The Role of Suburbanization in Metropolitan Segregation after 1940

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Abstract

The three decades from 1940 through 1970 mark a turning point in the spatial scale of black-white residential segregation. We decompose metropolitan segregation into three components: segregation within the city, within the suburbs, and between the city and its suburbs. We then show that extreme levels of segregation were well established in most cities by 1940, and they changed only modestly by 1970. In this period, changes in segregation were greater at a metropolitan scale, driven by racially selective population growth in the suburbs. We also examine major sources of rising segregation, including region, metropolitan total and black population size, and indicators of redlining in the central cities based on risk maps prepared by the Home Owners Loan Corporation (HOLC) in the late 1930s. In addition to overall regional differences, segregation between the city and suburbs and within suburbia increased more in metros with larger black populations, but this relationship was only found in the North. Contradicting some recent theorizing, there is no association between preparation of an HOLC risk map or the share of city neighborhoods that were redlined and subsequent change in any component of segregation.

Keywords: Segregation, Metropolis, Cities, Suburbs, Neighborhoods

The Role of Suburbanization in Metropolitan Segregation after 1940

Residential segregation today has a metropolitan scale, and it is well understood that an important component of segregation is the divide between cities and their surrounding suburbs. This phenomenon was already evident in the 1970s when accelerated suburban growth and population loss in many older central cities signaled the start of the "urban crisis" (Sugrue 1996, see also Beauregard 2006). Farley et al. (1978) emphasized this phenomenon's racial dimension by pointing to the growing divide between the "chocolate city and vanilla suburbs." Van Valey, Roof, and Wilcox (1977, p. 843), who published the first metropolitan-wide study of segregation, noted the "massive redistribution" of population created by "continued migrations of blacks to the central cities and whites to the surrounding ring," and called on researchers to "turn our efforts away from a narrow concentration on the central city to the broader context of the entire metropolitan area." Yet neither they nor other segregation researchers were yet dealing with this broader metropolitan context.

That is our purpose here in the first nationwide study of trends in metropolitan segregation. Using newly available data for each year, we compare segregation in 1940 to segregation in 1970. We build on a strong foundation of research on central cities that showed how unevenly blacks and whites were distributed across city neighborhoods by 1940, when the black ghetto had become firmly established (Cutler, Glaeser and Vigdor 1999). After 1940, despite the consolidation and expansion of black ghettos in many cities due to black population growth, average city levels of segregation (measured by the Index of Dissimilarity, D), were at a standstill. Having risen between 1940 and 1950 (Cowgill 1956, Taeuber and Taeuber 1965),

they were actually lower in 1970 than in 1940 in Northern cities, while barely changing in the South (Sørensen et al. 1975).

If segregation was no longer rising in most cities, was it increasing at a metropolitan scale? Up to now there is little evidence that it did. Van Valey, Roof, and Wilcox (1977) reported that the average level of metropolitan segregation (D) was nearly unchanged from 1960 to 1970 (declining from 75.6 to 75.1). By analyzing a longer time period that includes changes in the 1940s and 1950s we show that after 1940 segregation between neighborhoods across the whole metropolitan area increased substantially, especially as a result of the deepening disparity between cities and suburbs. There was a decisive shift in the residential patterns of metropolitan areas. In 1940, most metropolitan residents lived in central cities, whereas by 1970 most lived in the suburbs. This reversal coincides with a small decline in urban population and a massive increase in new construction in suburban areas, primarily occupied by white households.

Besides describing the trajectories of segregation across metropolitan regions, this study takes initial steps toward identifying the sources of variation at the metropolitan scale, within cities and suburban regions, and between the city and suburbs (macro-segregation in the terminology in Parisi, Lichter and Taquino 2011). The analysis includes predictors that were prominent in segregation research in this period: regional differences, population size, and size of the African American population. It also examines the role of institutional discrimination encouraged by the federal government, which has become a prominent factor in more recent scholarship.

Regional differences and minority group threat

A major focus of past research has been to assess regional differences. The urban South was distinctive in the period we study in both the share of African Americans in the urban

population (many times larger than in other areas of the country) and in its Jim Crow regime. The strict controls on race relations embodied in that system have been described as an alternative to residential segregation by scholars who concluded that segregation in Southern cities was lower than in the North (Massey and Denton 1993). However, Cutler, Glaeser and Vigdor (1999, p. 464) reported almost no difference for their samples of matched cities in 1940 (.46 in the South, .45 in the Northeast, and .49 in the Midwest). Similarly, Taeuber and Taeuber (1965, p. 44) reported that the average value of the block-level Index of Dissimilarity (D) in 1940 was 84.9 in Southern cities, compared to 83.2 in the Northeast, 88.4 in the North Central, and 82.7 in the West, and 85.2 in all regions combined (see also Cowgill 1956). They point out, in addition, that the Southern city average remained similar to the national average in 1950 (a single point higher) but was more than four points higher by 1960. More recent studies suggest that Southern cities in the past appeared to be less segregated because African Americans were not concentrated in a few large districts, as was more often the case in the North, but instead were dispersed into many smaller clusters on side streets and alleys (Grigoryeva and Ruef 2015, Logan and Parman 2017, Logan and Martinez 2018).

The North-South dichotomy overlaps heavily with other metropolitan characteristics that have been expected to affect segregation, including population size, period of development, and black population share. A standard hypothesis is that segregation will be lower in smaller, more recently developing and faster growing urban areas, where the housing market is expected to be more flexible and offer more options to minorities (Farley and Frey 1994). These characteristics are believed to have moderated segregation in the South. Another factor that is given much attention in the literature is the size of the black population, which Blalock (1956) interpreted in terms of a theory of minority group threat. His theoretical reasoning is that racial prejudice

stems in part from a dominant group's sense that their position is threatened by a subordinate group, and one possible response is to strengthen the spatial boundaries between groups. The plausibility of this hypothesis rests partly on a coincidence of timing. That is, "the racial group threat hypothesis is consistent with the finding that Black–White segregation increased in northern metropolitan areas in the first decades of the twentieth century as the Northern Black population swelled" (Iceland and Sharp 2013, p. 666). Group threat is the core notion in Massey and Denton's (1993) account of rising segregation at this time. In the North, "as the size of the urban black population rose steadily after 1900, white racial views hardened and the relatively fluid and open period of race relation in the North drew to a close" (1993, p. 30). Even in the South, where many cities had black population shares in the range of 30-40% after the Civil War, "whites were not completely immune to threats posed by black urbanization. After 1910 black populations also began to rise in southern cities … and whites similarly became alarmed at the influx of black migrants" (1993, p 41).

In the post-1940 period, there is limited evidence of an effect of group threat on segregation. Most relevant for 1940-1970 is the analysis of block data in the decades 1940-1950 and 1950-1960 by Taeuber and Taeuber (1965). In both decades, they found that white population growth was positively related to increases in segregation, but the association with nonwhite population growth was negative. In a multivariate model including several other city characteristics, neither white nor nonwhite growth had significant effects in the 1940-50 decade. But in 1950-1960, the strongest predictor of changing segregation was the negative effect of black population growth, a result that they note "is contrary to that usually assumed" (1965, p. 77). More recent studies have mixed results. Group threat is nevertheless now a standard hypothesis in research on subsequent decades, and these studies have mixed results. A

multivariate analysis of segregation that pooled data for all four decades in the 1980-2010 period (Iceland and Sharp 2013) found that black white segregation was consistently higher in metros with larger shares of black residents. However, several other studies found no evidence for the group threat hypothesis. These include an analysis of metropolitan black-white segregation in 1980 (Massey and Denton 1987), and also analyses of change in segregation between 1980 and 1990 (Farley and Frey 1994) and 1990-2000 (Logan, Stults and Farley 2004).

Institutional drivers of segregation and suburbanization

Increasing attention is now being given to non-market factors that limit locational options for minority groups while expanding housing choices for whites. In the literature on institutional racism in housing in the period we are studying, the focus has been on state policy, especially legal support for exclusionary deed restrictions and federal encouragement of private market redlining in mortgage lending (Massey & Denton 1994, Rothstein 2017). The current study relies on information about redlining in the form of mortgage risk maps developed by the Home Owners Loan Corporation (HOLC) in the late 1930s. These redlining maps are pointed to by many scholars as evidence of federal intervention in the housing market. Probably a better source would be the actual lending patterns of FHA, which have been studied in a few specific cities by Xu (2020) and Fishback et al (2021), or private lending data such as Hillier (2003) assembled for Philadelphia. In the absence of nationwide data about mortgage lending and on restrictive covenants and other discriminatory behavior by the real estate industry, however, the HOLC maps provide a starting point for study. We will test the independent effects of preparation of a redlining map and share of city neighborhoods that were designated as "high risk" on changes in segregation at the metropolitan and city levels. However, as reviewed below, there are reasons to expect that private market redlining and restrictive covenants were so

widespread in this period that they are unlikely to explain much variation across urban areas, and that their most likely effect was not on segregation within cities but rather on hardening the divide between cities and suburbs. Here we review past studies of both kinds of policies to clarify this argument.

Restrictive covenants

The intention of restrictive covenants was to accomplish what abortive efforts to impose racial zoning in several cities before 1920 had failed to do – draw strong boundaries around areas where blacks were allowed to live. Once legally instituted and until enforcement of deed restrictions was declared unconstitutional in 1948, property owners could go to court to enjoin properties from being rented or sold to black households. Scholars have pointed out that such covenants were only one element in the repertoire of creating a dual housing market (Hirsch 1983, Massey and Denton 1993). But they had the special advantage of the force of law. In addition, the legitimacy of discrimination in American society was continually reinforced by earlier court rulings that affirmed that covenants constituted a valid contract.

Where and how did covenants matter? The literature includes differing interpretations. On one hand, Myrdal (1944) asserted that if enforcement of racial covenants were outlawed, residential segregation in the North could not long be sustained. They were described in similarly strong terms by Long and Johnson (1947, p. 8)): "Real estate agents, merchants, bankers, workers, housewives and church congregations" have created … a cordon of formal and informal restrictions designed to make forever impossible for any Negro family to escape this blight and depression." Gordon (2008) described covenanted neighborhoods in St. Louis as creating a "ring of steel" around the black ghetto. Yet he noted that this ring was "breached at points where covenants had never taken hold, had expired, or had simply fallen apart in the face

of racial transition" (p. 77), and "by the late 1930s, the hold of the covenant was clearly loosening" (p. 82). Similarly, Weaver (1948, p. 212) argued that where covenants were deployed within cities to block the expansion of the Black Belt, they "seldom offered a permanent barrier to Negro entrance … In outlying areas they have been and are much more effective." Perhaps for this reason, Gotham (2002) emphasizes their use by large-scale suburban real estate developers, like the JC Nichols Company in Kansas City who blocked African Americans' path to the suburbs.

If these latter arguments are correct, we should understand racially selective suburbanization, which we measure here as changing segregation between cities and suburbs (macro-segregation), to be partly a consequence of the legitimacy of restrictive policies. As Long and Johnson (1947) observed, it was easier to create and enforce covenants in new subdivisions outside the central city core where real estate developers themselves had direct control of marketing. By many accounts restrictive covenants were almost ubiquitous in the 1920-1950 era in suburban tracts. Early studies of dozens of suburban subdivisions around the country (Monchow 1928, Hubbard 1925) documented deed restrictions barring African Americans as early as 1906. Almost all such covenants after 1920 included specific prohibitions based on race. This trend was later encouraged by federal policy. The Federal Home Administration (FHA) guaranteed mortgages for a large share of large subdivisions in both cities and suburbs after the foreclosure crisis of the early Depression. Writing in the mid-1940s, Long and Johnson (1947, p. 38) reported that "F.H.A. has insisted upon the use of restrictive covenants in new developments as a basis of using federal funds to insure mortgage investments." Consequently, the effects of deed restrictions may be less likely to appear in the form of increasing segregation within central cities, and more likely to influence the city-suburb divide.

Redlining

While deed restrictions operate by strengthening the boundary between specific white and black neighborhoods, redlining could have more indirect effects. Access to capital is the lifeblood of the housing market, as all phases of development (land acquisition, construction, and marketing) depend mainly on borrowed money. Deprived of credit, a neighborhood's housing stock would naturally deteriorate over time, reducing local home ownership and becoming less attractive to households with better options. Redlining is the most common practice cited by social scientists to confirm the effect of law and public policy on creation of black ghettoes (Hirsch 1983, Massey and Denton 1993, Sugrue 1996, Dreier et al 2005, Rothstein 2017).

After the mortgage foreclosure crisis of the early 1930s, a large share of loans for new housing development was guaranteed by FHA, which insisted on standardizing the criteria for assessing mortgage risk. Its underwriting manual emphasized aspects of neighborhood location as a basis for judging risk, including protection from "adverse influences." This criterion was listed as "one of the most important features in the Rating of Location" (Federal Housing Administration 1938, p. 932). The standards favored protective zoning, but noted 'Deed restrictions are apt to prove more effective than a zoning ordinance in providing protection from adverse influences" (1938, pp. 933-944). They highlighted the problem of "threatening or probable encroachments of incongruous land uses and by threatening or probable infiltration of inharmonious racial groups […] The probability or imminence of such encroachments or infiltrations will result always in low ratings" (1938, p. 1360). The manual also supported deed restrictions, including restrictive covenants concerning who would be allowed to buy or rent in a neighborhood. It noted "Deed restrictions are apt to prove more effective than a zoning ordinance in providing protection from adverse influences" (1938, pp. 933-944). Hence FHA

legitimated a variety of discriminatory practices, including most notably racially restrictive covenants and redlining. And its standards carried weight because half of all housing in the 1950s and 1960s was financed with FHA or VA loans[1] (Jackson 1980: 447).

There is a growing literature on the effects of redlining. Heightened attention to the federal role was stimulated by Jackson's (1980) review of the Home Owner Loan Corporation (HOLC) risk security maps that he discovered in the FHA archives. On these maps, "D"-graded neighborhoods were outlined in red, and neighborhood description documents justified the grades with explicit descriptions of the racial composition of the area. This led Jackson to argue that, "HOLC initiated the practice of 'redlining'" (1980, p. 423). Research has been further stimulated by the distribution of digital versions of these maps by the University of Richmond's Mapping Inequality Project. Jackson himself interpreted the redlining maps as an indicator of the larger context of FHA policy that favored certain kinds of housing and neighborhoods – particularly housing in the suburbs where restrictive covenants were enforced by subdivision builders. In his view, FHA's policy biases implicitly destined inner-city neighborhoods to be the exclusive locale of growing minority populations, paying artificially high rents for substandard housing. Gotham (2002, p. 74) argues these biases then "became the standards adopted and applied by private real estate firms, lending institutions, appraisers, and builders throughout the housing and lending industries." In this way the main effect of FHA policy would have been to favor racially restrictive suburban development, and its impact would be on the city-suburb divide, not on segregation within the city.

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[1] The Veterans Administration, enabled by the 1944 Servicemen's Readjustment Act (more commonly known as the "G.I. Bill"), adopted the same racially discriminatory terms as the FHA in the lending it issued to the millions of veterans returning home (Rothstein 2017).

It is difficult to show that FHA policy had a direct and independent effect on housing outcomes. The logic of the argument is that the risk maps reinforced private lending decisions that motivated white residents to desert disfavored neighborhoods in favor of newer areas from which African Americans were excluded. The older racially or ethnically mixed neighborhoods that they were leaving then experienced declining home ownership and greater shares and higher densities of the growing African American population that was blocked from the newer neighborhoods. Yet the direction of causality is unclear. This is because, as Gotham (2002, p. 74) also points out, FHA policies institutionalized guidelines that had long been promoted and applied by the real estate industry (i.e., "the segregationist ideology developed by real estate elites and community builders"). As Aaronson et al (2020, p. 2) also acknowledge, "the maps may have simply reflected and codified pre-existing differences in neighborhoods but didn't actually *cause* any changes in credit access." Consistent with that interpretation, Greer (2013) conducted a study of how the HOLC risk ratings were related to previous private sector behavior in thirteen major cities, as reported by the appraisers who were responsible for assigning these ratings. He showed a significant positive association between the HOLC ratings and the reported private sector mortgage availability prior to creation of the redlining maps.

Hillier (2003) casts doubt on whether the HOLC maps affected lending decisions by conventional financial institutions after 1940. She used address-level mortgage data in Philadelphia from 1938 to 1950 to determine if actual mortgage patterns varied in accord with the HOLC risk categories. Her analysis used data on transactions and sheriff sales between 1928 and 1937 to control for market characteristics prior to HOLC mapping. She found that interest rates on loans were higher in redlined areas, but there were no consistent differences in the number of mortgages or the loan-to-value ratio of mortgages. "Redlined" neighborhoods, then,

were not avoided by banks. In her view, it is necessary to trace discrimination in the mortgage market to well before HOLC was created. "Even before the Depression," she argues, "private lenders chose to avoid certain areas, particularly those home to African Americans, certain ethnic groups including new immigrants, and with older, cheaper housing" (2003, p. 414).

Faber (2020) found no evidence that the distribution of grades assigned by HOLC in a city was related to subsequent changes in segregation. However, he reports that cities that were mapped by HOLC experienced more persistent segregation in subsequent decades than comparable cities that were not mapped. In other words, the content of the mapping did not matter, but "the institutional process of just being appraised is all that matters" (2020, p. 8).   If no maps had been prepared for any city, "average white-black dissimilarity among appraised cities would have peaked at .60 in 1960, rather than .68" (2020, p. 24). This conclusion is consistent with arguments about how both restrictive covenants (e.g., Long and Johnson) and redlining (e.g., Jackson) widen the gulf between white and black sections of urban areas. Yet while it is well documented that the redlining maps were intended to restrict mortgage lending in "riskier" neighborhoods, and that the racial composition of neighborhoods was understood as a major risk factor, no study has examined their effect on a metropolitan scale. In the following analysis we examine the HOLC redlining maps' relationship with changing segregation in metropolitan areas, between cities and suburbs, and within each of these parts of the metropolis.

Research questions and design

Our overall purpose is to describe and interpret the trajectories of segregation in metropolitan regions throughout the United States between 1940 and 1970. Although this period was the focus for many of the early specialists in segregation research, most of what we know is based on studies of central cities. What were the levels of segregation in metropolitan regions in

1940 and how did they change by 1970? What was the relative contribution of changing patterns of settlement within central cities and within suburban regions to these trends, and especially what was the contribution of the racially selective population shifts that occurred between cities and suburbs? Based on past research we anticipate relatively little change in cities, but like previous scholars we expect to document a large impact of the redistribution of white populations to suburbs while central cities absorbed the bulk of African American newcomers.

Our descriptive analysis goes beyond prior studies of this period in several ways. Studies of segregation as early as 1940 were limited to the largest cities for which the census provided block or tract data. New data sources for 1940 allow us to expand the geographic scope of analysis to whole metropolitan areas, and to extend the sample to include the much larger number of metros that were defined by the census by 1970. We are also able to refine the category of "white" residents to exclude Hispanics. The tables presented below summarize the trends in segregation for cities, suburbs, and the whole metropolis, as well as the changing composition of both cities and suburbs and the growing racial divide between them.

We also explore the sources of variation in these changes. Following the lead of studies of overall rates of suburbanization and trends in central city segregation in this period, as well as studies of metropolitan segregation in more recent times, we are particularly interested in differences by regional location, size, and racial composition. In addition, we will assess the possible effect of creation of HOLC maps in many metropolitan regions. One test of the effect of mapping is whether mapped metropolitan areas had greater increases (or smaller declines) in segregation by 1970 than urban areas that were not mapped, as argued by Faber (2020) based on his city-level analyses. A related test is whether the actual distribution of risk ratings in cities

affected segregation on a metropolitan scale, i.e., whether the racial disparity between cities and suburbs was greater in metros whose central cities were especially disfavored by redlining.

Population data sources

Population data for 1940 are from the Minnesota Population Center's 100% microdata based on data from Ancestry.com (Ruggles et al. 2021), which include geographic identifiers for each household's state, county, city, and enumeration district (ED), including all EDs in every county. In 1940 the census tabulated data for blocks (a smaller unit) and census tracts (a slightly larger area) for many large cities, but block data are not available in digital form and blocks and census tracts were defined only for larger central cities, excluding most urbanized areas outside of central cities. Hence the ED is the smallest 1940 neighborhood unit currently available for analyses of segregation at a metropolitan scale.

Population data for 1970 were aggregated from the original, confidential population samples in a Federal Statistical Research Data Center (FSRDC). These ED-level counts were approved for public disclosure by the Census Bureau, along with their county and city/place location.

Race and ethnicity

In past research, racial groups in 1940 and 1970 have most often been categorized as white, black, and "other race." Some studies have relied on a less specific dichotomy of white vs. nonwhite. The nonwhite category includes Asians and Native Americans, which is especially problematic in parts of the country, especially in the West, with large Asian American populations in urbanized areas. The "white" category poses an additional problem in urbanized areas with large Hispanic populations, particularly Puerto Ricans in the Northeast and Mexican-origin persons in the South and West. Because black residents are generally less segregated from

Hispanics (most of whom were categorized as white in the census) than from non-Hispanic whites, segregation measures using the white-black dichotomy are biased downwards, compared to what the values would be if Hispanics were removed from the white category (this effect is documented by Taeuber and Taeuber 1958, pp 64-68).

Therefore, we estimated the non-Hispanic white population at the neighborhood level in the following ways. Using the 100% 1940 microdata, we adopted the coding of Hispanics developed by Gratton and Gutman (2000) that considers several indicators such as whether they, their spouse, or parents were born in Latin America and whether they spoke Spanish at home during childhood. A non-Hispanic white, then, is a person of white race who is not Hispanic by these indicators. For 1970 we relied on the confidential, 20% sample data in the FSRDC to identify Hispanics as person who spoke Spanish in their household during childhood. We used person weights to then create ED-level population estimates. The non-Hispanic white count in an ED is the full-sample count of whites less the weighted sample count of white Hispanics. In this way we are able to measure segregation between non-Hispanic whites and African Americans in both 1940 and 1970, as is done in research with post-1970 census data.

Identifying metropolitan areas for study

An initial question is how to define metropolitan areas in a consistent way in both 1940 (the starting point for the study) and 1970 (the end point). The census changed its criteria for metropolitan status during these years. In 1940 only 140 "metropolitan districts" were identified. A metropolitan district required a total population of 100,000 or more and a central city of 50,000 or more (or in some cases two cities with a combined population exceeding 50,000). The included area was the central city, plus adjacent minor civil divisions or places with densities of at least 150 persons/square mile. By November 1970, the census identified 227 standard

metropolitan statistical areas (SMSAs), retaining the central city size criteria but expanding the area covered to one or more whole counties. We apply the 1970 metropolitan definitions here for two reasons: 1) they reflect the urban development process through 1970, and 2) being based on counties and central cities, they can readily be adapted to the available 1940 census data. New metropolitan areas were incrementally added and defined by the Census Bureau as populations grew over the course of the study period. We exclude those metros that were newly added for the 1970 census publications, because they were not otherwise considered metropolitan in the prior study years and thus relatively small. Another special difficulty is dealing with New England metros, which in 1970 were defined by towns rather than counties, and sometimes a single county was divided into two different metros. We use the solution put forward by Bogue (1953), who combined New England metros into whole-county designations.[2]

With this reduction, we begin with a potential sample of 219 cases for analysis. We reduce the sample in two ways. First, we omit metropolitan areas with less than 500 black residents in 1940 (leaving a sample of 192 metros), because segregation measures are unreliable when the minority population is very small. The results below in Tables 1-4 are from this sample of 192 metros. Second, in the multivariate analyses we omit Cincinnati (see below) and 39 unmapped metropolitan areas whose central city had less than 40,000 residents in 1940. This omission is necessary because we wish to estimate the relationship between HOLC mortgage risk mapping and segregation, and HOLC intentionally mapped no central cities smaller than 40,000. Of the remaining 152 metros, 136 were mapped and 16 were not mapped for unknown

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[2] The resulting New England metros are Boston-Lowell-Lawrence, Bridgeport-Stamford-Norwalk, Brockton, Fall River-New Bedford, Hartford-New Britain-Bristol, Manchester, New Haven-Waterbury, Pittsfield, Portland, Providence, Springfield-Holyoke, and Worcester.

reasons, including several with very large central cities (Washington, DC, Worcester and Fall River, over 200,000 population), several in the range of 70,000 to 140,000, and others in the 40,000-70,000 range. Including controls in the multivariate analysis for some likely predictors of being mapped (population size, black population size, and region), these unmapped cases allow us to test whether unmapped metros had different segregation trajectories through 1970 than the comparable metros that were mapped.

We also need a consistent sample of central cities in order to assess changes in macro-segregation and to analyze segregation trends within the city and suburbs separately. We accept the census identification of central cities in 1970 with the addition of three cities that had previously been recognized as central cities in 1940: Niagara Falls, NY; Council Bluffs, IA; and Elizabeth, NJ. The remainder of the metropolitan territory is classified as "suburban."

Metropolitan areas with redlining maps

We rely on the Mapping Inequality project at the University of Richmond (https://dsl.richmond.edu/panorama/redlining) for HOLC risk maps. In most cases, these maps include some suburban neighborhoods, while leaving out most suburban neighborhoods. An exceptional case is Cincinnati, where the only mapped area is in Covington, KY. Because no central city neighborhood was mapped, we are unable to use this case to assess the effect of central city redlining on segregation trends, and we omit it from the multivariate analysis. However, Cincinnati is included in the descriptive tables and figures.

Measures of segregation

A key feature of this study is our effort to highlight both the high levels of segregation found in cities and the contribution of suburban development to segregation at a metropolitan scale. Here we follow the lead of researchers (Parisi et al. 2011, Lichter et al. 2015) who

emphasized a distinction between micro-level segregation (uneven distribution across census tracts or blocks in the metropolitan area) and macro-segregation (the disparity between areas at larger scales). Most relevant to the period we study, Fisher et al. (2004) showed that in the decade from 1960 to 1970, segregation within central cities declined while the city/suburb disparity increased substantially.

One measure of segregation is the Dissimilarity Index that has been the workhorse of historical segregation studies. This is defined as

$$D = \frac{1}{2} \sum_{i=1}^{n} \left| \frac{v_i}{V} - \frac{w_i}{W} \right|$$

where for racial groups v and w, the population sub-geography is indicated by v_i and w_i and largest geography population totals are represented by V and W. We calculate total metropolitan segregation across enumeration districts (D_{total}) as well as the macro-segregation between cities and suburbs ($D_{between}$) and the segregation across neighborhoods within central cities (D_{cc}) and within suburbs (D_{sub}).

We also use Theil's H, an entropy-based measure that also reflects unevenness of distribution. Entropy (E) represents the overall diversity of a given area, and is defined as

$$E = -\sum_{r=1}^{n} \pi_r \, log(\pi_r)$$

where π_r is the proportion of racial group r in the area. H measures how closely E of the sub-geographies aligns with the E of the largest geography.

$$H = \sum_{i=1}^{M} \frac{t_i (E - E_i)}{ET}$$

where for T and t_i represent the total population of the largest geography and the sub-geography, respectively. E and E_i similarly represent the entropy scores for the largest geography and the sub-geography.

We then decompose the total segregation into the share of each scale that is attributable to each geography. We draw here on the approach of Wong (2003) to decompose D into a component at a smaller scale (we will refer to this as level 1, which might be EDs or census tracts) and a component at a larger scale (level 2, the city vs suburban zones). The racial make-up of the city and suburban zones mathematically constrains the composition of tracts or EDs within them. At the extreme, in an all-white suburban zone, all neighborhoods must be all-white, and there could be no segregation within suburbia. Conversely, if each zone's racial composition were like the metro as a whole, segregation between zones would equal zero, and all segregation would arise from differences among neighborhoods within them. Following Wong, we define the "zone contribution" to D as the observed value of D between the city and suburban zones. The "tract or ED contribution" refers to the average segregation across neighborhoods within the two zones. The total metropolitan D is the observed value of D at the neighborhood scale, and it is equal to the sum of between and within components.

We also carry out the decomposition using H, as is conventional in the macro-segregation literature (Reardon, Yun and Eitle 2000). The decomposition is as follows

$$H_{total} = H_{between} + \frac{T_{cc}E_{cc}}{TE}H_{cc} + \frac{T_{sub}E_{sub}}{TE}H_{sub}$$

The first term represents the share of the total segregation attributable to segregation *between* the cities and suburbs (which we will refer to as macro-segregation), and the second and third terms reflect the share that comes from segregation *within* the cities and the suburbs, respectively.

D and H are measures of the same aspect of segregation (unevenness of distribution across areas), and they are highly correlated with one another. For example, in 1940 the correlation between D and H was .74 at the metro scale and .81 for central cities. However, because there are slight differences in their distributional properties, they will not necessarily yield the same results in every analysis.   When they reveal the same pattern of change and variation, one can have greater confidence in the findings. When they differ, no strong conclusion can be drawn.

Analytical methods

The analysis proceeds in steps that reflect our effort to move segregation research for this period toward a metropolitan scale. In each step the primary axis of comparison is between Southern and non-Southern (which we will refer to simply as "Northern") cities. The situation in the urban South was distinctive throughout the late 19th and 20th Centuries in multiple ways. In addition to population differences these include the residue of slavery that favored physical proximity between whites and blacks and the many restrictions on black residents reflected in Jim Crow laws that remained in force throughout the decades that we study. Because this regional dichotomy overlaps considerably with other characteristics that are considered relevant to segregation, it is challenging to introduce them into a multivariate model. Table 1 summarizes these relationships. Southern cities on average had dramatically larger shares of African American residents (24%) than Northern cities (3%), with almost no overlap in their distributions. Difference on other variables are less extreme. There are substantial differences in total city and metropolitan population size in 1940, with Northern urban areas more than twice as large. (Because their cities were larger, Northern urban areas were also identified about a decade earlier as metropolitan by the Census Bureau.) Related to this size difference, Northern cities

were more likely to have been mapped by HOLC (82% vs 57%). But if they were mapped, the distribution of neighborhood ratings was quite similar in cities of both regions. On average 25% of neighborhood areas in Northern cities were rated in the lowest category (D), compared to 28% in Southern cities.

Table 1 about here

The multivariate models reported here are based on a subsample of 152 metropolitan areas whose central city had at least 40,000 residents in 1940, which means that it was formally eligible for HOLC appraisal and mapping. Analyses include a pooled model for all urban areas combined as well as separate models for North and South. Black population size is included only in the separate regional models because of the extreme collinearity between it and region. Metropolitan population size in 1940 is transformed to its natural logarithm to reduce the impact of the outsized Northern areas like New York and Philadelphia, and metropolitan black population is also introduced in log form. Redlining is represented in two variables. One is a dummy variable representing the 16 unmapped metros. The other is the percent of city neighborhoods in the metro that were graded D (e.g., "redlined"). Unmapped metros have been assigned the mean value of mapped metros on this predictor.

The outcome variables for these models are the difference between segregation in 1940 and 1970 (1970 less 1940). Segregation is modeled for four different spatial scales: total metropolitan segregation, segregation in the central city and in the suburban periphery, and macro-segregation (segregation between the city and its suburbs).

Findings

Trajectories of segregation, 1940-1970

We begin by reporting the average levels of segregation (both D and H) in 1940 and 1970 across all 192 metropolitan regions in Table 2. In the following text we refer specifically to values of D, but we note that the same patterns are found for H. Averages for all indicators are weighted by the number of African American residents in the metro in 1940, so that the mean represents the level of segregation experienced by the average black resident in a U.S. metropolitan region (in the region as a whole, its central city, its suburbs, or between city and suburb). Central city segregation has previously been reported for 1940-1970 at the block and tract levels, but not for enumeration districts. Reports of metropolitan and suburban segregation have previously been published only for 1960-1970, and no prior study has measured macro-segregation in this period. Table 2 distinguishes between areas in the North (n=110) and South (n=82), which reveals regional differences as well as trends in the size of those differences. The table also reports standard deviations, showing on which measures there was a general convergence or divergence among metros.

Table 2 about here

At the scale of whole metropolitan regions, segregation was already very high (D = 0.72) in 1940, and it increased by 12 points by 1970. This increase occurred mainly in the South, which began at a much lower level than the North in 1940 (0.64 versus 0.82), but reached near-parity by 1970. One consequence of the rising average level in the South was a reduction in overall variation among metros, which was also found within each region. These trends suggest a generalized convergence to a similarly high level of segregation not only between regions but also within each part of the country. Recall that Van Valey, Roof, and Wilcox (1977) reported

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almost no change (a small decline) in average metropolitan segregation between 1960 and 1970.

By going further back in time to 1940 we can see that segregation had been increasing

substantially in Southern metros, though not so much in the rest of the country.

Central city segregation had also reached a very high level by 1940 (D = 0.78), but like

prior researchers (Sørensen et al. 1975), we find the peak was starting to be reached by the mid-

century, and it increased only 6 points in the ensuing three decades. Northern cities remained

about the same, while Southern cities saw an increase in segregation, exceeding the Northern

average by 1970. Again, we note that the variation across cities in both regions declined in this

period, and this convergence was evident for D and H indices.

While the national average increase in segregation within the central cities was modest,

segregation in their suburban peripheries was increasing more. It was somewhat low in 1940

(D=0.57) but then rose to 0.76 by 1970. Hence, one source of the increase in metropolitan

segregation overall was the increase in suburbia. The increase occurred particularly in the South,

where suburban segregation increased by 26 points between 1940 and 1970. The North had

much higher suburban segregation already in 1940, and its average value increased by only 11

points. Although there was considerable convergence between North and South, there was little

change in the standard deviation of D within either region (and in fact, there was some increase

in variation in H).

There is one other contributor to change in metropolitan segregation, a growing racial

disparity between cities and suburbs in both regions of the country – the "chocolate city vanilla

suburbs" phenomenon. The national average of D between city and suburb rose from 0.15 to

0.39 in this period of rapid suburbanization. The 1940 average was higher in the North (D =

0.18) than in the South (D = 0.13). The gap widened by 1970, reaching 0.44 in the North and 0.31 in the South.

In short, segregation was actually falling in central cities in the North. Meanwhile, suburban segregation was reaching the same level as in the cities, and there was a very large increase in the city-suburb divide. In contrast, segregation increased considerably in the South among neighborhoods within the central city and the suburbs, at the same time as macro-segregation was also growing. The net result was a larger metro-level increase. Again, it would be informative to know how much each component of segregation contributed to the overall level. We approach these questions through a decomposition of segregation into each of these three components. The decomposition is reported in Table 3 for both D and H. The direction of change is the same for both indices, but the decomposition of D gives more weight to the change in city-suburb macro-segregation.

Table 3 about here

In the North, the main contributor to metropolitan segregation in 1940 was within the central cities (64%). By 1970 its contribution had dropped to only 34%, with the shift going entirely to the city-suburb divide (up from 22% to 51%). The shifts in the South were in the same direction, but while they were substantial they were less extreme. At a national level, pooling the two regions together, with little change in the share attributable to segregation within suburbia, the city share dropped from 61% to 38%, while the macro-segregation share increased from 21% to 46%.

Population shifts resulting in rising city/suburb segregation

These figures underline the importance of the macro-segregation between city and suburb. We explore this phenomenon now in more detail in order to illustrate more fully what

changes were occurring. The growing importance of suburbanization to metropolitan segregation results from two aspects of population shifts in the metropolis, 1) the rapid growth of suburban population in the face of the relatively stagnant central city population, and 2) the racially selective nature of changes in each zone. Table 4 summarizes these trends by aggregating the white and black population counts in cities and suburbs across all metros to show the overall flows of population.

Table 4 about here

The table shows some well-known features of urban change in this period. First, summing across all 192 metropolitan areas in our sample, the total city population increased by about a third from 45.3 million to 59.2 million. At the same time, the total suburban population more than doubled from 29.2 million to 73.3 million. Between 1940 and 1970, the composition of metropolitan areas shifted from most people living in central cities to most people living in suburbs. In the North, central city populations increased modestly, while the vast majority of the population growth was in the suburbs. In the South, central city and suburban populations grew more in parallel.

We are mainly interested in the changes by race. In Northern central cities, the white population actually declined while the Northern suburbs experienced a dramatic gain of nearly 31 million whites. At the same time, the number of central city black residents grew by a factor of nearly 4. The black suburban population in the North also increased at a very rapid rate, but the absolute volume of black growth in cities (increasing by over 6 million) was much greater than in the suburbs (1.4 million). This very large disparity in the location of growth by whites and blacks is summarized in the increasing city-suburb segregation score from reported in Table 2, from .18 to .44.

Urban areas in the South followed a somewhat different trajectory. Southern cities were experiencing both white and black population growth in this period, so the balance between whites and blacks in cities was not changing as dramatically as in the North. Also, although white suburban growth greatly outpaced black suburbanization in the South, Southern suburbs were still averaging 12.4% black in 1970, a much higher share than in the North. Hence although city-suburb segregation was increasing in this period in the South, it increased less and remained at a lower level than in the North.

A concern in interpreting these data is that many cities in this period were growing partly by annexation of adjacent suburbs. Researchers in the 1940s and 1950s (e.g., Bogue 1953) were careful to measure changes within constant city boundaries, noticing that the observed population counts for cities could be very much affected by including people who lived within the newly annexed areas. We can quantify the effect of annexation on the city-suburban racial disparity for a subsample of 64 larger metropolitan for which GIS maps of the cities in 1940 can be overlaid on a 1970 city map. We document the result in more detail in Appendix A. In general, accounting for annexation does not change the direction of changes in population or segregation trends, but it does affect the magnitude. The one exception is the central city white population in the South. Without accounting for annexation, the central city white population seems to increase, while using consistent geographic boundaries shows a decrease. This suggests that the areas in the South that were annexed were inner-ring suburbs that were predominantly white. Because accounting for annexation does not change the directions of segregation trends, we proceed with the remainder of the analysis with the subsample of 152 metros with at least 500 black residents and a central city population exceeding 40,000 in 1940. Future research with

more complete GIS mapped data should replicate the analysis that we present here with controls for annexation.

Predictors of Segregation

Not shown here, plots of the average values of segregation in 1940 against those in 1970 show much variability in both the initial levels of segregation and in the changes over time. This variation offers an opportunity to begin to assess the predictors of segregation. As a first step, we estimate the change between 1940 and 1970 for all four geographies analyzed above. Table 5 reports results using D as the measure of segregation and Table 6 predicts change in H. As noted above, these measures are both intended to provide information about the unevenness of the distribution of two groups across local areas, and they are highly correlated with one another. Still, some relationships with change in D in Table 5 differ from those reported for H in Table 6. Neither can be thought of as superior to the other. Our approach is to consider a relationship to be confirmed when the coefficient is statistically significant in both versions and to be disconfirmed when both are non-significant. In cases where a coefficient is significant in one model but not the other, we consider it to be unconfirmed but worthy of future investigation.

In these analyses every case is counted equally, with no weighting. As noted above, one predictor is the North-South dichotomy. Because Northern urban areas were larger and size may be associated with greater segregation, we include the natural logarithm of 1940 metropolitan population as a second predictor. To test the effects of mapping at a metropolitan scale, we include a dummy variable where the reference category indicates central cities that were not mapped. To subsequently test whether the qualitative distribution of risk ratings affected

segregation, we include a continuous measure of the share of neighborhood areas that were

redlined (graded D) by HOLC in each mapped central city.[3]

<center>Tables 5-6 about here</center>

Additionally, in separate models for North and South we include a measure of the total

black population (logged) in 1940 to test whether urban areas with a larger black presence had

higher levels of segregation or greater increases over time.[4] This variable cannot be included in

the pooled model because there is almost no overlap in black population size between Northern

and Southern cases. There are many other area characteristics that could be associated with

segregation. We intend these models as a starting point for understanding relationships with a

few theoretically key variables.

We begin with the more commonly studied predictors: region, metropolitan size, and

black population size. The pooled models in Tables 5-6 show the metros in the South were

likely to have greater increases in segregation in the city, total metro, and suburbs. In contrast,

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[3] By definition, measures of redlining are meaningful only among mapped metros. To preserve a valid estimate of redlining while retaining an estimate for mapped status, all metros that were not mapped were assigned the % redlined mean value among all mapped metros (i.e., unmapped metros do not contribute to the estimate of the coefficient for % redlined in the models). Alternative measures of redlining (the population of redlined areas or their land area) could not be calculated for most cities in our sample, because we lack detailed GIS maps for them. In separate analyses for a subsample of cities with available maps, most coefficients were in the same direction, though many no longer statistically significant, due to the reduction in sample size. We rely here on the results for the larger sample.

[4] We choose to employ measures of the black population total rather than measures of their relative share of the metro population. This reflects our view that, particularly within regions, the absolute size of the black population is likely to be a greater predictor of metro-wide segregation trends. However, we replicated all multivariate models with an alternative measure, % black, and all substantive results remained the same. We also separately estimated models using change in black population as a predictor rather than the 1940 value and found no more consistent effects.

change in macro-segregation was smaller in the South (statistically significant only in the model for H). These results are consistent with the descriptive findings in Table 2 above.

Associations with population size are reported in both the pooled models and the region-specific models. These are mostly consistent across models. Larger metro size is associated with smaller increases in segregation in the city and the total metro in the pooled models for both D and H and also in the region-specific models. (There is only one exception: in the South model for H, the size effect on change in metro segregation is negative but not significant.) One reason for this relationship, we believe, is that larger metros already had higher levels of segregation in 1940, and to some extent the smaller metros converged toward their level by 1970. The opposite relationship is found with macro-segregation. Larger metros experienced greater increases in macro-segregation as shown in the pooled models for D and H and in the South regional models. In the North, where metros were much larger and macro-segregation was also greater in 1940, size had no relationship with changing macro-segregation. Finally, size was unrelated to change in suburban segregation in the pooled models and in the South. But it was negatively associated with changing suburban segregation in the North.

Larger black populations are expected by the minority threat model to be associated with greater segregation. As noted above, we test this hypothesis only in the region-specific models because of the extreme difference in racial composition between regions. Results are mixed. Because this theory was developed at a time when segregation was perceived mainly as a central city phenomenon, one might have expected the clearest evidence to be for changing city segregation. However, there is no significant coefficient for city segregation in either North or South nor for D or H. On the contrary, some effects are found for metropolitan and suburban segregation and for macro-segregation. Inexplicably, however, these are not consistent across

models, and we cannot explain this variability. Larger black population is associated with increasing metro and suburban D in both North and South, with suburban H in the North but not in the South, and with metropolitan H in neither North nor South. It is associated with rising macro-D and macro-H in the North but not in the South. This set of results contradicts the minority threat hypothesis for the central cities where it was most expected. However, these mixed results indicate a need for further research on how black population size may have been a factor in the broader metropolis as more white households moved to the suburbs, particularly in the North.

The remaining predictors are intended to reflect the possible causal effect of HOLC risk mapping in the late 1930s on subsequent changes in segregation. Here the results are heavily against this hypothesis. In none of the pooled models or models for Southern metros does mapping itself or the share of city neighborhoods that were redlined have a significant association with changing segregation. Most coefficients in the models for Northern metros are also non-significant. There are two exceptions, and they are in different directions. In the North model for change in central city H, unmapped metros are found to have significantly smaller increases in segregation. But in the North model for change in macro-D, metros whose central cities were more likely to be redlined also had smaller increases, the opposite of what might have been expected.

Conclusion

The main purpose of this study is to provide new and more detailed information on the fundamental reorganization of the metropolis due to the massive and racially selective process of suburbanization in the three decades after 1940. This period is well understood in general terms. Its impact on racial residential segregation is the main theme of important works such as

Jackson's Crabgrass Frontier (1985). Yet until now there has been no study of the actual changes in patterns of segregation at the metropolitan scale in these years. We draw on newly available microdata from the censuses conducted in 1940 and 1970 to analyze the trends systematically. The flexibility in being able to aggregate the original individual-level data allows us to measure segregation specifically for non-Hispanic whites and African Americans, avoiding the ambiguity of the white-nonwhite or white-black measures in previous studies. The main advantage of these microdata is that they cover the whole territory of every county, so it is possible to study trends within a constant geographic area. The study hinges on distinguishing segregation across neighborhoods in different parts of the metropolis, and for this purpose we must treat central cities as they were defined in 1940 and in 1970, without controlling for annexation that extended their boundaries. However, for the subset of cities where extant GIS maps allow us to do so, we also analyzed patterns based on constant 1940 city boundaries and found similar results.

The key findings highlight the impact of suburbanization and also the differences between metropolitan areas in the North and South. In the North, segregation within the central city was stable or declining in this period, and segregation at a metropolitan scale increased only because of growing divisions between the city and its suburbs and among suburban neighborhoods. In the South, in contrast, segregation was initially lower than in the North, but it increased at every scale – at the metro level, within cities and within suburbia, and at the macro-level of city vs suburbs. Most striking and previously unnoticed is the change in relative shares of total segregation that we revealed by spatially decomposing total metropolitan segregation. In both regions, there was a substantial fall in the share contributed by segregation within central cities, matched by very large increases in the share contributed by macro-segregation.

This shift reflects the massive reorganization of the metropolitan population that took place in these years, which others have called attention to. While the total central city population in the North grew only slightly, there was a net loss of over three million non-Hispanic whites and an increase of six million African Americans. At the same time, the suburban grew by nearly 34 million, of which only a little over one million was African American. In the South, cities continued to grow in both white and black residents, approximately doubling in total size, but suburbs grew faster, and with a disproportionate increase in white population. We found that much central growth in the South was due to annexation, with formerly suburban areas adjacent to the city – both white and black – incorporated within the new borders. Yet the net result was still a shift toward macro-segregation.

Although there was a convergence toward high levels of segregation in the North and South, as well as within each region, there was also much variation in the changes experienced in different metropolitan areas. This variation provides a basis for asking what metropolitan characteristics were associated with higher or lower increases. With only a moderate sample size of metros, it is possible to estimate multivariate regression models with a limited number of covariates. Following up on the descriptive tables, we controlled for region, and we estimated models separately in each region. The key predictors based on current theory are minority threat (operationalized as the size of the black population, while controlling for total population size) and redlining (operationalized using the HOLC maps).

Results for black population size are mixed. In no case does it show the negative effect reported by Taeuber and Taeuber (1965) for 1950-1960 for central city segregation; all coefficients predicting central city segregation (North and South, for D and H) are non-significant. The two consistent effects (i.e., the same for both segregation measures) are only in

the North, where a larger black population is significantly associated with higher suburban and macro-segregation. Negative findings should not be surprising in light of the lack of evidence for minority threat in prior research, despite the intuitive appeal for this hypothesis. Given the very large black populations in Southern regions that date back to the 19th Century and the strength of the Jim Crow regime there, it would be surprising for minority threat to be a major factor in that region. But why would it find support in the North only for patterns related to suburbanization? One line of reasoning is to consider the black presence in a metropolitan region to be a stimulus for white flight from central cities, assuming that there was a generalized desire by whites to live in all white communities. To the extent that "black avoidance" became a motive for living in the suburbs, it could also translate into increasing segregation of those African Americans who did live in the suburban ring. This explanation relies on speculation about motives that is consistent with the results reported here but we have no information about how people made choices in this period. This logic also raises another question about black avoidance, which is when it became a determinant of white residential choices and why, once in lay, there is so little evidence of it in the 1980s and 1990s.

If HOLC redlining contributed to segregation, as many urbanists have argued, its effect could have been seen in higher segregation increases in metropolitan areas whose central city had been mapped by HOLC (as reported by Faber 2020) or in those where a higher share of city neighborhoods had been graded as most risky (for which Faber found no evidence). Our analyses show no support for either of these expectations for total metropolitan segregation or for any of its components. If the redlining maps discouraged mortgage credit in city neighborhoods, it is reasonable to anticipate that this would especially incentivize whites (who had more housing options) to locate outside the city, hence causing an increase specifically in macro-segregation.

There is a hint of an effect in the opposite direction for Northern metros in Table 5 (predicting D) but not in Table 6 (predicting H).

Another interpretation is that both redlining (which we measured) and restrictive covenants and other exclusionary devices in the suburbs (which we did not measure) actually did affect segregation, but that their impact was not specific to any particular cities. Possibly redlining and suburban exclusion were so widespread at a national level, that they affected all metropolitan areas, and this global effect overwhelmed whatever variations there were between them. We put this proposition forward cautiously. Much more needs to be known in order build a case for it. Was private market redlining already so effective that the impetus given by HOLC (or by FHA in its loan approvals) was inconsequential, or did private lenders develop different standards for appraisals? When data become available for restrictive covenants in more cities and especially beyond the city limits, did they promote segregation? Alternatively, what other mechanisms, such as exclusionary zoning, were at work? It seems likely that policies that depressed central city housing markets while strengthening suburban development, combined with racially discriminatory implementation of those policies, worked together to segregate the metropolis in the postwar period. At this point, however, the evidence is inconclusive.

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		Metro Population	Central City Population	Metro Percent Black	Percent Mapped	Percent Graded D (Central City)
				Table 1: Descriptive Statistics for Metropolitan Areas, 1940		
North	**Mean**	536,717	329,465	3.0	81.8	25.1
	SD	1,048,916	817,674	2.9		10.6
	N	110	110	110	110	90
South	**Mean**	188,524	110,006	23.6	57.3	27.6
	SD	196,200	140,762	14.6		8.8
	N	82	82	82	82	47
Total	**Mean**	388,010	235,738	11.8	71.4	26
	SD	820,988	633,878	14.1		10.1
	N	192	192	192	192	137

Table 2: Weighted Means of Segregation Indices by Region, 1940-1970									
		Total		Central City		Suburbs		Macro-Segregation	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Dissimilarity (D):									
North	1940	0.83	0.07	0.85	0.08	0.71	0.09	0.18	0.10
	1970	0.86	0.06	0.83	0.07	0.82	0.07	0.44	0.13
South	1940	0.64	0.10	0.73	0.11	0.47	0.10	0.13	0.08
	1970	0.82	0.07	0.84	0.06	0.73	0.11	0.31	0.21
Total	1940	0.72	0.13	0.78	0.11	0.57	0.15	0.15	0.09
	1970	0.84	0.06	0.84	0.07	0.79	0.10	0.39	0.18
Entropy (H):									
North	1940	0.64	0.14	0.68	0.15	0.40	0.12	0.03	0.02
	1970	0.71	0.10	0.68	0.11	0.58	0.14	0.14	0.07
South	1940	0.46	0.12	0.56	0.14	0.24	0.08	0.02	0.02
	1970	0.70	0.09	0.73	0.09	0.51	0.13	0.10	0.11
Total	1940	0.53	0.16	0.61	0.16	0.31	0.13	0.02	0.02
	1970	0.70	0.10	0.70	0.11	0.55	0.14	0.13	0.09

Table 3: Components of segregation (as % of total metropolitan segregation)					
				Unique contribution (%)	
		Total Segregation	Within Central City	Within Suburbia	Macro-Segregation
Dissimilarity (D):					
North	1940	0.83	64%	14%	22%
	1970	0.86	34%	15%	51%
South	1940	0.64	60%	21%	20%
	1970	0.82	42%	21%	37%
Total	1940	0.72	61%	18%	21%
	1970	0.84	38%	17%	46%
Entropy (H):					
North	1940	0.64	80%	16%	4%
	1970	0.71	60%	21%	20%
South	1940	0.46	75%	21%	4%
	1970	0.7	60%	26%	15%
Total	1940	0.53	77%	19%	4%
	1970	0.7	60%	23%	18%

Table 4: Means and Total Populations of Central Cities and Suburbs by Region, 1940-1970							
		North		South		Total	
		Mean	Sum	Mean	Sum	Mean	Sum
Central cities:							
Total	**1940**	329,465	36,241,124	110,006	9,020,487	235,738	45,261,611
	1970	380,438	41,848,198	211,406	17,335,293	308,247	59,183,491
White	**1940**	303,862	33,424,836	78,775	6,459,571	207,731	39,884,407
	1970	276,455	30,410,084	136,795	11,217,191	216,809	41,627,275
Black	**1940**	19,204	2,112,386	27,292	2,237,982	22,658	4,350,368
	1970	74,044	8,144,785	58,320	4,782,205	67,328	12,926,990
Suburbs:							
Total	**1940**	207,253	22,797,799	78,518	6,438,461	152,272	29,236,260
	1970	512,940	56,423,355	208,666	16,901,985	383,902	73,325,340
White	**1940**	199,090	21,899,928	60,908	4,994,451	140,075	26,894,379
	1970	477,600	52,536,010	178,852	14,486,992	350,906	67,023,002
Black	**1940**	4,406	484,664	15,290	1,253,776	9,054	1,738,440
	1970	16,830	1,851,321	22,179	1,796,493	19,099	3,647,814

Table 5. OLS Models Predicting Change in Index of Dissimilarity (D), Pooled and by Region

	Pooled				North				South			
	Total	Central City	Suburbs	Macro-Segregation	Total	Central City	Suburbs	Macro-Segregation	Total	Central City	Suburbs	Macro-Segregation
South	0.107***†	0.085*	0.165*	-0.038								
	(0.012)	(0.015)	(0.019)	(0.025)								
Population (ln)	-0.017*	-0.032*	-0.007	0.066*	-0.044*	-0.049*	-0.073*	-0.005	-0.048*	-0.068*	-0.052	0.121*†
	(0.006)	(0.008)	(0.010)	(0.013)	(0.009)	(0.012)	(0.012)	(0.022)	(0.020)	(0.024)	(0.035)	(0.037)
Black population (ln)					0.022*	0.015	0.053*	0.048*†	0.030*	0.025	0.045*	0.002
					(0.006)	(0.008)	(0.008)	(0.014)	(0.012)	(0.014)	(0.021)	(0.022)
Unmapped	-0.002	-0.007	0.018	-0.030	-0.017	-0.036	0.007	0.006	0.056	0.063	0.097	-0.038
	(0.018)	(0.022)	(0.029)	(0.038)	(0.019)	(0.026)	(0.026)	(0.045)	(0.034)	(0.041)	(0.059)	(0.064)
% Redlined	0.046	0.047	0.136	-0.079	0.018	0.049	0.065	-0.320*†	-0.013	-0.053	-0.027	0.356
	(0.057)	(0.071)	(0.094)	(0.121)	(0.056)	(0.077)	(0.077)	(0.135)	(0.129)	(0.156)	(0.239)	(0.242)
Constant	0.242*	0.401*	0.109	-0.624***	0.400*	0.480*	0.492*	-0.089	0.428*	0.677*	0.384	-1.474*
	(0.080)	(0.101)	(0.131)	(0.172)	(0.085)	(0.117)	(0.117)	(0.205)	(0.200)	(0.241)	(0.352)	(0.375)
N	152	152	152	152	99	99	99	99	53	53	53	53
R-sq	0.433	0.316	0.377	0.198	0.225	0.189	0.356	0.244	0.159	0.177	0.117	0.298

*p<.05. Standard Error in Parentheses; † p<.05 for Chow test of differences in North-South coefficients

Table 6. OLS Models Predicting Change in Entropy Index (H), Pooled and by Region

	Pooled				North				South			
	Total	Central City	Suburbs	Macro-Segregation	Total	Central City	Suburbs	Macro-Segregation	Total	Central City	Suburbs	Macro-Segregation
South	0.078*	0.059*	0.133*	-0.022*								
	(0.016)	(0.018)	(0.021)	(0.011)								
Population (ln)	-0.025*	-0.045*	0.002	0.034*	-0.035*	-0.039*	-0.054*	0.004	-0.039	-0.076*	-0.032	0.059*†
	(0.008)	(0.009)	(0.011)	(0.006)	(0.013)	(0.014)	(0.017)	(0.010)	(0.027)	(0.032)	(0.035)	(0.016)
Black population (ln)					0.005	-0.004	0.045*	0.019*†	0.025	0.024	0.035	0.004
					(0.009)	(0.009)	(0.011)	(0.006)	(0.016)	(0.019)	(0.021)	(0.009)
Unmapped	-0.008	-0.011	0.006	-0.008	-0.051	-0.075*†	0.005	-0.018	0.081	0.107	0.058	0.030
	(0.024)	(0.027)	(0.032)	(0.016)	(0.028)	(0.029)	(0.036)	(0.020)	(0.046)	(0.054)	(0.059)	(0.026)
% Redlined	-0.025	-0.046	0.085	0.017	-0.020	-0.018	0.019	-0.057	-0.044	-0.072	-0.040	0.143
	(0.077)	(0.086)	(0.104)	(0.052)	(0.083)	(0.087)	(0.108)	(0.059)	(0.175)	(0.206)	(0.237)	(0.100)
Constant	0.440*	0.662*	0.057	-0.356*	0.522*	0.626*	0.384*	-0.116	0.436	0.848*	0.261	-0.767*
	(0.109)	(0.123)	(0.146)	(0.074)	(0.126)	(0.133)	(0.165)	(0.090)	(0.271)	(0.318)	(0.349)	(0.155)
N	152	152	152	152	99	99	99	99	53	53	53	53
R-sq	0.220	0.225	0.226	0.257	0.129	0.229	0.156	0.263	0.099	0.174	0.066	0.378

*p<.05. Standard Error in Parentheses; † p<.05 for Chow test of differences in North-South coefficients

Appendix A: Dealing with annexation

As we shift the focus to segregation at a metropolitan scale, there is another distinctive characteristic of urban development in the South that needs to be considered. We draw particular attention to disparities in racial composition between cities and their surrounding suburbs. However, cities continued to expand their boundaries through annexation during 1940-1970, especially in Southern metropolitan regions. Some researchers (including the Taeubers) were able to control for annexation by measuring city segregation within constant 1940 boundaries. This is not possible for the current study.

Annexation does not affect measures of overall metropolitan segregation, but it does complicate efforts to learn how suburbanization contributed to changes in segregation. As people moved into newly developing areas around cities after 1940, they were suburbanizing, but in many cases their communities had been reclassified as "central city" by 1970. To fully understand the impacts of suburbanization we need to identify three zones (the original city, the annexed territory by 1970, and the remaining suburban area). This is the case throughout the nation but especially in the South, where otherwise the measures risk being misleading.

In our analysis of metropolitan segregation, we look at racially selective suburbanization and changing patterns within cities. This step raises a conceptual question: what is city and what is suburb? Many cities expanded their boundaries through annexations, sometimes very substantially, between 1940 and 1970, as they had been doing in prior decades and they continued to do through the present. Politically, the newly developing suburban area became part of the city. Was it already "city" in 1940 by virtue of its impending annexation? For some purposes that is the real story. Changing political geographies represent spatial changes of who represents the constituents of a government. And yet if our intention is to assess how suburban

development outside the original city borders contributed to metropolitan segregation, changes in the annexed area may need to be separately accounted for. To assess whether our results might be sensitive to changing boundaries, we conduct a sensitivity analysis on a subset of metros.

We separately assign enumeration districts to urban or suburban areas, based on the boundaries used in 1970 and the boundaries for the city as it was defined in 1940. We accomplish this in the following way. First, we accept the population data for geographies as they were identified in each year. Then, for a subsample of the largest metropolitan regions for which we have GIS maps in each year, we distinguish between neighborhoods within the original 1940 boundaries, those in the formerly suburban territory that became part of the city by 1970, and those that remained outside the city in 1970. This can be accomplished simply by overlaying the 1940 and 1970 city boundaries on top of the ED data for the 1970 metropolitan areas, and tabulating population counts for the different geographies.

We created 1940 ED shapefiles to extract the 1940 central city boundaries for the central cities of 64 metropolitan areas. There is no full ED-level GIS map for 1970. Instead, we used a census resource (a version of MEDLIST that provides the centroid of every EDs and block groups in the metro in 1970), to identify the centroids of each ED. Where an ED included more than one block group, we used the mean latitude and longitude of the block group centroids as the location of the ED. We then assign EDs to urban and suburban territory via the ED centroids, so that we can create tabulations for metropolitan areas.

The results are shown in Appendix Table A1, which document the changing population distributions between cities and suburbs, depending on whether we use the 1940 city boundaries or the 1970 boundaries. For the full sample of 64 metros and in the North, the substantive conclusions are the same, but the magnitudes change. Regardless of which boundaries are used,

suburbs grew substantially while central cities shrank, and the suburbs became overwhelmingly white while cities saw large increases of black residents.

The difference comes in the South. When using the 1970 political boundaries, central cities grew and saw increases of white residents, while the black population grew in the suburbs. Yet when we use the cities as they were defined in 1940, we see that the trend looks more similar to the rest of the country. This suggests that the annexed areas in the south were predominantly white inner-ring suburbs.

Since our main research question concerns the changing levels of segregation between cities and suburbs, it is possible that these boundary changes could change our conclusions, particularly in the south. Appendix Table A2 shows recalculated segregation measures for the 64 metros, with mean levels similarly weighted by the metropolitan black population. We find that the levels of the different types of segregation (both H and D) are nearly identical, regardless of whether one chooses the 1940 or the 1970 city boundaries. There may be a slight decline in segregation within the suburbs if one uses the 1970 boundaries compared to the original 1940 territories.

In light of the robustness of our findings to the choice of city boundary, we concluded that the remainder of the analysis could be conducted with our full 192 metro sample. We re-ran some of the models we could with the smaller sample of 64 metros, and came up with similar results. The problem is that nearly all of the 64 metros were mapped, thus limiting what is possible to test regarding redlining variables. Thus, we cannot rule out the possibility that these findings might not hold if we had 1940 boundaries for the remaining 128 metros, though we feel comfortable with the results of this check.

	Census Year	City boundary year	North		South		Total	
			Mean	Sum	Mean	Sum	Mean	Sum
Appendix Table A1: Means and Total Populations of Central Cities and Suburbs by Region, based on 1940 and 1970 Central City Boundaries								
Central cities								
Total	1940	1940	692,041	31,141,851	299,885	5,697,810	575,620	36,839,661
	1970	1940	671,816	30,231,717	302,119	5,740,252	562,062	35,971,969
	1970	1970	742,832	33,427,447	518,873	9,858,584	676,344	43,286,031
White	1940	1940	636,089	28,623,984	217,958	4,141,211	511,956	32,765,195
	1970	1940	455,918	20,516,296	145,028	2,755,529	363,622	23,271,824
	1970	1970	517,640	23,293,779	310,792	5,905,051	456,232	29,198,830
Black	1940	1940	42,888	1,929,951	73,435	1,395,271	51,957	3,325,222
	1970	1940	158,672	7,140,234	131,797	2,504,135	150,693	9,644,369
	1970	1970	164,622	7,407,988	167,919	3,190,459	165,601	10,598,447
Suburbs								
Total	1940	1940	388,644	17,488,994	152,786	2,902,931	318,624	20,391,925
	1970	1940	1,074,306	48,343,766	741,624	14,090,865	975,541	62,434,631
	1970	1970	1,003,290	45,148,036	554,030	9,972,533	874,930	55,120,569
White	1940	1940	374,584	16,856,270	123,875	2,353,628	300,155	19,209,898
	1970	1940	996,294	44,833,221	626,604	11,905,485	886,542	56,738,706
	1970	1970	934,572	42,055,737	486,442	8,755,964	806,535	50,811,701
Black	1940	1940	9,073	408,288	25,911	492,312	14,072	900,600
	1970	1940	42,195	1,898,757	81,183	1,542,475	53,769	3,441,232
	1970	1970	36,245	1,631,003	47,564	856,151	39,479	2,487,154

		Central City		Suburbs		Macro-Segregation	

Appendix Table A2: Weighted Means of Segregation Indices by Region

Based on 1940 and 1970 Central City Boundaries

	Census Year	City boundary year	Central City Mean	Central City SD	Suburbs Mean	Suburbs SD	Macro-Segregation Mean	Macro-Segregation SD
Dissimilarity (D):								
North	1940	1940	0.86	0.06	0.72	0.09	0.18	0.09
	1970	1940	0.84	0.06	0.83	0.07	0.45	0.13
	1970	1970	0.84	0.06	0.83	0.07	0.44	0.13
South	1940	1940	0.78	0.06	0.49	0.09	0.12	0.06
	1970	1940	0.83	0.05	0.79	0.07	0.42	0.16
	1970	1970	0.85	0.06	0.76	0.08	0.40	0.21
Total	1940	1940	0.83	0.07	0.61	0.14	0.15	0.09
	1970	1940	0.84	0.06	0.82	0.07	0.44	0.14
	1970	1970	0.84	0.06	0.80	0.08	0.43	0.16
Entropy (H):								
North	1940	1940	0.70	0.13	0.41	0.12	0.03	0.02
	1970	1940	0.70	0.10	0.61	0.13	0.14	0.08
	1970	1970	0.70	0.10	0.59	0.13	0.14	0.07
South	1940	1940	0.62	0.09	0.25	0.08	0.02	0.01
	1970	1940	0.72	0.07	0.62	0.12	0.16	0.11
	1970	1970	0.73	0.08	0.53	0.11	0.15	0.12
Total	1940	1940	0.67	0.12	0.34	0.13	0.02	0.02
	1970	1940	0.71	0.09	0.61	0.13	0.15	0.09
	1970	1970	0.71	0.09	0.58	0.13	0.15	0.09