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The Effects of the 1930s HOLC "Redlining" Maps

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Abstract: In the wake of the Great Depression, the Federal Government created new institutions such as the Home Owners' Loan Corporation (HOLC) to stabilize housing markets. As part of that effort, the HOLC drew residential security maps for over 200 cities to grade the riskiness of lending to neighborhoods. The maps were color-coded using an A to D scale. We trace out the effects of these maps over subsequent decades by linking geocoded HOLC maps to both census and modern credit bureau data. Our analysis looks at the difference in outcomes between residents living on a lower graded side versus a higher graded side of an HOLC boundary within highly close proximity to one another. We compare these differences to "counterfactual" boundaries using propensity score methods. In addition, we exploit borders that are least likely to have been endogenously drawn. We find that areas that were on the lower graded side of "D-C" and "C-B" boundaries in the 1930s experienced a marked increase in the share of the population that is African American in subsequent decades, a result that peaks around 1970 and declines thereafter. We also find evidence of a long-run decline in home ownership, house values, rents, and credit scores along the lower graded side of borders that persists today. For some outcomes, these declines were larger and more enduring along the C-B than the D-C boundaries. We confirm these findings using an independent discontinuity strategy that exploits the HOLC's decision to limit maps to cities with a population of 40,000 or more. In total, our results provide strongly suggestive evidence that the HOLC maps had a causal and lasting effect on the development of urban neighborhoods through credit access.

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Introduction

Social scientists have long been interested in the link between place and socioeconomic success. With better data and more convincing sources of identification, there is now a greater recognition that where you grow up may causally affect academic performance, earnings, economic mobility, health, and longevity (e.g. Ludwig et al 2013; Chetty et al 2014, 2016a, 2016b; Reardon, Kalogrides, and Shores 2016). Moreover, striking racial differences in these same outcomes have been the basis of a large literature examining the role of residential segregation in explaining geographic disparities (e.g. Cutler and Glaeser 1997; Cutler, Glaeser, and Vigdor 1999; Ananat 2007; Boustan 2011; Chetty and Hendren 2017). Our study focuses on one potentially important channel that could drive both place- and race-based disparities, namely access to credit.

In the aftermath of the Great Depression, the Federal Government undertook dramatic reforms to limit foreclosures and stabilize the housing market. One seemingly innocuous development was the overhaul of property appraisal practices. The Home Owners Loan Corporation (HOLC), a now-defunct federal agency, drew maps for over 200 cities in order to document the relative riskiness of lending across neighborhoods. Neighborhoods were classified based on detailed information about housing age, quality, occupancy, prices, and other related risk-based characteristics. However, non-housing characteristics such as race, ethnicity, and immigration status were influential factors as well. Since the lowest rated neighborhoods were drawn in red and often had the vast majority of African American residents, these maps have been associated with the so-called practice of "redlining" in which borrowers are denied access to credit due to the racial composition of their neighborhood. However, credit was also potentially restricted to neighborhoods scoring in the next lowest neighborhood grade marked in yellow, which has received much less public and academic attention.

A voluminous literature studies the channels in which restricted access to credit can limit economic opportunities.[1] In total, that work makes a compelling case that policies that improperly restrict credit are potentially objectionable on the grounds of both equity and efficiency. Moreover, entire neighborhoods that are inappropriately deprived credit could suffer from insufficient investment and become further magnets for an array of social problems related to poverty.

Our study attempts to estimate the causal effects of the HOLC maps on neighborhood development across the urban U.S. We merge 149 geocoded city maps digitized by the Digital Scholarship Lab at the University of Richmond with (a) address level data from the 100 percent count of the 1910 to 1940 U.S. decennial Censuses (Minnesota Population Center and Ancestry.com 2013), (b) census tract-

[1] A small sampling includes Cameron and Taber (2004) on skill investment, Black and Strahan (2002) on entrepreneurship, Carroll (2001) on consumption, and Breza and Kinnan (2017) on economic activity.

level data from the 1950 to 1980 Censuses, and (c) block-level data from the 1990 to 2010 Censuses. This results in up to a century of data on neighborhood characteristics including race, homeownership, house values, rents, and population. We further merge block-level data on Equifax Risk Scores™ (credit scores) from the 1999 to 2016 Federal Reserve Bank of New York Consumer Credit Panel/Equifax (CCP).

Since our analysis is non-experimental, our methodology must address confounding factors for valid inference. A key concern is that the maps may have simply reflected and codified pre-existing differences in neighborhoods but didn't actually *cause* any changes in credit access. We address this through a multi-pronged approach. We begin by considering changes over time in the difference in outcomes between neighbors that live on either side of a HOLC boundary within a very tightly defined geographic band, typically a few city blocks. Comparisons of spatially proximate neighbors address some confounding factors like access to labor markets, public transportation, or other local amenities that might differentially influence neighborhood growth. However, a border design on its own is insufficient since, as we document, there were pre-existing differences and differential trends even among nearby neighbors. To address this problem, our main strategy compares "treated" boundaries with a set of counterfactual boundaries using propensity score weighting. The patterns in racial segregation and housing characteristics in our weighted counterfactual boundaries in the pre-period are virtually identical to the treated boundaries.

Our second strategy simply limits our sample to a subset of the HOLC borders that are least likely to have been predicted to be borders based on our propensity score analysis. We hypothesize that the demarcation of many of these borders reflected idiosyncratic factors. For example, some borders may have been drawn in order to close a polygon and did not reflect a perceived gap in creditworthiness. Reassuringly, this sample of low propensity score borders exhibits *no* pre-existing differences or trends across the two sides of the boundaries and therefore eliminates the need for a control group.

Our results show that the HOLC maps affected the degree of racial segregation as measured by the fraction of African American residents on each side of a neighborhood boundary. We show that areas graded "D" become more heavily African American than nearby C-rated areas over the 20^{th} century. This segregation gap rises steadily from 1930 until about 1970 or 1980 before declining thereafter. Moreover, we find a strikingly similar pattern in "C" neighborhoods that bordered "B" neighborhoods. The C-B result is particularly noteworthy given there were virtually no black residents in either C or B neighborhoods prior to the maps. We believe these results reveal for the first time the importance of "yellow-lining" as an historical phenomenon.

The maps also had an economically important negative effect on homeownership, house values, rents, and vacancy rates with analogous time patterns to share African-American, suggesting economically significant housing disinvestment in the wake of restricted credit access.[2] For these outcomes, the effects were larger and somewhat more persistent along the C-B boundaries than the D-C boundaries. We discuss some plausible explanations for the additional impact along C-B boundaries but are unable to come to any firm conclusions.

We further confirm our results using a third independent discontinuity strategy that exploits the HOLC's decision to limit maps to cities with a population of 40,000 or more. We compare the outcomes of cities with a population between 30,000 and 39,999 to cities with a population between 40,000 and 49,999 as of the 1930 Census. Like our border design, we find that the cities with HOLC maps experienced a relative decline in home ownership, house values, and rents, which was accompanied by a rise in the share of African Americans.

To provide a sense of the relative economic importance of the maps, we report back-of-the-envelope calculations of how much our estimated causal effects could potentially account for the overall gaps between different HOLC grade neighborhoods (not just across boundaries) post-WWII. We find that the maps could account for between 15 and 30 percent of the overall D-C gap in share African-American and homeownership and 40 percent of the gap in house values over the 1950 to 1980 period. The maps account for roughly half of the homeownership and house value gaps along the C-B borders over the same period.

After 1970, our border estimates begin to rapidly revert, suggestive that federal policies -- such as the 1968 Fair Housing Act (FHA), the 1974 Equal Credit Opportunity Act (ECOA), and the 1977 Community Reinvestment Act (CRA) -- designed to expand access to lending markets to low and moderate income households may have played a role in reversing the influence of the HOLC maps. Using different measures of segregation, Glaeser and Vigdor (2012) document a similar hump-shaped time pattern and likewise speculate that housing policies may have contributed to the decline in segregation post-1970.

[2] We discuss how reduced credit access and higher borrowing costs may lead to disinvestment in section VII. Appel and Nickerson (2016), which was written contemporaneous to ours, also find that the HOLC maps affected home prices. Their analysis differs from ours in several important respects: 1) they use a regression discontinuity strategy that relies on the assumption of no pre-existing discontinuities along HOLC borders which we show does not hold in our data; 2) they combine all HOLC border types in their analysis, our results show that there are important differences across border types; 3) they do not analyze patterns of segregation, home ownership, rents, vacancies, or credit scores; 4) they only examine home prices in one year, 1990, which misses the interesting dynamics over the 20th century; 5) their data only go back to 1940 which they consider to be a pre-treatment period, even though maps were completed before then. This sample period does not allow them to consider pre-existing trends; 6) they use a much smaller set of cities. Krimmel (2017) also looks at the impact of the maps on a small set of cities but faces some of the same issues as Appel and Nickerson. Other studies, such as Hillier's (2005) seminal study of Philadelphia and Fishback's (2014) on New York, focus on individual cities.

However, many factors undoubtedly contributed toward secular trends in racial and housing patterns in the second half of the 20th century and this reversal clearly remains an important topic for future research.[3]

We also find substantial heterogeneity in the effects of the maps across cities. This variation is highly correlated with differences in the causal effects of place on upward intergenerational mobility as estimated by Chetty and Hendren (2017). Finally, we make a preliminary effort at trying to understand this heterogeneity. We consider pre-existing differences in financial concentration, the relative coarseness of boundaries, city size, and the level of inflows of African Americans due to the Great Migration. We find no compelling evidence that these factors played an economically important role in mediating the effects but we think much more research is needed to explore these and other possible channels.

Our study contributes to several literatures. The HOLC maps highlight the way in which access to credit can have an economically influential impact on the growth of urban neighborhoods (e.g. Rossi-Hansberg, Sarte, and Owens 2010; Autor, Palmer, and Pathak 2014; Diamond and McQuade 2017; Owens, Rossi-Hansberg, and Sarte 2018). Moreover, similar to other recent papers (e.g. Hornbeck 2012; Hornbeck and Keniston 2016; Feigenbaum, Lee, and Mezzanotti 2017; Shertzer, Twinam, and Walsh 2016), we document how an important intervention can have large and strikingly persistent effects on the long-run development of local communities. Our findings are also the first to quantify one key explanation for the robust rise of segregation and inequality in homeownership in American cities during the key decades immediately following WWII (Cutler and Glaeser 1997; Cutler, Glaeser, and Vigdor 1999; Ananat 2007; Boustan 2011; Glaeser and Vigdor 2012). Some recent research has linked housing with the growing Black-White wealth gap throughout the latter half of the 20th century (Blau and Graham 1990; Conley 2001; Charles and Hurst 2002; Krivo and Kaufman 2004).

I. Background

The HOLC and the City Survey Program

After the Great Depression, house prices fell precipitously and a foreclosure crisis ensued (White 2014).[4] To address this devastating situation, the Roosevelt Administration initiated a series of Federal programs intended to alter the nature of housing finance. These policies contributed to a shift away from short duration loans with large balloon payments to fully amortized higher loan-to-value mortgages with

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[3] Other factors that contributed to trends in segregation and urban disinvestment include restrictive covenants, zoning regulations (Shertzer, Twinam, and Walsh 2016), the location of highway construction (Brinkman and Lin 2017), urban renewal policies (Collins and Shester 2013), the urban riots of the 1960s (Collins and Margo 2007), public housing location (Hunt 2009), and FHA policies (Rothstein 2017). Some of these forces undoubtedly interacted with and were a part of the long-run reduced form effect of the HOLC maps.

[4] For example, foreclosure rates in New York City rose from essentially zero throughout the 1920s to as high as 7 percent in 1935 and averaged about 2 to 3 percent per year during the early and mid-1930s (Ghent 2011).

15 to 20 year durations. Mortgage insurance was provided through the Federal Housing Administration (FHA), and a secondary loan market was created through the Federal National Mortgage Agency (FNMA).[5]

In 1932, the Federal Home Loan Bank Act was enacted which created the Federal Home Loan Bank Board (FHLBB) to charter and oversee Federal savings and loan associations. The FHLBB essentially policed the operations of the newly created Federal consumer banking system. One important new agency operating at the direction of the FHLBB was the Home Owners' Loan Corporation (HOLC). Created in 1933, the HOLC was initially tasked with issuing bonds in order to buy and refinance mortgages at more favorable terms to borrowers. By 1936, the HOLC had refinanced over 1 million home loans or roughly 1 in 10 non-farm mortgages (Fishback et al 2011).

The focus of our study is an initiative undertaken by the HOLC at the behest of the FHLBB to introduce a systematic appraisal process that included neighborhood-level characteristics when evaluating individual residential properties. The FHLBB was concerned both about the long-term value of the real estate investments now owned by the Federal Government and the general health of the lending industry, which was devastated by the foreclosure crisis (Hillier 2005; Nicholas and Scherbina 2013). Using the new appraisal techniques, the HOLC drew residential "security" maps for 239 cities between 1935 and 1940 as part of its City Survey Program and completed more than 5 million residential appraisals. The maps and the appraisal process were seen as a mechanism for solving a coordination problem that would help ensure the continued stability of property values throughout the nation.[6]

The maps were based on the input of thousands of local brokers and appraisers, as well as neighborhood surveys of housing markets and demographic and economic characteristics. Neighborhoods were graded on a scale of A (least risky/most stable) to D (most risky/least stable). The appraisal manuals were candid in how they differentiated grades. Hillier (2005) quotes the 1937 FHLBB Appraisal Manual in describing neighborhood grades as follows:

- Grade A = "homogeneous," in demand during "good times or bad."
- Grade B = "like a 1935 automobile-still good, but not what the people are buying today who can afford a new one"

[5] Several studies describe details of the residential real estate environment at the time and evaluate the effectiveness of various HOLC and FHA initiatives to deal with the foreclosure crisis (Wheelock 2008, White 2014, Fishback et al 2011, Rose 2011, Ghent 2011, and Fishback et al 2017). Fishback et al (2017) emphasize the many complications in the mortgage market that ultimately slowed the 1930s housing recovery. Rose (2018) provides evidence that, even prior to the 1930s, long duration loans were more prevalent in Baltimore than previously understood.

[6] Hillier (p. 210) cites an FHLBB document: "[HOLC] experts believe that since its interest is duplicated by that of all home-financing and mortgage institutions, a program can be evolved which will reclaim large residential areas which are doomed unless some concerted action is taken. Those experts believe that a joint program of Government agencies and private capital can save millions of dollars in property values now being wasted each year. If such efforts are undertaken in the future, the HOLC will be able to contribute surveys made of more than 300 cities throughout the United States—an accumulation of real estate and mortgage data never before available."

- Grade C = becoming obsolete, “expiring restrictions or lack of them” and “infiltration of a lower grade population.”
- Grade D = “those neighborhoods in which the things that are now taking place in the C neighborhoods, have already happened.”

The term “redlining” is thought by many to derive from the red shading that demarcated the lowest ranked D neighborhoods. There is clear evidence that the racial makeup of neighborhoods were explicit factors that were often pivotal in assigning grades to neighborhoods. This is apparent in the area description files that accompanied the HOLC maps.[7] A more formal statistical analysis in the Appendix confirms the importance of race and other economic and housing characteristics in determining HOLC grades.

How Were the HOLC Maps Used?

There is an active debate among historians about the degree to which lenders accessed the HOLC maps. Hillier (2003) stresses that access was not widespread despite high demand for the maps among private lenders. She argues that the FHLBB sought to preserve their confidentiality from the private sector as a matter of policy and thereby allowed only a limited number of copies (50 to 60) of each map to be made. She further asserts that there is little historical record of the use of the maps prior to researchers discovering them in the U.S. National Archives.

This contention is disputed by Woods (2012), who argues that the FHLBB widely distributed information concerning the HOLC appraisal practices, fostered close communication between the private sector and government institutions, and that these interactions had a profound influence on national lending practices by creating a uniform appraisal process.[8] Woods further argues that, as a matter of regulator policy, banks were required to construct their own maps describing their geographic lending patterns.[9] If

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[7] Appendix Figure A2 shows an example of the area description for a D-graded neighborhood in Tacoma, Washington where it is stated that: “This might be classed as a ‘low yellow’ area if not for the presence of the number of Negroes and low class Foreign families who reside in the area.” In numerous other examples, race appears to be pivotal. Berkeley, California Area 2 (C-grade): “Northeastern part of area, north of University, could be classed as High Yellow, but for infiltration of Orientals and gradual infiltration of Negroes from south to north.”; Brooklyn, Bedford-Stuyvesant, Area 8 (D-grade): “Colored infiltration a definitely adverse influence on neighborhood desirability although Negroes will buy properties at fair prices and usually rent rooms.”; Oakland, Piedmont, Area 14 (B-grade): “Some parts of this area would be considered only High Yellow but for the rigid restrictions existing in Piedmont as to type of new construction and also the fact that there are no Negroes or Asiatics allowed in the city limits.”; Warren, Ohio Area 8 (C-grade): “Section is "killed" by influx of negroes from D-3 to attend Francis Willard School in C-8”; and Youngstown, Ohio Area 3 (D-grade): “Ever growing influx of Negroes and low class Jewish in the westerly end.”

[8] The dissemination of HOLC appraisal practices included a) the creation of a Joint Committee on Appraisal and Mortgage Analysis in 1937 that included three private agencies whose purpose was “to share appraisal data throughout all segments of the national lending industry,” and b) the dissemination of a monthly FHLBB journal entitled the *Federal Home Loan Bank Review* with articles “that provided painstaking detail regarding the influence of neighborhood demographics on mortgage finance.” 6,000 copies of the review were circulated each month and the list of subscribers “was so extensive that it reached a representative cross section of the national urban housing industry

[9] The FHLBB required that lending practices take into account neighborhood demographics. Woods specifically argues that “there existed a relationship between the HOLC security maps and FHLBB lending policies” (p. 1043). In

Woods is correct on these points, then it makes it at least plausible that the information contained in the HOLC maps could have filtered out and been used in lending decisions even if the actual HOLC maps were not disseminated. Given their large investment in the City Survey Program, it would seem to have been in the FHLBB's interest to have shared the maps' content despite its stated policy.[10]

Moreover, there are at least suggestive anecdotes that some lenders accessed the maps. Jackson (1980), citing evidence from an FHLBB survey of New Jersey bankers and the participation of local realtors as consultants in constructing the St. Louis maps, argues that "private banking institutions were privy to and influenced by the government security maps" (p. 430). Hillier (2003) cites an example of a Chicago real estate official who wrote the following to the City Survey Program director: "I hope to be able to 'borrow' a map from your portfolio when you are not looking during your journey in Chicago." More broadly, Greer (2012) suggests that in total, thousands of real estate professionals played a role in the development of the maps and many likely remained actively involved in the industry through the post-war era. To take one publicly available example, six of the 14 individuals listed as having reviewed the HOLC map for Cuyahoga County (Cleveland), were from local lending institutions and two others were local appraisers.[11]

We may never know with certainty the degree to which the original HOLC maps were used by lending institutions. It is clear, however, that the FHLBB fostered the general practice of using maps to classify the credit worthiness of entire neighborhoods. If, in fact, the maps developed by lenders differed from the original HOLC maps such that boundaries were drawn along slightly different streets, it suggests that our estimates are, if anything, likely to *understate the overall effects of the general practice of redlining* even if they capture the effects of the HOLC maps.

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particular, as a matter of policy, the balance sheets of lending institutions had to include a "security map of the institution's lending area" and that institutions were instructed that "the best method of grading residential neighborhoods as lending areas is to make a scientific analysis of the entire community and of each neighborhood within it." Woods further notes that "The FHLBB widely distributed the instructions necessary for creating this critical appraisal material throughout the national lending industry. The Mortgage Rehabilitation Division of the FHLBB 'has prepared simple instructions for making the security maps of residential neighborhoods' available 'to any experienced mortgage lender.' The Rehabilitation Division of the FHLBB 'recognize[d] four broad categories of lending areas, ranging from most desirable to least desirable. Each category was represented by a different color, so that the map could be read at a glance.' These four categories were identical to those created by the HOLC."

[10] Woods (2012) cites a 1935 Federal Home Loan Bank Review article: "[i]t is inevitable, therefore, that the HOLC's appraisals should exert a major influence in setting values on urban-home properties throughout the country. The magnitude of the operation insures that this influence shall be more than temporary, and that the Corporation's appraisals will affect all property values for many years."

[11] See the "Cuyahoga County Explanation and Area Description File available at: https://library.osu.edu/projects/redlining-maps-ohio/area-descriptions/CuyahogaCounty_Explanation_and_A1-A31_Area_Description.pdf.

FHA Manuals and Maps

The FHA created a parallel set of maps that likewise rated neighborhoods on a color-coded A to D scale and were based on a systematic appraisal process that took demographic characteristics of neighborhoods into account. Indeed, the 1930s and 1940s FHA manuals explicitly emphasize "undesirable racial or nationality groups" as one of the underwriting standards; their use was ultimately outlawed by the 1968 Federal Housing Act and the 1977 Community Reinvestment Act.[12] The enormous influence of the FHA is highlighted by the fact that, by 1949, one-third of newly constructed homes were insured by the FHA (Woods 2012). Therefore, perhaps at least as important as whether lenders had direct access to the HOLC maps is whether the HOLC maps were shared with the FHA and thus influenced the provision of housing credit through the FHA's decisions regarding whether to insure loans in low graded neighborhoods.

On this issue, there is more agreement among historians. Light (2010) highlights "ample evidence" to support the influence of the HOLC appraisal methods and maps on the FHA's practices.[13] As an example, Woods (2012) cites a 1938 FHA underwriting manual that provided examples directly from HOLC appraisals. Hillier (2003) also states that the HOLC maps were shared with the FHA as well as other government agencies. However, she minimizes the link between the FHA and HOLC by arguing that the FHA had their own independent sources of information for developing maps.

The limited availability of FHA maps today makes a broad comparison with the HOLC maps infeasible (Light 2011). However, in one prominent and available case, we find that they are strikingly

[12] See Jackson (1980) and Light (2010) for discussions of how FHA risk maps were created and the instructions provided to underwriters to evaluate areas. The 1934 FHA manual includes race as one of the underwriting standards to be applied to new loans: "The more important among the adverse influential factors (of a neighborhood's character) are the ingress of undesirable racial or nationality groups…All mortgages on properties in neighborhoods definitely protected in any way against the occurrence of unfavorable influences obtain a higher rating. The possibility of occurrence of such influences within the life of the mortgage would cause a lower rating or disqualification." See http://archives.ubalt.edu/aclu/pdf/Plex48.pdf. Frederick Babcock, a Chicago realtor who later became the director of the underwriting division of the FHA wrote in a 1932 book, *The Valuation of Real Estate*, that "most of the variations and differences between people are slight and value declines are, as a result, gradual. But there is one difference in people, namely race, which can result in a very rapid decline. Usually such declines can be partially avoided by segregation and this device has always been in common usage in the South where white and Negro populations have been separated" (Rutan 2016, p 36). Thurston (2018) describes how the NAACP received a number of complaints about discriminatory mortgage lending practices as early as the late 1930s and consequently confronted senior FHA leadership. For example, drawing from a 1938 letter from Roy Wilkins, Assistant Secretary of the NAACP to Stewart McDonald, Director of the FHA, Thurston states: "NAACP officials also continued with their investigation into lending practices in the Jamaica area, learning from banks and developers that lenders in the New York City area seemed to be aware of an FHA policy and rejected loans in anticipation of it, as well as an FHA practice of requiring restrictive covenants on the properties it insured" (Thurston 2018, p 109).

[13] See footnote 85 of Light (2010). For example, Light writes: "FHA records indicate the agency kept the HOLC security maps on file in connection with the construction of its Economic Data System … and comments from Federal Home Loan Bank Board general counsel Horace Russell on how the FHA 'was fortunate in being able to avail itself of much of the (t)raining and experience in appraisal and the development of appraisal data by Home Owners Loan Corporation' underscores the two agencies' close ties."

similar. Roughly 82 percent of population weighted Chicago has the same grade on both maps, including 86 percent of D graded areas. However, we acknowledge that we cannot speak to the similarity of other cities, so we instead emphasize that our estimates capture the sum of any HOLC and FHA effects where the boundaries align and only the HOLC effect where the boundaries differ.

II. Data and Descriptive Facts

HOLC Maps and Area Description Files

We obtained geocoded renderings of the original HOLC maps for 149 cities from the Digital Scholarship Lab at the University of Richmond.[14] Figure 1 shows that the geographic coverage is quite extensive especially relative to the distribution of the population in 1930. Our 149 cities comprise 89 percent of the population living in the 100 largest cities in 1930 and 1940, including 9 of the largest 10 and 17 of the largest 20 cities, and 30 of the 42 cities with a population above 200,000.[15] The HOLC maps for three prominent cities -- New York, Chicago, and San Francisco – are displayed in Figure 2. The large set of boundaries separating neighborhood types, especially evident in the New York City and San Francisco maps, illustrate the variation utilized for our main identification strategy that takes advantage of households living in a narrow band (i.e. within a few city blocks) on each side of an HOLC border.

To create a sample of borders, we begin with the boundaries of cities as they were defined in the Census 2000 place boundary shapefile; this restriction primarily discards suburbs. Next, we assign an ID to each straight line segment of an HOLC boundary that is at least a quarter mile in length. We then draw rectangular areas that extend a quarter of a mile on each side of a boundary. We refer to these areas interchangeably as boundary buffer zones, buffer zones, or simply buffers. Each boundary has two such buffers -- the lower graded side (LGS) and higher graded side (HGS). A visual depiction of the boundary buffer zones for New York City is in Appendix Figure A1. We also refer to boundaries between C and D neighborhoods as "D-C" and those separating B and C areas as "C-B."[16]

[14] See Appendix Table A8 for the list of cities. The HOLC created separate maps for each of the boroughs of New York City. Throughout our analysis, we use New York City to refer to Manhattan. Brooklyn, Queens, and the Bronx are also included in our sample.
[15] Of the 20 most populous cities, we are missing Los Angeles (#5), Washington DC (#11), and Cincinnati (#17). Since 30 percent of U.S. residents lived in the 100 most populous cities as of 1930, our 149 cities contain over a quarter of the total U.S. population.
[16] There are not enough A areas to estimate effects along the B-A boundaries. In the spirit of analyzing similar neighbors separated by a boundary, we do not look at boundaries separated by more than one grade (e.g. D-B).

Accompanying the maps are a set of area description files (ADFs) that provide additional quantitative and qualitative detail on the neighborhoods. An example of an ADF for a neighborhood in Tacoma, Washington is provided in Appendix Figure A2. We describe how we use this data as we go along.

1910 to 2010 Censuses

We match the geocoded maps to the 1910 to 2010 Censuses. For 1910 to 1940, we use the 100 percent count Censuses that contain street addresses. Of the universe of household heads with non-missing street addresses, we successfully match between 60 and 80 percent per census to modern street locations.[17] That allows us to locate 49, 50, 79 and 62 percent of 1910 to 1940 Census respondents and ultimately assign them to HOLC neighborhoods (see Appendix Table A1 for details). Variables are then aggregated to the boundary buffer by taking means of all observations which fall inside of a boundary buffer zone so long as a buffer contains at least 3 households.

Beyond 1940, we must use publicly available aggregated data. The smallest geographic unit currently available for 1950 to 1980 is the census tract. Since census tracts change over time, we overlay the tract boundaries from each census with the boundary buffer shapes and calculate weighted means of any tract for which at least 15 percent of the area of the tract lies within the boundary buffer.[18]

Starting in 1990, the census provides smaller geographic tabulations called blocks, which contain on average roughly 100 people.[19] Since blocks are much smaller than census tracts, we use a 50 percent threshold for calculating weighted means of the boundary buffer (i.e. we take the block population weighted means of all blocks for which the area of the block is more than 50 percent within the boundary buffer). Our analysis uses the panel of boundary buffer means created for each decade from 1910 to 2010. Some further detail about data consistency with regard to housing measures is provided in the Appendix.

In section VI, we explicitly show that our results are not driven by changing geographic units or selection into the sample.

[17] As might be expected, characteristics such as race and home ownership predict the probability of being geocoded. However, our empirical strategy (described below) of comparing changes over time in boundary differences to changes over time in control boundary differences (a triple difference) should be robust to any sample selection concerns around geocoding.
[18] The choice of the 15 percent threshold balances a tradeoff between sample size and measurement precision. Our results are robust to alternative census tract inclusion thresholds such as 10, 20 or 25 percent.
[19] Some variables, notably house value, rent, house age, and foreign born population, are only reported at the block group level, which are aggregates of blocks and typically contain between 600 and 3,000 people. For these variables, we assign the block the values of the block group it is in. In 2000 (2010), there were over 8 (11) million blocks, 208,790 (217,740) block groups, and 65,443 (73,057) census tracts.

Credit Bureau Data

We supplement our census-based boundary buffer panel with modern credit bureau data from the Federal Reserve Bank of New York's Consumer Credit Panel/Equifax (CCP). The CCP, which covers roughly 5 percent of the population, provides block-level data on credit scores between 1999 and 2016. We use two measures: a) mean credit scores as measured by Equifax Risk Score™ and b) the share of borrowers that are subprime, as traditionally measured by Equifax as a score below 620.

Summary Statistics

Table 1 shows summary statistics by neighborhood grade. Panel A reports the share of African Americans over time. Columns (1) to (4) include all households in the 543 neighborhoods with an A grade, 1,351 with a B grade, 2,156 with a C grade, and 1,399 with a D grade. In 1930, before the maps were drawn, African Americans comprised 14.6 percent of the residents living in D-rated neighborhoods but only 1.5 percent of those living in C-rated neighborhoods, a gap of 13.1 percentage points (pps). By 1980, African Americans accounted for 46.2 percent of residents in D-rated neighborhoods and 30.7 percent of residents living in C-rated neighborhoods. These rates converged to 35.7 and 29.0 percent, respectively, by 2010. The time patterns for each neighborhood grade are shown graphically in Panel A of Figure 3.

Statistics for those living in a buffer zone along the C-B and D-C boundary are shown in columns (5) to (8). There are a total of 1,965 C-B boundaries and 2,111 D-C boundaries that meet our criteria. The gaps across these two boundary types are shown in columns (9) and (10). As expected, the gap in the share of African Americans is always smaller along the D-C boundary buffer zones than across the full D and C neighborhoods. For example, in 1930, the gap along the D-C boundary buffers was 7.2 pps (column 10), compared to 13.1 pps across all D-C residents (columns 4 minus 3). The racial gaps within the D-C boundary peaked at between 15 and 17 pps between 1950 and 1970, before declining sharply thereafter. By 2010, the gap stood at just 3.1 pps. This secular hump-shaped pattern in the racial gap also characterizes the C-B boundaries. There was a relatively meager 0.4 percentage point gap in 1930 that grows to 5.7 pps by 1970 and then subsequently wanes.

Panel B of Table 1 and Panel B of Figure 3 show corresponding patterns for home ownership among households. In 1930, the D-C and C-B home ownership gaps in the buffer zone were 5.2 and 4.9 pps, respectively. By 1960, these differences had increased to 6.2 and 7.1 pps. As of 2010, the D-C gap in home ownership had fallen to just 2.3 pps. However, the homeownership gap remained elevated along the C-B boundary at 6.4 pps. Panels C and D of Figure 3 plot the patterns for house values and rents. Like homeownership, we find that gaps in house values and credit scores continue to exist even today and are larger among the C-B borders than the D-C borders.[20]

In the Appendix, we consider statistical models of the determinant of the HOLC grades. Like Hillier (2005) and Fishback (2014), who were only able to examine single cities, we find a clear monotonic relationship between grades and nearly all the key economic and housing covariates that are available in the census whether considered individually or, as in the table, simultaneously.

III. Identification and Methodology

Our empirical strategy is guided by the historical narrative that the creators of the HOLC maps explicitly considered existing characteristics of neighborhoods and their recent trends when drawing the borders. This is confirmed by the HOLC's area description files that accompanied the maps and which provided explanations for the grades. Therefore, we use multiple approaches to try to overcome this obstacle to identification.

Differencing

We begin by considering a naive difference-in-differences (DD) strategy. The DD method compares changes over time in neighborhood-level outcomes, pre- and post- the construction of the HOLC maps in places that are spatially proximate but on different sides of an HOLC boundary, similar in spirit to a border regression discontinuity design (RD) used extensively elsewhere (e.g. Holmes 1998; Black 1999; Bayer, Ferreira, and McMillan 2007; Dube, Lester, and Reich 2010; and many others). Along the line segments that make up these boundaries, we compare nearby neighbors that live within 1/4 mile (1320 feet) from the boundary – what we refer to as boundary "buffers." This allows us to remove potentially important, but typically hard to measure, confounding factors that influence residents on both sides of a border. Neighbors living within hundreds of feet of each other, but on opposite sides of a border, share similar amenities such as access to labor markets, public transportation, retail stores, and the like.

The statistical model underlying the DD estimator is:

(1) $$y_{gbt} = \sum_{t=1910}^{2010} \beta_t 1[lgs]\gamma_t + \beta_{lgs} 1[lgs] + \gamma_t + \alpha_b + \epsilon_{gbt}$$

where y_{gbt} is an outcome in geographic unit g (e.g. ¼ mile boundary buffer) on boundary b, at census year t, $1[lgs]$ is an indicator that the geographic unit is on the lower-graded side of the HOLC boundary, γ_t are year dummies, and α_b are boundary fixed effects. Differencing across the boundary is captured by the $\alpha_b's$.

[20] House values and rents are unavailable prior to 1930. All dollar denominated variables are expressed in real terms, adjusted to 2010 dollars. The data are provided in Table 1. Table 1 also shows patterns in share immigrant, which grew faster in C areas than D areas in the middle of the century but then equalized thereafter. Along the C-B borders the gap remained quite small until 1990 at which point the foreign born share grew higher in C areas than B areas.

Our coefficients of interest, the β_t's, capture the change in the mean outcome in year *t* relative to 1930 (the census year before the maps were drawn, which we omit). The gap in the mean outcome in year *t* is therefore β_t+β_{lgs} for years other than 1930 and β_{lgs} for 1930.

Parallel Trends Assumption Violated

The DD strategy relies on the assumption of parallel trends which does not hold in our case. We know from the area description files that the choice of the borders were based in part on demographic and housing characteristics which were already diverging along these boundaries. This divergence can be seen visually in Figure 4, which plots the D-C gap for one key neighborhood characteristic, the share of African-Americans, living in buffer zones on either side of the boundaries from 1910 through 1940. As early as 1910 and 1920, there was a 3 percentage point racial gap between the D and C sides, which grew to 6 pps by 1930, a clear violation of the parallel trends assumption. Similar violations are apparent in other variables such as homeownership, house values, and rents. Interestingly, the racial gap along C-B boundaries is virtually non-existent before the maps were drawn which might suggest that the DD strategy may be appropriate for identifying effects on this outcome at least along the C-B boundaries. However, we again find notable pre-trends in the gaps in housing outcomes along the C-B boundaries as well.

The anecdotal evidence and the patterns in the data along the buffer zone also suggest that a RD design will likely not satisfy the assumptions of continuity along the HOLC borders. We show examples of several distance plots in Appendix Figure A3 where each dot represents the mean characteristic (regression adjusted for border fixed effects) in bins of $1/100^{th}$ of a mile (roughly 50 feet) of distance in each direction from the D-C or C-B border. The dashed vertical lines represent $⅛^{th}$ mile cutoffs. It is clear that for several of our outcomes, even limiting our sample to observations that are just a city block away from the border would lead to meaningful discontinuities and render an RD design invalid.

We propose two strategies to address the failure of the parallel trends assumption.

Control Boundaries

The first strategy creates a set of counterfactual or control boundaries with similar characteristics and trends to the HOLC treatment boundaries before the maps were drawn. To implement this approach, we take advantage of what we refer to as "missing" HOLC borders. The idea is that there may have been difficulties in constructing polygons that fully reflected homogeneous neighborhoods --especially if there were small areas within larger neighborhoods that had fundamentally different characteristics. A prototypical example is a small island of, say, C type streets within a larger ocean of D. We provide a stylized illustration in the top panel of Appendix Figure A4. The Chicago HOLC map, shown in Panel A of Figure 2, also illuminates the plausibility of such missing borders. Among the large swath of D (red) in the heart of Chicago, there undoubtedly lies pockets of streets that might be better labeled C (yellow) or higher.

We identify these potential control boundaries in two ways. First, we draw ½ mile by ½ mile grids over each city. We then create ¼ mile boundary buffers around any grid line segment that does not overlap with HOLC treatment boundaries. This set of potential control boundaries are referred to as our "grid" controls. See Appendix Figure A5 for an example of a grid placed over New York City. Second, the HOLC often drew boundaries separating two "unique" neighborhoods with the same grade. For example, returning again to the large red area in Chicago, there are many HOLC-defined boundaries between D graded neighborhoods. We do not fully understand why the HOLC felt it necessary to draw these divisions; it could be the case that cities were broken into neighborhoods first and then each of those neighborhoods were evaluated. Therefore, we see this as evidence that there may have been borders that were considered but ultimately rejected because they did not rise to the same level of dissimilarity as our treated borders. We refer to these same grade (e.g. B-B, C-C, or D-D) line segments as our "same-grade" controls.

Having defined the two types of counterfactual borders, we apply propensity scoring methods to choose weights to minimize the pre-treatment differences in outcomes and covariates.[21] We use the logic that if pre-treatment differences are eliminated using these weights, then it may be valid to interpret any post-treatment difference between treatment and control as an estimate of the causal effect of the HOLC grade. Since each set of treated boundaries has a side which has been deemed riskier by the HOLC (such as the D side of a D-C boundary), we need a similar construct for the control boundaries. We do this by randomly picking one of the sides of each control boundary to be the riskier or lower graded side.[22] We then construct a measure of the difference across the boundary by subtracting the mean of our outcome variable on the higher-graded side from the mean of our outcome variable on the lower-graded side. These differences across the boundaries are referred to as gaps. For example, the mean share of residents that are African American on the D side minus the mean share of residents that are African American on the C side of a D-C boundary is the D-C gap in the share African American.

To construct the propensity score, we pool a set of control and treatment boundaries, where each boundary is an observation. For each grade type difference (e.g. D-C, C-B), only controls from the same

[21] We also used the Synthetic Control Method (SCM) of Abadie, Diamond, and Hainmueller (2010) and found very similar results. We prefer the propensity score method for our application as SCM is more difficult to implement without a balanced panel of geographic units (address-tract-block).

[22] Random assignment ensures that the distribution of the within boundary differences in our control group is representative of all control boundaries and is not skewed toward either tail of the distribution.

HOLC graded areas are used. That is, when we estimate the effects of the D-C borders, the controls only include C-C or D-D boundaries (from the grid or same grade set of controls) and not A-A or B-B boundaries. We then estimate the following probit separately for D-C and C-B boundaries:

$$(2) \qquad 1\{Treated\}_{b,c} = \alpha_c + \sum_{k=1}^{K} \beta_{1910}^{k} z_{b,c}^{k,1910} + \beta_{1920}^{k} z_{b,c}^{k,1920} + \beta_{1930}^{k} z_{b,c}^{k,1930} + \epsilon_{b,c}$$

where $1\{Treated\}_{b,c}$ is an indicator variable for whether boundary *b* in city *c* is a "treated" boundary, α_c is a city fixed effect, and $z_{b,c}^{k,t} = x_{lgs,b,c}^{k,t} - x_{hgs,b,c}^{k,t}$ are the gap between an explanatory variable *k* on the lower-graded side (*lgs*) and the higher graded-side (*hgs*) at time *t* =1910, 1920, and 1930. The variables indexed by *k* include share African American, African American population density, white population density, share foreign born, the home ownership rate, the share of homeowner households that have a mortgage, log house value, and log rent.[23] Our estimate of the propensity score (pscore) is equal to the predicted probability of treatment from the probit. We then form weights; for the control boundaries, $w = \frac{pscore}{1-pscore}$ and for the "treated" boundaries, $w = 1$. Appendix Figure A6 (panels A and B) shows that there is considerable overlap in the distributions of the propensity scores for the treated and control groups along these boundaries.[24] In Panels C and D of Appendix Figure A6 we pick one of our outcomes, home ownership, and demonstrate that the reweighted control boundaries look much more similar to the treated boundaries, than the unweighted control boundaries.

We highlight estimates based on the grid controls mainly because we can create much larger samples of control boundaries than with the more limited set of same-grade boundaries. In addition, the same-grade boundaries potentially induce some effect arising from having a boundary associated with it, which we would prefer to purge. In any event, the results are similar with either approach.

Exploiting Idiosyncratic Borders

A second simpler strategy to eliminating confounding factors takes advantage of the possibility that some HOLC boundaries might have been more idiosyncratic in nature and were simply drawn in order to

[23] The model is run using a balanced panel in which at least one of the following three variables contains no missing values (on either boundary side) from 1910 through 1930: share African American, the homeownership rate, or share foreign born. House values and rents are only available in 1930. Whether the household has a mortgage is only available in 1910 and 1920. For a measure that should be available but is missing, it is recoded to a constant value and a missing indicator variable is turned on. The probit models are weighted by the log of the total population of the buffers on both sides of the boundary. We experimented with adding data from transcribed area description files (ADFs). However, they had little additional explanatory power and led to a significant reduction in sample size due to spotty coverage. We also experimented with nearest neighbor matching but found our samples were too thin once we limit the neighbors to the same city as the treatment.

[24] We trim the sample by dropping treated boundaries with a higher propensity score than the maximum control boundary and control boundaries with a lower propensity score than the lowest treated boundary.

close a polygon. Consider the hypothetical example of a "misaligned" border in the bottom panel of Appendix Figure A4. The northern part of the neighborhood contains largely "red" blocks and the Southern area contains largely "yellow" blocks. It may not have been entirely clear where exactly to draw the southern border and the HOLC agents may have just chosen a major street to define the neighborhood. These "treated" boundaries may not have reflected a discontinuous change in creditworthiness and would be much less likely to exhibit "pre-trends" in outcomes.[25]

We identify these more idiosyncratic boundaries by computing the propensity score – or predicted probability of being treated -- for each HOLC boundary and then use only those borders whose propensity score is below the median. As we show later, this subsample of treated borders exhibits virtually no pre-trends. While this strategy is more straightforward and does not rely on constructing a comparison group, it reduces power and does not generalize to all HOLC borders if there are heterogeneous effects.[26]

IV. Main Results

We start by describing our baseline results which compare the full set of HOLC boundaries to the weighted grid controls, presented separately for the D-C and C-B boundaries. The main outcomes are the share African-American, homeownership rate, house values, and rents. A second set of results, where we only use boundaries that we contend were drawn more idiosyncratically, are then presented. A variety of robustness checks, including an independent identification strategy based on the population discontinuity determining HOLC involvement, are provided in the next section.

Baseline Results Along the D-C Boundary

To see how we arrive at our baseline specification, Table 2 walks through a detailed accounting for one particular outcome, the share African American, along one type of boundary, D-C.[27] Column (1) begins by comparing entire neighborhoods (D vs. C) rather than just the narrow buffers around the D-C boundaries. Specifically, we estimate a version of Equation (1) where the geographic unit g indexes HOLC neighborhoods and boundary fixed effects α_b are excluded. Consistent with what we show in Figure 3, the D-C gap in the share African American is quite large in 1930, at 13.5 (1.4) percentage points, rises to 25

[25] An example of such a situation is found in the area description file for a neighborhood (D98) in Chicago where the notes mention that "The eastern portion of the area is not quite so heavily populated with foreign element." Therefore, which particular street was used to demarcate the eastern boundary of this neighborhood may have been idiosyncratic.
[26] This is similar to standard heterogeneity analysis which selects subsets of the data based on observables. In our case we select on an index of observables used to construct the *p*-score.
[27] Analogous tables for the other outcomes along the D-C borders are in Appendix Tables A2 to A4.

(2.1) percentage points in 1960, and then falls to 8.1 (1.6) percentage points by 2010.[28] Adding city fixed effects (column 2) has little impact.

The consequence of using buffer zones becomes apparent when we move to column (3), which limits the analysis to presumably more similar households living within ¼ mile of a boundary. In this specification, the D-C gap starts at just 6.3 (1.0) pps in 1930, rises to 13.8 (2.7) pps by 1970 and thereafter falls to 3.7 (0.8) pps points by 2010. These estimates are slightly lower but not appreciably different when we include boundary fixed effects (column 4). However, although the variation is now restricted to comparing residents living, at most, a quarter mile from the same boundary, there are still significant pre-trends (Figure 4).

To further address the pre-existing differences along our boundary buffers, column (5) shows estimates obtained from using our weighted grid counterfactuals based on the propensity score analysis. These counterfactual boundaries successfully mimic the pre-trends in the treated boundaries. For example, the grid counterfactuals have a D-C gap in African American share of 2.4 (0.6) pps in 1920 rising to 5.4 (1.2) pps in 1930. This 3.0 percentage point increase is similar to the 3.3 percentage point increase in the treated boundaries. However, *after the maps were drawn*, the treated and control estimates begin to diverge sharply. This is illustrated in panel A of Figure 5, which plots the estimates for both the treated and control groups from columns (4) and (5). We find that the gap in the share African American in the treated group continues to rise in subsequent decades and peaks as high as 11.3 (2.3) pps by 1970 before declining. In contrast, the analogous gap in the control group drops slightly to 4.0 (0.9) pps in 1940 before reverting to roughly 0 by 1960. By 2010, the estimates are 3.4 (0.7) pps in the treated group and 0.6 (0.5) pps in the control group.

A set of "triple difference" estimates that takes the difference between the treatment and control groups (relative to 1930) are reported in column (6) of Table 2 and Panel A of Figure 5. These estimates show that a racial gap emerges in 1940 and continues to rise, peaking at 11.2 (3.1) pps in 1970 before beginning to converge. Nevertheless, there still remains an economically relevant 3.2 (1.3), 1.9 (1.1), and 1.9 (1.2) percentage point racial gap in 1990 to 2010, over half century after the maps were drawn.

A similar analysis along the D-C boundaries for our three housing related outcomes -- homeownership, house values, and rents -- is displayed in the remaining panels of Figure 5 and Appendix Tables A2 through A4. In all three cases, we again document pre-existing gaps along the HOLC boundaries which we are able to successfully mimic using propensity score weighting of control boundaries. For all of these outcomes, we find meaningful differences emerge between the treated and control boundaries starting in 1940, generally grow larger in subsequent decades, and persist to varying degrees through 2010.

[28] City-clustered standard errors are in parentheses. Bootstrapped standard errors, stratified by city, are similar in magnitude.

Specifically, after the HOLC maps were drawn, the home ownership gap among the treated D-C boundaries stayed relatively constant at around -3 to -4 pps through 1980 before falling to -1 to -2 pps by the 1990 to 2010 period. By contrast, the homeownership gap in the control boundaries closed relatively quickly and remained at roughly 0 (with a standard error of around 1 pp) through 2010. The relative widening of the homeownership gap between the treatment and control boundaries, especially through 1980, was accompanied by an economically significant move toward larger gaps in house values and rents. Among treated boundaries, the D-C house value gap starts at around -16 (1.2) pps in 1930, gradually climbs to around -27 (4.0) pps by 1980, before falling to around -8.7 (1.7) pps in 1990, -7.9 (1.3) pps in 2000 and -2.6 (1.3) pps in 2010. By comparison, the house value gap in the control boundaries quickly reverts from -14.4 (1.9) pps in 1930 to -0.1 (4.5) pps by 1950 and remains statistically indistinguishable from zero thereafter. The peak in the rent gap occurs earlier than the other outcomes and steadily declines after 1950. As of 2010 it stands at -3.6 (1.1) pps.

Baseline Results Along the C-B Boundary

Figure 6 shows analogous results along the C-B boundaries. As noted earlier, the African American population was sparse in both B and C neighborhoods in 1930 so we do not expect pre-trends to be an issue for racial gaps and, indeed, they are not (Panel A). After the maps were drawn, however, a meaningful gap of about 4 percentage points opens up by 1950 and continues to rise to a peak of over 8 percentage points by 1970 before falling back down to about 2 percentage points in 2010. In contrast, we estimate virtually a flat line around 0 for the control group of boundaries. The treatment results are almost a perfect inverse V-shape and suggest that restricted access to credit in yellow areas (what we refer to as "yellow-lining") was also a meaningful phenomenon.

We also find consistent evidence of gaps opening up in housing market measures along the C-B boundaries (Figure 6, Panels B to D). Moreover, most of these C-B housing gaps are larger and more persistent than those along the D-C boundary. For example, in 1930 there was about a 5.5 percentage point homeownership gap in both treated and control boundaries (Panel B). By 1950, that gap was eliminated in the control boundaries. However, in the treated areas, the homeownership gap fell even further in subsequent decades reaching as high as 7.8 pps in 1990 and remaining relatively steady at 7.0 pps in 2010. By comparison, the corresponding home ownership gap is only about 2 pps as of 2010 along the D-C borders. Similarly, as of 2010, the C-B gap in house values stood at 7.5 percent while the D-C gap was just 2.5 percent.[29] Unlike home ownership and house values, the gap in rents (Panel D) appear to have followed

[29] Appel and Nickerson (2016) estimate a roughly 4 percentage point gap in house values in 1990 aggregating all boundaries.

a more similar pattern in both the D-C and C-B borders and are actually slightly larger in recent decades along the D-C borders.

Section VII proposes some possible explanations for the difference in effect sizes along the D-C and C-B borders.

Estimates from Low Propensity Score Borders

Our second identification strategy attempts to isolate borders that may have been more idiosyncratic in nature, perhaps in order to arbitrarily close a polygon. We hone in on this sample by dividing the treated D-C borders into 2 groups: those below the median propensity score and those at or above the median.[30] We concentrate in particular on the below median (low propensity) borders because those were least likely to have been predicted to be drawn. The low propensity point estimates for the share African American gap are shown in column (7) of Table 2 and plotted in the blue line of Panel A, Figure 7. For ease of reference, the grey line reproduces the estimates for all treated boundaries (column 4 of Table 2).

Perhaps what is most compelling about this strategy is that there is no longer a pre-trend for the low propensity borders –the gap in 1910, 1920 and 1930 is essentially zero, the parallel trends assumption is fully satisfied and there is no longer a need to construct a control set of boundaries. Moreover, this research design is further confirmed by the distance plot for the African American share similar to what we showed in Panel A of Figure A3; only now, the racial gap is a smooth continuous function with no abrupt change near the border (Panel A of Appendix Figure A7).

Using the low propensity borders, we find that there is a meaningful rise in the D-C gap in share African Americans after the maps are drawn that peaks at a 9.1 (2.1) percentage point difference in 1970 before falling to just below 2 (0.8) percentage points by 2010. The timing and magnitude of these gaps is similar to our triple difference estimates that use the full sample of D-C borders.

Figure 7 plots the D-C estimates for the three housing outcomes in panels B through D and for the corresponding C-B boundaries in panels E through H. In every case the use of the low propensity boundaries fully eliminates gaps in the pre-map period. Further, for many of the outcomes the low propensity estimates after the maps were drawn are nearly identical to the estimates using all treated boundaries. This is perhaps most evident for the C-B gap in share African American (panel E) where we obtain nearly identical estimates using either approach, suggesting that the estimates for the effects of yellow-lining on segregation might be especially credible. The most persistently disparate estimates are for

[30] We considered directly trying to capture the phenomenon of "closing the polygon" by looking only at neighborhoods that had "multiple" different grade treated boundaries and then using only the boundary that had the lowest propensity score. The logic is that the lowest propensity score border within a polygon is most likely drawn to close the shape. Unfortunately, the sample of such boundaries is far too small.

home ownership along the C-B borders where the gaps did not grow nearly as large in the post-map period using the low propensity borders. As of 2010 the gap in the low propensity treated borders was roughly half as large (3.6 pps) compared to using all the treated boundaries (7.0 pps).

Overall, we are agnostic as to which estimates should be preferred. Under the assumption that pre-trends are nonexistent with regard to other variables as well, the low propensity method might be particularly useful in cases where we do not have pre-1940 data; one such case is discussed in section VII. The low propensity borders might reasonably be interpreted as either a lower bound on the true causal estimates, or perhaps more conservatively, as the true causal effect. Regardless, the maps appear to have had economically and statistically significant negative effects on the lower graded side of the HOLC border.

Long-run Effects on Credit Scores

We also examine the long run effects of the HOLC designated borders on modern-day credit scores and the likelihood of being considered "subprime" (Equifax Risk Score < 620) in Figure 8. Subprime borrowers are less likely to access credit or may have to pay higher interest rates. These series begin in 1999, unfortunately well after the peak of the maps' impact, and run through 2016. As before, we compare the actual treated HOLC borders to weighted grid-based controls. The cross-border gap in the levels of credit score in our control group fluctuates between roughly 0 and -5 for the entire 18-year period for both border types. However, for the treated boundaries, we find statistically significant gaps that are always lower. As of 2016, that gap stood at 8.0 (1.9) pps in the treated D-C boundaries and 9.4 (2.3) pps in the treated C-B boundaries. When we examine the probability of being subprime, the gaps in 2016 are just over 3 pps in both border samples. However, during the 2000s the subprime gap was as high as 8.6 (1.6) pps points along C-B borders and 6.2 (1.1) pps along D-C borders.

V. Robustness Checks

Control Boundaries, Sample Selection, and Geographic Choice

We considered many variations on our empirical approach. As discussed earlier, we used a set of "same-grade" HOLC boundaries as an alternative control group and found very similar, albeit, less precise results. These are shown in the second column of charts in Figures 5 and 6 where we compare the triple difference estimates using the grid versus same-grade borders. As can be seen visually, in all cases the 95 percent confidence intervals overlap and the point estimates are typically quite similar.

In Figure 9, we consider a number of additional robustness checks and show how they affect our findings on the share African American for both the D-C and C-B boundaries. Analogous figures for housing outcomes are shown in Appendix Figures A8 to A10. In panel A, we use a narrower ⅛ mile-wide cutoff on each side of the boundary to construct our buffer zone. There is a tradeoff in using a narrower buffer between having a more similar across-boundary group on the one hand and having smaller samples and a greater share of the sample that is extremely close to the boundary and potentially contaminated by across-border spillovers. In panel B, we restrict our samples to cities with above the median rate of geocoding in 1920. In panel C, we exclude all borders with a significant overlap with rivers or railroads under the assumption that these borders may be most prone to pre-existing trends. In panel D, we use a consistent level of geography -- census tracts -- in all years. This is a potentially important check because we often find a sharp increase in outcome gaps between 1950 and 1980 which is precisely when we are using the most highly aggregated data. Nevertheless, we find that the results in each case are broadly similar to our benchmark estimates in Figures 5 and 6. Notably, even in Panel D when we use a consistent level of geography, we continue to find that the 1950 to 1980 period remains well above the pre-period and convergence begins post-1980. As an added safeguard, however, we also constructed a "geography-consistent" time-series (dashed line) that adjusts the baseline 1950 to 1980 point estimates by an estimate of the bias from using tracts in these years.[31]

Alternative Identification: the 40,000 Population Cutoff

Additionally, we use an entirely distinct approach to identification that exploits the discontinuity that arises because the FHLBB only constructed maps for cities with a population of 40,000 or more (e.g. Hillier 2005). This cutoff enables us to compare the outcomes of cities with a population just below 40,000 to cities just above before the maps were drawn. Our working assumption is that cities on either side of 40,000 would not be systematically different with respect to the outcomes we consider and that any relative differences that emerge over subsequent decades could therefore be attributed to the HOLC maps. We have not encountered any evidence that there was any strategic choice in the FHLBB's choice of the cutoff but we assess this assumption directly below.

In principle, this research design is a cleaner empirical strategy since we have a stronger case for exogenous treatment. That said, there are drawbacks which cause us to consider this analysis a robustness check rather than our preferred baseline. First, statistical power will be hampered by a much smaller set of cities. Second, our results may not be generalizable to the broader set of treated cities, especially if there are heterogeneous effects by city size.[32] Third, we must examine aggregate city-level outcomes where the effects might be much more difficult to detect compared to the more tightly focused analysis that precisely

[31] Specifically, we construct a city-specific block-to-tract adjustment ratio $\frac{\beta^{block}_{1990-2010,c}}{\beta^{tract}_{1990-2010,c}}$ based on block-level and census track-level estimates derived from the 1990 to 2010 Censuses when both geographies are available and when the denominator is not very close to zero. This adjustment typically, but not always, lowers our 1950 to 1980 estimates but has little impact on the general contours of our results. The adjustment is not necessary in Panel H, where the tract-level estimates do not indicate a larger effect than the block-level estimates (shown in Panel A of Figure 6).

[32] We do not find any compelling evidence of differences in effects by city size in Section VII.

targets neighborhoods around the HOLC borders. On the other hand, if we do find effects at the city level it suggests that our localized effects are not offset in the aggregate due to other countervailing forces, at least in cities of the size that we must focus on.

For the analysis, we use a control group of 26 cities with a population of 30,000 to 40,000 in 1930 and a treatment group of 27 cities with a population between 40,000 and 50,000.[33] A list of the cities along with their 1930 population and their mean outcomes in 1930 and 1980 can be found in Appendix Table A10. Our control sample of cities (Panel A) appears to be, if anything, more negatively selected on housing characteristics and has a higher share of African Americans than the treated cities (Panel B). However, the differences are relatively small. For example, the 1930 mean home ownership rate is 46 percent in the control cities and 48 percent in the treated cities. By 1980, however, the control cities have a higher home ownership rate at 58 percent compared to 55 percent in the treated group of redlined cities. This shift in the relative gap in home ownership of 5 percentage points is of a very similar magnitude to the 4 and 4.5 percentage points in the 1980 D-C and C-B homeownership gap using our baseline triple difference estimates.

Figure 10 plots the difference between the treated and untreated cities for all four outcomes. Briefly, we find the same general pattern in housing outcomes as our previous analysis. From 1910 to 1940, housing outcomes were roughly similar in both sets of cities. But in subsequent decades, they diverge, with housing markets growing stronger in non-mapped cities for several decades and then showing some degree of reversion in more recent decades, especially with regard to homeownership rates. The racial gap also begins to diverge after 1940 but interestingly has yet to show evidence of reversion as of 2010. Of course, to be clear, the racial composition gap we are measuring here is between entire cities rather than across borders so, relative to the previous analysis, it is not directly comparable. Nevertheless, the figures are striking and lend additional credence to our baseline findings.

VI. City Estimates

We next document heterogeneity across cities. Our purpose is twofold. First, a standardized causal methodology allows a direct comparison of HOLC effects across multiple cities for the first time. Second, city-level estimates could be used to further understand the consequences of the effects of redlining.

[33] We exclude any non-redlined city within 50 miles of a redlined city to avoid the possibility that it might have effectively been treated. Our redlining cities were drawn from the 149 cities that were digitized by the University of Richmond's Digital Scholarship Lab and a list of additional HOLC mapped cities from Price Fishback. The additional list resulted in the inclusion of Jamestown, NY and Perth Amboy, NJ. City population size was based on published volumes of the 1930 Census.

In particular, we show that city-level estimates are correlated with an important measure of socioeconomic success developed by Chetty and Hendren (2017).

That said, there are some clear limitations to cutting the data by city. Many of our 149 cities have too few D-C and C-B boundaries to reliably estimate a city-specific effect. Consequently, we limit this analysis to cities with at least 5 D-C or C-B borders. For the 1950-1980 and 1990-2010 periods, that allows us to produce estimates for up to 51 and 80 cities, respectively.[34] Related, constructing control boundaries within a specific city has proven infeasible given the limited number of potential controls. Instead, we examine treated boundaries and assume that there are no effects on the control boundaries based on the national evidence shown in Figures 5 and 6.

Those important caveats aside, we find evidence of a significant degree of heterogeneity by city. For instance, the estimated African American share D-C gaps between 1950 and 1980 (Table A6 column 1) vary from 3 pps in Chicago to 9 pps in St. Louis to 21 pps in Detroit, to take a few large Midwest cities where the estimates are relatively more precise as examples. The comparable gaps in some Southern and Rust Belt cities (Birmingham, AL; Columbus, OH; Erie, PA; Evansville IN, Lexington KY; Mobile, AL and Toledo, OH) exceed 40 pps. By 1990 to 2010, these gaps have fallen considerably but some of the same cities continue to have the largest racial gaps along the D-C border. Along the C-B boundaries (Tables A6 and A7, column 2), we tend to see the largest African American share effects among Northeastern and Midwest cities, including St. Louis, New York, and Philadelphia. Tables A6 and A7 also report similar sized variation in city-specific estimates of homeownership, house values, and rent.

Correlations with Causal Effects of Place on Upward Mobility

Our findings of widening gaps along HOLC borders, combined with comparable sized city-levels effects along the 40,000 population discontinuity, raises the question of whether our estimates capture a phenomenon that was consequential at the city level. If so, the impact of the maps may have even clearer implications for social welfare.

Highly influential work by Chetty et al (2014) highlight that residential and economic segregation is one of the possible explanations for the variation in rates of upward intergenerational economic mobility across cities. More recently, Chetty and Hendren (2017) produced a set of estimates of the causal effects of commuting zones (CZs) on upward intergenerational mobility using the timing of moves during childhood. These CZ-specific measures of upward mobility are constructed based on the expected rank of a child whose parents were at the 25th percentile in the income distribution, rescaled to standard deviation units.

[34] The precise number of cities depends on the outcome and the boundary type. The number of boundaries per city are shown in Appendix Table A9.

In Figure 11, we show associations between the Chetty and Hendren (2017) measure of causal effects on mobility and our estimates of the effects of redlining across cities for two of our outcomes -- share African American and log house values.[35] The regression coefficients are economically large and statistically significant. For example, a city with a 10 percentage point racial gap along its D-C border would be expected to have nearly a 0.6 standard deviation lower degree of upward mobility than one with no racial gap. New Orleans stands out for both large effects of the HOLC maps and especially low levels of upward mobility while Seattle, Minneapolis and Portland are examples cities with relatively small gaps along HOLC borders and high rates of upward mobility. These associations provide suggestive evidence that segregation and the accumulation of wealth through investment in housing could play a role in understanding the geographic variation in the effects of place on economic mobility.

Possible Causes of City Heterogeneity

We considered several hypotheses to better understand the sources of heterogeneity across cities but were unable to find a compelling explanation. First, we explored whether there might have been differential effects on credit access due to pre-existing differences in competition in the lending sector. That is, cities where bankers faced less competition and had greater scope for discretion may have been more able to discriminate.[36] Second, we examined whether the coarseness of boundaries in a city influenced the size of the effects. For example, perhaps cities which had many fewer borders, like Chicago and its vast swatch of red surrounded by a ring of yellow (Figure 2), were less able to use the maps to promote lending practices. Third, we explored whether the effects differed by city size.[37] In all three cases, we found no consistent statistically significant patterns.

Lastly, given that our analysis coincides with the period of the Great Migration of Southern African Americans to Northern cities, we considered whether our race results might have been influenced by this major historical event. Perhaps cities where there were large inflows of African Americans were more prone to reacting through discriminatory practices. Boustan (2010) finds that there was a significant white outflow in Northern cities that experienced exogenous inflows of African Americans from the South. To address, this possibility, we use our city estimates for 1950-1980 and 1990-2010 and examine whether the gaps in the share African American across borders were systematically different across Northern cities by their level of inflow during the Great Migration. We found mixed patterns depending on the border type

[35] We match the average commuting zone-level redlining gap from 1990 to 2010 to the causal effect estimates for the 50 largest CZs shown in Table 3 of Chetty and Hendren (2017). When more than one redlined city fell into a CZ, we took the CZ's 1980 population weighted average. We use the 1990-2010 gaps to maximize our sample of cities.

[36] We used 1930 data on banks per-capita at the county level available from Price Fishback at: https://econ.arizona.edu/weather-demography-economy-and-new-deal-county-level-1930-1940. We correlated these with each of our outcomes for each border type at different time periods.

[37] Along the C-B borders there were some outcomes in some years where the differences were statistically significant by city size, but these also could have been due to chance.

and years considered. Perhaps the most compelling evidence was a statistically significant negative correlation between Great Migration inflows and D-C border gaps in white population density, consistent with Boustan (2010). However, this association does not translate into statistically significant correlations between Great Migration inflows and gaps in the share of African Americans.

VII. Discussion

Mechanisms Leading to Urban Disinvestment

The most straightforward explanation of why the HOLC maps had significant and long-lasting effects on subsequent urban development is that they led to reduced access to credit and higher borrowing costs in lower graded neighborhoods. Standard economic models of housing markets with lower access to credit and higher borrowing costs predict a reduction in the value of houses. Lower home prices in turn raise the likelihood that property owners with mortgages could be left owing more than the market value of their property (Glaeser and Gyourko 2005). Homeowners whose market value is below replacement costs or who are likely to default are much less likely to invest in their properties (Gyourko and Saiz 2004; Haughwout, Sutherland, and Tracy 2013; Melzer 2017).[38] Disinvestment in housing occurs when investment in maintenance does not keep pace with depreciation.

Perhaps the strongest evidence of HOLC-related disinvestment is the decline in homeownership, housing values, and rents documented in previous figures. Other direct measures -- such as the housing vacancy rate, total housing units, and ratings of housing quality -- tend to have flaws for our purpose. Nevertheless, they also are consistent with long-run disinvestment. In particular, we took the 50 redlined cities in which there are census tract housing vacancy data available beginning in 1940. We assume our low propensity score approach in which the parallel trends assumption is fully satisfied for other housing variables would take care of the problem here as well. If so, we find that the D-C gap in vacancy rates increased from 0.1 (0.3) percentage point in 1940 to 0.6 (0.3) percentage points in 1990. Over the same period, the C-B gap increased from 0.2 (0.4) percentage points to 0.7 (0.4) percentage points.[39] Further

[38] Moreover, disinvestment may have been exacerbated by the common pre-WWII practice of contract sales in heavily African American neighborhoods (Satter 2009). Individuals who could not obtain mortgages through the formal lending sector (commercial banks, savings and loans, and life insurance companies), in some cases because of low HOLC grades, may have instead purchased homes by entering into long-term loans known as contract sales. Under these contracts, ownership did not transfer until the final payment was made and failure to meet the terms of the loan at any point could lead residents to lose all equity in the home. Furthermore, contract sales typically had higher implicit interest rates than available in the formal lending sector and could be quite onerous on residents, leaving them responsible for all repairs, maintenance, and property taxes.

[39] Using the full sample of borders in the same cities, the 1990 estimate is 0.9 (0.3) and 1.2 (0.3) for the treated D-C and C-B boundaries and 0.1 (0.3) and 0.5 (0.3) for the D-C and C-B grid-based controls. The mean 1940 vacancy rate is 3.6 and 4.0 percent in D-C and C-B buffer zones. The mean 1990 vacancy rate is 9.8 and 7.1 percent in D-C and C-B buffer zones.

corroborative support can be found in Krimmel (2017), who finds a 20 percent reduction from 1940 to 1970 in the number of housing units in census tracts on the D side of HOLC boundaries relative to tracts on the C side. Finally, the 1960 Census asked directly about housing quality. Conditioning on a rich set of income, education, and occupation variables, we estimate that the rate of deteriorating or dilapidated housing is 6.2 (1.1) pps higher in D than C and B neighborhoods.[40] Together, we view these suggestive patterns as providing additional empirical support that declining investment caused long-term harm to housing markets in lower graded neighborhoods post-HOLC mapping.

Possible Explanations for Differences by Border Type

Our housing results often uncovered larger and more persistent negative effects among the C-B borders. Most strikingly, some of our estimated effects reverse course along D-C borders after 1970 or 1980 but not along C-B borders. We can think of at least three possible reasons.

One explanation could be that policies enacted later in the 20th century, such as the Fair Housing Act of 1968 and the Community Reinvestment Act (CRA) of 1977, designed to address discriminatory housing practices may have successfully targeted D but not C rated areas. The CRA, for example, instituted a process whereby bank regulators examine whether banks were providing adequate levels of loans to low and moderate income individuals in the areas they serve. Since low and moderate income individuals are more likely to be in D-graded neighborhoods than C-graded neighborhoods, lending by banks to satisfy CRA compliance could have led to a reduction in home ownership and housing value gaps between and D and C areas but less so between C and B areas. However, because CRA was instituted federally and not locally, it is difficult to convincingly show its passage causally led to the reversal in racial and housing gaps that began sometime in the 1970s.

A second hypothesis is that the effects of the HOLC grades may have had significantly more "bite" in C graded neighborhoods than D graded neighborhoods. If lending was more restricted in D areas than C areas in the pre-map period, then the marginal effects of the maps might have been more pronounced in C areas leading to larger sized C-B effects that also take longer to dissipate. Relatedly, it may have been the case that the maps revealed more information concerning the long-term prospects of C-rated neighborhoods than D-rated neighborhoods. This is consistent with the fact that the pre-existing gaps between B and C areas were much less pronounced than gaps between C and D areas.

A third reason is that D areas were quicker to be redeveloped and perhaps "gentrified" than the C areas and so the gaps were more quickly dissipated. This could arise because the D areas are closer to the central business district (CBD) and such areas are generally more likely to redevelop first (Brueckner and

[40] The mean rate of deteriorating or dilapidated housing in 1960 is 31, 12, and 5 percent in D, C, and B neighborhoods. Of course, we concede that it is difficult to interpret this particular result without a pre-period.

Rosenthal 2009; Baum-Snow and Hartley 2016). That said, we examined whether our results differed by the proximity of a border to the CBD but found no compelling evidence that this played an important role.[41] Alternatively, the building stock in D areas may have depreciated more quickly and thus was more suitable and less costly for redevelopment; this seems consistent with significantly higher levels of older, vacant, and deteriorating and dilapidated properties in D neighborhoods.

Population Dynamics by Race

One important question about rising segregation in post-WWII urban areas is the extent to which it was driven by white outflow or African American inflow.[42] The HOLC maps could have had an impact on each. They may have caused older housing units to "filter down" to African Americans (Rosenthal 2014). The maps may have also acted as a coordination mechanism for the outward expansion of African American neighborhoods by lowering home values in primarily white neighborhoods that were near African American neighborhoods. This dynamic may have amplified the well-known phenomenon of white flight.

Interestingly, we find that the population flows responsible for the increase in share African American vary by border type, with a combination of increased white outflow and African American inflow boosting the share African American along D-C borders but black inflows being solely responsible along C-B borders. Figure 12 illustrates these population dynamics by border type.[43] As usual, blue lines are our treatment boundaries and red lines are our grid controls.

Panel A shows that by 1950 there was an initial relative increase in the overall population density along the D side of the D-C boundaries. However, this reverted in subsequent decades, and after 1970, the total population density was higher on the C side. No meaningful changes are found along the grid control boundaries. Panel B shows that there was a large and sustained relative increase in the population density of African Americans from 1940 to 1950 that slowly reverted back to a balance thereafter. In contrast, the difference in white population density dropped abruptly along the D-C boundaries after the maps were drawn and continued to fall through 1980, consistent with white flight. Panel D shows that the population dynamics of immigrants appeared to follow a similar pattern as that of whites.

On the other hand, the rising share of African-Americans along the C-B borders is driven entirely by increased and persistent inflows of African American residents (Panel F). If anything, there is evidence

[41] We divided the sample into terciles by distance to the CBD of the city. We then compared the first tercile to a sample combining the second and third terciles. We found no statistically significant differences. If anything, we find suggestive evidence that the effects on segregation from 1950 to 1980 were larger along borders that were closer to the CBD.

[42] There is a long literature in demography, economics, and history that discusses the importance of urban white flight on racial segregation. Recent studies include Card, Mas, and Rothstein (2008), Boustan (2010), and Shertzer and Walsh (2016).

[43] We measure the across border differences in *density* rather than population *levels* to account for the different units of geography available in each census.

of a relative inflow of white population along the C side compared to the B side in 1950 (Panel G), although that reverts by 1960, when African American population density begins to increase on the C side. Therefore, white flight appears to be associated with the redlined but not yellow-lined boundaries.

We also examined whether the maps resulted in especially large changes in racial gaps along the borders that might occur if there were racial composition tipping points, as in Card, Mas, and Rothstein (2008). We found large and statistically significant effects on the probability that racial gaps along D-C or C-B boundaries were either 50 pps or more, 75 pps or more and 90 pps or more. This suggests that our effects on the mean racial gaps across borders conceals very large effects on the upper tail of the racial gap distribution.

Back-of-the-Envelope Economic Impact

Finally, to provide a sense of the relative importance of the maps, we calculated how much our estimated effects could account for the overall gaps between the different HOLC grades (not just across boundaries). In particular, we took our low propensity estimates reported in Column 7 of either Table 2 or Appendix Tables A2 to A4 and divided by the full neighborhood estimate reported in Column 1 of those same tables.[44] We made these calculations for three of our main outcomes (share African-American, home ownership, and house values), each border type, and for each of two time periods (1950 to 1980 and 1990 to 2010). Overall, we conclude that the maps could account for between 15 to 30 percent of the overall gaps in share African American and home ownership over the 1950 to 1980 period and 40 percent of the gap in house values. If we focus just on the C versus B neighborhoods over the 1950-1980 period, the maps account for roughly half of the homeownership and house value gaps.[45] After 1980, our border estimates drop and therefore can account for between 0 and 20 percent of the full neighborhood gap in each of our outcomes.

VIII. Conclusion

In response to the Great Depression, the Federal government fundamentally reshaped the nature of housing finance to stabilize housing markets and support the lending industry. A slew of new Federal agencies were created including the FHLBB, and, under its auspices, the HOLC. Among their many initiatives, the FHLBB directed the HOLC to create a systematic and uniform scientific property appraisal process and to produce residential security maps for all major cities. Some have argued that these initiatives had a profound and long-lasting influence on the real estate industry by initiating the so-called practice of

[44] We concentrate on the low propensity specifications because of the lack of a pre-trend. Nevertheless, to be conservative, we still subtract out the 1930 estimate.
[45] There are very few African Americans in C-B neighborhoods until 1960, making it somewhat difficult to interpret this calculation for share African American, at least until later years.

"redlining." The residential security maps, which explicitly took into account demographic characteristics (e.g. race, ethnicity) of entire neighborhoods, were drawn for the purpose of influencing the property appraisal process. This in turn may have influenced lending decisions as well as the provision of Federal mortgage insurance.

We attempt to identify the causal effects of the HOLC maps on neighborhood development from 1940 through 2010. A major challenge for our analysis is that the maps were not exogenous and instead likely reflected existing neighborhood differences and trends. Therefore, there is a concern that the evolution of gaps in the post-map period may have reflected practices that would have occurred even in the absence of the maps. To address these challenges, we use a variety of empirical approaches including the use of counterfactual boundaries that experienced the same pre-existing trends but where the HOLC did not ultimately draw borders. We also employ borders that appear to have been chosen for idiosyncratic reasons and where endogeneity is much less of a concern. Finally, we exploit a discontinuity in the HOLC's decision to only create maps for cities with a population above 40,000.

Using these approaches, we consistently find a significant and persistent causal effect of the HOLC maps on the racial composition and housing development of urban neighborhoods. These patterns are consistent with the hypothesis that the maps led to reduced credit access and higher borrowing costs which, in turn, contributed to disinvestment in poor urban American neighborhoods with long-run repercussions. We show that being on the lower graded side of D-C boundaries led to rising racial segregation from 1930 until about 1970 or 1980 before starting to decline thereafter. We also find this same pattern along C-B borders, revealing for the first time that "yellow-lining" was also an important phenomenon. That the pattern begins to revert starting in the 1970s is at least suggestive that Federal interventions like the Fair Housing Act of 1968, the Equal Credit Opportunity Act of 1974, and the Community Reinvestment Act of 1977 may have played a role in reversing the increase in segregation caused by the HOLC maps. Nevertheless, racial segregation along both the C-B and D-C borders remains in 2010, almost three quarters of a century later. Moreover, we also find that the maps had sizable effects on homeownership rates, house values and rents. Intriguingly, the effects on homeownership, and to a somewhat lesser extent house values, dissipate over time along the D-C boundaries but remain highly persistent along the C-B boundaries. We believe our results highlight the key role that access to credit plays on the growth and long-running development of local communities.

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Figure 1: Geographic Coverage of Digitized HOLC Maps

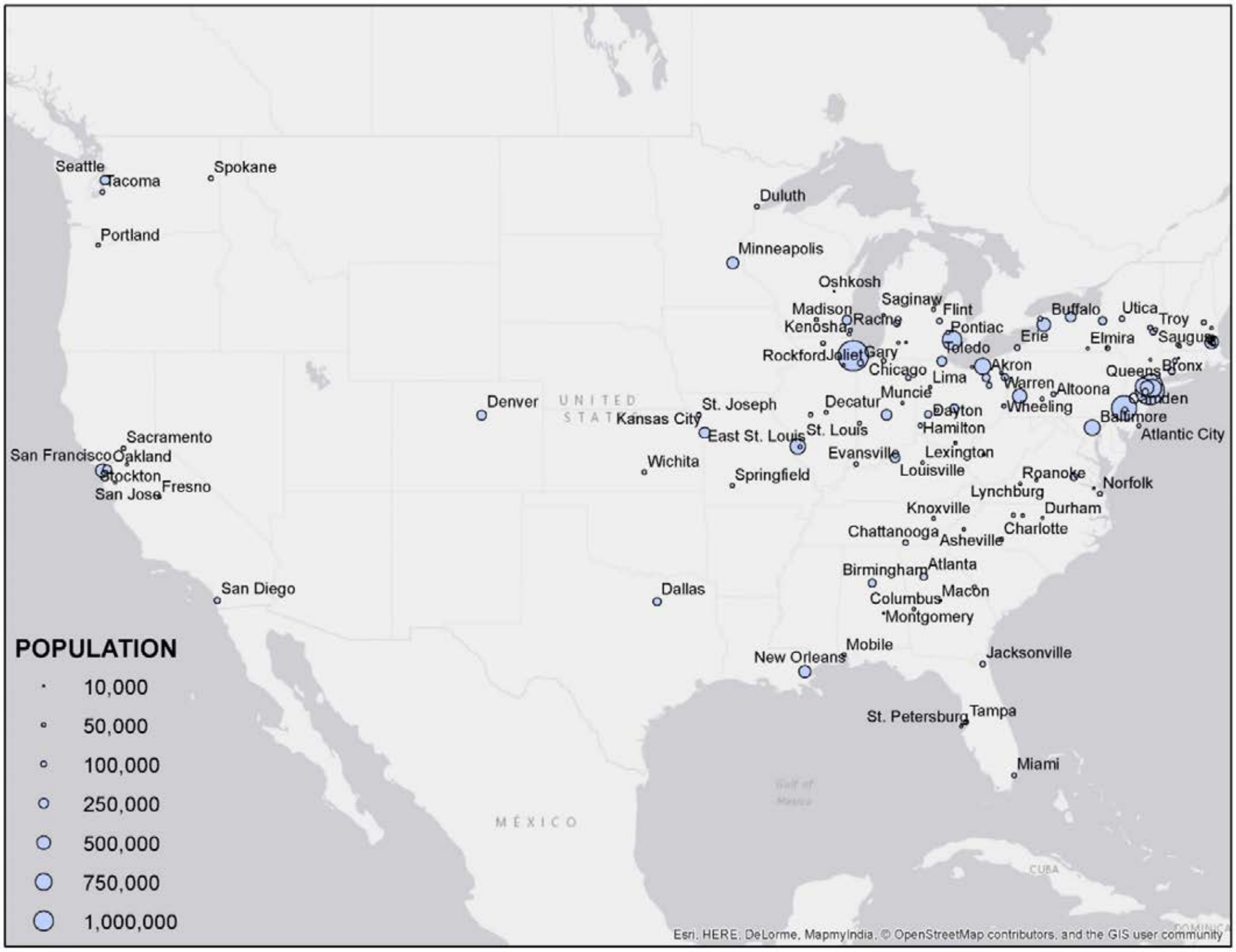
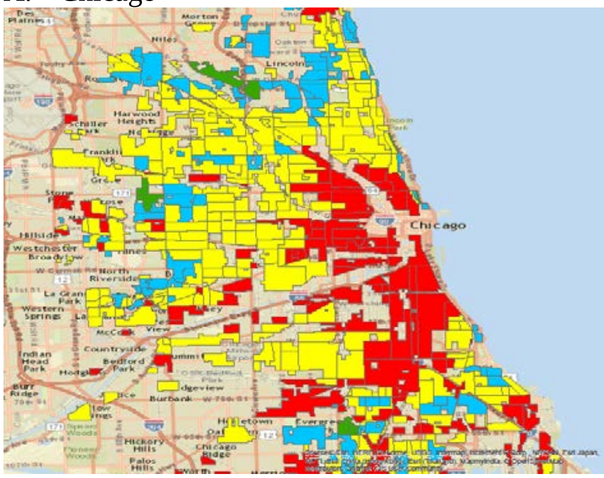
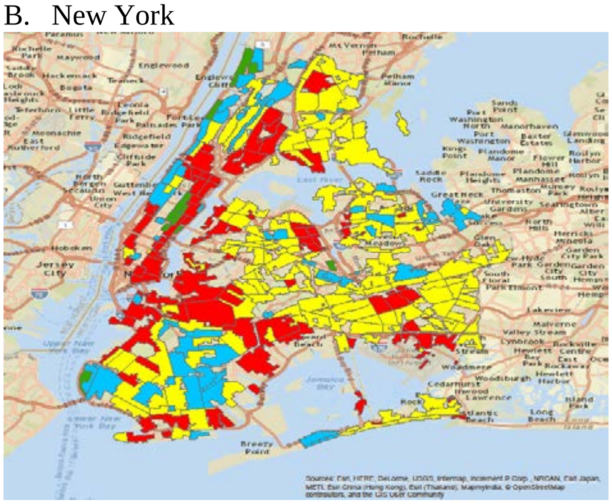


Figure 2: HOLC Maps for Chicago, New York, and San Francisco

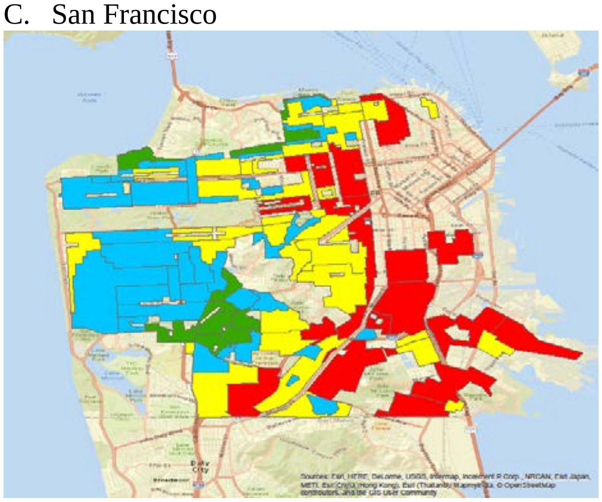
A. Chicago



B. New York



C. San Francisco



HOLC Grades (in order of riskiness):

A=Green (least)

B=Blue

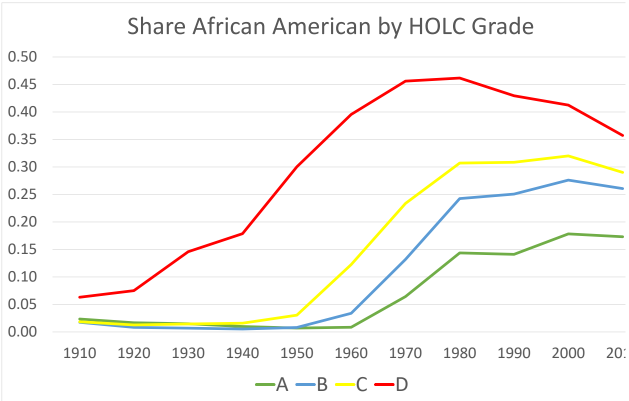
C=Yellow

D=red (most)

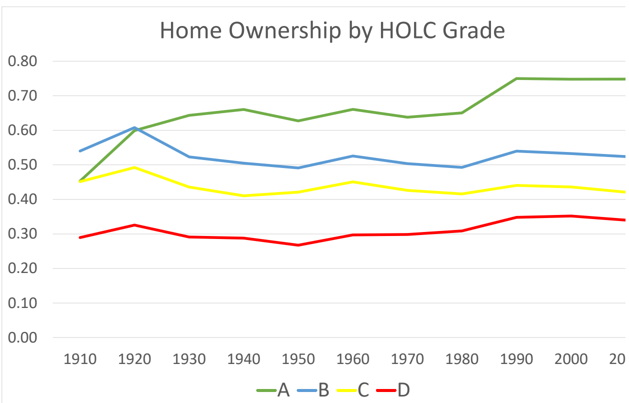
U=unclassified

Figure 3: Changes Over Time in Mean Outcomes, by HOLC Neighborhood Grade

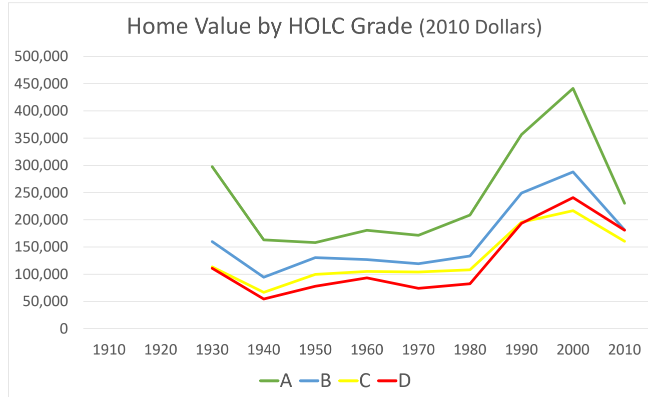
Panel A: Share African American



Panel B: Home Ownership



Panel C: Home Values



Panel D: Rent

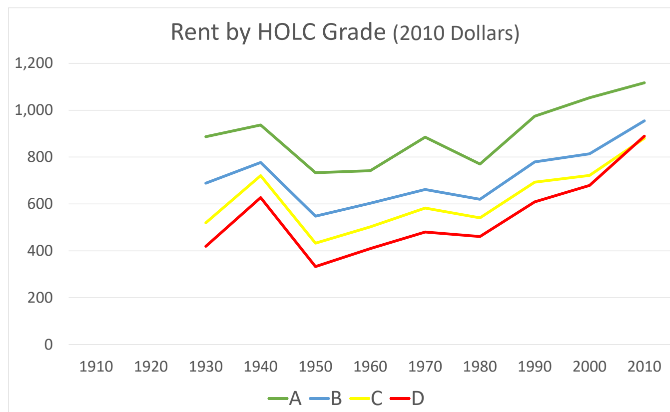
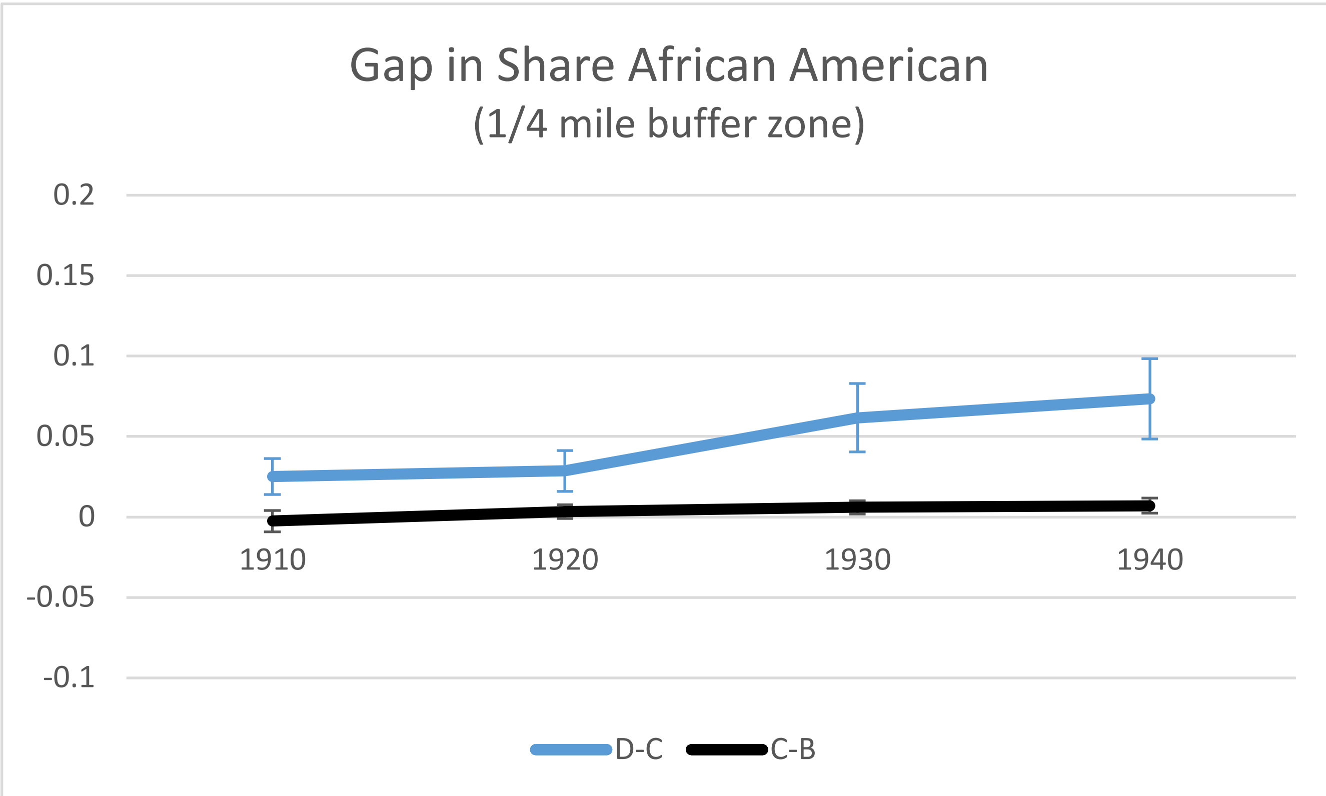


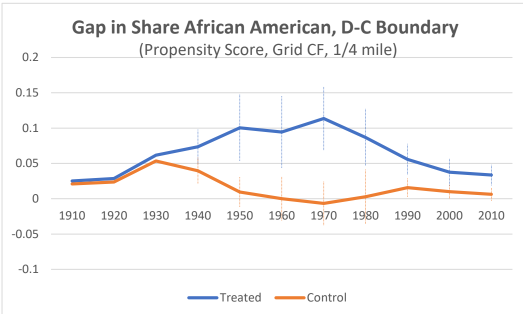
Figure 4: Pre-trends Along D-C and C-B Borders

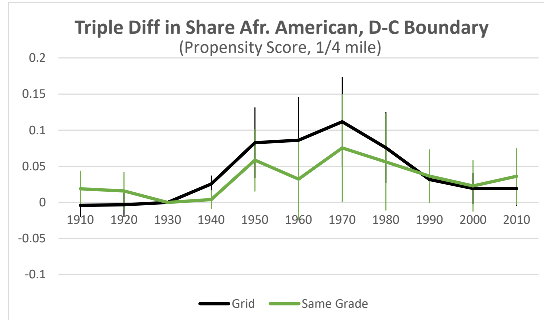


Notes: Estimates for D-C boundaries are based on regressions shown in Table 2, column 4.

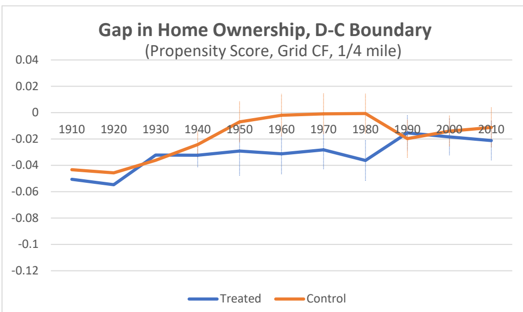
Figure 5: Effects on D-C Gaps in Main Outcomes

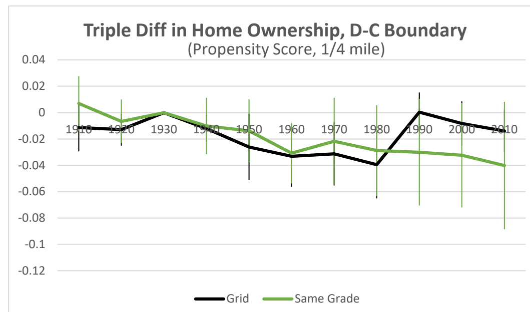
Panel A: Share African American



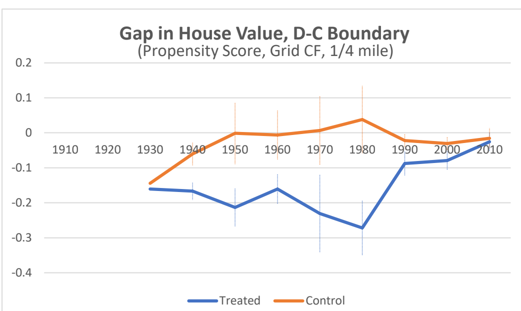


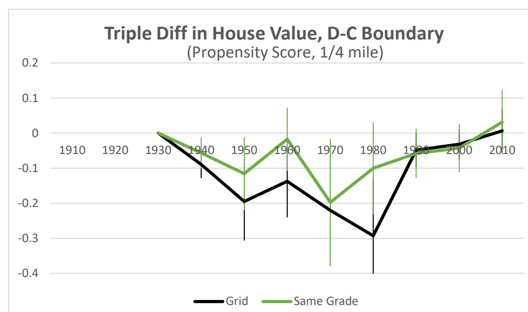
Panel B: Home Ownership



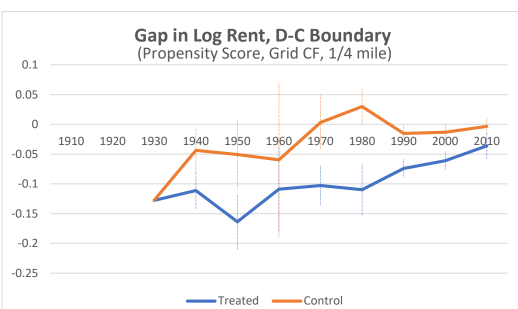


Panel C: Log House Values





Panel D: Log Rent



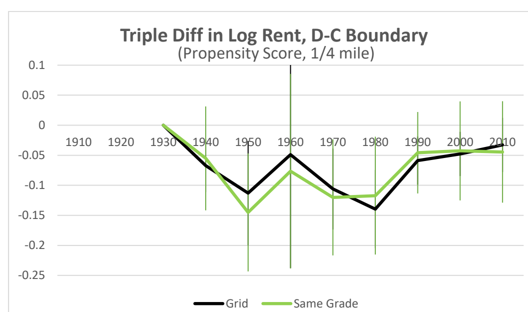
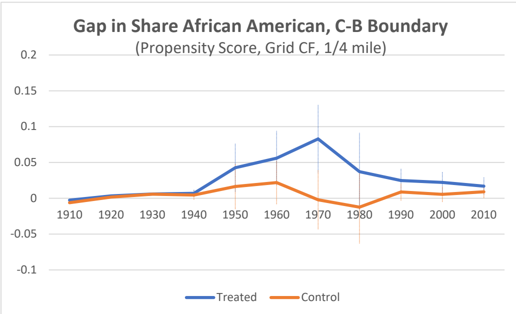
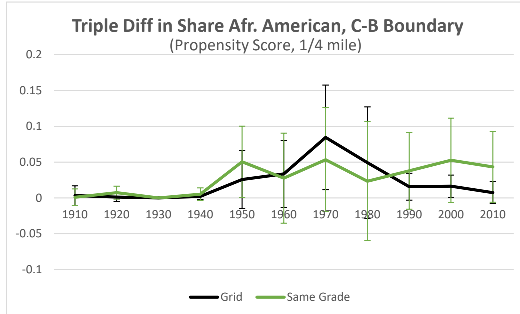


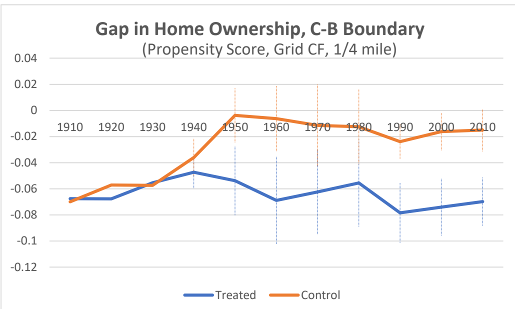
Figure 6: Effects on C-B Gaps in Main Outcomes

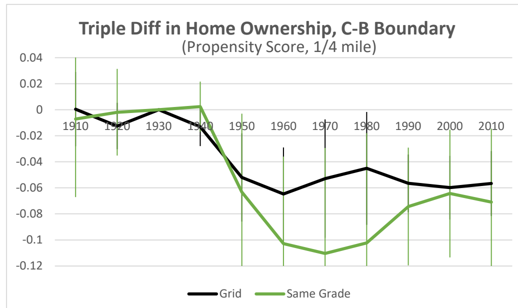
Panel A: Share African American



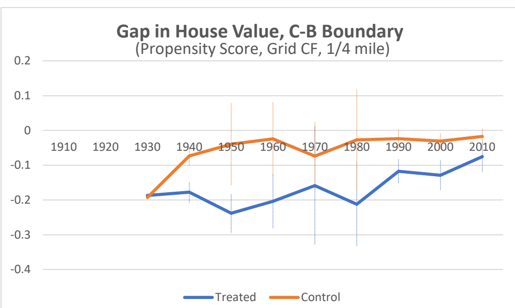


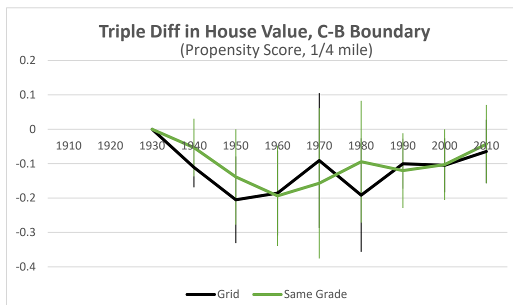
Panel B: Home Ownership



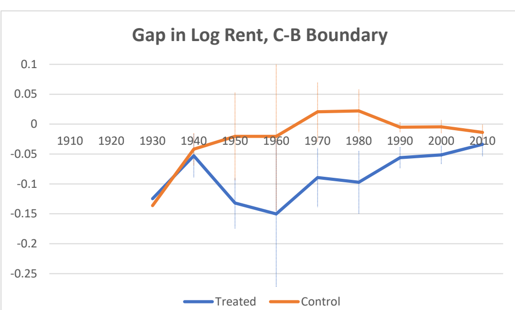


Panel C: Log House Values





Panel D: Log Rent



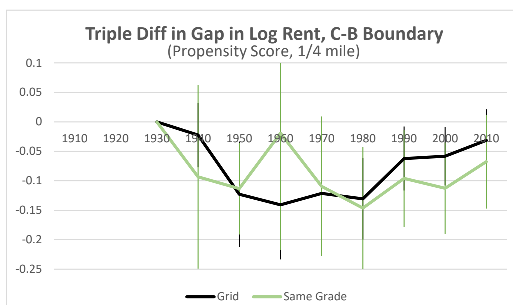
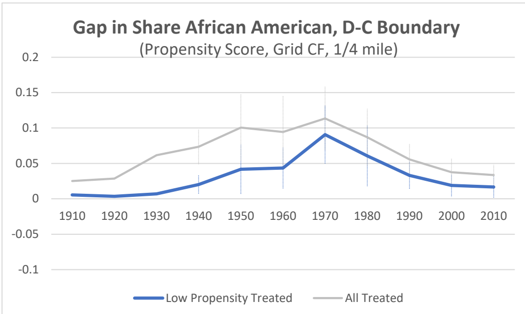
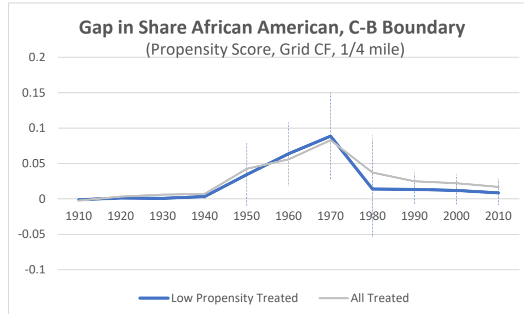


Figure 7: Effects on D-C and C-B Gaps, Using Low Propensity for Treatment Boundaries

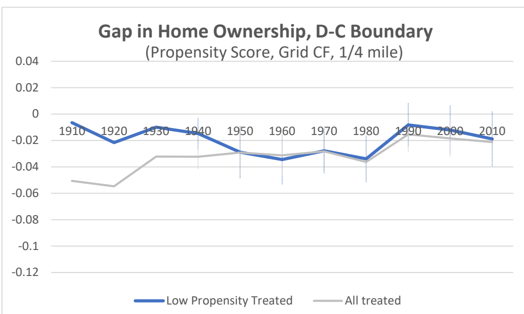
Panel A: Share African American, D-C



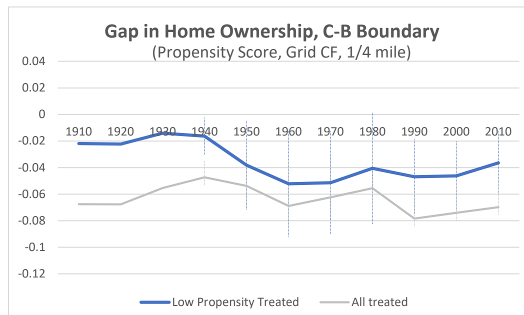
Panel E: Share African American, C-B



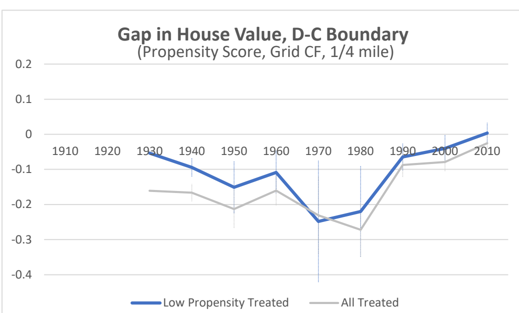
Panel B: Home Ownership, D-C



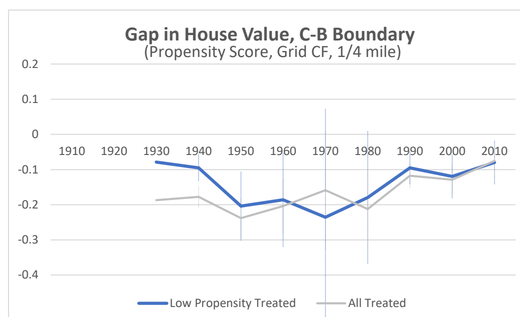
Panel F: Home Ownership, C-B



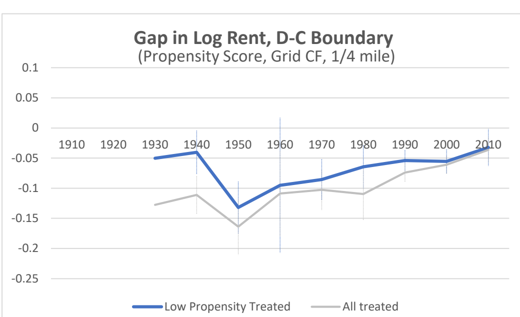
Panel C: Log House Values, D-C



Panel G: Log House Values, C-B



Panel D: Log Rent, D-C



Panel H: Log Rent, C-B

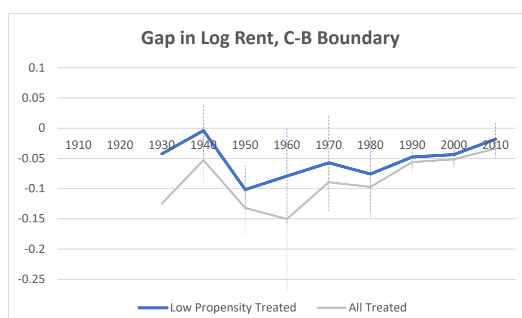
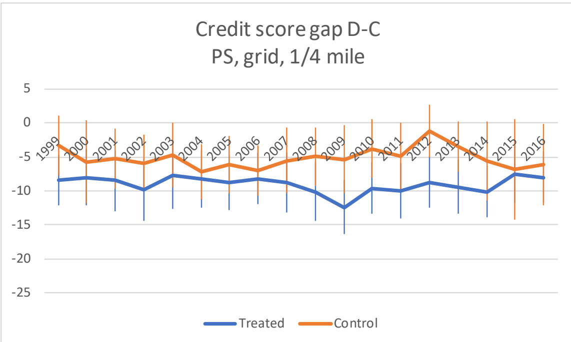
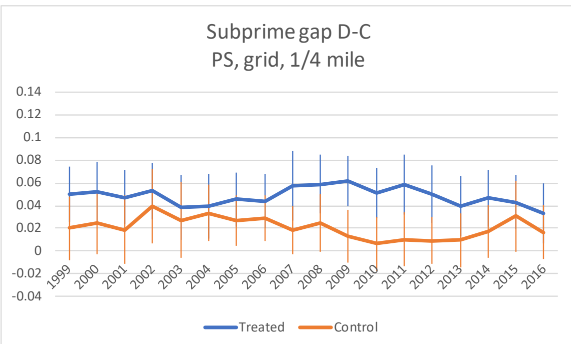


Figure 8: Effects on D-C and C-B Gaps in Credit Scores

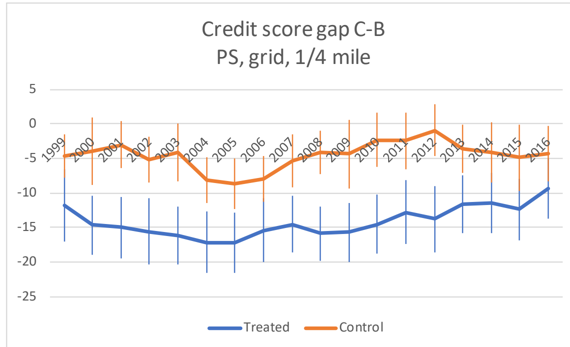
Panel A: D-C Gaps in Credit Scores



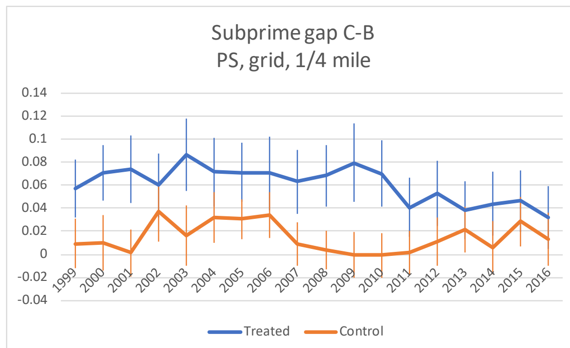
Panel B: D-C Gaps in Subprime



Panel C: C-B Gaps in Credit Scores



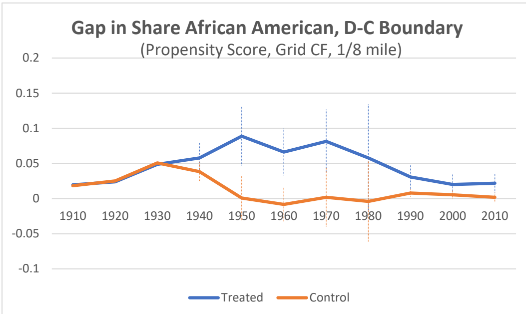
Panel D: C-B Gaps in Subprime



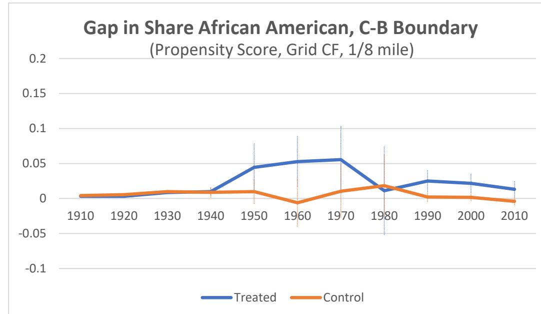
Source: FRBNY Consumer Credit Panel/Equifax

Figure 9: Robustness Checks, Effects on African American Share D-C, C-B Boundaries

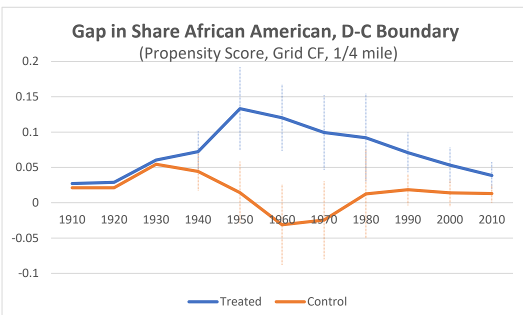
Panel A: 1/8th mile Boundaries, D-C



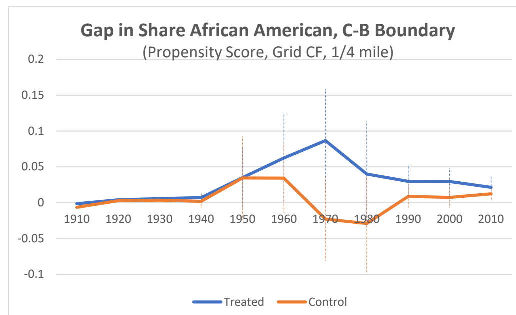
Panel E: 1/8th mile Boundaries, C-B



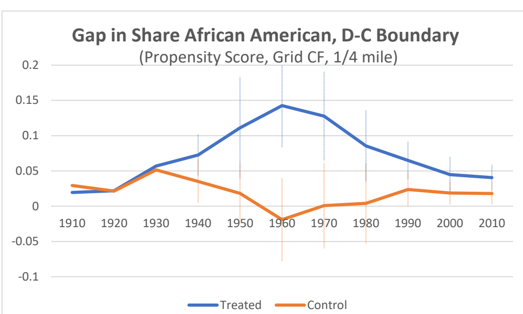
Panel B: High Geocoding Rate Cities, D-C



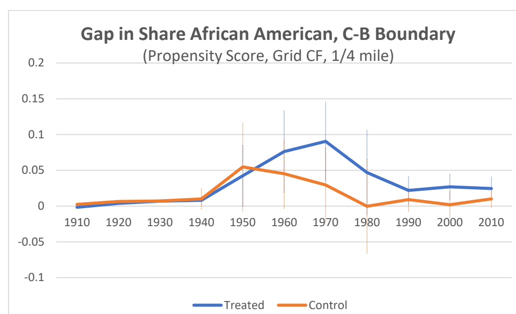
Panel F: High Geocoding Rate Cities, C-B



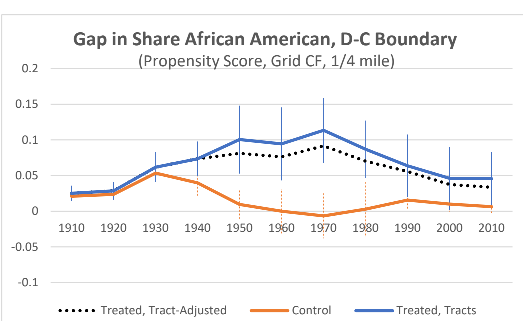
Panel C: Excluding Trains and Rivers, D-C



Panel G: Excluding Trains and Rivers, C-B



Panel D: Using Tracts in All Years, D-C



Panel H: Using Tracts in All Years, C-B

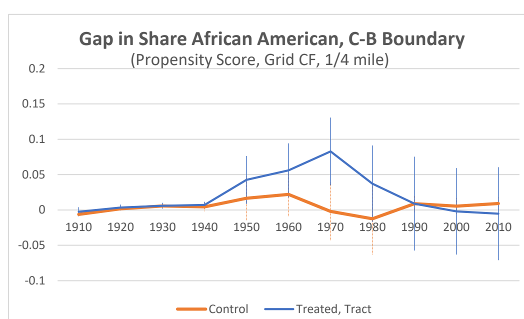
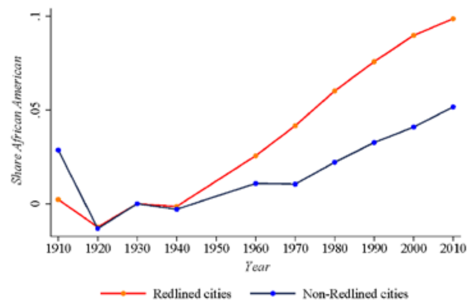
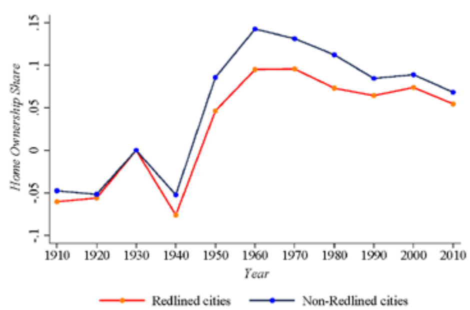


Figure 10: Comparison of Redlined versus Non-Redlined Cities Using 40,000 Population Cutoff

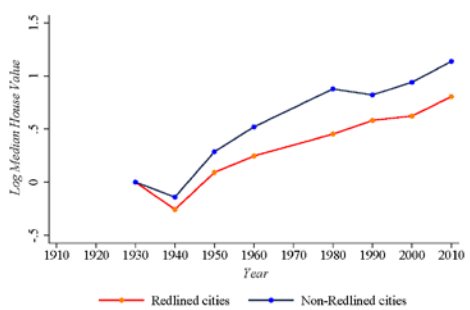
Panel A: Trends in Share African American (Normalized relative to 1930)



Panel B: Trends in Home Ownership Rate (Normalized relative to 1930)



Panel C: Trends in Log Median House Value (Normalized relative to 1930)



Panel D: Trends in Log Median Rent (Normalized relative to 1930)

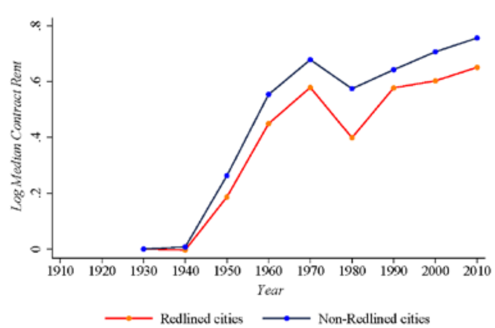
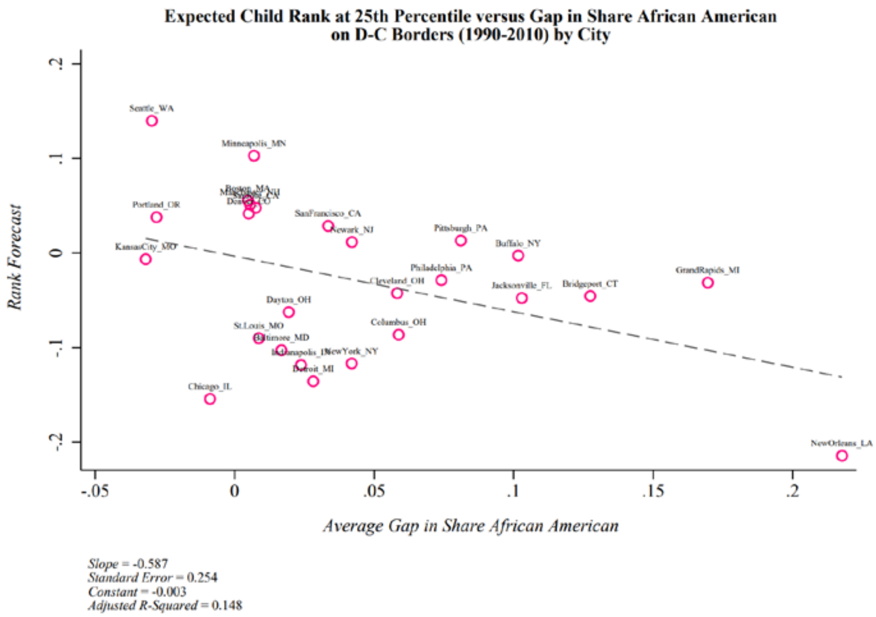


Figure 11: Association between HOLC Boundary Gaps and Upward Mobility

Panel A: Gaps in Share African American and Upward Mobility



Panel B: Gaps in House Values and Upward Mobility

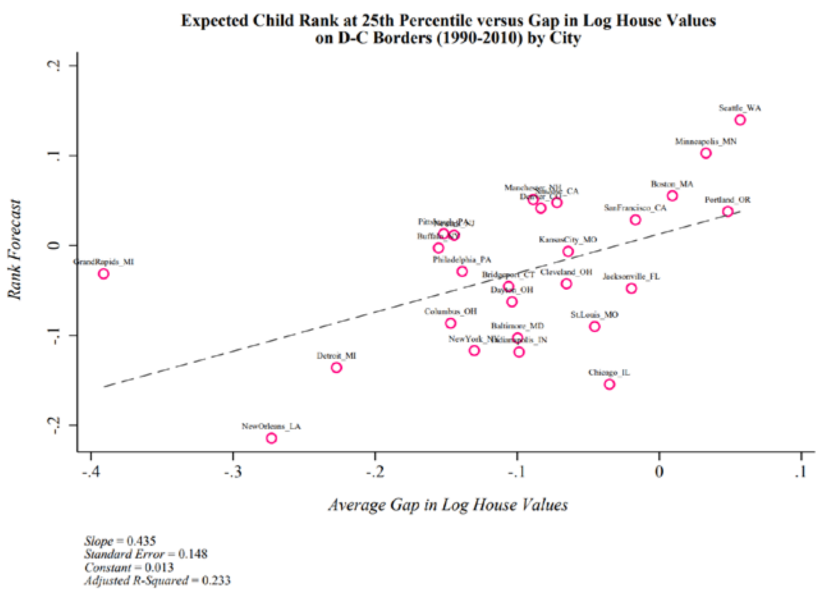
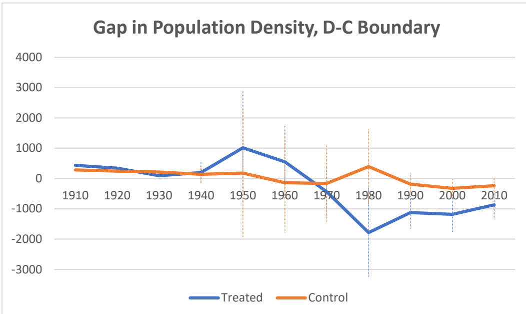
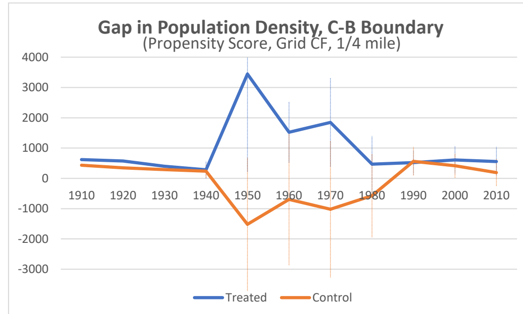


Figure 12: Population Dynamics Along the D-C and C-B Boundaries

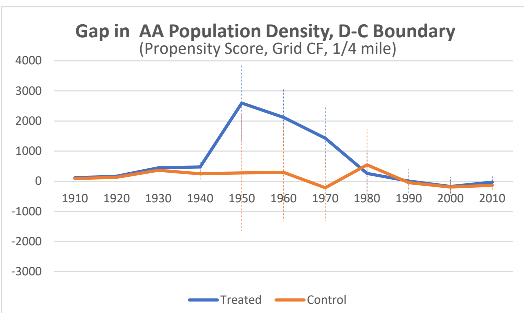
Panel A: Gap in Population Density, D-C



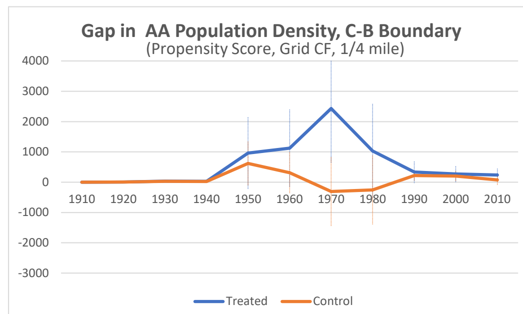
Panel E: Gap in Population Density, C-B



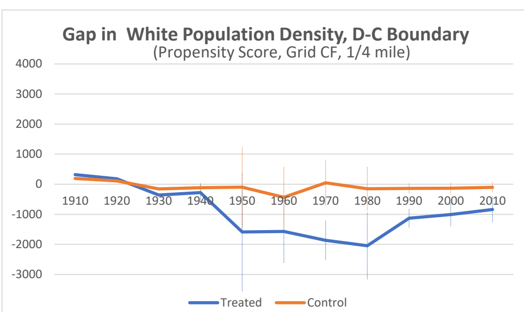
Panel B: Gap in Afr. American Density, D-C



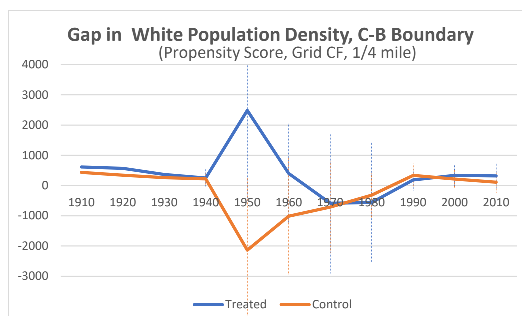
Panel F: Gap in Afr. American Density, C-B



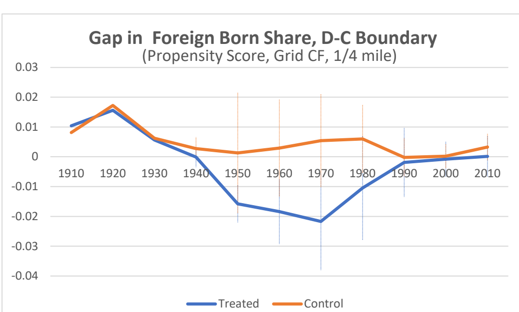
Panel C: Gap in White Density, D-C



Panel G: Gap in White Density, C-B



Panel D: Gap in Foreign Born Share, D-C



Panel H: Gap in Foreign Born Share, C-B

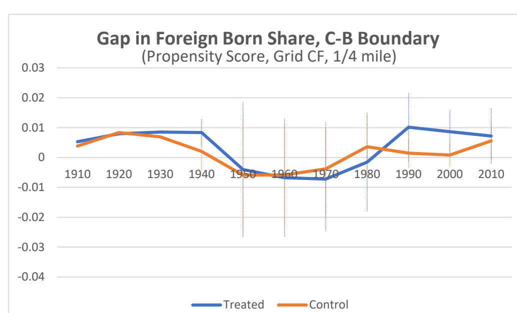


Table 1: Summary Statistics

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Sample Type		Full				Boundary Buffer Zones					
		HOLC Neighborhoods				C-B Borders		D-C Borders		Buffer Gaps	
Grade		A	B	C	D	B	C	C	D	C-B	D-C
N		*543*	*1351*	*2156*	*1399*	*1965*	*1965*	*2111*	*2111*	*1965*	*2111*
Panel A.	year										
Share	1910	0.023	0.018	0.019	0.063	0.019	0.014	0.027	0.060	-0.005	0.034
African	1920	0.017	0.008	0.013	0.075	0.008	0.009	0.020	0.063	0.001	0.043
American	1930	0.015	0.007	0.015	0.146	0.008	0.012	0.025	0.097	0.004	0.072
	1940	0.010	0.005	0.016	0.179	0.006	0.010	0.029	0.121	0.004	0.092
	1950	0.007	0.008	0.031	0.300	0.006	0.039	0.055	0.226	0.033	0.171
	1960	0.009	0.034	0.123	0.396	0.080	0.112	0.218	0.371	0.033	0.153
	1970	0.064	0.132	0.234	0.456	0.168	0.225	0.313	0.469	0.057	0.156
	1980	0.144	0.243	0.307	0.462	0.312	0.305	0.373	0.494	-0.006	0.121
	1990	0.141	0.251	0.309	0.430	0.342	0.351	0.397	0.443	0.009	0.046
	2000	0.178	0.276	0.320	0.412	0.365	0.365	0.401	0.431	0.000	0.030
	2010	0.173	0.261	0.290	0.357	0.324	0.331	0.355	0.386	0.007	0.031
Panel B.											
Home	1910	0.453	0.540	0.451	0.289	0.564	0.481	0.441	0.374	-0.082	-0.067
Ownership	1920	0.599	0.608	0.492	0.326	0.600	0.535	0.467	0.395	-0.064	-0.072
Rate	1930	0.643	0.523	0.436	0.291	0.482	0.433	0.403	0.350	-0.049	-0.052
	1940	0.660	0.505	0.410	0.288	0.441	0.394	0.362	0.311	-0.047	-0.051
	1950	0.627	0.491	0.421	0.267	0.361	0.298	0.359	0.292	-0.064	-0.067
	1960	0.661	0.526	0.451	0.297	0.395	0.324	0.362	0.300	-0.071	-0.062
	1970	0.638	0.504	0.426	0.299	0.337	0.286	0.337	0.284	-0.051	-0.053
	1980	0.650	0.493	0.416	0.309	0.336	0.287	0.348	0.290	-0.049	-0.058
	1990	0.750	0.540	0.441	0.348	0.429	0.360	0.365	0.336	-0.070	-0.029
	2000	0.748	0.533	0.436	0.352	0.425	0.357	0.359	0.336	-0.068	-0.023
	2010	0.748	0.524	0.421	0.340	0.410	0.346	0.339	0.316	-0.064	-0.023
Panel C.											
Home	1930	297	160	113	111	168	129	112	102	-38	-10
Value	1940	163	95	67	55	93	77	63	56	-16	-7
(1000s)	1950	158	130	100	78	128	116	92	76	-12	-16
	1960	181	127	105	93	127	121	102	88	-6	-14
	1970	172	119	104	74	124	113	95	78	-11	-17
	1980	209	134	108	82	133	116	104	77	-17	-27
	1990	357	249	196	193	241	227	189	178	-14	-10
	2000	441	288	217	241	263	243	211	192	-20	-20
	2010	230	181	161	181	182	176	165	173	-6	8

Table 1: Summary Statistics, cont.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Sample Type		Full				Boundary Buffer Zones					
		HOLC Neighborhoods				C-B Borders		D-C Borders		Buffer Gaps	
Grade		A	B	C	D	B	C	C	D	C-B	D-C
N		*543*	*1351*	*2156*	*1399*	*1965*	*1965*	*2111*	*2111*	*1965*	*2111*
Panel D.	year										
Rent	1930	887	689	520	419	1073	913	847	821	-159	-26
	1940	937	777	721	627	1645	1768	1218	1072	123	-146
	1950	733	548	433	333	506	462	407	340	-45	-67
	1960	742	603	503	410	571	534	493	436	-37	-57
	1970	885	662	582	480	621	589	534	480	-32	-54
	1980	770	620	541	461	586	557	506	453	-29	-53
	1990	974	779	693	609	707	690	631	598	-17	-33
	2000	1053	814	722	679	742	724	678	644	-18	-34
	2010	1117	955	880	889	897	884	862	844	-13	-18
Panel E.											
Share	1910	0.305	0.194	0.205	0.268	0.175	0.184	0.198	0.211	0.008	0.014
Foreign	1920	0.203	0.152	0.182	0.237	0.143	0.159	0.180	0.197	0.016	0.017
Born	1930	0.157	0.166	0.205	0.243	0.181	0.199	0.208	0.220	0.017	0.013
	1940	0.100	0.134	0.162	0.172	0.148	0.161	0.163	0.164	0.013	0.001
	1950	0.132	0.155	0.157	0.128	0.171	0.178	0.154	0.141	0.008	-0.013
	1960	0.113	0.141	0.132	0.099	0.156	0.152	0.127	0.104	-0.003	-0.023
	1970	0.090	0.121	0.118	0.086	0.146	0.145	0.109	0.086	-0.001	-0.023
	1980	0.095	0.140	0.145	0.116	0.177	0.186	0.121	0.113	0.009	-0.008
	1990	0.121	0.243	0.298	0.246	0.282	0.303	0.198	0.195	0.021	-0.004
	2000	0.103	0.181	0.222	0.195	0.211	0.237	0.191	0.201	0.025	0.010
	2010	0.107	0.188	0.238	0.217	0.221	0.244	0.204	0.217	0.023	0.013
Panel F.											
Credit	1999	709	674	653	640	659	651	641	634	-8	-6
Score	2016	729	692	671	662	682	675	665	662	-6	-3
Fraction	1999	0.122	0.218	0.306	0.384	0.246	0.286	0.373	0.418	0.040	0.046
Subprime	2016	0.105	0.173	0.232	0.281	0.19	0.199	0.252	0.257	0.009	0.004

Table 2: Effect of D versus C grade on Share African Americans

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sample Type	HOLC Neighorhoods		1/4 Mile D-C Boundaries				
Year	D-C	D-C	D-C	D-C	Grid C.F's	Triple Diff	Low PS D-C
1910	0.061	0.053	0.026	0.025	0.021	-0.004	0.006
	(0.011)	(0.01)	(0.005)	(0.006)	(0.01)	(0.008)	(0.004)
1920	0.069	0.063	0.030	0.029	0.024	-0.003	0.003
	(0.009)	(0.008)	(0.006)	(0.006)	(0.006)	(0.009)	(0.004)
1930	0.135	0.133	0.063	0.062	0.054	--	0.007
	(0.014)	(0.013)	(0.01)	(0.011)	(0.012)	--	(0.004)
1940	0.150	0.147	0.076	0.073	0.040	0.026	0.020
	(0.015)	(0.013)	(0.012)	(0.012)	(0.009)	(0.006)	(0.007)
1950	0.224	0.214	0.119	0.101	0.010	0.083	0.042
	(0.02)	(0.019)	(0.026)	(0.024)	(0.011)	(0.025)	(0.018)
1960	0.250	0.234	0.121	0.094	0.000	0.086	0.044
	(0.021)	(0.018)	(0.031)	(0.026)	(0.016)	(0.03)	(0.015)
1970	0.216	0.203	0.138	0.113	-0.007	0.112	0.091
	(0.024)	(0.02)	(0.027)	(0.023)	(0.016)	(0.031)	(0.021)
1980	0.172	0.159	0.107	0.087	0.003	0.076	0.061
	(0.028)	(0.023)	(0.028)	(0.021)	(0.02)	(0.025)	(0.022)
1990	0.130	0.126	0.059	0.056	0.016	0.032	0.033
	(0.018)	(0.014)	(0.011)	(0.011)	(0.007)	(0.013)	(0.01)
2000	0.106	0.103	0.042	0.038	0.010	0.019	0.019
	(0.017)	(0.013)	(0.01)	(0.01)	(0.005)	(0.011)	(0.008)
2010	0.081	0.079	0.037	0.034	0.006	0.019	0.017
	(0.016)	(0.012)	(0.008)	(0.007)	(0.005)	(0.012)	(0.008)
Cities	*148*	*148*	*115*	*115*	*115*	*115*	*97*
Neighborhoods	*3532*	*3555*	--	--	--	--	--
Boundaries	--	--	--	*1133*	*4214*	*5347*	*567*
N	*27814*	*27814*	*16676*	*16676*	*61415*	*78091*	*8519*
R2	*0.215*	*0.383*	*0.426*	*0.645*	*0.683*	*0.675*	*0.647*
F.E.	*None*	*City*	*City*	*Bound.*	*Bound.*	*Bound.*	*Bound.*

Notes: Table entries are from regressions that estimate the gaps between D and C rated neighborhoods in the share African American. Columns 1 and 2 use entire neighborhoods. Columns 3 to 7 use 1/4 mile boundary buffer zones. Columns 3 and 4 use actual HOLC "treated" boundaries. Column 5 shows effects on counterfactual boundaries weighted by propensity scores to be similar to treated boundaries. Column 6 shows the difference in the gap between treated and control boundaries relative to 1930. Column 7 uses only those treated boundaries with below median propensity scores.

Appendix

Census Housing Variable Construction

Whenever possible, we attempt to use consistently defined census variables from 1910 to 2010. Typically, this means relying on the version of the data cleaned and coded by IPUMS. However, we must deviate from IPUMS sometimes with regard to house values, monthly contract rent, and vacancy rates. For 1930 and 1940, we trim the bottom and top 1 percent of the national house value and rent distribution separately for each census out of concern about extreme outliers. In 1950, census tract tabulations report monthly contract rents and house values in bins. We use these bins to calculate a mean by assuming that the mean of each bin is equal to its midpoint. For the highest bin, we assume that its mean is equal to 1.5 times its lower bound. We repeat this procedure for 1960 house values. In 1970 and 1980, we calculate mean house value and mean monthly contract rent by dividing the aggregates of these variables by the number of owner-occupied units with house value reported and by the number of renter-occupied units with non-zero contract rent, respectively. For our vacancy rates, we use number of "dwelling" units in 1940 and number of "housing" units in 1990.

HOLC Grade Determinants

Appendix Table A5 shows a series of regressions that associate neighborhood grades with pre-HOLC 1930 housing and demographic characteristics, as well as changes between 1920 and 1930 when available. Columns (1) and (2) report marginal effects from an ordered logit where D is coded as 4 and A is coded as 1. Columns (3) to (8) are marginal effects of the probability of moving one grade lower: i.e. from A to B, from B to C, or from C to D, respectively. All specifications include city fixed effects and are weighted by the log of neighborhood population in 1930. Standard errors are clustered at the city level.

Like Hillier (2005) and Fishback (2014), who were only able to examine single cities, we find a clear monotonic relationship between grades and nearly all the key economic and housing covariates that are available in the census whether considered individually or, as in the table, simultaneously.[46] Unsurprisingly, a higher homeownership rate, log home value, log rent, occupational earnings, radio ownership, and literacy are associated with a higher HOLC grade. To take one example, the results in column (2) imply that a 10 percentage point increase in homeownership rates raises the probability of a being assigned one letter grade higher by 7.6 (0.7) percentage points. These results are unsurprising because they conform with what we know about the appraisal process from the detailed forms, called area

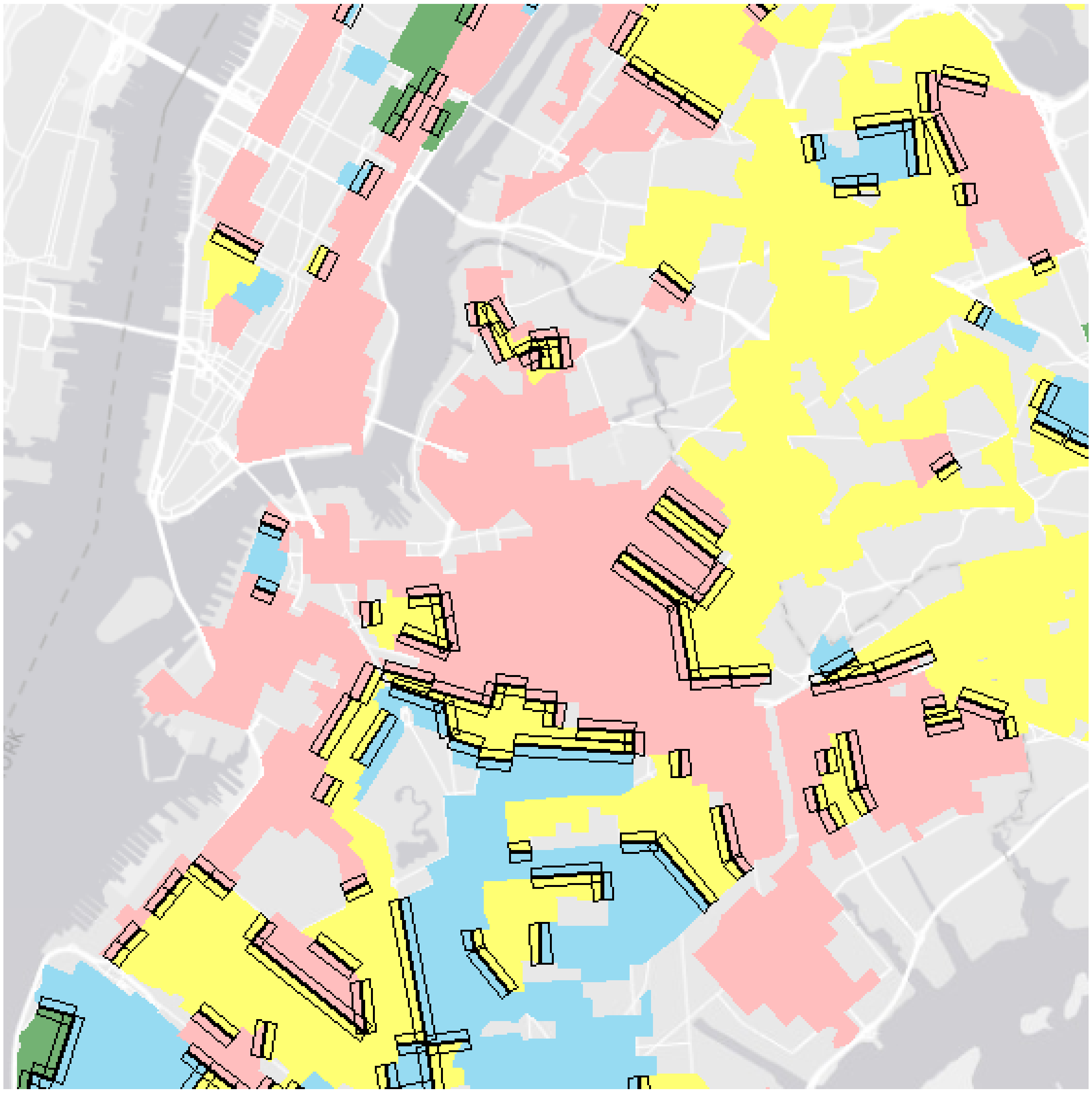
[46] We find weaker evidence that recent changes in housing and household characteristics between 1920 and 1930 affected HOLC grades. These coefficients are suppressed in Table 2 for space but are available on request. However, it is plausible that changes between 1920 and 1930 are not the correct time frame for evaluating appraisals that were taking place in the mid-1930s.

description files (ADF), that were recorded at the time. The ADFs consistently document that homeownership, vacancy, housing age, housing quality, and economic and demographic characteristics of neighbors were key factors used to grade neighborhoods.

Appendix Table A5 also shows that the marginal effect of most of our observable housing and employment variables is roughly the same for grade determination between B versus C (columns 5 and 6) and C versus D (columns 3 and 4). For example, in the sample of C and D neighborhoods, a 10 percentage point increase in the homeownership rate increases the probability of a C grade by 4.5 (0.5) percentage points. Likewise, in the C-B sample, a 10 percentage point increase in the homeownership rate increases the probability of a B grade by 4.8 (0.6) percentage points.

The case of race is somewhat more complicated. Similar to previous studies, we show that a neighborhood is more likely to be graded D than C if the African-American share is higher, even after conditioning on a set of housing and economic characteristics and city fixed effects. To highlight the pivotal role of race in grading D neighborhoods, Appendix Figure A2 shows the ADF for a particular neighborhood in Tacoma, Washington which was graded D. The notes at the bottom of the document clarify: “This might be classed as a ‘low yellow’ area if not for the presence of the number of Negroes and low class foreign families who reside in the area.” It is worth noting that the fraction of African Americans in this Tacoma neighborhood was 2 percent. However, interestingly, the share African-American has the opposite effect when we examine grade determination among A versus B neighborhoods and B versus C neighborhoods. That is, B grades are more likely than C grades, and A grades are more likely than B grades, in areas with a higher share of African Americans.

Appendix Figure A1: Boundary Buffer Zones for New York City



Appendix Figure A2: Area Description File for Tacoma, Washington

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AREA DESCRIPTION - SECURITY MAP OF Tacoma

1. AREA CHARACTERISTICS:
   a. Description of Terrain. Low lying level.

   b. Favorable Influences. Schools, churches, stores and transportation conveniently available.

   c. Detrimental Influences. Unimproved streets - Heterogeneous population.

   d. Percentage of land improved 50 %; e. Trend of desirability next 10-15 yrs. Static

2. INHABITANTS:
   a. Occupation Laborers ; b. Estimated annual family income $ 1000 to $1800

   c. Foreign-born families few %; American born predominating; d. Negro Yes ; 2 %

   e. Infiltration of Lower classes slowly; f. Relief families Many

   g. Population is increasing Slowly ; decreasing ---- ; static ----

3. BUILDINGS:

	PREDOMINATING 90 %		OTHER TYPE 10 %		OTHER TYPE %	
a. Type	4 & 5 room		Miscellaneous			
b. Construction	frame					
c. Average Age	15 Years		Years		Years	
d. Repair	poor to fair					
e. Occupancy	95 %		%		%	
f. Home ownership	50 %		%		%	
g. Constructed past yr.	None					
h. 1929 Price range	$ 1000 to $2500	100%	$	100%	$	100%
i. 1933 Price range	$ 500 to $1500	60 %	$	%	$	%
j. 1937 Price range	$ 800 to $2000	80 %	$	%	$	%
k. Sales demand	$ 1500 - fair		$		$	
l. Activity	fair					
m. 1929 Rent range	$ 10 to $25	100%	$	100%	$	100%
n. 1933 Rent range	$ 5.00 to $12	50 %	$	%	$	%
o. 1937 Rent range	$ 12 to $20	95 %	$	%	$	%
p. Rental demand	$ 15 good		$		$	
q. Activity	good					

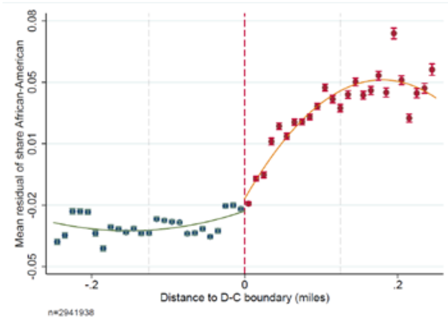
4. AVAILABILITY OF MORTGAGE FUNDS: a. Home purchase limited ; b. Home building limited

5. CLARIFYING REMARKS: This might be classed as a 'Low Yellow' area were it not for the presence of the number of Negroes and low class Foreign families who reside in the area. Lot values run from $2.00 to $5.00 per front foot.

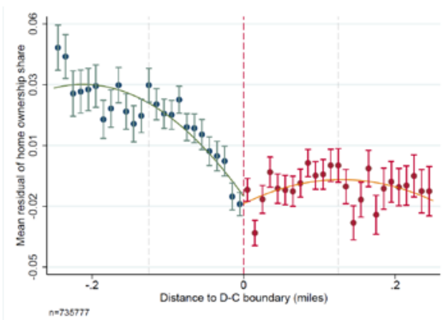
6. NAME AND LOCATION Tacoma SECURITY GRADE D AREA NO. 7

Appendix Figure A3: Distance Plots Around HOLC Borders

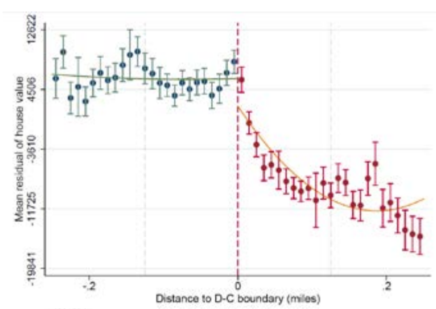
Panel A: African American Share, 1930, D-C



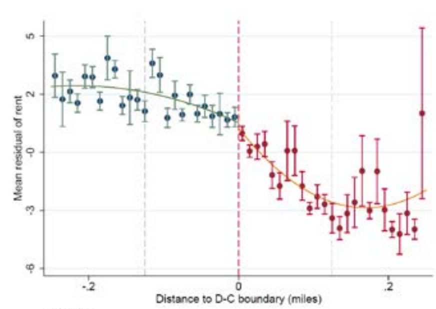
Panel B: Home Ownership, 1930, D-C



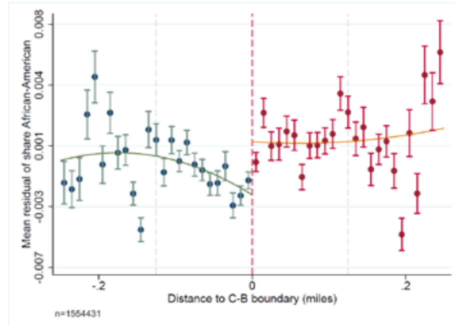
Panel C: House Values, 1930, D-C



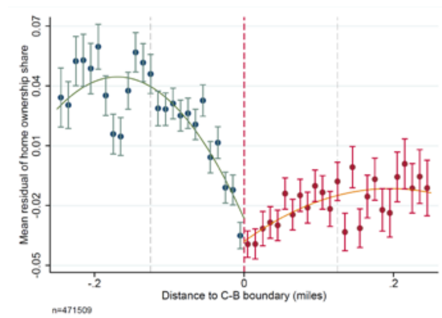
Panel D: Rent , 1930, D-C



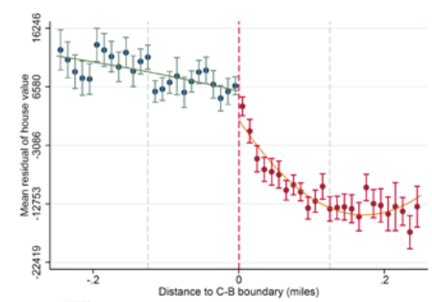
Panel E: African American Share, 1930, C-B



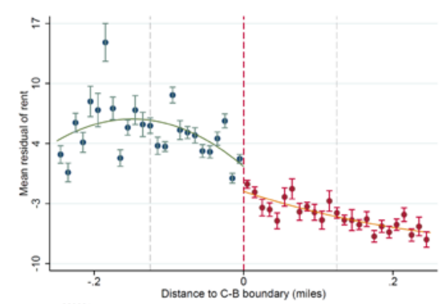
Panel F: Home Ownership, 1930, C-B



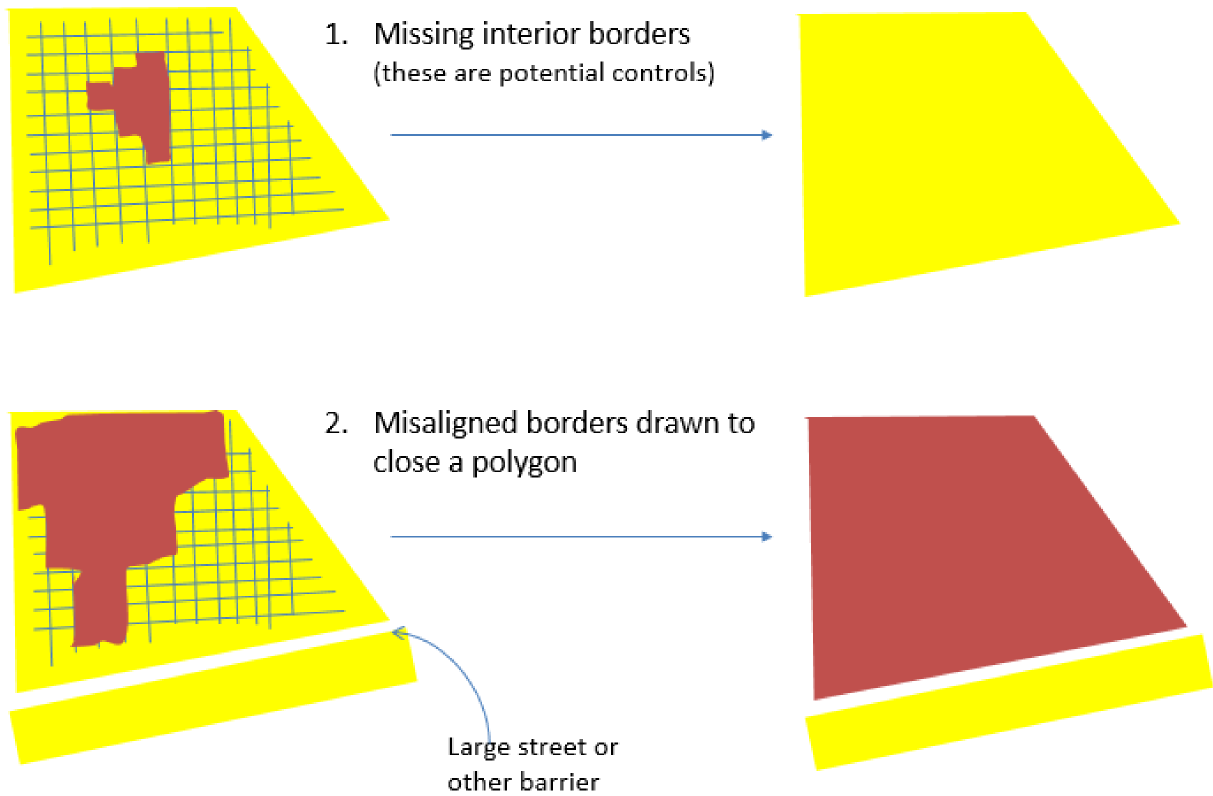
Panel G: House Values, 1930, C-B



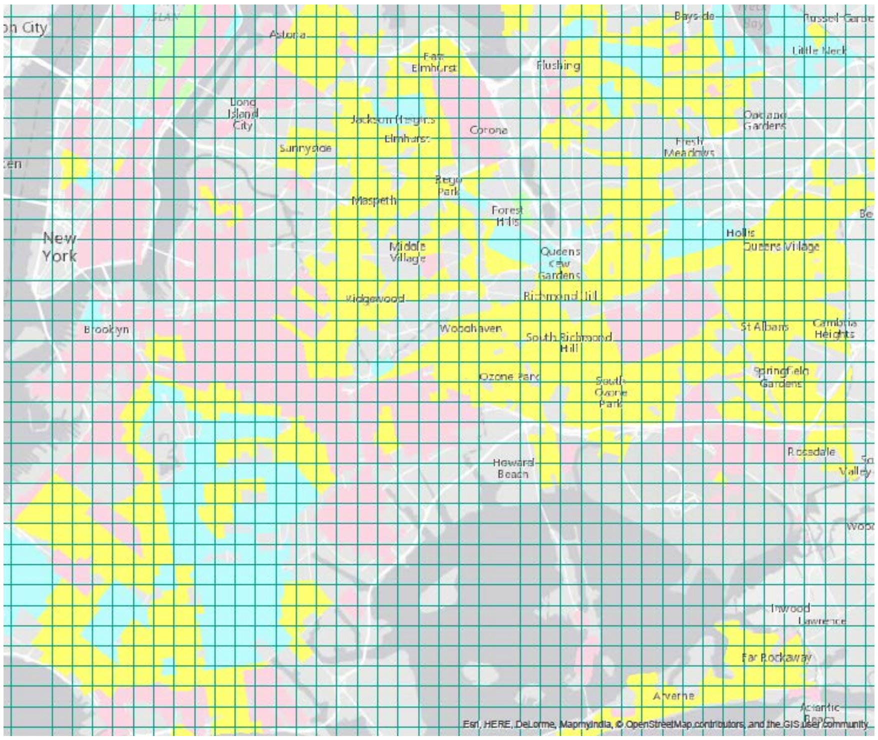
Panel E: Rent , 1930, C-B



Appendix Figure A4: Hypothetical Examples of Missing and Misaligned Borders

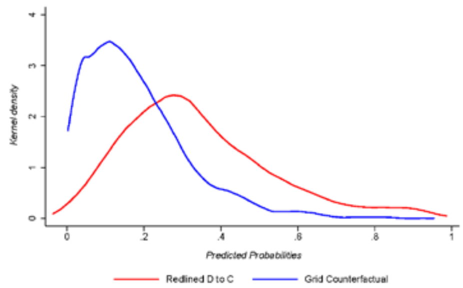


Appendix Figure A5: Example of Grid Placed over New York City

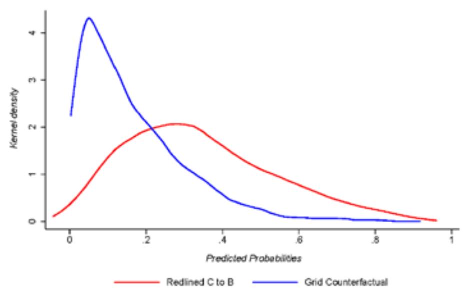


Appendix Figure A6: Distribution of Propensity Scores and Effects of Re-weighting

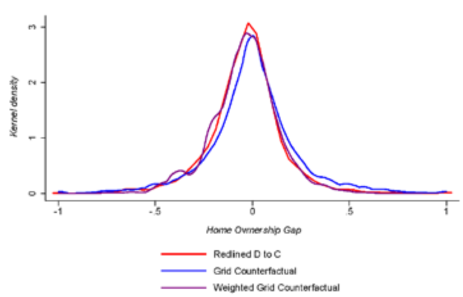
Panel A: Propensity Score Distribution, D-C Boundaries



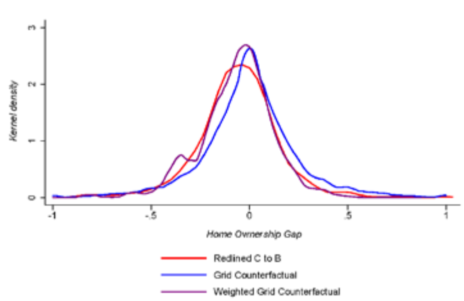
Panel B: Propensity Score Distribution, C-B Boundaries



Panel C: Distributions of 1930 Home Ownership Gaps, D-C Boundaries

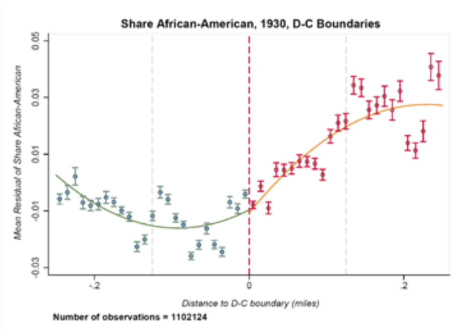


Panel D: Distributions of 1930 Home Ownership Gaps, C-B Boundaries

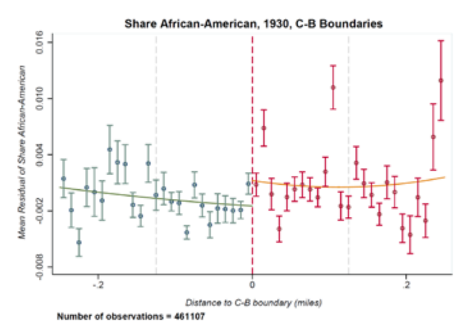


Appendix Figure A7: Distance Plots Around HOLC Borders Using Low Propensity Treated

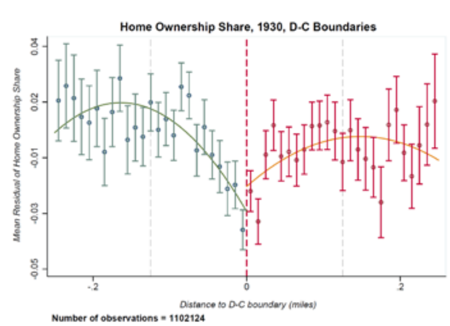
Panel A: African American Share, 1930, D-C



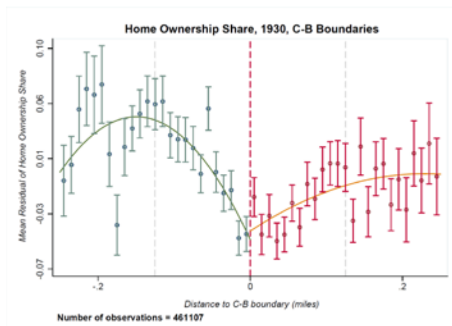
Panel E: African American Share, 1930, C-B



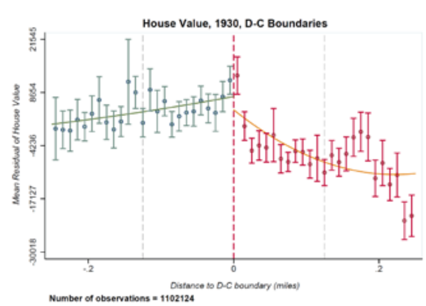
Panel B: Home Ownership, 1930, D-C



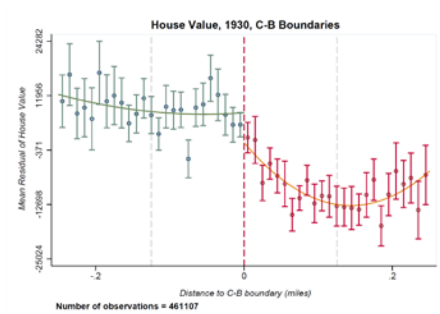
Panel F: Home Ownership, 1930, C-B



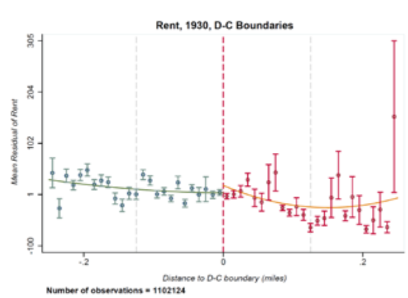
Panel C: House Values, 1930, D-C



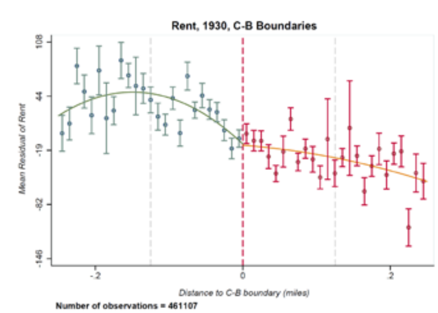
Panel G: House Values, 1930, C-B



Panel D: Rent , 1930, D-C

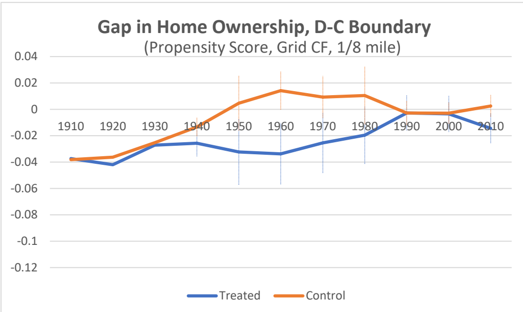


Panel E: Rent , 1930, C-B

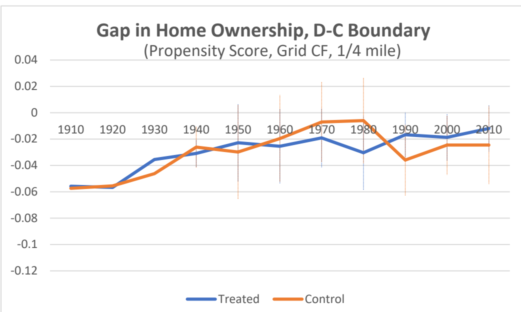


Appendix Figure A8: Robustness Checks, Effects on Home Ownership D-C, C-B Boundaries

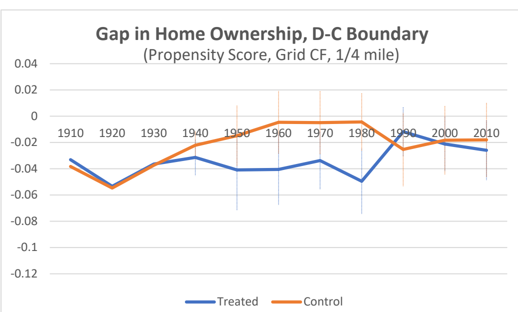
Panel A: 1/8th mile Boundaries, D-C



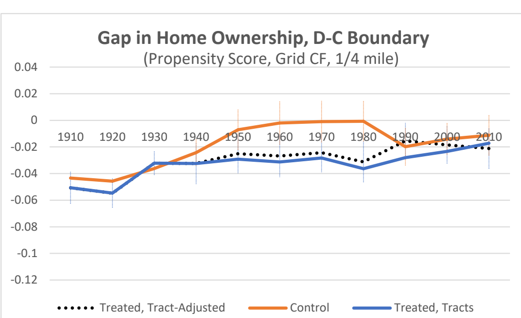
Panel B: High Geocoding Rate Cities, D-C



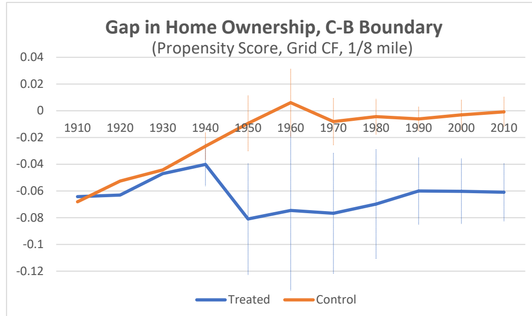
Panel C: Excluding Trains and Rivers, D-C



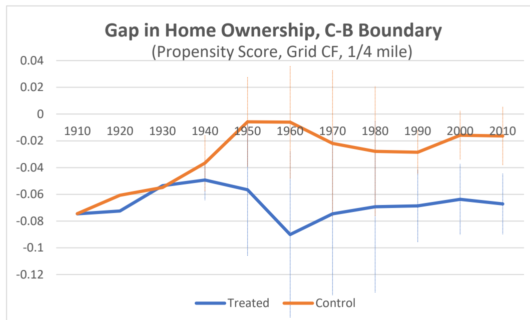
Panel D: Using Tracts in All Years, D-C



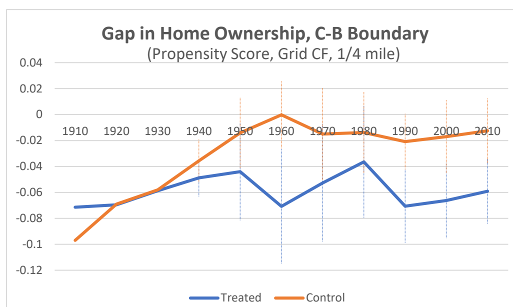
Panel E: 1/8th mile Boundaries, C-B



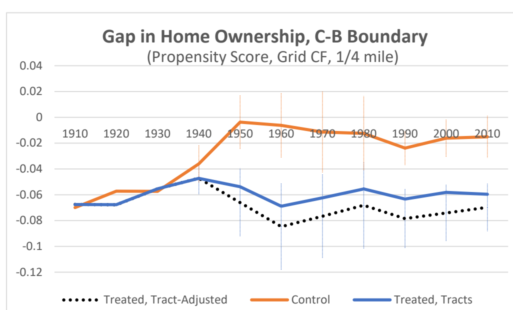
Panel F: High Geocoding Rate Cities, C-B



Panel G: Excluding Trains and Rivers, C-B

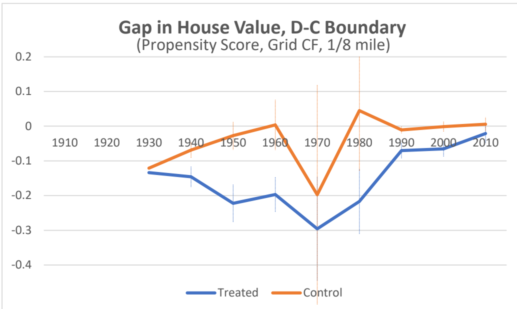


Panel H: Using Tracts in All Years, C-B

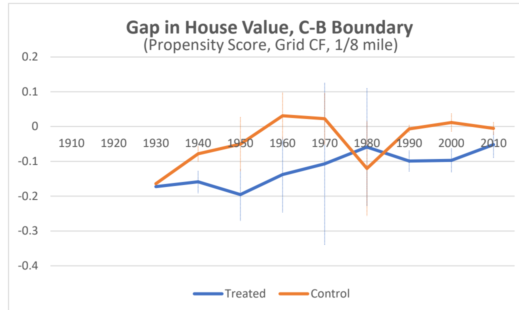


Appendix Figure A9: Robustness Checks, Effects on House Values D-C, C-B Boundaries

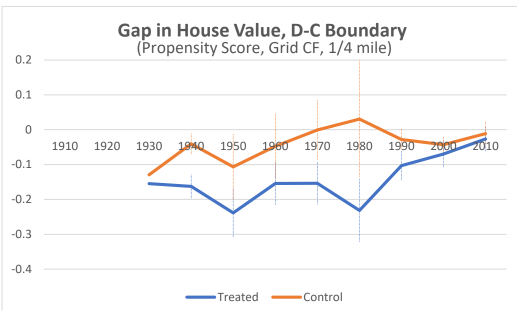
Panel A: 1/8th mile Boundaries, D-C



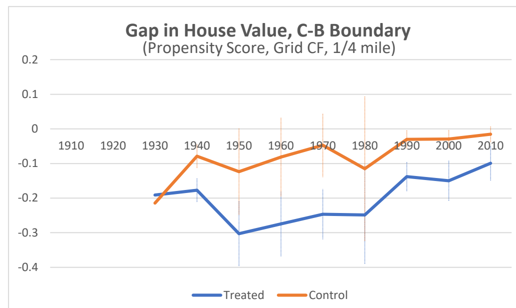
Panel E: 1/8th mile Boundaries, C-B



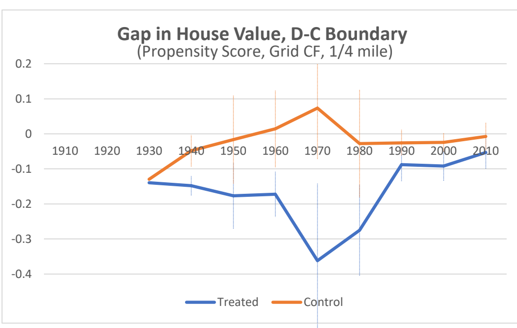
Panel B: High Geocoding Rate Cities, D-C



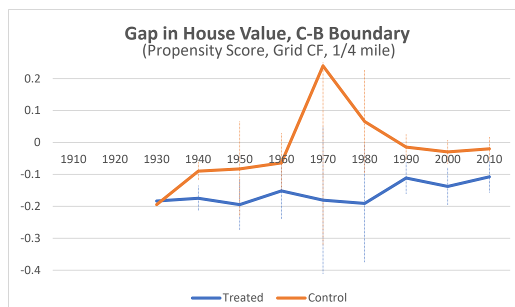
Panel F: High Geocoding Rate Cities, C-B



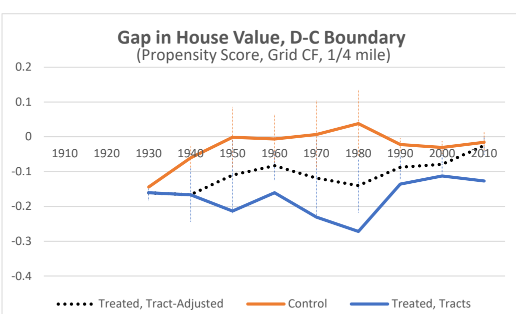
Panel C: Excluding Trains and Rivers, D-C



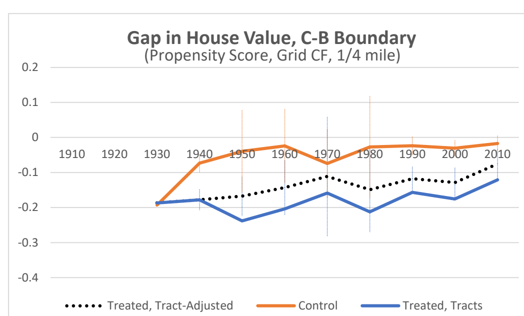
Panel G: Excluding Trains and Rivers, C-B



Panel D: Using Tracts in All Years, D-C

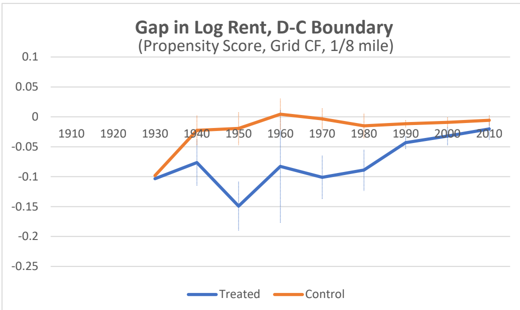


Panel H: Using Tracts in All Years, C-B

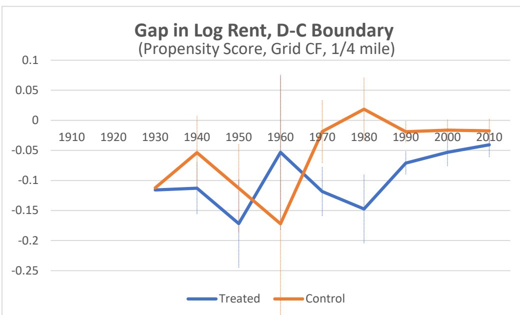


Appendix Figure A10: Robustness Checks, Effects on Rent D-C, C-B Boundaries

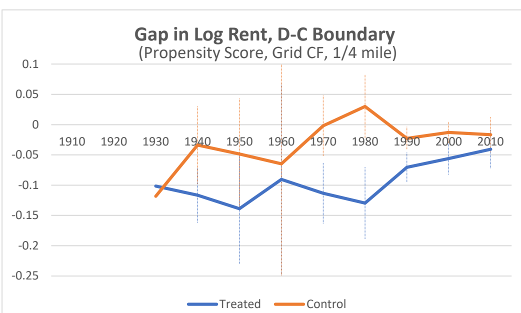
Panel A: 1/8th mile Boundaries, D-C



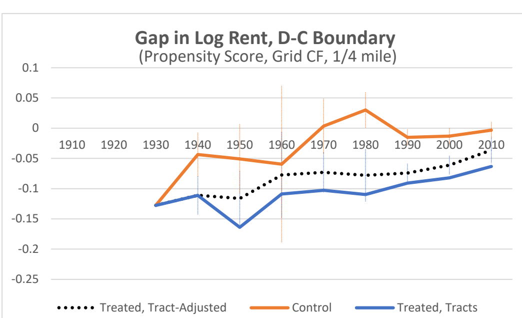
Panel B: High Geocoding Rate Cities, D-C



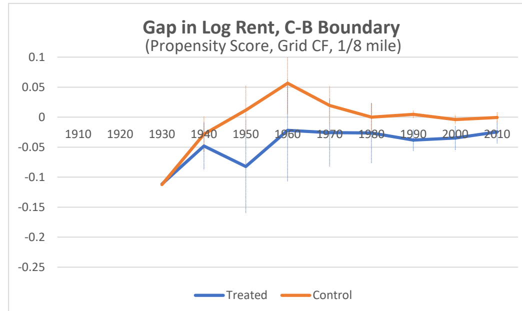
Panel C: Excluding Trains and Rivers, D-C



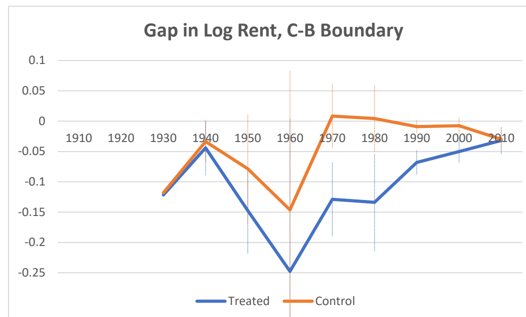
Panel D: Using Tracts in All Years, D-C



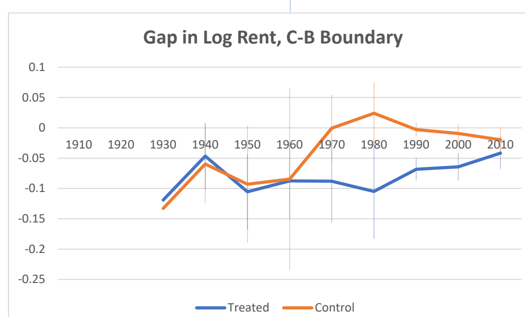
Panel E: 1/8th mile Boundaries, C-B



Panel F: High Geocoding Rate Cities, C-B



Panel G: Excluding Trains and Rivers, C-B



Panel H: Using Tracts in All Years, C-B

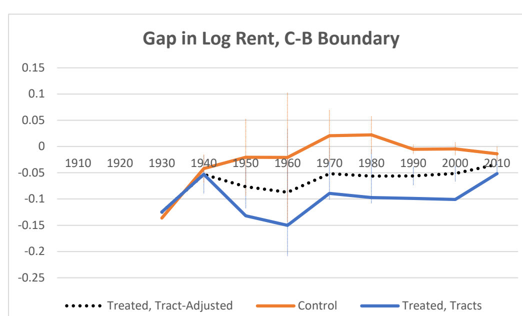


Table A1: Geocoding Statistics

	1910	1920	1930	1940
Share of population with a non-missing address	73%	72%	99%	82%
Share of population successfully geocoded	49%	50%	79%	62%
Share of non-missing addresses successfully geocoded	63%	68%	79%	74%

Table A2: Effect of D versus C Grade on Home Ownership

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sample Type	HOLC Neighorhoods		1/4 Mile D-C Boundaries				
Year	D-C	D-C	D-C	D-C	Grid C.F's	Triple Diff	Low PS D-C
1910	-0.124	-0.118	-0.052	-0.051	-0.043	-0.011	-0.007
	(0.012)	(0.01)	(0.006)	(0.006)	(0.007)	(0.009)	(0.008)
1920	-0.137	-0.128	-0.055	-0.055	-0.046	-0.013	-0.022
	(0.011)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)
1930	-0.110	-0.101	-0.033	-0.032	-0.036	--	-0.010
	(0.012)	(0.007)	(0.005)	(0.005)	(0.006)	--	(0.005)
1940	-0.105	-0.097	-0.034	-0.032	-0.024	-0.012	-0.015
	(0.011)	(0.007)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
1950	-0.136	-0.117	-0.039	-0.029	-0.007	-0.026	-0.029
	(0.023)	(0.009)	(0.011)	(0.01)	(0.008)	(0.013)	(0.01)
1960	-0.141	-0.115	-0.041	-0.031	-0.002	-0.033	-0.034
	(0.021)	(0.009)	(0.009)	(0.008)	(0.008)	(0.012)	(0.01)
1970	-0.120	-0.096	-0.035	-0.028	-0.001	-0.031	-0.028
	(0.017)	(0.009)	(0.01)	(0.008)	(0.008)	(0.012)	(0.009)
1980	-0.112	-0.086	-0.050	-0.036	-0.001	-0.040	-0.034
	(0.019)	(0.009)	(0.011)	(0.008)	(0.008)	(0.013)	(0.009)
1990	-0.076	-0.067	-0.016	-0.015	-0.020	0.000	-0.008
	(0.01)	(0.006)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)
2000	-0.073	-0.065	-0.017	-0.018	-0.014	-0.008	-0.012
	(0.01)	(0.007)	(0.007)	(0.007)	(0.006)	(0.009)	(0.009)
2010	-0.072	-0.063	-0.020	-0.021	-0.011	-0.014	-0.019
	(0.009)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)	(0.011)
Cities	*148*	*148*	*115*	*115*	*115*	*115*	*97*
Neighborhoods	*3522*	*3554*	--	--	--	--	--
Boundaries	--	--	--	*1133*	*4214*	*5347*	*567*
N	*27786*	*27786*	*16663*	*16663*	*61305*	*77968*	*8510*
R2	*0.071*	*0.285*	*0.287*	*0.616*	*0.598*	*0.602*	*0.64*
F.E.	*None*	*City*	*City*	*Bound.*	*Bound.*	*Bound.*	*Bound.*

Notes: Table entries are from regressions that estimate the gaps between D and C rated neighborhoods in Home Ownership. Columns 1 and 2 use entire neighborhoods. Columns 3 to 7 use 1/4 mile boundary buffer zones. Columns 3 and 4 use actual HOLC "treated" boundaries. Column 5 shows effects on counterfactual boundaries weighted by propensity scores to be similar to treated boundaries. Column 6 shows the difference in the gap between treated and control boundaries relative to 1930. Column 7 uses only those treated boundaries with below median propensity scores

Table A3: Effect of D versus C grade on Log House Values

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sample Type	HOLC Neighorhoods		1/4 Mile D-C Boundaries				
Year	D-C	D-C	D-C	D-C	Grid C.F's	Triple Diff	Low PS D-C
1910							
1920							
1930	-0.307	-0.283	-0.159	-0.161	-0.144	--	-0.054
	(0.051)	(0.032)	(0.011)	(0.012)	(0.019)	--	(0.016)
1940	-0.355	-0.327	-0.166	-0.166	-0.060	-0.089	-0.095
	(0.039)	(0.026)	(0.012)	(0.013)	(0.017)	(0.02)	(0.014)
1950	-0.341	-0.303	-0.202	-0.213	-0.001	-0.195	-0.151
	(0.044)	(0.031)	(0.03)	(0.028)	(0.045)	(0.057)	(0.037)
1960	-0.239	-0.238	-0.156	-0.161	-0.006	-0.137	-0.108
	(0.054)	(0.028)	(0.024)	(0.022)	(0.036)	(0.052)	(0.031)
1970	-0.394	-0.399	-0.230	-0.231	0.007	-0.220	-0.248
	(0.08)	(0.117)	(0.054)	(0.057)	(0.05)	(0.081)	(0.089)
1980	-0.293	-0.293	-0.257	-0.272	0.038	-0.293	-0.220
	(0.033)	(0.034)	(0.042)	(0.04)	(0.049)	(0.081)	(0.067)
1990	-0.191	-0.174	-0.088	-0.087	-0.022	-0.048	-0.065
	(0.055)	(0.025)	(0.017)	(0.017)	(0.009)	(0.025)	(0.019)
2000	-0.169	-0.151	-0.083	-0.079	-0.031	-0.032	-0.040
	(0.048)	(0.021)	(0.012)	(0.013)	(0.01)	(0.022)	(0.02)
2010	-0.112	-0.099	-0.024	-0.026	-0.016	0.007	0.003
	(0.058)	(0.026)	(0.014)	(0.013)	(0.015)	(0.031)	(0.015)
Cities	*148*	*148*	*115*	*115*	*115*	*115*	*97*
Neighborhoods	*2798*	*3542*	--	--	--	--	--
Boundaries	--	--	--	*1133*	*4214*	*5347*	*567*
N	*22152*	*22152*	*11620*	*11620*	*41645*	*53265*	*6005*
R2	*0.195*	*0.564*	*0.505*	*0.625*	*0.622*	*0.623*	*0.614*
F.E.	*None*	*City*	*City*	*Bound.*	*Bound.*	*Bound.*	*Bound.*

Notes: Table entries are from regressions that estimate the gaps between D and C rated neighborhoods in Log House Values. Columns 1 and 2 use entire neighborhoods. Columns 3 to 7 use 1/4 mile boundary buffer zones. Columns 3 and 4 use actual HOLC "treated" boundaries. Column 5 shows effects on counterfactual boundaries weighted by propensity scores to be similar to treated boundaries. Column 6 shows the difference in the gap between treated and control boundaries relative to 1930. Column 7 uses only those treated boundaries with below median propensity scores.

Table A4: Effect of D versus C Grade on Log Monthly Contract Rents

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sample Type	HOLC Neighorhoods		1/4 Mile D-C Boundaries				
Year	D-C	D-C	D-C	D-C	Grid C.F's	Triple Diff	Low PS D-C
1910							
1920							
1930	-0.315	-0.286	-0.126	-0.128	-0.127	--	-0.050
	(0.03)	(0.025)	(0.01)	(0.01)	(0.019)	--	(0.013)
1940	-0.285	-0.254	-0.110	-0.111	-0.044	-0.067	-0.040
	(0.036)	(0.028)	(0.016)	(0.016)	(0.018)	(0.022)	(0.019)
1950	-0.291	-0.259	-0.170	-0.164	-0.051	-0.113	-0.132
	(0.026)	(0.028)	(0.025)	(0.024)	(0.03)	(0.044)	(0.022)
1960	-0.284	-0.256	-0.112	-0.109	-0.060	-0.049	-0.095
	(0.066)	(0.052)	(0.036)	(0.036)	(0.066)	(0.096)	(0.057)
1970	-0.228	-0.206	-0.107	-0.103	0.003	-0.106	-0.086
	(0.024)	(0.02)	(0.019)	(0.017)	(0.024)	(0.034)	(0.017)
1980	-0.218	-0.201	-0.109	-0.110	0.030	-0.140	-0.064
	(0.031)	(0.02)	(0.022)	(0.022)	(0.015)	(0.033)	(0.019)
1990	-0.180	-0.155	-0.072	-0.074	-0.015	-0.059	-0.054
	(0.025)	(0.011)	(0.009)	(0.008)	(0.007)	(0.02)	(0.009)
2000	-0.140	-0.116	-0.060	-0.061	-0.013	-0.048	-0.055
	(0.025)	(0.011)	(0.007)	(0.008)	(0.007)	(0.019)	(0.011)
2010	-0.090	-0.066	-0.034	-0.036	-0.003	-0.033	-0.032
	(0.029)	(0.013)	(0.011)	(0.011)	(0.007)	(0.023)	(0.016)
Cities	*148*	*148*	*115*	*115*	*115*	*115*	*97*
Neighborhoods	*667*	*3542*	--	--	--	--	--
Boundaries	--	--	--	*1133*	*4214*	*5347*	*567*
N	*22291*	*22291*	*12098*	*12098*	*44281*	*56379*	*6235*
R2	*0.188*	*0.424*	*0.425*	*0.53*	*0.54*	*0.538*	*0.533*
F.E.	*None*	*City*	*City*	*Bound.*	*Bound.*	*Bound.*	*Bound.*

Notes: Table entries are from regressions that estimate the gaps between D and C rated neighborhoods in Log Rents. Columns 1 and 2 use entire neighborhoods. Columns 3 to 7 use 1/4 mile boundary buffer zones. Columns 3 and 4 use actual HOLC "treated" boundaries. Column 5 shows effects on counterfactual boundaries weighted by propensity scores to be similar to treated boundaries. Column 6 shows the difference in the gap between treated and control boundaries relative to 1930. Column 7 uses only those treated boundaries with below median propensity scores.

Table A5: Assessing HOLC Grading Criteria

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Ordered Logit		Probit					
Coefficients	ABCD	ABCD	DC	DC	CB	CB	BA	BA
Share AA	2.824	1.510	2.742	2.093	-2.857	-3.531	-5.514	-10.147
	(1.233)	(1.521)	(0.870)	(1.125)	(1.146)	(1.398)	(1.262)	(2.283)
Share Home Own	-6.600	-7.590	-3.353	-4.523	-3.966	-4.818	-3.786	-3.857
	(0.594)	(0.737)	(0.428)	(0.529)	(0.485)	(0.593)	(0.565)	(0.753)
Log House Value	-3.057	-3.319	-1.570	-1.936	-1.474	-2.005	-1.598	-1.676
	(0.225)	(0.268)	(0.239)	(0.218)	(0.178)	(0.189)	(0.195)	(0.281)
Log Rent	-0.154	-0.163	-0.095	-0.071	-0.118	-0.145	0.064	0.035
	(0.080)	(0.091)	(0.060)	(0.072)	(0.061)	(0.075)	(0.073)	(0.092)
Occscore	-4.318	-6.012	-0.514	-2.231	-1.593	-3.875	-3.004	-2.971
	(1.166)	(1.246)	(1.091)	(1.177)	(0.968)	(1.215)	(1.055)	(1.258)
Employment	-0.139	-0.148	-0.143	-0.203	-0.132	-0.170	0.030	0.051
	(0.031)	(0.038)	(0.041)	(0.049)	(0.022)	(0.037)	(0.023)	(0.030)
Radio	-6.665	-7.163	-3.812	-2.894	-3.809	-4.260	-1.336	-2.214
	(0.753)	(0.910)	(0.530)	(0.576)	(0.622)	(0.765)	(0.766)	(0.930)
Literacy	-7.825	-10.676	-7.803	-10.726	-0.649	-0.888	-4.699	-4.003
	(2.349)	(2.698)	(1.802)	(2.331)	(3.618)	(3.596)	(3.834)	(6.512)
School Attendance	4.198	6.099	1.059	1.329	2.210	4.537	1.783	2.645
	(0.811)	(1.192)	(0.729)	(0.947)	(0.661)	(1.014)	(0.721)	(1.202)
Share Foreign Born	-0.332	-1.194	-2.548	-3.139	0.466	0.172	0.681	0.609
	(1.373)	(1.757)	(0.824)	(0.968)	(1.023)	(1.139)	(1.298)	(1.832)
Includes changes*	--	X	--	X	--	X	--	X
Cities	147	146	138	137	144	142	120	102
N	4717	3928	3146	2704	3045	2506	1479	1088
Psuedo R^2	0.482	0.511	0.498	0.538	0.442	0.502	0.348	0.399

Note: This table reports estimates of the relationship between HOLC map grades and 1930 neighborhood characteristics and 1920 to 1930 trends in characteristics. Each observation represents an HOLC neighborhood. In the ordered logit specification, the dependent variable is coded such that the neighborhood graded as riskiest has the highest value (e.g. the dependent variable is coded as D=4, C=3, B=2, and D=1). All specifications include city fixed effects and are weighted by the log of the population of the HOLC neighborhood in 1930. Standard errors are shown in parentheses and are clustered by city.

Table A6: City Level Average Estimates 1950 to 1980

City	African American Share		Home Ownership Share		Log House Value		Log Rent	
	D-C	*C-B*	*D-C*	*C-B*	*D-C*	*C-B*	*D-C*	*C-B*
Akron, OH	0.22	0.56	-0.08	-0.02	-0.20	0.01	0.09	-0.20
Arlington, MA		0.01		0.14		-1.11		-0.92
Baltimore, MD	0.13		-0.13		-0.24		-0.13	
Bay City, MI	0.03		-0.30		0.06		0.03	
Binghamton, NY		0.01		-0.35		-0.31		-0.12
Birmingham, AL	0.43	-0.49	-0.16	0.20	0.97	0.52	-0.41	-0.08
Boston, MA	0.14		-0.03		-0.18		-0.08	
Bronx, NY	0.12	0.02	0.00	0.04	-0.30	-0.43	-0.17	-0.08
Brooklyn, NY	0.04	0.06	-0.01	-0.06	-0.22	-0.16	-0.06	-0.08
Buffalo, NY		0.14		-0.07		-0.47		-0.37
Cambridge, MA	0.16		0.03		-0.35		-0.36	
Chicago, IL	0.03	0.01	-0.03	-0.09	-0.13	-0.20	-0.09	-0.08
Cleveland, OH	0.07	0.01	0.01	-0.28	-0.16	0.23	-0.08	-0.05
Columbus, OH	0.45	0.05	-0.17	-0.02	-0.19	-0.18	-0.22	-0.33
Dayton, OH	-0.05	0.03	-0.19	-0.27	-0.06	-0.22	-0.11	0.04
Decatur, IL	0.25		-0.09		-0.06		-0.48	
Denver, CO		0.00		-0.12		-0.72		-2.57
Detroit, MI	0.21		0.01		0.02		-0.03	
Duluth, MN		0.01		-0.30		0.03		-0.41
East St. Louis, IL	-0.04		-0.25		-1.04		-0.42	
Elmira, NY		0.02		-0.18		0.70		-0.28
Erie, PA	0.43	0.12	-0.07	-0.08	-0.09	-0.23	-0.02	-0.27
Evansville, IN	0.51		-0.18		-0.05		-0.48	
Fort Wayne, IN		0.02		-0.05		0.49		0.02
Grand Rapids, MI	0.07		-0.01		-0.33			
Hudson County, NJ	0.19	-0.06	-0.07	-0.04	-0.27	-0.14	-0.10	0.02
Indianapolis, IN	0.08	0.19	0.03	-0.16	-0.20	-0.20	-0.03	0.08
Kansas City, MO	-0.04		-0.06		-0.14		-0.11	
Lexington, KY	0.45		-0.04		0.59		-0.66	
Louisville, KY	-0.17		0.10		-0.39		0.02	
Malden, MA	0.01		-0.03		-0.46		-0.91	
Minneapolis, MN	0.01	-0.02	-0.08	-0.03	-0.14	-0.13	-0.19	-0.07
Mobile, AL	0.64		0.07		0.02		-0.39	
New Britain, CT		0.03		-0.46		-0.18		-0.20
New Haven, CT	0.22		-0.03		-0.89		-0.41	
New Orleans, LA	0.23	-0.12	-0.03	-0.07	-0.27	0.00	-0.20	-0.74
New York, NY	0.22	0.16	-0.01	-0.01	-0.52	-0.08	-0.25	-0.21
Niagara Falls, NY		0.00		0.18		0.88		-0.03
Oakland, CA	0.03	-0.02	0.08	-0.04	-0.11	-0.39	-0.06	-0.28
Philadelphia, PA	0.18	0.11	0.00	-0.15	-0.32	-0.25	-0.25	-0.08
Pittsburgh, PA	0.05	0.01	0.03	-0.16	-0.24	-0.36	-0.12	-0.05

Table A6: City Level Average Estimates 1950 to 1980, cont.

	African American Share		Home Ownership Share		Log House Value		Log Rent	
City	***D-C***	***C-B***	***D-C***	***C-B***	***D-C***	***C-B***	***D-C***	***C-B***
Rochester, NY	0.08	0.03	-0.07	-0.07	-0.28	-0.14	-0.08	-0.02
Rockford, IL	0.12		-0.22		0.77		-0.08	
San Diego, CA		0.03		-0.24		-0.06		0.01
San Francisco, CA	0.30		-0.01		0.02		0.09	
Somerville, MA	0.00		-0.10		0.06		-0.04	
Spokane, WA		0.01		-0.04		-0.28		-0.17
St. Louis, MO	0.09	0.19	-0.05	0.05	-0.24	-0.29	-0.24	-0.25
Staten Island ,NY	0.08	0.07	-0.03	-0.18	-0.28	-0.61	-0.19	-0.44
Syracuse, NY		0.06		0.00		-0.17		-0.14
Toledo, OH	0.45		0.02		-0.06		-0.03	

Table A7: City Level Average Estimates 1990 to 2010

	African American Share		Home Ownership		Log House Value		Log Rent	
City	***D-C***	***C-B***	***D-C***	***C-B***	***D-C***	***C-B***	***D-C***	***C-B***
Akron, OH	0.17	0.07	0.07	0.11	-0.10	-0.05	-0.06	-0.04
Altoona, PA	0.00	0.01	-0.10	-0.04	0.03	-0.11	0.03	-0.11
Arlington, MA		0.01		-0.04		-0.12		-0.07
Aurora, IL	0.00	0.03	0.06	-0.14	-0.04	-0.07	-0.04	-0.05
Baltimore, MD	0.02	-0.02	-0.04	0.04	-0.10	0.18	-0.11	-0.01
Battle Creek, MI	0.10		0.01		0.06		0.00	
Bay City, MI	0.01		0.01		-0.04		-0.09	
Binghamton, NY		-0.01		-0.09		0.09		-0.02
Birmingham, AL	0.09	0.09	-0.10	-0.12	-0.07	-0.17	-0.11	-0.12
Boston, MA	0.00	0.01	-0.07	-0.15	0.06	-0.02	-0.16	-0.16
Bronx, NY	0.04	0.04	0.03	0.07	-0.21	0.23	-0.10	0.02
Brooklyn, NY	0.03	0.01	-0.01	-0.07	-0.09	-0.13	-0.06	-0.02
Buffalo, NY	0.14	0.02	-0.14	0.05	-0.22	-0.38	-0.09	-0.08
Cambridge, MA	0.06		-0.03		-0.15		-0.24	
Camden, NJ		-0.16		-0.14		-0.25		-0.06
Chelsea, MA	-0.01		-0.08		0.00		-0.08	
Chicago, IL	-0.01	-0.02	0.02	-0.13	-0.04	-0.08	-0.02	-0.04
Cleveland, OH	0.01	0.03	-0.03	-0.20	-0.05	-0.34	-0.01	0.07
Columbus, OH	0.06	0.03	0.02	-0.08	-0.15	0.02	-0.03	-0.08
Dayton, OH	0.02	-0.06	-0.06	-0.20	-0.10	-0.07	-0.15	0.12
Decatur, IL	0.13	0.08	-0.02	-0.09	-0.05	-0.10	0.00	0.03
Denver, CO	0.00	0.00	-0.12	-0.13	-0.08	-0.10	-0.08	-0.07
Detroit, MI	0.03		-0.04		-0.23		-0.11	
Duluth, MN		0.01		-0.05		-0.10		-0.01
East St. Louis, IL	-0.03		0.00		0.08		-0.16	
Elmira, NY	-0.03	0.02	0.16	-0.05	0.10	-0.18	-0.07	-0.06
Erie, PA	0.11	0.07	0.06	-0.06	-0.01	-0.15	-0.02	-0.09
Evansville, IN	0.12		0.00		-0.02		-0.12	
Everett, MA	0.02		0.04		-0.02		-0.02	
Fort Wayne, IN	0.15	0.01	-0.13	-0.15	-0.33	-0.10	-0.19	0.00
Grand Rapids, MI	0.17		0.05		-0.39		-0.01	
Hamilton, OH		0.00		-0.13		-0.10		-0.05
Hudson County, NJ	0.04	0.02	-0.04	-0.05	-0.14	-0.11	-0.11	-0.06
Indianapolis, IN	0.02	0.06	-0.01	-0.01	-0.10	-0.27	-0.03	-0.13
Jacksonville, FL	0.10		0.17		-0.02		-0.04	
Joliet, IL		0.01		-0.01		-0.05		-0.03
Kansas City, MO	-0.03		-0.01		-0.06		-0.04	
Knoxville, TN	0.05		-0.11		-0.15		-0.01	
Lexington, KY	-0.01	-0.01	0.01	0.01	0.03	-0.10	0.01	0.02
Lima, OH	0.04		-0.06		0.00		-0.01	
Louisville, KY	-0.02	0.03	-0.01	0.00	-0.14	-0.03	-0.02	-0.01

Table A7: City Level Average Estimates 1990 to 2010, cont.

	African American Share		Home Ownership		Log House Value		Log Rent	
City	***D-C***	***C-B***	***D-C***	***C-B***	***D-C***	***C-B***	***D-C***	***C-B***
Malden, MA	0.01		-0.06		0.00		-0.01	
Manchester, NH	0.01		-0.03		-0.09		0.00	
Melrose, MA		0.01		-0.15		-0.08		-0.17
Minneapolis, MN	0.01	0.04	0.05	-0.08	0.03	-0.07	-0.05	-0.03
Mobile, AL	0.05		-0.16		0.02		-0.15	
Muncie, IN	0.11		-0.26		-0.06		-0.27	
New Britain, CT		0.02		-0.09		-0.07		-0.08
New Haven, CT	0.13		-0.01		-0.11		-0.23	
New Orleans, LA	0.22	0.33	-0.07	-0.14	-0.27	-0.50	-0.13	-0.25
New York, NY	0.08	0.09	-0.02	-0.05	-0.14	-0.13	-0.04	-0.25
Niagara Falls, NY		-0.05		0.00		-0.03		-0.14
Oakland, CA	0.05	0.05	-0.01	-0.12	-0.04	-0.16	-0.07	-0.12
Oshkosh, WI	0.00		-0.08		-0.08		-0.04	
Philadelphia, PA	0.07	0.01	0.00	-0.02	-0.14	-0.17	-0.07	-0.05
Pittsburgh, PA	0.08	0.04	-0.01	-0.03	-0.15	-0.21	-0.04	-0.06
Portland, OR	-0.03		0.00		0.05		0.00	
Quincy, MA		0.01		-0.06		0.05		0.03
Roanoke, VA	-0.03		-0.03		-0.10		-0.02	
Rochester, NY	0.04	0.07	0.01	-0.15	-0.07	-0.15	-0.04	-0.04
Rockford, IL	0.02	0.03	-0.05	-0.05	0.03	-0.07	-0.05	-0.03
Saginaw, MI	-0.09		0.09		-0.08		-0.04	
San Diego, CA		0.02		-0.09		-0.05		-0.06
San Francisco, CA	0.02	0.04	-0.02	-0.20	-0.01	-0.27	-0.02	-0.07
San Jose, CA	0.01		-0.06		-0.07		-0.09	
Schenectady, NY		0.03		-0.10		-0.09		-0.05
Seattle, WA		0.03		-0.20		-0.27		-0.20
Somerville, MA	0.03		-0.03		-0.11		-0.06	
Spokane, WA		0.00		-0.17		0.06		-0.05
Springfield, IL	0.10	0.07	-0.04	-0.13	-0.02	-0.03	-0.02	-0.02
St. Joseph, MO	-0.01		0.02		0.00		0.00	
St. Louis, MO	0.01	0.03	0.00	0.03	-0.06	-0.24	-0.03	-0.07
Staten Island ,NY	-0.02	0.02	-0.13	-0.10	-0.05	-0.19	0.01	0.00
Syracuse, NY	0.09	0.05	-0.08	-0.05	0.05	-0.07	-0.08	-0.03
Tacoma, WA	-0.03	0.00	0.02	-0.01	0.06	-0.04	0.01	-0.06
Terre Haute, IN	0.08		0.00		-0.04		-0.01	
Toledo, OH	0.22	-0.08	0.01	-0.06	0.01	-0.04	-0.10	-0.01
Troy, NY	0.08	0.03	0.01	-0.21	-0.23	-0.08	0.00	-0.02
Wichita, KS	0.01		-0.06		-0.10		-0.03	
Youngstown, OH	-0.05	0.13	-0.04	0.09	-0.10	-0.08	-0.08	-0.26

Table A8: City Characteristics from 1930 Census

	1930 Census Variables													
City	Pop'n geo'd	Share AA	Home Own	House Values	Share FB	Radio Own	Att. School	Lab F Part.	Rent	Occ. Score	Earn Score	Educ Score	Emp. Rate	Read or Write
Akron, OH	188,793	0.04	0.54	6174	0.13	0.53	0.63	0.60	53	25	51	14	0.82	0.98
Albany, NY	107,893	0.02	0.40	10432	0.14	0.58	0.63	0.60	74	26	55	17	0.84	0.99
Altoona, PA	70,209	0.01	0.61	5449	0.07	0.45	0.61	0.52	54	27	59	14	0.81	0.98
Arlington, MA	31,589	0.00	0.56	9723	0.22	0.74	0.62	0.55	65	28	57	21	0.84	0.99
Asheville, NC	35,807	0.24	0.40	7839	0.02	0.32	0.59	0.61	56	24	46	17	0.80	0.97
Atlanta, GA	161,227	0.27	0.35	6780	0.02	0.31	0.61	0.63	46	24	47	16	0.84	0.97
Atlantic City, NJ	46,508	0.23	0.30	19838	0.16	0.57	0.64	0.63	79	23	43	14	0.81	0.98
Augusta, GA	43,210	0.40	0.29	4983	0.01	0.16	0.57	0.65	39	21	41	12	0.83	0.93
Aurora, IL	39,485	0.02	0.66	6641	0.13	0.71	0.62	0.57	81	26	55	15	0.80	0.98
Baltimore, MD	635,110	0.16	0.56	5421	0.09	0.52	0.56	0.62	53	25	50	14	0.85	0.97
Battle Creek, MI	25,244	0.03	0.60	5845	0.08	0.53	0.63	0.60	72	26	55	15	0.82	0.99
Bay City, MI	36,733	0.00	0.71	2974	0.14	0.49	0.64	0.55	61	26	54	14	0.73	0.97
Belmont, MA	19,988	0.00	0.54	11678	0.22	0.78	0.64	0.55	50	28	56	24	0.88	0.98
Binghamton, NY	61,732	0.01	0.48	7888	0.13	0.50	0.65	0.63	38	25	51	14	0.84	0.97
Birmingham, AL	194,055	0.35	0.39	6109	0.02	0.31	0.57	0.60	47	24	49	15	0.86	0.95
Boston, MA	514,816	0.03	0.29	8504	0.31	0.56	0.66	0.61	69	25	49	15	0.79	0.96
Braintree, MA	12,568	0.00	0.70	5985	0.18	0.77	0.63	0.55	61	27	57	18	0.87	0.99
Bronx, NY	1,072,492	0.01	0.13	13455	0.38	0.65	0.61	0.60	71	26	54	17	0.83	0.96
Brookline, MA	38,951	0.01	0.38	21847	0.27	0.80	0.73	0.57	146	25	47	23	0.83	1.00
Brooklyn, NY	2,191,580	0.03	0.30	11738	0.34	0.59	0.61	0.60	73	26	53	16	0.82	0.95
Buffalo, NY	507,445	0.02	0.47	8354	0.21	0.56	0.62	0.58	50	26	55	15	0.80	0.98
Cambridge, MA	101,103	0.05	0.28	9470	0.29	0.56	0.63	0.61	43	25	50	16	0.80	0.97
Camden, NJ	100,093	0.09	0.51	4903	0.16	0.54	0.60	0.61	67	25	53	12	0.80	0.95
Canton, OH	83,883	0.02	0.56	6348	0.12	0.51	0.61	0.57	44	26	56	15	0.83	0.97
Charleston, WV	31,078	0.11	0.40	10311	0.03	0.46	0.63	0.59	44	26	51	20	0.84	0.98
Charlotte, NC	44,003	0.26	0.35	8803	0.01	0.37	0.53	0.64	51	23	45	15	0.84	0.93
Chattanooga, TN	81,609	0.23	0.36	5638	0.01	0.24	0.54	0.61	31	24	49	14	0.85	0.96
Chelsea, MA	39,184	0.01	0.33	6906	0.38	0.51	0.63	0.58	46	26	52	13	0.79	0.93
Chicago, IL	2,416,387	0.07	0.38	9346	0.26	0.64	0.62	0.61	89	25	53	14	0.80	0.97
Chicopee, MA	40,247	0.00	0.46	5822	0.28	0.44	0.62	0.62	27	25	51	10	0.80	0.95

Table A8: City Characteristics from 1930 Census

	1930 Census Variables													
City	Pop'n geo'd	Share AA	Home Own	House Values	Share FB	Radio Own	Att. School	Lab F Part.	Rent	Occ. Score	Earn Score	Educ Score	Emp. Rate	Read or Write
Cleveland, OH	736,884	0.07	0.42	7305	0.26	0.48	0.65	0.60	46	25	52	13	0.78	0.96
Columbus, GA	34,395	0.28	0.23	6003	0.01	0.17	0.52	0.66	44	22	43	11	0.85	0.93
Columbus, OH	224,650	0.09	0.46	6597	0.05	0.52	0.62	0.59	43	26	54	16	0.82	0.99
Dallas, TX	182,283	0.11	0.42	6224	0.04	0.45	0.55	0.62	51	25	51	18	0.85	0.98
Dayton, OH	143,851	0.08	0.50	6285	0.06	0.58	0.62	0.60	50	26	53	15	0.83	0.99
Decatur, IL	47,825	0.03	0.56	5238	0.04	0.50	0.59	0.57	38	26	54	16	0.82	0.99
Dedham, MA	12,036	0.00	0.67	6588	0.23	0.63	0.64	0.58	60	25	53	16	0.85	0.98
Denver, CO	248,476	0.03	0.48	5421	0.11	0.53	0.63	0.58	41	26	52	19	0.81	0.99
Detroit, MI	1,058,107	0.05	0.49	8977	0.26	0.60	0.61	0.60	73	26	55	13	0.80	0.98
Duluth, MN	69,910	0.00	0.59	6155	0.23	0.53	0.67	0.57	31	26	53	17	0.77	0.99
Durham, NC	30,791	0.27	0.33	6097	0.01	0.22	0.53	0.67	36	24	47	13	0.85	0.95
East Hartford, CT	14,886	0.01	0.50	8098	0.18	0.62	0.61	0.60	33	26	53	14	0.82	0.97
East St. Louis, IL	58,444	0.17	0.45	4350	0.06	0.43	0.58	0.58	41	26	54	13	0.80	0.98
Elmira, NY	39,621	0.01	0.53	6523	0.09	0.47	0.66	0.58	38	26	54	16	0.79	0.98
Erie, PA	99,410	0.01	0.52	7731	0.15	0.51	0.61	0.56	85	26	53	14	0.83	0.97
Essex County, NJ	669,167	0.07	0.42	12616	0.22	0.66	0.63	0.60	51	26	53	17	0.82	0.97
Evansville, IN	75,901	0.06	0.46	4149	0.02	0.34	0.60	0.58	38	25	52	13	0.83	0.99
Everett, MA	43,906	0.02	0.44	6321	0.29	0.65	0.59	0.58	48	26	54	14	0.81	0.97
Flint, MI	102,596	0.02	0.64	5096	0.14	0.55	0.60	0.59	57	26	55	12	0.83	0.99
Fort Wayne, IN	93,848	0.02	0.60	6398	0.05	0.64	0.60	0.59	35	27	56	15	0.83	0.99
Fresno, CA	28,727	0.01	0.50	5075	0.21	0.38	0.67	0.56	37	26	51	19	0.79	0.96
Gary, IN	86,873	0.19	0.44	7264	0.21	0.46	0.62	0.59	62	25	54	12	0.88	0.95
Grand Rapids, MI	117,085	0.02	0.64	5689	0.16	0.50	0.65	0.57	45	26	54	16	0.78	0.98
Greensboro, NC	30,773	0.24	0.47	7648	0.01	0.32	0.56	0.62	36	24	48	17	0.85	0.97
Hamilton, OH	44,014	0.03	0.55	5140	0.04	0.51	0.54	0.57	35	26	55	12	0.84	0.98
Haverhill, MA	42,292	0.01	0.46	5423	0.22	0.51	0.64	0.62	47	25	48	12	0.76	0.97
Holyoke, MA	49,464	0.00	0.27	11802	0.29	0.52	0.68	0.61	34	25	51	13	0.80	0.97
Hudson County, NJ	507,548	0.03	0.29	9256	0.26	0.62	0.61	0.62	84	26	54	14	0.84	0.96
Indianapolis, IN	277,757	0.10	0.44	5881	0.04	0.49	0.59	0.60	63	26	53	16	0.83	0.99
Jacksonville, FL	84,535	0.31	0.35	6927	0.04	0.29	0.58	0.61	31	24	47	16	0.84	0.97

Table A8: City Characteristics from 1930 Census

		1930 Census Variables												
City	Pop'n geo'd	Share AA	Home Own	House Values	Share FB	Radio Own	Att. School	Lab F Part.	Rent	Occ. Score	Earn Score	Educ Score	Emp. Rate	Read or Write
Johnson City, NY	11,678	0.00	0.54	6128	0.07	0.53	0.61	0.66	33	25	49	10	0.83	0.99
Johnstown, PA	52,542	0.02	0.45	6238	0.14	0.40	0.61	0.54	37	25	52	14	0.86	0.96
Joliet, IL	23,480	0.03	0.51	8027	0.16	0.60	0.62	0.57	44	26	55	17	0.82	0.99
Kalamazoo, MI	36,932	0.01	0.66	6181	0.11	0.58	0.66	0.57	45	26	54	18	0.83	1.00
Kansas City, MO	319,031	0.09	0.44	6600	0.07	0.52	0.64	0.61	52	26	52	17	0.85	0.99
Kenosha, WI	45,374	0.00	0.60	7686	0.24	0.63	0.68	0.58	46	25	53	12	0.78	0.96
Knoxville, TN	48,395	0.12	0.42	5279	0.01	0.29	0.56	0.60	42	26	52	16	0.83	0.97
Lexington, KY	35,158	0.27	0.37	6057	0.01	0.31	0.60	0.60	30	23	44	16	0.81	0.96
Lexington, MA	7,490	0.00	0.75	9028	0.20	0.75	0.64	0.55	215	25	50	19	0.87	0.98
Lima, OH	37,340	0.03	0.47	4914	0.04	0.47	0.62	0.58	43	26	55	15	0.84	0.99
Lorain, OH	39,324	0.02	0.62	5137	0.28	0.41	0.62	0.58	46	25	54	11	0.81	0.94
Louisville, KY	241,349	0.13	0.45	5459	0.03	0.37	0.57	0.59	57	25	51	15	0.82	0.98
Lynchburg, VA	31,821	0.23	0.47	5290	0.01	0.24	0.57	0.62	31	24	47	14	0.80	0.95
Macon, GA	18,559	0.34	0.28	4976	0.01	0.18	0.55	0.64	68	23	45	14	0.81	0.95
Madison, WI	51,536	0.00	0.56	8778	0.09	0.65	0.66	0.57	64	27	54	21	0.82	0.99
Malden, MA	53,282	0.01	0.47	6168	0.28	0.66	0.61	0.58	47	26	54	16	0.81	0.98
Manchester, NH	61,731	0.00	0.37	5502	0.29	0.41	0.62	0.64	53	25	49	12	0.79	0.97
Medford, MA	56,087	0.01	0.54	7536	0.23	0.73	0.60	0.57	59	27	56	17	0.84	0.98
Melrose, MA	19,787	0.00	0.67	7033	0.17	0.78	0.65	0.54	65	27	57	22	0.84	1.00
Miami, FL	69,057	0.19	0.35	5993	0.12	0.27	0.58	0.61	60	24	48	17	0.75	0.97
Milton, MA	12,285	0.00	0.69	12359	0.21	0.81	0.68	0.56	50	25	51	21	0.85	1.00
Milwaukee, WI	242,173	0.02	0.46	6719	0.20	0.65	0.66	0.59	52	26	55	14	0.83	0.98
Minneapolis, MN	363,688	0.01	0.51	6070	0.17	0.62	0.67	0.59	53	26	53	18	0.83	0.99
Mobile, AL	47,529	0.33	0.41	4997	0.03	0.22	0.56	0.60	48	23	46	14	0.84	0.94
Montgomery, AL	26,798	0.32	0.33	6288	0.02	0.24	0.57	0.63	29	23	46	16	0.86	0.93
Muncie, IN	34,855	0.06	0.51	4314	0.01	0.47	0.57	0.56	31	26	54	14	0.82	0.99
Muskegon, MI	28,208	0.01	0.61	4640	0.14	0.55	0.66	0.59	43	26	54	15	0.79	0.99
Needham, MA	6,709	0.00	0.73	10936	0.20	0.78	0.66	0.54	63	27	55	22	0.85	0.98
New Britain, CT	61,671	0.01	0.38	9356	0.31	0.41	0.64	0.61	36	26	54	13	0.83	0.92
New Castle, PA	41,741	0.02	0.60	5402	0.16	0.42	0.62	0.53	39	26	54	14	0.78	0.94

Table A8: City Characteristics from 1930 Census

	1930 Census Variables													
City	Pop'n geo'd	Share AA	Home Own	House Values	Share FB	Radio Own	Att. School	Lab F Part.	Rent	Occ. Score	Earn Score	Educ Score	Emp. Rate	Read or Write
New Haven, CT	136,643	0.03	0.35	10769	0.25	0.55	0.64	0.60	45	26	53	16	0.81	0.96
New Orleans, LA	378,493	0.27	0.30	7107	0.04	0.23	0.58	0.60	48	23	47	14	0.81	0.95
New York, NY	1,420,354	0.11	0.04	42199	0.38	0.46	0.62	0.66	88	23	45	15	0.83	0.94
Newport News, VA	25,862	0.34	0.38	4028	0.04	0.33	0.55	0.60	27	26	55	14	0.90	0.96
Newton, MA	16,306	0.01	0.57	12314	0.25	0.69	0.67	0.58	95	25	49	18	0.82	0.98
Niagara Falls, NY	65,818	0.01	0.50	7505	0.33	0.59	0.65	0.59	43	26	55	14	0.84	0.95
Norfolk, VA	76,526	0.29	0.40	5795	0.04	0.38	0.60	0.60	38	25	50	17	0.84	0.96
Oakland, CA	218,891	0.03	0.53	6026	0.19	0.60	0.66	0.57	46	27	55	18	0.80	0.98
Oshkosh, WI	15,475	0.00	0.64	5568	0.12	0.57	0.67	0.55	45	25	51	16	0.79	0.99
Philadelphia, PA	1,623,342	0.11	0.55	6372	0.20	0.57	0.60	0.62	94	25	51	14	0.82	0.97
Pittsburgh, PA	518,768	0.07	0.46	8994	0.16	0.55	0.61	0.58	65	25	50	15	0.80	0.98
Pontiac, MI	47,428	0.04	0.54	6186	0.14	0.53	0.60	0.62	70	25	53	13	0.73	0.98
Portland, OR	42,912	0.01	0.49	5709	0.16	0.58	0.67	0.61	40	26	51	19	0.79	0.99
Portsmouth, OH	32,464	0.04	0.51	5353	0.02	0.40	0.58	0.57	35	26	55	14	0.83	0.98
Poughkeepsie, NY	34,674	0.03	0.39	9636	0.14	0.59	0.61	0.59	46	26	54	16	0.83	0.97
Queens, NY	837,973	0.02	0.51	9986	0.25	0.76	0.60	0.60	84	27	56	17	0.86	0.98
Quincy, MA	65,037	0.00	0.56	6658	0.25	0.72	0.59	0.58	44	27	58	18	0.86	0.98
Racine, WI	58,532	0.01	0.60	7300	0.21	0.69	0.68	0.58	59	26	56	14	0.83	0.98
Revere, MA	32,016	0.00	0.46	5797	0.27	0.64	0.62	0.56	48	26	55	15	0.79	0.95
Richmond, VA	140,735	0.25	0.37	7659	0.02	0.39	0.60	0.61	48	25	50	16	0.84	0.97
Roanoke, VA	42,518	0.19	0.47	5681	0.01	0.28	0.58	0.58	34	24	50	12	0.84	0.97
Rochester, NY	284,366	0.01	0.58	8052	0.23	0.57	0.67	0.60	68	26	54	16	0.80	0.96
Rockford, IL	77,126	0.01	0.53	7600	0.22	0.62	0.61	0.60	92	26	55	14	0.81	0.98
Sacramento, CA	71,415	0.01	0.50	5698	0.16	0.56	0.66	0.59	40	26	53	18	0.80	0.97
Saginaw, MI	47,237	0.03	0.64	4296	0.15	0.56	0.63	0.57	37	26	54	15	0.78	0.98
San Diego, CA	117,541	0.02	0.49	6409	0.15	0.55	0.64	0.53	34	25	51	19	0.74	0.99
San Francisco, CA	485,501	0.01	0.39	8247	0.27	0.51	0.64	0.61	71	26	52	18	0.82	0.98
San Jose, CA	42,403	0.00	0.60	5193	0.18	0.58	0.69	0.53	47	25	51	18	0.74	0.95
Saugus, MA	12,578	0.01	0.75	4866	0.20	0.74	0.60	0.57	47	27	57	15	0.82	0.98
Schenectady, NY	65,710	0.01	0.51	8295	0.20	0.59	0.68	0.58	43	27	58	18	0.84	0.97

Table A8: City Characteristics from 1930 Census

	1930 Census Variables													
City	Pop'n geo'd	Share AA	Home Own	House Values	Share FB	Radio Own	Att. School	Lab F Part.	Rent	Occ. Score	Earn Score	Educ Score	Emp. Rate	Read or Write
Seattle, WA	265,620	0.01	0.53	5422	0.21	0.55	0.67	0.59	47	26	54	18	0.82	0.99
Somerville, MA	93,503	0.00	0.36	7044	0.29	0.64	0.60	0.59	46	26	54	15	0.82	0.97
South Bend, IN	77,632	0.03	0.62	6006	0.14	0.52	0.60	0.60	71	26	53	14	0.76	0.98
Spokane, WA	70,583	0.01	0.62	3768	0.14	0.52	0.65	0.58	33	26	53	18	0.80	0.99
Springfield, IL	57,261	0.04	0.57	5425	0.09	0.50	0.62	0.60	45	25	52	15	0.78	0.98
Springfield, MO	41,132	0.02	0.52	4162	0.02	0.28	0.61	0.54	24	26	54	17	0.81	0.99
Springfield, OH	55,778	0.11	0.48	5413	0.03	0.56	0.62	0.58	50	26	54	14	0.81	0.99
St. Joseph, MO	61,335	0.05	0.43	4172	0.05	0.49	0.62	0.58	30	25	51	15	0.83	0.99
St. Louis, MO	665,880	0.08	0.36	7254	0.10	0.53	0.59	0.60	58	25	52	15	0.83	0.98
St. Petersburg, FL	30,831	0.17	0.49	6194	0.06	0.25	0.64	0.51	26	24	48	18	0.67	0.98
Stamford, CT	36,991	0.03	0.43	11729	0.27	0.62	0.60	0.60	62	25	52	14	0.84	0.95
Staten Island ,NY	132,112	0.02	0.56	8327	0.25	0.67	0.64	0.59	56	27	57	17	0.84	0.97
Stockton, CA	34,605	0.01	0.46	5334	0.17	0.53	0.67	0.59	35	26	52	18	0.79	0.98
Syracuse, NY	173,151	0.01	0.49	10068	0.17	0.57	0.66	0.59	49	27	55	17	0.80	0.97
Tacoma, WA	70,786	0.01	0.63	3500	0.19	0.52	0.64	0.57	61	26	53	16	0.81	0.99
Tampa, FL	66,802	0.16	0.40	4046	0.16	0.16	0.58	0.62	25	24	47	13	0.79	0.96
Terre Haute, IN	52,646	0.05	0.49	4345	0.05	0.44	0.67	0.56	39	26	53	16	0.75	0.99
Toledo, OH	250,820	0.04	0.53	6688	0.12	0.62	0.63	0.59	49	26	55	14	0.80	0.98
Troy, NY	58,090	0.01	0.40	6558	0.14	0.53	0.65	0.61	83	26	53	15	0.82	0.98
Utica, NY	82,770	0.00	0.48	7994	0.21	0.48	0.66	0.60	43	26	52	14	0.79	0.94
Waltham, MA	31,475	0.00	0.42	7830	0.27	0.65	0.62	0.60	53	26	53	14	0.83	0.98
Warren, OH	29,274	0.05	0.57	6080	0.16	0.48	0.63	0.57	49	26	56	14	0.83	0.97
Watertown, MA	31,759	0.00	0.46	9267	0.28	0.67	0.61	0.59	50	27	55	17	0.83	0.98
Wheeling, WV	45,311	0.03	0.46	7169	0.08	0.50	0.58	0.57	36	25	52	16	0.81	0.98
Wichita, KS	62,996	0.03	0.48	4726	0.02	0.40	0.65	0.57	38	26	53	18	0.83	0.99
Winchester, MA	11,489	0.02	0.69	11351	0.19	0.76	0.67	0.54	80	25	50	20	0.84	0.98
Winston-Salem, NC	44,493	0.31	0.38	8166	0.01	0.22	0.53	0.67	25	24	48	13	0.84	0.94
Winthrop, MA	14,977	0.00	0.55	8466	0.21	0.76	0.67	0.55	78	28	58	23	0.84	0.99
Youngstown, OH	136,985	0.07	0.57	6055	0.20	0.46	0.65	0.56	47	26	55	14	0.78	0.96

Table A9: Counts of Boundaries by City

	Number of Boundaries			
	4th		8th	
City	C-B	D-C	C-B	D-C
Akron, OH	62	28	65	29
Albany, NY	6	3	6	3
Altoona, PA	14	7	13	7
Arlington, MA	6	4	6	4
Asheville, NC	11	18	11	21
Atlanta, GA	13	1	12	1
Augusta, GA	1	4	1	5
Aurora, IL	12	13	13	14
Baltimore, MD	19	15	18	16
Battle Creek, MI	6	14	7	12
Bay City, MI	1	19	1	13
Belmont, MA	1	0	1	0
Binghamton, NY	11	2	13	1
Birmingham, AL	19	71	19	69
Boston, MA	6	22	9	24
Braintree, MA	3	0	3	0
Bronx, NY	8	17	8	17
Brookline, MA	4	0	4	0
Brooklyn, NY	44	73	41	75
Buffalo, NY	18	6	15	5
Cambridge, MA	4	8	4	4
Camden, NJ	8	3	3	2
Canton, OH	15	9	15	10
Charleston, WV	5	3	9	3
Charlotte, NC	1	3	1	5
Chattanooga, TN	8	14	6	14
Chelsea, MA		5	0	5
Chicago, IL	118	117	112	121
Chicopee, MA	2	0	2	0
Cleveland, OH	42	62	45	62
Columbus, GA	1	7	2	8
Columbus, OH	58	41	67	45
Dallas, TX	14	4	12	4
Dayton, OH	17	17	18	20
Decatur, IL	18	16	20	16
Dedham, MA	4	2	3	2
Denver, CO	33	24	34	23
Detroit, MI	41	109	41	109
Duluth, MN	16	3	15	2
Durham, NC	5	6	7	5
East Hartford, CT	2	2	2	2

Table A9: Counts of Boundaries by City, cont.

	Number of Boundaries			
	4th		8th	
City	C-B	D-C	C-B	D-C
East St. Louis, IL	7	8	7	7
Elmira, NY	10	9	11	8
Erie, PA	11	8	13	8
Essex County, NJ	51	46	52	45
Evansville, IN	8	11	8	9
Everett, MA	0	8	0	8
Flint, MI	24	7	21	5
Fort Wayne, IN	16	8	15	10
Fresno, CA	7	11	7	11
Gary, IN	10	11	9	9
Grand Rapids, MI	23	23	21	17
Greensboro, NC	3	5	3	5
Hamilton, OH	10	5	11	7
Holyoke, MA	1	1	1	1
Hudson County, NJ	8	22	8	21
Indianapolis, IN	25	67	25	65
Jacksonville, FL	12	15	11	14
Johnson City, NY	3	0	4	0
Johnstown, PA	2	4	3	4
Joliet, IL	10	8	9	8
Kalamazoo, MI	4	5	3	4
Kansas City, MO	30	50	31	49
Kenosha, WI	8	20	6	21
Knoxville, TN	8	18	5	16
Lexington, KY	5	8	6	8
Lima, OH	5	6	5	6
Lorain, OH	2	3	2	1
Louisville, KY	25	29	23	28
Lynchburg, VA	1	7	1	6
Macon, GA	1	3	2	2
Madison, WI	6	11	9	13
Malden, MA	1	10	1	10
Manchester, NH	5	9	5	8
Medford, MA	3	0	3	0
Melrose, MA	8	0	8	0
Miami, FL	30	25	32	19
Milton, MA	2	0	2	0
Milwaukee, WI	11	18	14	18
Minneapolis, MN	63	40	66	50
Mobile, AL	0	7	1	7
Montgomery, AL	2	7	3	6

Table A9: Counts of Boundaries by City, cont.

	Number of Boundaries			
	4th		8th	
City	C-B	D-C	C-B	D-C
Muncie, IN	1	6	1	7
Muskegon, MI	4	8	4	9
Needham, MA	3	0	3	0
New Britain, CT	6	0	7	0
New Castle, PA	8	4	10	4
New Haven, CT	4	11	4	9
New Orleans, LA	24	53	25	55
New York, NY	10	5	10	5
Newton, MA	3	3	3	3
Niagara Falls, NY	11	5	8	5
Norfolk, VA	6	5	5	3
Oakland, CA	23	23	22	15
Oshkosh, WI		11	1	13
Philadelphia, PA	58	53	61	49
Pittsburgh, PA	25	28	26	31
Pontiac, MI	5	3	5	3
Portland, OR	71	39	63	25
Portsmouth, OH	2	7	2	6
Poughkeepsie, NY	1	3	0	2
Queens, NY	35	27	32	26
Quincy, MA	5	0	5	0
Racine, WI	9	8	10	9
Revere, MA	0	3	0	2
Richmond, VA	5	5	9	5
Roanoke, VA	0	5	0	5
Rochester, NY	25	21	23	16
Rockford, IL	10	20	11	20
Sacramento, CA	12	0	12	0
Saginaw, MI	9	11	9	11
San Diego, CA	30	15	32	15
San Francisco, CA	13	25	17	16
San Jose, CA	15	13	15	8
Saugus, MA	3	5	3	5
Schenectady, NY	9	5	9	4
Seattle, WA	68	26	70	28
Somerville, MA	4	6	4	7
South Bend, IN	11	9	11	10
Spokane, WA	29	37	28	36
Springfield, IL	24	28	29	30
St. Joseph, MO	4	6	6	7
St. Louis, MO	51	31	50	29

Table A9: Counts of Boundaries by City, cont.

	Number of Boundaries			
	4th		8th	
City	C-B	D-C	C-B	D-C
St. Petersburg, FL	12	20	13	17
Stamford, CT	0	2	0	2
Staten Island ,NY	17	20	17	20
Stockton, CA	4	1	5	1
Syracuse, NY	18	8	18	8
Tacoma, WA	22	28	24	28
Tampa, FL	10	6	11	6
Terre Haute, IN	6	25	8	22
Toledo, OH	31	21	33	21
Troy, NY	9	8	10	8
Utica, NY	7	9	8	7
Waltham, MA	3	2	2	2
Warren, OH	9	4	9	2
Watertown, MA	4	0	4	3
Wheeling, WV	1	2	4	0
Wichita, KS	7	22	8	21
Winchester, MA	1	0	1	0
Winston-Salem, NC	3	4	2	4
Winthrop, MA	2	0	2	0
Youngstown, OH	25	31	25	30
Total	*1965*	*2111*	*2000*	*2047*

Table A10: Summary Statistics of Cities Around the 40,000 Population Cutoff

Non-Redlined Cities

		Mean Characteristics							
		1930				1980			
City	1930 Pop'n	Share AA	Home Own	Log Rent	Log H Value	Share AA	Home Own	Log Rent	Log H Value
Baton Rouge, LA	30,729	0.35	0.38	5.54	10.83	0.36	0.54	6.33	11.90
Bellingham, WA	30,823	0.00	0.65	5.54	10.55	0.00	0.54	6.38	11.94
Hagerstown, MD	30,861	0.05	0.37	5.72	11.06	0.06	0.43	6.04	11.50
Fort Smith, AR	31,429	0.11	0.44	5.43	10.55	0.07	0.61	6.07	11.42
Pensacola, FL	31,579	0.31	0.36	5.02	10.55	0.34	0.66	6.10	11.53
Meridian, MS	31,954	0.37	0.40	4.84	10.40	0.37	0.60	5.72	11.36
Muskogee, OK	32,026	0.21	0.45	5.54	10.36	0.18	0.67	5.92	11.26
Watertown, NY	32,205	0.00	0.49	5.87	11.06	0.00	0.51	6.04	11.31
Moline, IL	32,236	0.01	0.53	5.76	11.06	0.01	0.65	6.38	11.83
Wilmington, NC	32,270	0.41	0.40	5.02	10.55	0.39	0.47	5.93	11.20
Tucson, AZ	32,506	0.03	0.40	5.94	10.95	0.04	0.60	6.39	11.85
Laredo, TX	32,618	0.00	0.45	4.33	9.45	0.00	0.60	5.84	11.27
Colorado Springs, CO	33,237	0.03	0.54	5.54	10.70	0.06	0.59	6.33	11.99
Sioux Falls, SD	33,362	0.00	0.47	5.94	10.95	0.00	0.60	6.31	11.80
Joplin, MO	33,454	0.01	0.55	5.31	10.14	0.02	0.64	5.93	11.17
Mansfield, OH	33,525	0.03	0.54	5.94	11.24	0.16	0.61	6.05	11.39
Paducah, KY	33,541	0.20	0.38	5.18	10.14	0.19	0.59	5.79	11.25
Santa Barbara, CA	33,613	0.02	0.44	6.01	11.24	0.02	0.42	6.70	12.81
Lewiston, ME	34,948	0.00	0.34	5.63	11.15	0.00	0.47	6.13	11.58
Zanesville, OH	36,440	0.05	0.56	5.54	10.70	0.10	0.59	5.93	11.17
Hazleton, PA	36,765	0.00	0.44	5.94	11.06	0.00	0.61	5.96	11.16
San Bernardino, CA	37,481	0.01	0.53	5.76	10.83	0.15	0.59	6.30	11.89
Rock Island, IL	37,953	0.02	0.52	5.87	11.00	0.15	0.63	6.19	11.73
Quincy, IL	39,241	0.03	0.52	5.54	10.83	0.04	0.65	5.96	11.49
Butte, MT	39,532	0.00	0.40	5.76	10.14				
La Crosse, WI	39,614	0.00	0.55	5.63	10.78	0.00	0.55	6.23	11.72

Table A10: Summary Statistics of Cities Around the 40,000 Population Cutoff, cont.

Redlined Cities

		Mean Characteristics							
		1930				1980			
City	1930 Pop'n	Share AA	Home Own	Log Rent	Log H Value	Share AA	Home Own	Log Rent	Log H Value
Oshkosh, WI	40,108	0.00	0.68	5.76	10.83	0.01	0.61	6.15	11.60
Poughkeepsie, NY	40,288	0.03	0.37	5.94	11.59	0.26	0.38	6.22	11.63
St. Petersburg, FL	40,425	0.18	0.50	5.54	11.06	0.17	0.65	6.23	11.51
Lynchburg, VA	40,661	0.24	0.45	5.25	10.70	0.24	0.62	6.06	11.55
Warren, OH	41,062	0.06	0.54	6.10	11.15	0.18	0.62	6.09	11.50
Muskegon, MI	41,390	0.01	0.61	5.76	10.78	0.21	0.59	6.07	10.92
Lima, OH	42,287	0.03	0.46	5.63	10.83	0.20	0.62	6.04	11.33
Portsmouth, OH	42,560	0.04	0.46	5.63	11.06	0.05	0.60	5.84	11.23
Joliet, IL	42,993	0.03	0.53	5.94	11.32	0.20	0.61	6.24	11.75
Columbus, GA	43,131	0.33	0.24	5.02	10.83	0.34	0.57	5.90	11.36
Perth Amboy, NJ	43,516	0.02	0.41	5.87	11.39	0.08	0.44	6.37	11.66
Battle Creek, MI	43,573	0.04	0.58	5.94	11.06	0.23	0.59	6.15	10.96
Chicopee, MA	43,930	0.00	0.43	5.68	11.06	0.01	0.58	6.08	11.47
Lorain, OH	44,512	0.02	0.58	5.87	11.06	0.12	0.65	6.19	11.70
Jamestown. NY	45,155	0.01	0.54	5.76	11.24	0.03	0.55	5.97	11.26
Lexington, KY	45,736	0.29	0.36	5.54	10.95	0.13	0.53	6.34	11.87
Chelsea, MA	45,816	0.01	0.28	5.94	11.24	0.03	0.27	6.11	11.50
Stamford, CT	46,346	0.05	0.37	6.10	11.75	0.15	0.55	6.69	12.63
Muncie, IN	46,548	0.06	0.51	5.72	10.83	0.10	0.62	6.07	11.20
Aurora, IL	46,589	0.02	0.64	6.10	11.24	0.10	0.62	6.41	11.83
Bay City, MI	47,355	0.00	0.70	5.43	10.36	0.01	0.73	6.19	11.27
Elmira, NY	47,397	0.01	0.51	5.76	11.24	0.10	0.50	6.09	11.28
Brookline, MA	47,490	0.01	0.32	6.63	12.16	0.02	0.33	6.84	12.50
Stockton, CA	47,963	0.01	0.45	5.76	10.83	0.11	0.52	6.26	11.95
Everett, MA	48,424	0.02	0.40	6.01	11.24	0.02	0.41	6.21	11.84
Haverhill, MA	48,710	0.01	0.45	5.80	11.06	0.01	0.51	6.27	11.65
New Castle, PA	48,764	0.03	0.57	5.76	11.06	0.07	0.65	5.91	11.18

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