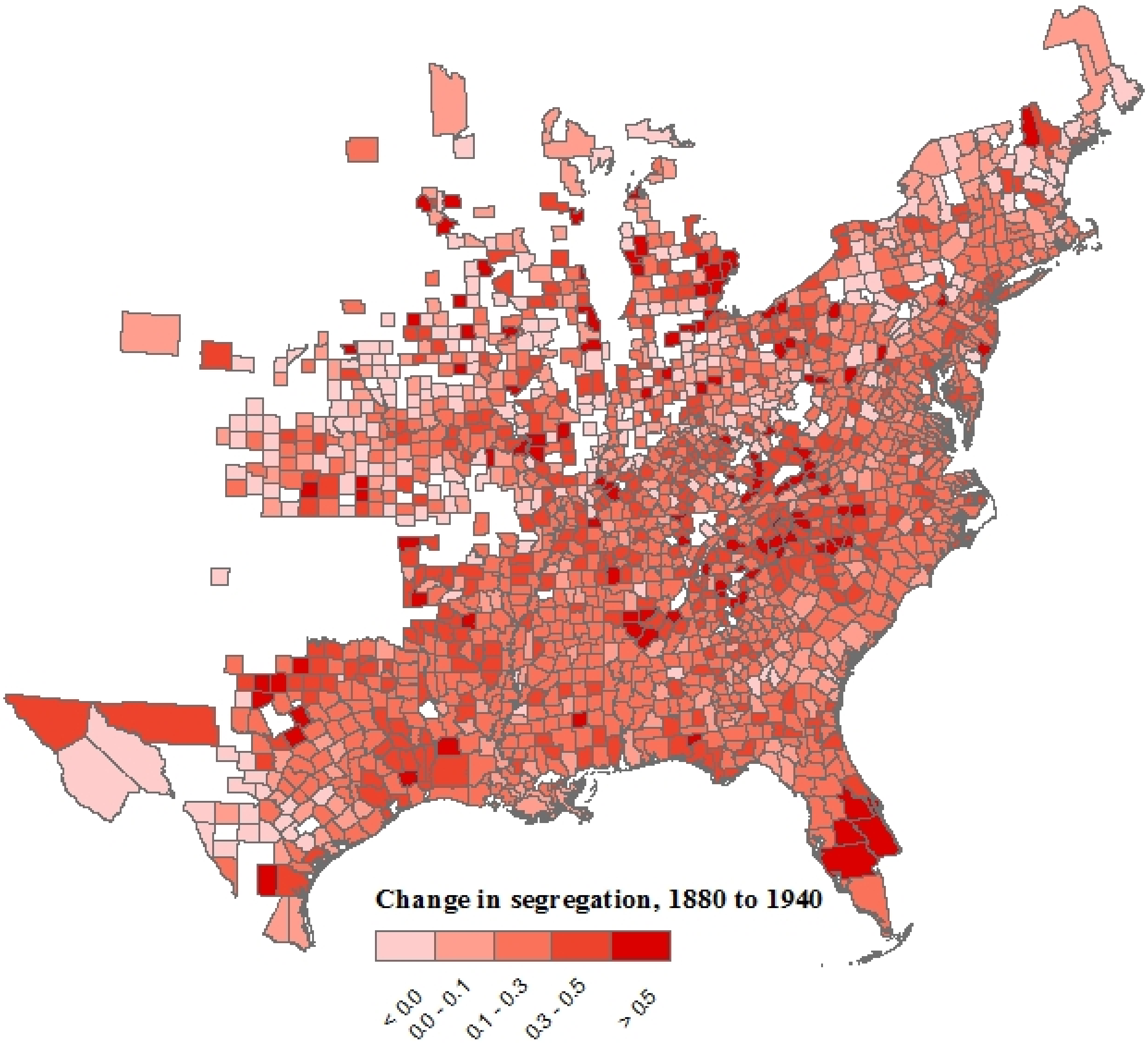

Figure 8: Change in the neighbor-based measure of segregation, 1880-1940. Source: Authors' calculations based on the 100 percent samples of the 1880 and 1940 federal censuses.

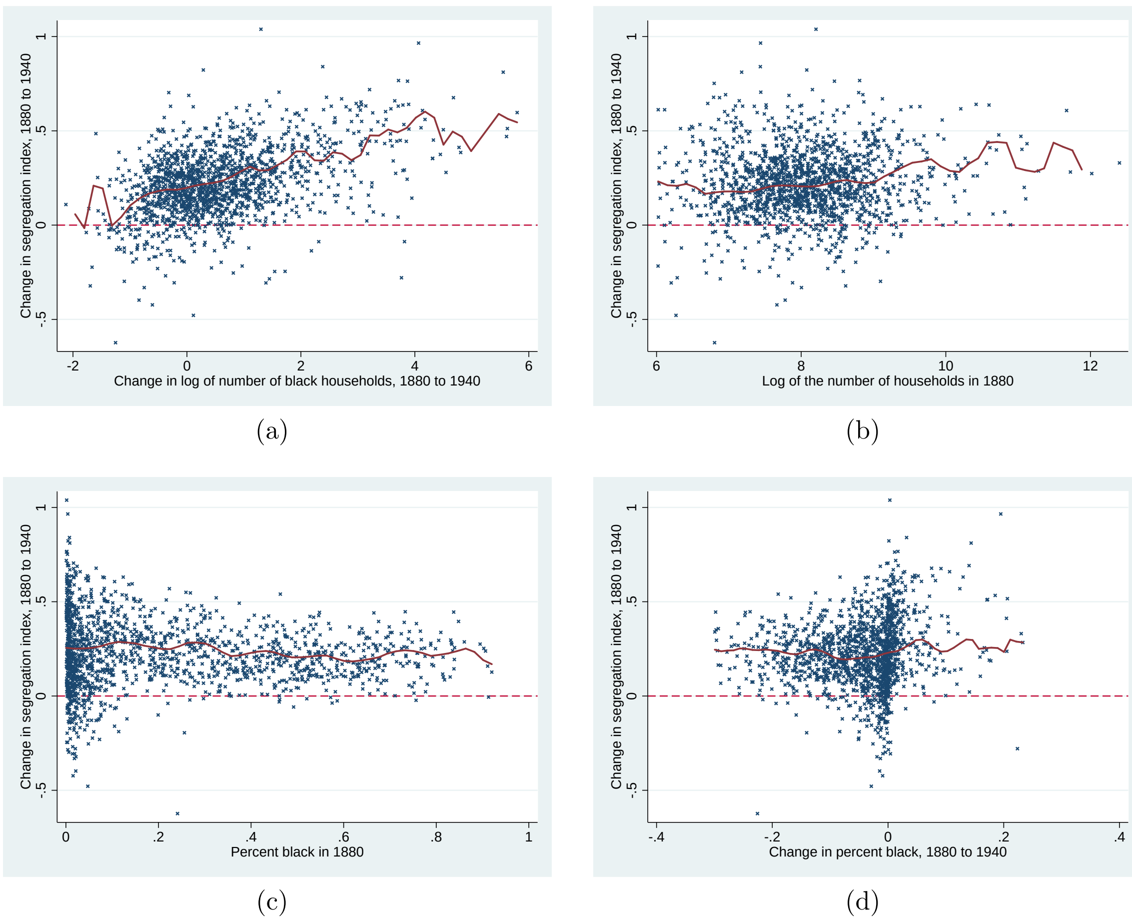

Figure 9: Changes in segregation by county, 1880-1940, by: (a) the change in the log of the number of black households, 1880-1940; (b) the log number of total households in 1880; (c) the percent black in 1880; and, (d) change in the percent black, 1880-1940. The solid lines are local polynomial smooth fits. Source: Authors' calculations based on the 100 percent samples of the 1880 and 1940 federal censuses.

A Deriving the Segregation Measure

Construction of the measure begins by identifying neighbors in the census. The complete set of household heads in the census is sorted by reel number, microfilm sequence number, page number and line number. This orders the household heads by the order in which they appear on the original census manuscript pages, meaning that adjacent households appear next to one another. There are two different methods for identifying each household head's next-door neighbors. The first is to simply define the next-door neighbors as the household head appearing before the individual on the census manuscript page and the household head appearing after the individual on the census manuscript page. An individual that is either the first or last household head on a particular census page will only have one next door neighbor identified using this method.

To allow for the next door neighbor appearing on either the previous or next census page and to account for the possibility that two different streets are covered on the same census manuscript page, an alternative method for identifying neighbors is also used that relies on street name rather than census manuscript page. In this alternative measure next-door neighbors are now identified by looking at the observations directly before and after the household head in question and declaring them next-door neighbors *if and only if* the street name matches the street name of the individual of interest (and the street name must be given, two blank street names are not considered a match). This approach has the advantage of finding the last household head on the previous page if an individual is the first household head on his census manuscript page or the first household head on the next page if the individual was the last household head on a manuscript page. However, the number of observations is reduced substantially relative to the first method because many individuals have no street name given. Few roads had names in historical census records. This is particularly true in rural areas.

Once next door neighbors are identified, an indicator variable is constructed that equals one if the individual has a next door neighbor of a different race and zero if both next-door neighbors are of the same race as the household head.[1] Two versions of this indicator variable are constructed, one in

[1]Based on the race assigned at enumeration. This is similar to the *racesing* coding of race constructed by IPUMS. One key feature of *racesing* for our purposes is places people with their race given as 'mulatto' in the same category as people with their race given as 'black'. So a black individual living next to two neighbors listed on the census as

which all observations are used and one in which only those observations for which both next-door neighbors are observed are used. This latter version reduces the sample size but, for the remaining individuals, gives a more accurate measure of the percentage of individuals with a neighbor of a different race.

Formally, we begin with the following:

- b_{all}: the total number of black household heads in the area
- $n_{b,B=1}$: the number of black household heads in the area with two observed neighbors
- $n_{b,B=0}$: the number of black household heads in the area with one observed neighbor
- x_b: the number of black household heads in the area with a neighbor of a different race

The equivalent variables for the set of white household heads are similarly defined. These components, by themselves, can be used to derive new measures of social interaction between races. For example, using the measures above one can calculate the share of households with an opposite race neighbor.

Given these measures, the basic measure of segregation is calculated as the distance the area is between the two extremes of complete segregation and the case where neighbor's race is entirely independent of an individual's own race. There are a total of four versions of the segregation measure. Each of these measures corresponds to one of the two different methods of defining next-door neighbors (whether the specific street of residence is identified on the census manuscript form) and whether all individuals with a neighbor present are included or only those individuals with both neighbors identified are used.

In the case of random neighbors, the number of black residents with at least one white neighbor will be a function of the fraction of black households relative to all households. In particular, the probability that any given neighbor of a black household will be black will be $\frac{b_{all}-1}{(b_{all}-1)+w_{all}}$.The probability that the second neighbor will be black if the first neighbor is black will then be $\frac{b_{all}-2}{b_{all}-2+w_{all}}$. The probability that a black household head will have at least one white neighbor can be written as a

mulatto would be considered to be of the same race as his neighbors.

function of these probabilities by expressing it as:

$$p(\text{white neighbor}) = 1 - \left(\frac{b_{all} - 1}{b_{all} - 1 + w_{all}}\right)\left(\frac{b_{all} - 2}{b_{all} - 2 + w_{all}}\right) \tag{1}$$

where the second term comes from the assumption that the races of adjacent neighbors are uncorrelated, a reasonable assumption given that we are considering randomly located neighbors. The expected value of x_b under random assignment of neighbors would then be:

$$E(\overline{x_b}) = p(\text{white neighbor}) \cdot n_b \tag{2}$$

$$E(\overline{x_b}) = n_b \left(1 - \left(\frac{b_{all} - 1}{b_{all} - 1 + w_{all}}\right)\left(\frac{b_{all} - 2}{b_{all} - 2 + w_{all}}\right)\right) \tag{3}$$

The calculation of this upper bound on x_b must be modified slightly when including household heads for which only one neighbor is observed. In this case, the expected number of black household heads with a white neighbor under random assignment of neighbors will be composed of two different terms, the first corresponding to those household heads with both neighbors observed and the second corresponding to those household heads with only one neighbor observed. Letting B be an indicator variable equal to one if both neighbors are observed and equal to zero if only one neighbor is observed, the expected total number of black household heads with a white neighbor is then:

$$E(\overline{x_b}) = p(\text{white neighbor}|B = 1) \cdot n_{b,B=1} + p(\text{white neighbor}|B = 0) \cdot n_{b,B=0} \tag{4}$$

$$E(\overline{x_b}) = n_{b,B=1} \left(1 - \left(\frac{b_{all} - 1}{b_{all} - 1 + w_{all}}\right)\left(\frac{b_{all} - 2}{b_{all} - 2 + w_{all}}\right)\right) + n_{b,B=0}\left(1 - \frac{b_{all} - 1}{b_{all} - 1 + w_{all}}\right) \tag{5}$$

Under complete segregation, the number of black individuals living next to white neighbors would simply be two, the two individuals on either end of the neighborhood of black residents, giving a lower bound for the value of x_b. However, it is necessary to account for observing only a fraction of the household heads. The expected observed number of black household heads living next to a white neighbor when sampling from an area with only two such residents will be:

$$E(\underline{x_b}) = p(\text{observe one of the two in } n_b \text{ draws}) \cdot 1 + p(\text{observe both in } n_b \text{ draws}) \cdot 2 \tag{6}$$

$$E(\underline{x_b}) = \frac{1}{\frac{1}{2}(n_b+1)} \left(1 - \prod_{i=0}^{n_b-1} \frac{b_{all}-i-2}{b_{all}-i}\right) + 2\left(1 - \frac{1}{\frac{1}{2}(n_b+1)}\right)\left(1 - \prod_{i=0}^{n_b-1} \frac{b_{all}-i-2}{b_{all}-i}\right) \tag{7}$$

The product in the expression above gives the probability of selecting neither of the two black household heads with white neighbors in n_b successive draws from the b_{all} black household heads. Thus one minus this product is the probability of drawing either one or both of the two household heads with white neighbors. Note that the product notation is used above because it makes it easier to see how the probability is being derived. In practice, the product reduces to $\frac{(b_{all}-n_b)(b_{all}-n_b-1)}{b_{all}(b_{all}-1)}$. The ratio $\frac{1}{\frac{1}{2}(n_b+1)}$ gives the fraction of these cases that correspond to drawing just one of the two household heads with white neighbors. This comes from noting that with n_b draws, that there are n_b ways to draw one of the two household heads while there are $\sum_{i=1}^{n_b-1}(n_b-i)$ or $n_b(n_b-1) - \frac{(n_b-1)n_b}{2}$ ways to draw both of the household heads.

Finally, in the case where household heads with only one observed neighbor are included, it is necessary to account for the probability that a black household head with a white neighbor will be drawn but that white neighbor is not the observed neighbor. The expected value of x_b accounting for the probability that the white neighbor is unobserved for a household head with only one observed neighbor is:

$$E(\underline{x_b}) = \left(\frac{n_{b,B=1}}{n_b} + \frac{n_{b,B=0}}{n_b} \cdot \frac{1}{2}\right) \tag{8}$$

$$\cdot \left[\frac{1}{\frac{1}{2}(n_b+1)} \left(1 - \prod_{i=0}^{n_b-1} \frac{b_{all}-i-2}{b_{all}-i}\right) + \right. \tag{9}$$

$$\left. 2\left(1 - \frac{1}{\frac{1}{2}(n_b+1)}\right)\left(1 - \prod_{i=0}^{n_b-1} \frac{b_{all}-i-2}{b_{all}-i}\right)\right] \tag{10}$$

In this equation, the fraction of black household heads with only one observed neighbor, $\frac{n_{b,B=0}}{n_b}$, has its expected value of x_b reduced by an additional factor of $\frac{1}{2}$ to account for the fact that if one of these individuals is one of the two black household heads living next to a white neighbor there is only a 50 percent chance that the white neighbor is the observed neighbor.

The degree of segregation in an area, η, can then be defined as the distance between these two extremes, measured from the case of no segregation:

$$\eta = \frac{E(\overline{x_b}) - x_b}{E(\overline{x_b}) - E(\underline{x_b})} \tag{11}$$

This segregation measure increases as black residents become more segregated within an area, equaling zero in the case of random assignment of neighbors (no segregation) and equalling one in the case of complete segregation.[2] Note that it is possible for this measure to be less than zero if the particular sample of household heads is actually more integrated than random assignment of neighbors. For example, suppose every other household head on the manuscript pages were black in an area that is 50 percent black. With random assignment of neighbors we would expect to observe at least some black household heads having black neighbors. In this case, x_b would be larger than $E(\overline{x_b})$ making η negative. The measure can also exceed one in the rare cases where only zero or one black household heads with a white neighbor are observed. In these cases x_b may actually be smaller than $E(\underline{x_b})$. We do not observe this for counties with more than ten black households.

In communities with large numbers of both black and white households, $E(\overline{x_b})$ will be substantially larger than $E(\underline{x_b})$, allowing us to approximate the above equation as

$$\eta \approx 1 - \frac{x_b}{E(\overline{x_b})} \tag{12}$$

This form of the segregation index is similar to measures of segregation based on evenness that take

[2]Given the evidence that population counts of the size of the African American community in census returns is biased, we are concerned about the problem of missing African Americans (Coale & Rives, 1973; Eblen, 1974; Preston et al., 1998). While it would appear that under-reporting of African Americans would be a concern, it would only bias estimates of the segregation measure if the missing African American households had white neighbors. To see how, note that $E(\underline{x_b})$ is invariant to the number of black and white households as it estimates the minimum number of households who would have opposite race neighbors, which itself is not a function of the size of either group. Since the measure of segregation is the ratio of the two differences ($E(\overline{x_b})$ - x_b and $E(\overline{x_b})$ - $E(\underline{x_b})$), only if the estimate of x_b is biased downward would missing black households have a material effect on the estimate of segregation. Given the reality of census enumeration, it is unlikely that enumerators deliberately skipped African American households in integrated communities as opposed to skipping entire groups of black households.

the following form

$$\rho = 1 - \frac{\frac{1}{N}\sum_{i=1}^{m} N_i D_i}{\frac{1}{N}\sum_{i=1}^{m} E(N_i D_i|\text{no segregation})} \tag{13}$$

where N is the total population of interest across all m subunits of the larger area, N_i is is the population of interest in subunit i, and D_i is the relevant measure of diversity in that subunit. If we define the subunit to be as small as possible, namely an individual black household, then N becomes the number of black households and N_i simply becomes one, reducing the above expression to

$$\rho = 1 - \frac{\frac{1}{n_b}\sum_{i=1}^{n_b} D_i}{\frac{1}{n_b}\sum_{i=1}^{m} E(D_i|\text{no segregation})} \tag{14}$$

where n_b is the same number of black households used in the derivation of our measure above. In the context of our measure, the diversity measure D_i is equal to one if a black household has a white neighbor and zero if it does not. Noting that x_b is the number of black households for which D_i is equal to one and $E(\overline{x_b})$ is the expected number of black households for which D_i is equal to one under no segregation, this generic expression for a measure of evenness becomes

$$\rho = 1 - \frac{\frac{1}{n_b} x_b}{\frac{1}{n_b} E(\overline{x_b})} = 1 - \frac{x_b}{E(\overline{x_b})} \tag{15}$$

which is identical to Equation 12, the approximation of our measure in the case of large numbers of black and white households. Thus our measure can be thought of as a household-level measure of evenness when the number of black and white households is large.

It is important to note that the assumption required for this reformulation of the measure, that $E(\overline{x_b})$ is substantially larger than $E(\underline{x_b})$, is a strong assumption. When applying our measure to smaller geographical areas such as individual enumeration districts and to areas with very small numbers of black households, $E(\overline{x_b})$ will not be orders of magnitude larger than $E(\underline{x_b})$. One key advantage of our measure as defined in Equation 11 relative to traditional measures is that it can still be applied to small black populations and small total populations while maintaining a consistent interpretation for the values of zero and one. As the simulations in the paper demonstrate, traditional measures of segregation such as dissimilarity and isolation do not reliably converge to zero in the case of complete integration or one in the case of complete segregation when populations are small while our measure does.

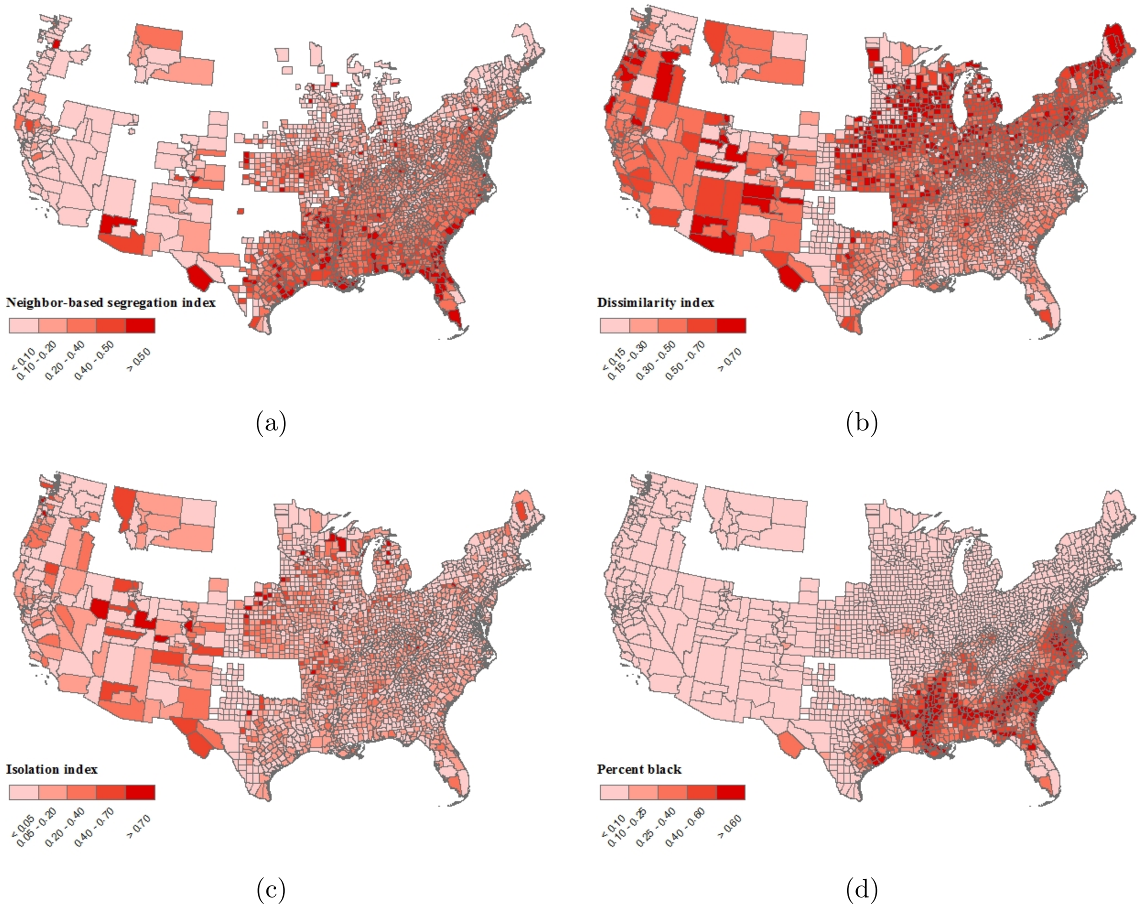

Figure A1: Segregation measures by county for the entire United States, 1880: (a) our neighbor-based measure; (b) index of dissimilarity; (c) index of isolation; and, (d) percent black.

Table A1: Means of county-level segregation measures by region, 1880.

	Rural counties				Urban counties			
	Neighbor-based segregtion	Percent black	Dissimilarity	Isolation	Neighbor-based segregtion	Percent black	Dissimilarity	Isolation
New England	0.101	0.007	0.581	0.075	0.191	0.014	0.582	0.061
	(0.127)	(0.010)	(0.219)	(0.115)	(0.172)	(0.014)	(0.136)	(0.054)
Middle Atlantic	0.145	0.015	0.541	0.076	0.201	0.017	0.527	0.048
	(0.145)	(0.020)	(0.146)	(0.105)	(0.135)	(0.014)	(0.118)	(0.048)
East North Central	0.120	0.012	0.523	0.126	0.143	0.025	0.506	0.061
	(0.144)	(0.026)	(0.257)	(0.168)	(0.133)	(0.047)	(0.186)	(0.058)
West North Central	0.139	0.015	0.366	0.113	0.184	0.047	0.479	0.065
	(0.156)	(0.034)	(0.323)	(0.173)	(0.164)	(0.057)	(0.138)	(0.043)
South Atlantic	0.275	0.338	0.201	0.056	0.459	0.484	0.28	0.107
	(0.132)	(0.231)	(0.127)	(0.065)	(0.114)	(0.196)	(0.123)	(0.077)
East South Central	0.276	0.266	0.289	0.091	0.378	0.306	0.314	0.083
	(0.129)	(0.234)	(0.119)	(0.093)	(0.12)	(0.234)	(0.079)	(0.043)
West South Central	0.336	0.233	0.241	0.09	0.391	0.398	0.218	0.073
	(0.161)	(0.248)	(0.197)	(0.127)	(0.147)	(0.26)	(0.137)	(0.046)
Mountain	0.079	0.010	0.303	0.134	0.07	0.005	0.536	0.018
	(0.146)	(0.024)	(0.267)	(0.218)	(0)	(0)	(0)	(0)
Pacific	0.048	0.005	0.357	0.119	0.066	0.01	0.484	0.041
	(0.119)	(0.006)	(0.258)	(0.17)	(0.071)	(0.007)	(0.147)	(0.022)

Notes: Standard deviations are given in parentheses. The rural/urban distinction is based on the 1880 census definition of an urban area being a place with more than 8,000 inhabitants.

Table A2: Means of county-level segregation measures by region with counties weighted by number of black households, 1880.

	Rural counties				Urban counties			
	Neighbor-based segregtion	Percent black	Dissimilarity	Isolation	Neighbor-based segregtion	Percent black	Dissimilarity	Isolation
New England	0.241	0.015	0.512	0.053	0.373	0.02	0.611	0.12
	(0.135)	(0.009)	(0.115)	(0.057)	(0.127)	(0.008)	(0.098)	(0.052)
Middle Atlantic	0.282	0.041	0.496	0.08	0.419	0.027	0.609	0.126
	(0.158)	(0.03)	(0.112)	(0.069)	(0.165)	(0.013)	(0.131)	(0.087)
East North Central	0.233	0.051	0.484	0.083	0.299	0.066	0.467	0.076
	(0.129)	(0.064)	(0.147)	(0.067)	(0.115)	(0.08)	(0.141)	(0.037)
West North Central	0.259	0.101	0.386	0.078	0.386	0.101	0.405	0.089
	(0.116)	(0.071)	(0.145)	(0.066)	(0.127)	(0.046)	(0.101)	(0.035)
South Atlantic	0.311	0.521	0.199	0.057	0.518	0.509	0.323	0.127
	(0.107)	(0.179)	(0.092)	(0.048)	(0.116)	(0.189)	(0.089)	(0.051)
East South Central	0.374	0.536	0.286	0.099	0.448	0.468	0.314	0.112
	(0.093)	(0.234)	(0.099)	(0.063)	(0.04)	(0.211)	(0.066)	(0.026)
West South Central	0.433	0.527	0.261	0.096	0.412	0.446	0.254	0.09
	(0.092)	(0.218)	(0.118)	(0.076)	(0.079)	(0.189)	(0.096)	(0.037)
Mountain	0.274	0.057	0.481	0.192	0.07	0.005	0.536	0.018
	(0.241)	(0.074)	(0.198)	(0.173)	(0)	(0)	(0)	(0)
Pacific	0.059	0.011	0.395	0.082	0.064	0.013	0.494	0.029
	(0.121)	(0.007)	(0.138)	(0.099)	(0.047)	(0.005)	(0.107)	(0.012)

Notes: Standard deviations are given in parentheses. The rural/urban distinction is based on the 1880 census definition of an urban area being a place with more than 8,000 inhabitants.

Table A3: Changes in the county-level dissimilarity index from 1880 to 1940 by region, counties weighted by number of black households.

	Rural counties					Urban counties				
	Mean, 1880	Standard deviation, 1880	Mean, 1940	Standard deviation, 1940	1940 - 1880, (3)-(1)	Mean, 1880	Standard deviation, 1880	Mean, 1940	Standard deviation, 1940	1940 - 1880, (8)-(6)
Region	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
New England	0.47	0.13	0.60	0.14	0.13	0.57	0.11	0.80	0.08	0.23
Middle Atlantic	0.46	0.11	0.55	0.09	0.09	0.59	0.12	0.83	0.10	0.24
East North Central	0.49	0.15	0.59	0.17	0.10	0.47	0.14	0.87	0.10	0.40
West North Central	0.39	0.15	0.48	0.16	0.09	0.40	0.10	0.71	0.22	0.31
South Atlantic	0.20	0.09	0.36	0.19	0.16	0.30	0.11	0.54	0.16	0.24
East South Central	0.28	0.10	0.38	0.09	0.10	0.32	0.09	0.57	0.13	0.25
West South Central	0.26	0.12	0.37	0.10	0.11	0.28	0.10	0.56	0.13	0.28
Mountain	0.45	0.21	0.67	0.18	0.22	0.52	0.17	0.63	0.11	0.11
Pacific	0.41	0.14	0.69	0.11	0.28	0.48	0.11	0.84	0.11	0.36
Entire country	0.25	0.12	0.37	0.15	0.12	0.36	0.15	0.67	0.19	0.31

Notes: All means and standard deviations are weighted by the number of black households in the county. The urban-rural distinction is based on the year the statistic corresponds to, so some of the counties in the 1880 rural calculations appear in the 1940 urban calculations.

Table A4: Changes in the county-level isolation index from 1880 to 1940 by region, counties weighted by number of black households.

	Rural counties					Urban counties				
Region	Mean, 1880 (1)	Standard deviation, 1880 (2)	Mean, 1940 (3)	Standard deviation, 1940 (4)	1940 - 1880, (3)-(1) (5)	Mean, 1880 (6)	Standard deviation, 1880 (7)	Mean, 1940 (8)	Standard deviation, 1940 (9)	1940 - 1880, (8)-(6) (10)
New England	0.05	0.09	0.07	0.04	0.02	0.09	0.05	0.31	0.19	0.22
Middle Atlantic	0.06	0.05	0.08	0.04	0.02	0.12	0.09	0.55	0.24	0.43
East North Central	0.09	0.07	0.14	0.12	0.05	0.07	0.04	0.64	0.24	0.57
West North Central	0.08	0.07	0.10	0.05	0.02	0.08	0.03	0.48	0.28	0.40
South Atlantic	0.06	0.04	0.18	0.18	0.12	0.12	0.06	0.37	0.18	0.25
East South Central	0.10	0.06	0.16	0.06	0.06	0.11	0.04	0.40	0.16	0.29
West South Central	0.09	0.07	0.17	0.08	0.08	0.10	0.06	0.37	0.16	0.27
Mountain	0.23	0.19	0.10	0.11	-0.13	0.14	0.13	0.26	0.13	0.12
Pacific	0.08	0.10	0.06	0.06	-0.02	0.03	0.02	0.45	0.23	0.42
Entire country	0.08	0.06	0.17	0.17	0.09	0.11	0.06	0.45	0.23	0.34

Notes: All means and standard deviations are weighted by the number of black households in the county. The urban-rural distinction is based on the year the statistic corresponds to, so some of the counties in the 1880 rural calculations appear in the 1940 urban calculations.

Table A5: The time series of traditional segregation measures, 1880-1940, segregation in 1940 as dependent variable.

Panel A: The Time Series of Dissimilarity, 1880-1940. DV: Dissimilarity in 1940

Segregation in 1880	0.430***	0.327***	0.329***	0.325***	0.324***
	(0.0220)	(0.0244)	(0.0244)	(0.0243)	(0.0243)
Change in Percent Black, 1880-1940			0.153**	0.189**	0.185**
			(0.0747)	(0.0745)	(0.0747)
Urban County in 1880				0.121***	0.116***
				(0.0211)	(0.0222)
Urban Population					1.17e-05
					(1.53e-05)
Constant	0.368***	0.533***	0.532***	0.517***	0.517***
	(0.00946)	(0.0360)	(0.0360)	(0.0358)	(0.0358)
Census Region Fixed Effects		X	X	X	X
Observations	2,523	2,523	2,523	2,523	2,523
R-squared	0.132	0.178	0.180	0.190	0.191

Panel B: The Time Series of Isolation, 1880-1940. DV: Isolation in 1940

Segregation in 1880	-0.00289	0.0252	0.0248	0.0408**	0.0322*
	(0.0198)	(0.0193)	(0.0193)	(0.0187)	(0.0182)
Change in Percent Black, 1880-1940			-0.0242	0.0155	-0.0130
			(0.0359)	(0.0350)	(0.0341)
Urban County in 1880				0.129***	0.0916***
				(0.00994)	(0.0101)
Urban Population					8.44e-05***
					(7.00e-06)
Constant	0.110***	0.0544***	0.0544***	0.0341**	0.0338**
	(0.00328)	(0.0160)	(0.0160)	(0.0156)	(0.0151)
Census Region Fixed Effects		X	X	X	X
Observations	2,523	2,523	2,523	2,523	2,523
R-squared	0.000	0.078	0.078	0.136	0.183

OLS estimates with standard errors given in parentheses. The unit of observation is a county.
Counties are defined as urban if greater than 25% of the county population lives in an urban area.
*** p<0.01, ** p<0.05, * p<0.1