5-2021

Census Tracts, Racial Separation, and the Landscape of Higher Education

Aaron Scholl
University of Nebraska-Lincoln

CENSUS TRACTS, RACIAL SEPARATION, AND THE LANDSCAPE OF HIGHER EDUCATION

by

Aaron Scholl

A DISSERTATION

Presented to the Faculty of

The Graduate College at the University of Nebraska

In Partial Fulfillment of Requirements

For the Degree of Doctor of Philosophy

Major: Economics

Under the Supervision of Professor John E. Anderson

Lincoln, Nebraska

May, 2021

CENSUS TRACTS, RACIAL SEPARATION,

AND THE LANDSCAPE OF HIGHER EDUCATION

Aaron Scholl, Ph.D.

University of Nebraska, 2021

Advisor: John E. Anderson

This dissertation centers on research at the intersection of labor, public, and urban economics. Chapter 1 details the role, process, and history of census tract delineation prior to each Decennial Census, and investigates short- and long-run implications of neighborhoods that receive further delineation, or become "split". Using a difference-in-differences empirical design, I exploit Decennial Censuses from 1980 to 2010 to find that "split" census tracts increase in their proportion of Black residents and these effects persist decades. Further evidence suggests that the Low-Income Housing Tax Credit program may play a role in concentrating residents in areas with greater census tract delineation. These results suggest that census tract delineation may play an important role in shaping neighborhood dynamics.

Chapter 2 focuses on the role urban racial inequality has in contributing to economic inequality for Black residents. Using variation in census tract boundaries to measure levels of urban racial separation, I find that tract-induced racial separation negatively impacts Black individuals across both income and skill distributions. Contributing factors include fewer local job opportunities in predominantly Black neighborhoods, and increased commuting costs for those with jobs. Further evidence suggests these increases in separation, in already predominantly Black neighborhoods, reduce economic and geographic mobilities into adulthood. These results have important implications for fostering equal economic opportunity in areas of high racial separation.

Chapter 3 documents the changing landscape of enrollment and graduation in higher education during the rapid expansion of the for-profit sector in the 2000s. I construct a measure of institutional quality and show that institutions of the lowest quality, primarily for-profit institutions, experienced the largest increases in enrollment as well as large decreases in graduation rates. Decomposing these changes in the lowest quality institutions suggests that aggregate graduation rates decreased primarily as a result of the changing enrollment landscape *across* higher education, while growth in aggregate rates of the highest quality institutions comes from *within* institution changes. These results suggest that as enrollment in higher education expands, schools become more selective in who they enroll, and may have consequences for students attending lower quality institutions.

ACKNOWLEDGMENTS

I would like to express my deepest appreciation to my dissertation committee chair Professor John E. Anderson, committee members Danny Tannenbaum, Brenden Timpe, Jin Yeub Kim, and Emie Yiannaka for guiding me through this important stage of my life and providing constructive comments for my dissertation and other research projects. I will forever value your infinite patience and wisdom as I transitioned from not only a consumer of scholarly work, but a producer as well.

I must also thank the Department of Economics Chairs Scott Fuess and David Rosenbaum, as well as Graduate Directors Matt Cushing and Sam Allgood for all the resources and generous support provided throughout my graduate education. Lastly, I would lilke to thank all of the support staff throughout this journey including Sara Simonsen, Sheila Hayes, Nes Vance, Kellie Reynolds, and Hope Anderson. None of this would have been possible without your expertise and assistance as I moved through the program.

To my beloved family and friends thank you for undertaking this journey with me – I know it hasn't always been easy. Your support and distractions from graduate student life have always provided me the motivation to push forward and see this thing through. We've all had quite the adventure here in Lincoln, and I wouldn't trade these memories for anything. I love you all.

Contents

List of Tables

List of Figures

Chapter 1

THE ROLE OF CENSUS TRACT BOUNDARIES

1 Introduction

In a majority of social science research, the census tract has long been the unit of analysis when studying "neighborhoods" because of their relatively stable geographic structure. For instance, economists often use census tracts to study neighborhood characteristics (Card et al., 2008; Farrell and Lee, 2011; Galiani et al., 2015; Bayer et al., 2016; Sharkey, 2016), create levels of racial separation (Cutler and Glaeser, 1997; Collins and Margo, 2000; Cutler et al., 2008; Ananat, 2011; Bayer and McMillan, 2012; Owens, 2016), or to measure the causal impacts of neighborhoods on various economic outcomes (Sharkey, 2016; Chetty et al., 2016; Chetty and Hendren, 2018; Chetty et al., 2020). While the most common usage of census tracts may be to distinguish geographically-stable neighborhoods, census tract boundaries also function through important public policy channels.

The largest and longest-running federal program to encourage the creation of affordable housing, the Low-Income Housing Tax Credit (LIHTC), uses census tract data in order to determine low-income, qualifying neighborhoods (Office of Policy Development and Research, 2013). Historically, census tract boundaries have also been used to establish election districts, precincts, and wards, which state and local governments create for administering elections (U.S. Census Bureau, 1994). Because of the potential implications census tract boundaries may have throughout cities,

incentives to delineate strategically may arise. In preparation for the Decennial Census, these boundaries are updated to accommodate population changes, and little is known to what extent these boundary changes impact neighborhood racial dynamics and economic opportunity.

In this paper, I exploit variation in census tract boundaries using two distinct data sets to describe how neighborhood dynamics, in terms of racial composition, have changed over both short- and long-run time horizons as neighborhoods continue to urbanize. To evaluate short-run impacts on neighborhood composition, I use annual data within the context of a difference-in-differences (DID) empirical design surrounding the 2010 Decennial Census. Specifically, I examine the annual racial composition of census tracts that split relative to those that don't, before and after the 2010 Decennial Census holding census tract boundaries fixed to their 2000 Decennial Census "envelopes". Similarly, long-run estimations use an event study approach with Decennial Census data from 1980 to 2010 to evaluate how census tract envelope racial composition changes each decade upon further delineation. I conclude by examining a potential mechanism through which census tract delineation may impact the racial composition of the neighborhood – the Low-Income Housing Tax Credit.

Central to the analysis is the configuration and conditions under which census tract boundaries change. When originally introduced and widely implemented for the 1980 Decennial Census, a typical census tract would split prior to the Census if the population surpassed 8,000 residents, and merge if residential population fell below 1,200 (U.S. Census Bureau, 1994).[1] Original census tracts of the 1970 and 1980 Decennial Censuses were intended to be relatively permanent statistical subdivisions that delineated the entirety of the United States, while future delineations were expected to fall predominantly within initial boundaries (U.S.

[1]These thresholds have not been updated since their introduction and continue to serve as a general guideline.

Census Bureau, 2008).[2] These delineations often reflect geographical boundaries, and were historically used to aid census enumerators in visually depicting boundaries which enclosed their respective areas of data collection.[3]

The key identifying assumption in estimating causal impacts of census tract delineation is that trends in neighborhood racial composition would have evolved in the same way in neighborhoods that received additional census tract splits as they would at non-split neighborhoods within the same city, absent census tract boundary updating. Within this context, I provide evidence that there are no observable racial differences between neighborhoods that split and those that don't prior to each Decennial Census. While my results lack evidence of differential neighborhood racial compositions prior to boundary updates, or parallel pre-trends, like all DID designs, I cannot directly tests for differences in pre-trends in unobserved determinants of neighborhood racial composition.

The first key finding of the analysis is that relative to census tract envelopes that don't receive further delineation, "split" census tract envelopes have higher proportions of black residents after the resulting Decennial Census boundary updates, and these effects persist decades. In terms of short-run effects, I find that 2000 Decennial Census census tract envelopes that split in the 2010 Census increased in their proportion of Black residents by 0.26 percentage points relative to census tracts that did not split. At the same time, I find evidence that census tract envelopes that were split reduced the proportion of white residents in the neighborhood by 0.16 percentage points immediately following the 2010 Decennial Census. Long-run estimates suggest these effects amplify over time: twenty years beyond further census tract delineation results in the neighborhood proportion of

[2]This was intended to simplify and enhance the tracking process of data at the census tract-level over time. Henceforth, I refer to census tracts originating in 1970 and 1980 as the census tract envelope.

[3]There are cases of "special" census tracts where these guidelines are abandoned and populations are much larger. For example, some census tracts that contain large college campuses can be considered a special census tract due to the large populations within the neighborhood.

Black residents increasing by 5.03 percentage points, while the proportion of white residents decreased 1.65 percentage points.

In exploring the LIHTC Qualified Census Tract mechanism, I find evidence of a concentration effect. My results suggest that low-income, qualifying census tracts are 1.6 percentage points more likely to receive multiple LIHTC-funded housing projects if the census tract envelope received further delineation in the 2010 Decennial Census, relative to similar low-income, qualifying census tracts that did not split. Investigating heterogeneous impacts suggests that the probability of multiple LIHTC-funded projects within a neighborhood increases by 0.6 percentage points for each additional split within the census tract envelope. Lastly, I find evidence that splits within low-income, qualifying neighborhoods temporarily increases housing values while at the same time reduces neighborhood rental rates – features that are likely explained by improvements to the neighborhood housing stock and the designation of LIHTC income-restricted rental units, respectively.

The most innovative feature of this paper is the application of census tract boundaries beyond their use of geographically stable neighborhoods. Rather than only using census tracts as the neighborhood unit of analysis (e.g., Card et al. (2008); Chetty and Hendren (2018); Chetty et al. (2020)), my empirical approach moves us forward in evaluating how further delineation of these boundaries impacts outcomes of interest. The program developed by Logan et al. (2014) allows me to combine and distribute census tract boundaries and characteristics to various points in time. Thus, I am able to create a consistent shell, or "envelope", for studying the economics of census tracts.

More broadly this paper contributes to a relatively new strand of literature studying the economics of maps. Nagaraj and Stern (2020) provide a detailed discussion of the significance of map making in directing and developing economic activity dating back to the Middle Ages. Jubara et al. (2021) work with

to-be-released National Historical Geographic Information System (NHGIS) census block data dating back to 1980 boundaries to explore the history of racial segregation and integration of the Black population in metropolitan Minnesota. They find that overlaying historical racial covenants and Home Owners' Loan Corporation (HOLC) zones with census block data continues to leave persistently low or high proportions of Black residents in targeted neighborhoods. In a forthcoming paper, Aaronson et al. (Forthcoming) study the effects of the 1930s HOLC "redlining" maps on the long-run trajectories of urban neighborhoods. The authors find that the HOLC maps of the early 20th century had meaningful and lasting effects on the racial development of urban neighborhoods through housing availability and neighborhood disinvestment.

More narrowly defined this paper contributes to understanding the link between census tract configuration and affordable housing options. To the extent that public policy, such as the LIHTC Qualified Census Tracts program, rely on the delineation of census tracts for determining qualified neighborhoods, several researchers discuss that little to no work exists in evaluating the consequences of such policy (e.g., Hollar and Usowski (2007); Dawkins (2013); Tax Policy Center (2017); Scally et al. (2018); Reid (2019)). This work serves to lay the foundation in establishing the role census tracts play in determining neighborhood racial composition through the LIHTC. I study whether further census tract boundary delineation influences the probability that low-income, qualifying neighborhoods receive LIHTC funds, as well as other housing market characteristics also likely to be influenced by the development of LIHTC housing.

The rest of this paper is organized as follows: Section 2 provides background into census tract formation, who determines boundaries, and public policy channels; Section 3 describes the data sources and their implementations; Section 4 presents the empirical analysis of studying census tract delineation; Section 5 investigates

whether the LIHTC program is related to census tract delineation; Section 6 concludes.

2 History and Implementation of the Census Tract

In this section I develop the history and intuition for evaluating census tract formation and boundary updates. I begin by formally discussing the historical timeline of census tracts in the U.S. Next, I describe how census tracts evolve in preparation for each Decennial Census, and provide a visual depiction of census tract boundary updates. I conclude with a discussion of who maintains and determines boundary delineation and potential channels through which the delineation process may create separation.

2.1 History of the Census Tract

As written in the U.S. Const. art. I, § 2.:

> *"Representatives and direct Taxes shall be apportioned among the several States which may be included within this Union, according to their respective Numbers [...] The actual Enumeration shall be made within three Years after the first Meeting of the Congress of the United States, and within every subsequent Term of ten Years, in such Manner as they shall by Law direct."*

Accordingly, the first census was carried out by U.S. marshals in 1790, consisted of six questions, and collected data on approximately 3.9 million people (U.S. Census Bureau, 2002). One hundred years later, Dr. Walter Laidlaw, the Executive Secretary of the New York City Census Committee, proposed that in order to study neighborhoods meaningfully it was necessary to have population data smaller than the borough or ward (U.S. Census Bureau, 2013). He argued these data collection

areas should remain unchanged from census to census, and first referred to the established areas in New York City as "sanitary districts" in 1906; however beyond this, little progress would be made on the development of district-level data over the following 20 years.[4]

In preparation for the 1940 Decennial Census, several other large cities adopted the census tract as an official geographic unit for which data would be published. Census tracts covered large urban environments and block number areas (BNAs) covered several other suburban cities. In 1970 the number of BNAs increased and criteria of BNAs were updated to match those of the census tract (U.S. Census Bureau, 2013). By the 1990 Decennial Census, the entirety of the U.S. was delineated in census tract and block number areas, and in 2000 the BNA concept was retired in exchange for consistent census tract terminology. 2010 marked the 100th anniversary of the delineation of the first census tract boundaries in the United States.

2.2 Definition of the Census Tract

Original census tracts of the 1970 and 1980 Decennial Censuses were intended to be relatively permanent statistical subdivisions that delineated the entirety of the United States (U.S. Census Bureau, 1994). As neighborhoods urbanized, and populations grew, boundaries needed to adjust for accurate, timely, and sufficiently small geographic detail in the data collection process by census enumerators. Rather than newly configuring census tracts every Decennial Census, they instead split from the pre-existing census tract envelopes of earlier Decennial Censuses (U.S. Census Bureau, 2008). While small adjustments may be made to already existing

[4]Decennial Census committee members were skeptical of the use of the more detailed level data relative to the level of preparation necessary for delineation and collection of smaller geographic districts. For instance, in the 1930 Decennial Census, some cities developed additional committees to aid in processing census tract-level data, but were unable to raise the necessary funds for publication of the final tables.

boundaries, this feature enhances the tracking of census tract geography over time.[5] Standard census tracts are usually split beyond a residential population of 8,000 residents, and merged if resident population falls below 1,200.[6] Figure 1 illustrates the evolution of census tract boundaries since their featured adoption for the 1970 Decennial Census. These population thresholds have not been adjusted since their widespread implementation of the 1970 and 1980 Decennial Censuses. So, while neighborhoods have become more crowded over the last 50 years, boundary delineations are usually accepted as long as they fall within the specified range.

2.3 Who Determines the Boundaries of Census Tracts?

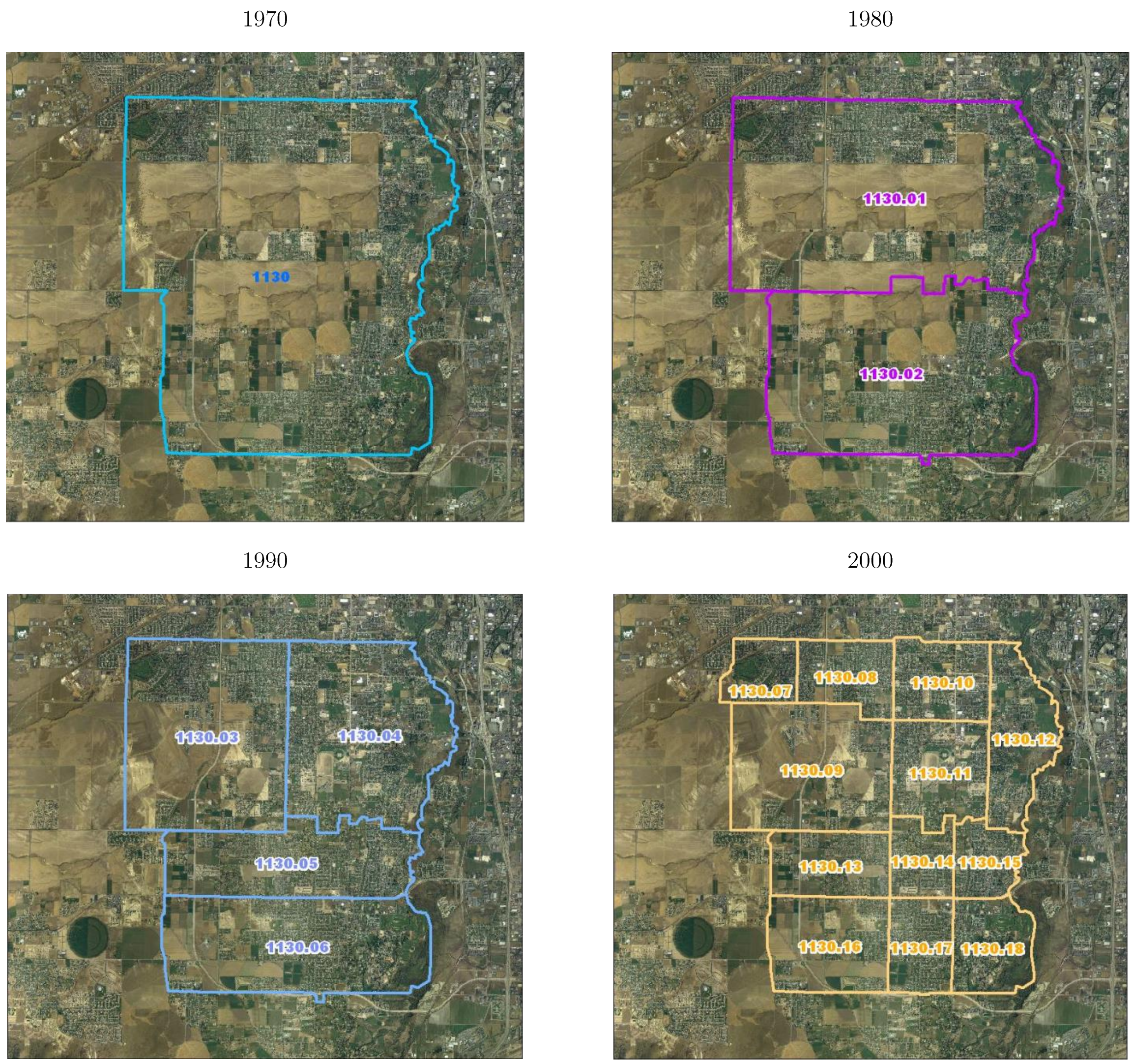
The Participant Statistical Areas Program (PSAP) through the U.S. Department of Commerce allows eligible participants to review, update, and delineate new census tracts prior to the upcoming Decennial Census. Participants may consist of any interested regional or local government entities, private organizations, and individuals familiar with the area. U.S. Census Bureau (2008) encourages participation for three primary reasons: (1) familiarity of local population changes and settlement patterns, (2) familiarity with unincorporated and emerging communities, and (3) resulting data to meet the needs of their communities. Because of the familiarity local participants have in determining census delineated places, the Census Bureau is able to meet many of the statistical and spatial needs required of the agency. U.S. Census Bureau (2008) discusses how data tabulated to these boundaries are used by local, state, and federal agencies and organizations for planning and funding purposes, as well as the private sector, academia, and the public.

Primary participants begin by agreeing to work with all interested parties so that

[5] These updates and small boundary corrections are allowed during intercensal population estimates.

[6] Special census tracts may be created for large special land use areas without housing or population (e.g., large public parks, forests, etc.) (U.S. Census Bureau, 2008)

Figure 1: Census Tract Boundary Changes



Source: U.S. Census Bureau (2013) This figure shows the evolution of census tract envelope 1130 of Salt Lake County, Utah, and illustrates how census tracts are split over time as the census tract becomes increasingly populated.

the resulting plan accommodates the needs and interests of governments, organizations, and individuals in the area.[7] Participants choose which counties they are interested in covering, and agree to review and update all Participant Statistical Areas within the specified county(ies). A final plan for each county is submitted to the Census Bureau where acceptable population criteria are verified.[8] Beyond approval from the Census Bureau, delineation files are inserted into the Topologically Integrated Geographic Encoding and Referencing (TIGER) Database.

2.4 Census Tracts in Public Policy

While U.S. Census Bureau (2008) describes that state and local governments may also use census tract geography in determining funding, the largest federal program to do so is the Low-Income Housing Tax Credit (LIHTC) Qualified Census Tracts program. Hollar and Usowski (2007) document the legislative history and methodology for designating and awarding LIHTC funds in qualified neighborhoods. The Tax Relief Act of 1986 created the LIHTC program, and the Omnibus Budget Reconciliation Act of 1989 amended the program to include additional incentives for rehabilitation and replacement of substandard rental housing in low-income areas, known as Qualified Census Tracts (QCTs).

Standard QCTs consist of tracts that have 50 percent of households with incomes below 60 percent of the Area Median Gross Income (AMGI), or have a poverty rate of 25 percent or more (Office of Policy Development and Research, 2013).[9] LIHTC funds for these neighborhoods are awarded on a state population basis from the Department of the Treasury, and distributed to housing developers through state

[7]U.S. Census Bureau (2008) strongly encourages soliciting input from non-governmental organizations, academics, and interested individuals.

[8]Census tracts that fall outside of standard census tract guidelines must have appropriate documentation for the decision.

[9]Ellen and Horn (2018) discuss varying features of individual state Qualified Allocation Plans, in addition to QCTs, that further encourage the development and rehabilitation of neighborhoods that meet specified criteria.

housing finance agencies. There is no federal oversight beyond initial distribution, and housing agencies have a wide discretion in determining projects to award credits. Tax credits that are not purposed within the state are returned and redistributed for use in other areas. While changes in census tract boundaries should have no effect on the allocation of tax credits each state receives, boundary manipulation could enhance the number of LIHTC-funded affordable housing units available within low-income or high-poverty areas, or both.

Census tracts are first ranked in terms of lowest-income and highest poverty neighborhoods and second by their combined rank. The combined ranking determines the level of priority in awarding LIHTC funds. Thus, QCT envelopes potentially receive excessive funds through additional boundary delineation while concentrating affordable housing in the lowest-income or highest poverty areas. Several researchers suggest the use of census tracts in determining who receives LIHTC funds provides incentives for concentrating affordable housing in low-income or high-poverty areas (eg., Dawkins (2013); Tax Policy Center (2017); Fischer (2018); Scally et al. (2018)). In fact Kennedy (2015), found that Texas was in violation of locating LIHTC-funded affordable housing units in neighborhoods of predominantly Black inner-city areas, and too few in predominantly white suburban neighborhoods.

While this work is primarily interested in how census tracts function within neighborhoods, historically census tract boundaries have also been used in determining voting districts. The boundaries of election districts after the 1970 Decennial Census were often drawn independent of Census Bureau geography, and relied on Census population counts. Because of the lengthy, and sometimes impossible, process in matching the features of state-provided election maps to features of Census Bureau geography, timely population counts were absent in updating districts (U.S. Census Bureau, 1994). Thus, the Census Bureau created

the Election Precinct Program for the 1980 Decennial Census whereby state officials were instructed to delineate voting districts to coincide with sufficiently large Census Bureau geography – census tracts.[10] This ensured that the Census Bureau would be able to deliver accurate and timely population data by the end of the first quarter of the following year. As a result, incentives arise to potentially delineate boundaries strategically such that the resulting districts reflect the goals of a legislator, rather than a representative community.

3 Data Background and Usage

The data sets used in the analysis include census tract data from the Longitudinal Tract Data Base (LTDB) and National Historical Geographic Information System (NHGIS), as well as Low-Income Housing Tax Credit census tract data from the Department of Housing and Urban Development (HUD). In this section I describe each data set and individual sampling criteria in further detail and place them into context of the analysis.

3.1 Longitudinal Tract Data Base

Long-run census tract-level data come from the Longitudinal Tract Data Base (LTDB) (Logan et al., 2014), and allow researchers to construct a variety of data that stem from full count and sample data in the 1980-2000 Decennial Censuses and the 2008-2012 ACS 5-year data file. These census tract-level data include variables on population, race, income, education, and workforce characteristics. The key advantage in using the LTDB lies in its choice of census tract boundaries. Data sets are available to reflect either longitudinally consistent boundaries fixed to a single

[10] At the end of the process, the Census Bureau returned all State-submitted maps to the States for their use in the redistricting process. Because the Census Bureau produced the election precinct tabulations as a special computer subfile, the data were not in any published report. Also of note, the Census Bureau kept no copies of these maps and did not show the boundaries of precincts on any 1980 census maps available to the public.(U.S. Census Bureau, 1994)

point in time, or the use of temporally-dependent census tract boundaries. Additionally, because the data are provided as raw population counts I am able to construct the characteristic of interest through aggregation of count data, rather than weighting proportions to fit within larger levels of aggregation.[11] Using the Historical Delineation Files available from U.S. Census Bureau (2011), I aggregate the detailed raw census tract data up to the MSA in order to construct city-level estimates of population counts.[12] I restrict my analysis to urban MSAs defined as having a resident population of at least 100,000 individuals. This results in 303 unique MSAs in 2010, the most recent period used in the analysis.

I also make use of another feature of the LTDB when implementing the main DID empirical strategy. Logan et al. (2014) construct a program through the LTDB that matches 2010 Decennial Census census tract boundaries within their 2000 Decennial Census envelopes. This allows me to examine the racial composition of 2000 Decennial Census envelopes that split relative to those that don't, before and after the 2010 Decennial Census. The program contains information on how many splits occurred within the 2000 census tract boundaries and appropriately weights mean, median, and proportion variables by their base.[13]

3.2 National Historical Geographic Information System (NHGIS)

Additional short-run census tract-level population data come from the NHGIS available through IPUMS (Manson et al., 2019). The NHGIS provides access to summary statistics and Geographic Information System (GIS) files for the Decennial Censuses and other nationwide surveys at varying levels of geography. I make use of

[11]For example, I am able to construct census tract-level proportions using the raw census tract data. I can also aggregate the raw data to higher levels of geography, such as the MSA-level, without having to weight census tract proportions by their population, for instance.

[12]Census tracts are designed to fall entirely within counties, and counties fall entirely within MSA boundaries. Thus, census tracts aggregate nicely within MSAs.

[13]For example, the base variable for median household income would be the total number of households.

the ACS 5-year data files from 2005 to 2018 aggregated to the census tract level in my DID empirical analysis of census tract splits surrounding the 2010 Decennial Census. Each 5-year file provides estimates of the average characteristics over the relevant period, and I use these characteristics to reflect the midpoint in each ACS 5-year sample. For instance, the 2005-2009 ACS 5-year file characteristics reflect the midpoint, 2007, in my analysis. Thus, my DID analysis uses data from midpoints 2007 to 2016 reflecting ACS 5-year data files from 2005-2009 to 2014-2018. Variables of interest include the total population, white alone, and Black alone populations, as well as median rent and housing prices.

I apply the LTDB conversion program discussed above to the NHGIS population data in order to convert all data back to their 2000 Decennial Census envelopes, and calculate proportions white, Black, median rent, and median housing value using 2000 census tract envelope boundaries. Thus, I have data centered at the midpoints of ACS 5-year data files from 2007 to 2016, aggregated to match exact 2000 Decennial Census boundaries. The resulting sample consists of 456,926 envelope-year observations within the MSAs of interest.

3.3 Department of Housing and Urban Development (HUD)

HUD's LIHTC database contains information on over 48,000 projects placed in service between 1987 and 2019. Variables used in the analysis include whether there exists multiple LIHTC-funded projects, the number of low-income restricted housing units, and whether units are new construction or rehabilitated. Data are available at the project level and aggregated to current census tract boundaries. I further apply the boundary conversion program developed by Logan et al. (2014) to adjust these characteristics to 2000 Decennial Census Boundaries. These data are merged with NHGIS data from 2007-2016 to analyze the impact of census tract delineation on the LIHTC characteristics of interest.

4 Empirical Analysis: the Effect of Census Tract Delineation

I begin my empirical analysis by studying the impact that additional boundaries have on the racial composition of census tract envelopes. The first section consists of a dynamic difference-in-differences (DID) empirical design estimating short-run impacts surrounding the 2010 Decennial Census. Then I present the main DID results empirically establishing significant effects *after* the 2010 Census, as well as heterogeneous impacts. I conclude by corroborating the results found in my short-run analysis with an alternate data set investigating long-run impacts.

4.1 Dynamic Difference-in-Differences

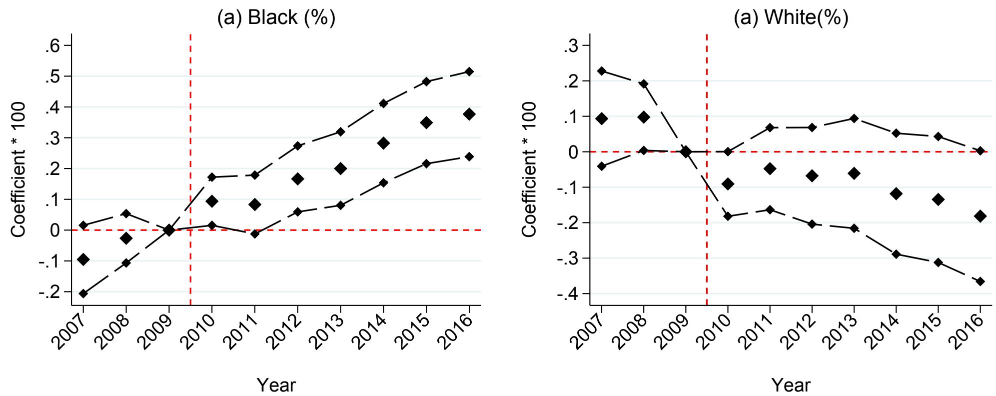
In order to characterize the impact that census tract delineation has on the racial composition of neighborhoods, I present a dynamic difference-in-differences analysis using the 2010 Decennial Census. Specifically, I examine the racial composition of 2000 Decennial Census census tract envelopes that split relative to those that don't, before and after the 2010 Decennial Census, from 2007 to 2016. My estimating equation of interest is:

$$y_{ict} = \alpha_0 + \delta treatment_i + \sum_{t=2007}^{2016} \gamma_t + \sum_{t=2007}^{2016} \delta_t treatment_i + x_{it}'\theta + \epsilon_{ict} \tag{1}$$

where the dependent variable y_{ict} is either the percent white or Black in census tract envelope i in city c at time t. The independent variable *treatment* equals 1 if the census tract envelope receives further delineation in the 2010 Decennial Census. The base year of analysis is 2009, the year before census tracts split. Additional controls in x_{it} include a quadratic function in population and city fixed effects. Standard errors are robust and clustered at the 2000 census tract envelope level.

The coefficient of interest in Equation 1 is δ_t and indicates the percentage point effect on the neighborhood racial composition in year t. The key assumption for

Figure 2: Effect of Census Tract Splits on Neighborhood Composition



The unit of analysis is the 2000 census tract envelope (N=456,926). Coefficients are estimated from the regression specified in equation 1, and have been multiplied by 100 for ease of interpretation. Additional controls include a quadratic function in neighborhood population, city and year fixed effects. Standard errors are robust and clustered to the census tract envelope level. Estimation is restricted to 2000 census tract envelopes that have a neighborhood population of at least 2,000 residents and a city population of at least 100,000. This captures 88.7 percent of neighborhoods covering 303 unique MSAs.

identification is that trends in neighborhood racial composition would have evolved in the same way in neighborhoods that received additional census tract splits as they would at non-split neighborhoods within the same city, absent census tract boundary updating. An F-test of the null hypothesis that the pre-period coefficients found in Figure 2 are jointly equal to zero fails to reject the null in both panels (panel (a): $F(2, 47, 187) = 1.46$, $p = 0.23$; panel (b): $F(2, 47, 187) = 2.10$, $p = 0.12$). While Figure 2 lacks evidence of differential neighborhood racial compositions prior to boundary updates, or parallel pre-trends, like all DID designs, I cannot directly test for differences in pre-trends in *unobserved* determinants of neighborhood racial composition.

The evidence provided in Figure 2 suggests that census tract delineation impacts the racial composition of neighborhoods immediately following the 2010 Census. Relative to census tract envelopes that don't split in the 2010 Decennial Census, 2000 Decennial Census envelopes that split increase in their proportion Black by

0.09 percentage points immediately following the 2010 delineation process. The effect on the envelope percent Black persists, and increases to 0.38 percentage points by 2016. At the same time, relative to census tract envelopes that don't split, 2000 Census envelopes that split decrease in their proportion white by 0.09 percentage points immediately after 2010 boundary updates and continue to decrease to 0.11 percentage points by 2016. While this effect remains persistently negative over time, standard errors are quite large beyond this first year. The traditional two period DID analysis can be found in Table A.1.

To study heterogeneous impacts of census tract splits, I examine whether the number of resulting census tracts within a 2000 Decennial Census census tract envelope differentially affect the racial composition of the neighborhood. As the number of resulting tracts increases within a given census tract envelope, there may exist additional opportunities to concentrate subsidized housing. For instance, three nested tracts resulting from the 2010 Decennial Census, within a 2000 Census envelope, suggests there could be three distinct neighborhoods eligible, instead of a single neighborhood in the case of a tract that doesn't split. To study the reduced-form impact of additional splits on neighborhood racial composition, I estimate an altered specification of the DID analysis found above:

$$y_{ict} = \gamma_0 + \gamma_1 post_t + \gamma_2 number\,of\,splits_i + \gamma_3 (post_t \times number\,of\,splits_i) + x'_{it}\theta + \epsilon_{ict} \quad (2)$$

where the dependent variable y_{ict} is either the percent white or Black in census tract envelope i in city c at time t, $post_t$ indicates whether y is measured after the 2010 Decennial Census, and $number\,of\,splits_i$ indicates the number of resulting census tracts in the 2010 Decennial Census nested within 2000 Decennial Census envelope i. Additional controls in x_{it} include a quadratic function in population, city fixed effects, and a linear time trend. Standard errors are robust and clustered at the

2000 census tract envelope level.

Table 1: Heterogeneous Effects of Census Tract Splits on Neighborhood Composition

	(1) % Black	(2) % White
Number of Splits	-1.128***	1.882***
	(0.068)	(0.080)
Post × Number of Splits	0.042**	-0.036
	(0.017)	(0.023)
R^2	0.228	0.261
N	456922	456922

The unit of analysis is the 2000 census tract envelope (N=456,922). Coefficients are estimated from the regression specified in equation 2, and have been multiplied by 100 for ease of interpretation. Additional controls include a quadratic function in neighborhood population, city fixed effects, and a linear time trend. Standard errors are robust and clustered to the census tract level. Estimation is restricted to 2000 census tract envelopes that have a neighborhood population of at least 2,000 residents and a city population of at least 100,000. This captures 88.7 percent of neighborhoods covering 303 unique MSAs.

Table 1 presents the effects of the number of splits within a 2000 census tract envelope on the racial composition of the neighborhood. Relative to census tract envelopes that do not split in the 2010 Decennial Census, an additional census tract within the 2000 Census envelope results in the neighborhood Black residency increasing by 0.042 percentage points. Conditional on an 2000 Census envelope splitting, the average number of resulting 2010 census tracts nested within are 2.58 (std. dev.=1). Again, while insignificant, the coefficient of interest differs in sign when comparing proportions Black and white in census tract envelopes.

4.2 Event Study Approach

Similar to the analysis above, this section estimates the long-run impact of boundary updates using the census tract envelope approach with envelopes now fixed to their original boundaries. Using decadal data from the Longitudinal Tract Data Base (LTDB) and an event study design, I corroborate the evidence found in Section 4.1.

If available, census tract envelopes are based upon the original configuration, when a majority of census tracts were delineated for urban areas.[14] Otherwise, the envelope is defined as the first time a new census tract appears, and is not encompassed within an envelope already.[15] Additionally, the event study exercise accounts for multiple splits of the same census tract envelope.[16] In event time, this exercise captures 30 years prior to 30 years after a census tract splits. For instance, a census tract envelope that existed in 1980, but did not split until 2010 would be reflected in the relative year -30. Alternatively, a census tract envelope that was split in 1980, and observed in 2010 would be reflected as 30 years after the event. Because census tracts that were first split in the 1980 Decennial Census appear more frequently in the data while those that were split in later Censuses appear less, the final sample consists of an unbalanced panel of 38,242 census tract envelopes within the MSAs of interest.

I adopt a two-way fixed-effects (TWFE) specification to estimate the long-run

[14]New census tracts falling within the original envelope are tagged with the number of the original envelope and appended with a decimal. To aggregate data to their original envelopes, I drop decimal points and collapse data to the original census tract envelope number.

[15]For example, as cities expanded, the Census Bureau had to further delineate this growth. This occurred up to the 1980 Decennial Census, where the Census Bureau expanded census tracts to cover the entire U.S.

[16]This occurs in the most dense areas of cities.

impacts of boundary delineation. My estimating equation of interest is:

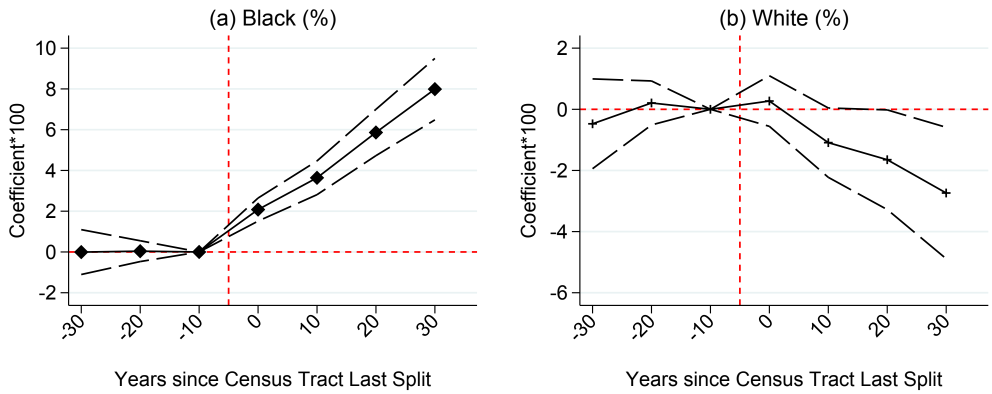
$$y_{ict} = \alpha_i + \alpha_t + \sum_{k=-30}^{-20} \gamma_k treatment_{it} + \sum_{k=0}^{30} \gamma_k treatment_{it} + x'_{it}\theta + \epsilon_{ict} \qquad (3)$$

where the dependent variable y_{ict} is either the percent white or Black in census tract envelope i in city c at time t, and α_i and α_t are census tract envelope and time fixed effects respectively. The independent variable *treatment* equals 1 if census tract envelope i receives further delineation in year t. The base year of analysis is $k = -10$, the observed period before the census tract is split, and is thus omitted. Additional controls in x_{it} include a quadratic function in neighborhood population and city fixed effects. Standard errors are robust and clustered at the census tract envelope level.

The coefficient of interest is γ_k and indicates the percentage point effect on the neighborhood racial composition in relative year k. Similar to the DID analysis above, the key identifying assumption is that census tracts would have continued to evolve in the same way if they had not received further boundary delineation in the following Decennial Censuses. While I cannot test this assumption directly, an F-test of the null hypothesis that the pre-period coefficients are jointly equal to zero fails to reject the null in both panels (panel (a): $F(2, 2, 758) = 0.01$, $p = 0.99$; panel (b): $F(2, 2, 758) = 1.16$, $p = 0.31$). Figure 3 presents the results of the event study analysis.

The evidence found in Figure 3 supports the results found in the short-run analysis of Figure 2. Results suggest that census tract boundary delineation significantly impacts the racial composition of neighborhoods, and effects not only persist decades but amplify over time. Panel (a) finds that ten years after a neighborhood receives further delineation, the proportion of Black residents increases 3.20 percentage points, and further increases to 5.03 percentage points twenty years after the census tract envelope is “split”, off a sample mean of 9.29

Figure 3: Long-Term Effect of Census Tract Splits on Neighborhood Composition



The unit of analysis is the original census tract envelope (N=38,242). Coefficients are estimated from the regression specified in equation 3. Additional controls include a quadratic function in neighborhood population and city fixed effects. Standard errors are robust and clustered to the census tract envelope level. Estimation is restricted to census tract envelopes that have a neighborhood population of at least 1,200 residents.

percent. Alternatively, ten years after the neighborhood is "split" the proportion of white residents decreases by 1.09 percentage points, and continues to decline thirty years after delineation. Summarized results of this exercise can be found in Table A.2

5 Mechanism Analysis: Investigating the LIHTC

The goal of this section is to consider whether federally subsidized low-income, affordable housing plays a significant role in contributing to neighborhood racial inequality through census tract delineation. While census tract boundaries are used by varying state, local, and private agencies to direct public policy, the largest federal program to do so is the Low-Income Housing Tax Credit (LIHTC) Qualified Census Tracts program. To explore this mechanism, I merge tract-aggregated LIHTC data available through the Department of Housing and Urban Development (HUD) with census tract data used earlier in the analysis to study whether census tract "splits" affect the probability of neighborhoods receiving LIHTC projects, and

their associated housing characteristics. Specific outcomes of interest include heterogeneous impacts of census tract "splits", designated low-income restricted housing units, whether units are more likely to be rehabilitated or newly constructed, and neighborhood rents and housing prices.

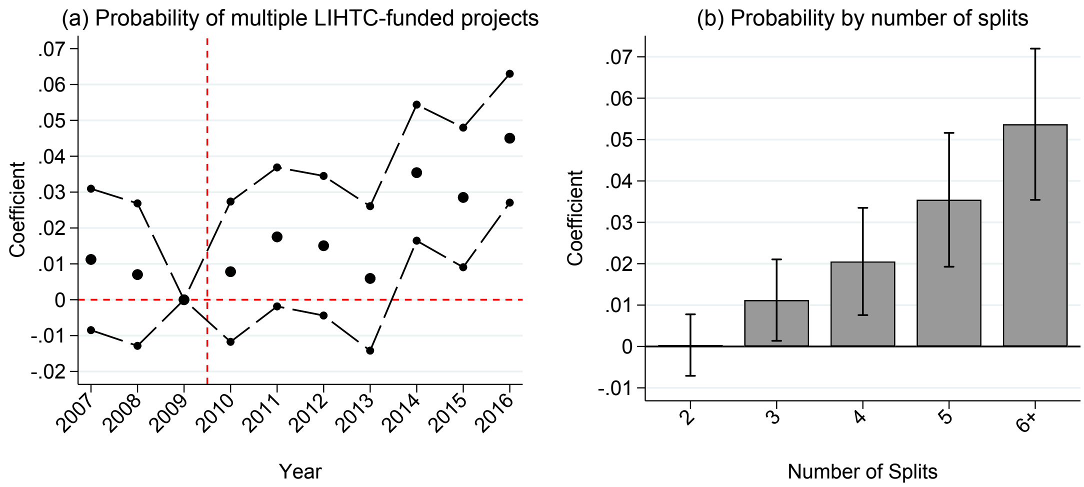
I begin by examining whether low-income, qualified neighborhoods that receive further delineation are more or less likely to receive LIHTC-funded housing projects and how the number of resulting tracts impacts this probability. I estimate a variant of Equation 1 where the dependent variable is replaced with an indicator if the 2000 census tract envelope received an LIHTC-funded project. Next, I examine the probability of the census tract envelope receiving LIHTC funds by the number of splits within the tract envelope. To study these heterogeneous impacts, I adopt the following econometric framework:

$$y_{ict} = \gamma_0 + \gamma_1 post_t + \sum_{l=2}^{6} \gamma_l number\,of\,splits_i + (post_t \times \sum_{s=2}^{6} \gamma_s number\,of\,splits_i) + x'_{it}\theta + \epsilon_{ict} \tag{4}$$

where y is an indicator if census tract envelope i received LIHTC funds, *post* indicates that time t is after the 2010 Decennial Census, and *number of splits* indicates the number of times census tract envelope i received additional boundaries. Additional controls in x_{it} include a quadratic function in neighborhood population and city fixed effects. Standard errors are robust and clustered at the 2000 census tract envelope level. This specification allows me to test whether there exists differential impacts for census tract envelopes that are split once relative to envelopes with multiple divisions.[17] Thus, the coefficient of interest is γ_s and indicates the percentage point effect on the probability that a low-income, qualified

[17] My sample consists of census tract envelopes that consist of up to 12 nested census tracts after the 2010 Decennial Census, but I limit the presentation of results in this exercise to envelopes that have 6 or fewer nested 2010 census tracts due to small sample sizes. Those with 6 splits or less make up over 99 percent of the analysis sample.

Figure 4: Evidence of the LIHTC in Census Tract Delineation



The unit of analysis is the 2000 census tract envelope and is conditional on the envelope being a low-income, qualified neighborhood from 2007 to 2016 (N=71,708). Coefficients are estimated from regressions specified in Equations 1 (Panel (a)) and 4 (Panel (b)). Additional controls include a quadratic function in neighborhood population, city fixed effects, and a linear time trend. The dependent variable of interest in each panel is an indicator that equals 1 if the census tract envelope received more than 1 LIHTC-funded project. Standard errors are robust and clustered to the census tract level.

neighborhood receives multiple LIHTC-funded projects.

The results in Figure 4 suggest that census tract delineation impacts the probability that neighborhoods receive multiple LIHTC-funded projects. Relative to census tract envelopes that don't split, 2000 qualified census tract envelopes that receive further delineation are more likely to receive multiple LIHTC-funded projects. Five years after the 2010 Decennial Census, the probability of multiple LIHTC projects within a qualified census tract envelope increases by almost 3 percentage points, off a sample mean of 64.32 percent. Panel (b) presents the heterogeneous impacts of census tract splits estimated from Equation 4, and suggests that increasing the number of resulting tracts within a 2000 qualified census tract envelope increases the probability of multiple LIHTC-funded projects. A 2000 tract envelope that is further delineated into six or more resulting census

tracts after the 2010 Decennial Census increases the probability of multiple LIHTC-funded projects by more than 5 percentage points. Summarized results of Figure 4 can be found in Table A.3.

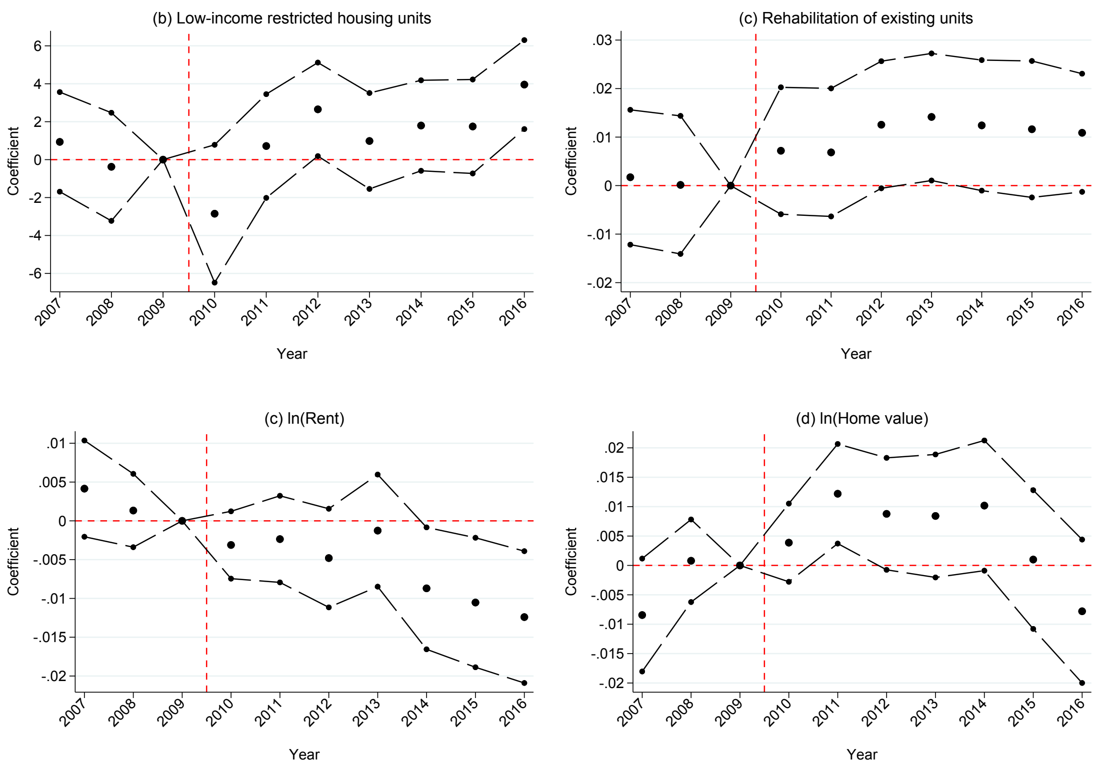
Next I turn my attention to more detailed characteristics of LIHTC-funded projects, as well as associated housing market characteristics including rent and housing prices. I use a similar econometric framework as in Equation 1 where the dependent variable is replaced with the LIHTC outcome of interest and the analysis is restricted to low-income qualifying neighborhoods. The work of Dillman et al. (2017) suggests that LIHTC-funded properties within low-income neighborhoods may improve the surrounding the property values by removing blight and vacant lots in exchange for affordable housing options within distressed neighborhoods. The results found in Figure 5 support their findings.

Figure 5 suggests that census tract delineation is also related to characteristics associated with LIHTC-funded projects. While not significant at conventional levels, low-income census tract envelopes receiving further delineation are more likely to contain housing classified as low-income restricted units, and further housing market evidence supports this finding – neighborhoods that receive further delineation experience modest rent declines relative to tract envelopes that remain intact. Additionally, while further delineated neighborhoods are more likely to experience the rehabilitation of existing housing units, these improvements appear to also temporarily improve local housing values in low-income neighborhoods.

6 Conclusion

Census tracts are most often applied in research to construct geographically stable neighborhoods, but a lesser known feature of census tract geography is their role in public policy. The largest and longest-running federal program to encourage the creation of affordable housing, the LIHTC, uses census tract data in order to

Figure 5: Census Tract Delineation and LIHTC-Funded Projects



The unit of analysis is the 2000 census tract envelope and is conditional on the envelope being a low-income, qualified neighborhood from 2007 to 2016 (N=71,708). Coefficients are estimated from the regression specified in Equation 1. Additional controls include a quadratic function in neighborhood population, city fixed effects, and a linear time trend. Low-income restricted housing units refer to units designated as separate living quarters and restricted to individuals below an income threshold determined by the state Housing Finance Agency (HFA). Rehabilitation is an indicator that equals 1 if the tract envelope received LIHTC-funded work to rehabilitate existing housing units rather than to build new structures. Median rent and home value are in 2010 dollars. Standard errors are robust and clustered to the census tract level.

determine low-income, qualifying neighborhoods. Because of the potential implications census tract boundaries may have throughout cities on affordable housing options, incentives to delineate strategically may arise.

In this paper, I exploit variation in census tract boundaries to describe how neighborhood dynamics, in terms of racial composition, have changed over both short- and long-run time horizons. To evaluate short-run impacts, I use a difference-in-differences empirical design surrounding the 2010 Decennial Census. Specifically, I compare the annual racial composition of census tracts that split relative to those that don't, before and after the 2010 Decennial Census holding census tract boundaries fixed to their 2000 Decennial Census "envelopes". I further corroborate my results within the short-run analysis using an alternative data set spanning 1980 to 2010 to capture long-run impacts. Lastly, I provide evidence that census tract delineation may yield such results through the Low-Income Housing Tax Credit by concentrating affordable housing in disadvantaged neighborhoods.

My first key result suggests that census tract boundaries are delineated in ways that concentrate Black residents in neighborhoods with additional census tract splits. Common trends analysis suggests this can not be explained by observable differences prior to the 2010 Decennial Census. Further analysis using long-run data, I find that these effects persist decades and amplify over time – twenty years beyond census tract delineation results in the neighborhood proportion of Black residents increasing 5.03 percentage points, off a pre-treatment sample mean of 9.29 percent. I further provide evidence that the LIHTC may play a role in concentrating Black residents in neighborhoods with more tract boundaries. Conditional on low-income, qualifying neighborhoods, 2000 census tract envelopes are 1.6 percentage points more likely to receive multiple projects relative to neighborhoods that did not receive further delineation.

To my knowledge, this is the first paper to consider the impacts that census tract

delineation may have on the development and dynamics of urbanizing neighborhoods. A significant literature has documented the disparities and inequalities that result from unequal access to opportunity across neighborhoods, and this paper explores a new channel that may contribute to increasing neighborhood inequality. To the extent that public policy, such as the LIHTC program, relies on the delineation of census tracts in determining qualified neighborhoods, little work exists in evaluating the consequences of such criteria. Future work should continue to explore avenues in which neighborhood boundaries may influence the composition and direction of public policy.

Chapter 2

SPLITTING TRACTS: THE IMPACT OF NEIGHBORHOOD RACIAL DYNAMICS ON ECONOMIC OPPORTUNITY

1 Introduction

While the United States is the most diverse it's ever been, urban America continues to be racially and economically divided. Almost half of all Black families in the U.S. live in a neighborhood without a white presence, and the average white family lives in a neighborhood that is nearly 80 percent white (Abedin et al., 2017). This racial inequality holds a longstanding position as one of the prime components contributing to economic inequality for Black residents. A well established literature has attempted to measure the impacts of racial separation on economic outcomes for minority residents (e.g., Cutler and Glaeser (1997); Collins and Margo (2000); Cutler et al. (2008); Ananat (2011); Bayer and McMillan (2012); Owens (2016)); however, less attention has been placed on developing channels through which racial separation reduces economic opportunity.

This paper makes three contributions to this literature. First, using a novel identification strategy, I estimate the heterogeneous effects of racial separation on economic opportunities for minority residents spanning 30 years from 1980 to 2010. My strategy leverages variation in census tract boundaries resulting from the 1980 to 2010 Decennial Census boundary updates to measure changes in cumulative levels of urban racial separation. Specifically, I use this variation, conditional on

population characteristics, as an instrument to estimate the effects of racial separation on educational, labor market, and social opportunities.[1] Second, using newly available data from Opportunity Insights, I test two hypotheses as potential explanations into why neighborhood racial composition plays an important role in shaping the opportunities residents enjoy: (1) labor market attachment and (2) peer influences. I conclude by examining the impacts tract-induced racial separation has on the ability to leave predominnantly Black neighborhoods into adulthood.

Using an instrumental variables (IV) strategy to estimate the impacts of racial separation on economic outcomes requires two conditions to be met. The first requires that the instrument be related to racial separation, or the relevancy condition. Why should we expect census tract delineation to be related to levels of urban racial separation? Census tract boundaries often reflect visible features of the landscape, and were historically used to aid census enumerators in visually depicting boundaries which enclosed their respective areas of data collection (U.S. Census Bureau, 1994). Thus, similar to analyses found in Hoxby (2000) and Ananat (2011), census tract boundaries reflect natural geographic barriers that serve as a technology for creating racial separation. That is, as populations grow and neighborhoods become increasingly space-constrained, new residents expand by "falling back" to the next natural geographic boundary, like a major roadway, railroad track, or tree line – also reflected and updated through additional census tract delineation.[2]

The second condtion for a valid instrument requires the instrument to affect the outcomes of interest only through the endogenous variable, or the exclusion restriction. In measuring the impacts of racial separation, the exclusion restiction requires that census tracts are designed, and split, orthogonal to observable, as well

[1]The measure of racial separation I use is defined as the Index of Dissimilarity. This statistic indicates the proportion of the specified population that would have to relocate in order to create an equal distribution within the city.

[2]Ananat (2011) provides a detailed discussion of railroad delineation as a technology for racial separation. This approach generalizes technology for creating racial separation to any geographic boundary reflected through census tract delineation.

as unobservable, characteristics that may influence one's economic opportunities. While this assumption cannot be tested directly, I provide a falsification test that suggests the first-stage relationship is not driven by some unobservable characteristic also linked to racial separation that may influence economic outcomes.

To conduct this falsification exercise, I rely on a unique feature of census tract delineation. Upon their widespread implementation, census tracts of the 1970 and 1980 Decennial Censuses were intended to be relatively permanent statistical subdivisions delineating the entirety of the United States, while future delineations were expected to fall predominantly within initial boundaries (U.S. Census Bureau, 2008).[3] Using this "envelope" feature, the falsification exercise holds neighborhoods fixed to their original census tract boundaries and tests for a relationship between contemporaneous census tracts in a city and the measure of racial separation calculated using the outer, or original, "envelopes". The intuition behind this test is as follows: If additional census tract delineation is related to racial separation and the measure of racial separation is calculated using a fixed number of census tract envelopes, then there should be no correlation between the number of contemporaneous census tracts and the envelope-fixed racial separation index over time.[4] In fact, my results suggest there exists no relationship between these two variables.

The first set of key findings suggests that increased racial separation negatively impacts Black residents in terms of educational attainment, earnings, idleness in the labor market, and single parenthood. A one percentage point increase in racial

[3]This was intended to simplify and enhance the tracking process of data at the census tract-level over time. A typical census tract would split prior to the Census if the population surpassed 8,000 residents, and merge if residential population fell below 1,200 (U.S. Census Bureau, 1994). These thresholds have not been updated since their introduction and continue to serve as a general guideline. Henceforth, I refer to census tracts originating in 1970 and 1980 as the census tract envelope.

[4]Alternatively, if a relationship did exist within this framework, it could be argued that the number of census tracts instead reflect some unobservable characteristic that also induces racial separation, rather than the boundaries themselves.

separation reduces the probability a Black young person (ages 20-30) earns more than median income in the national income distribution by 0.12 percentage points. In terms of moving out of extreme poverty, an increase in racial separation, reduces the probability a Black individual moves beyond the first income decile by 0.26 percentage points relative to a non-Black individual. Additionally, a one percentage point increase in racial separation reduces the probabilities that a Black resident completes high school or college by 0.16 and 0.60 percentage points, respectively. Estimating the differential impacts for non-Black residents suggests little to no improvements in terms of educational and labor market outcomes – estimates are generally insignificant and an order of magnitude smaller than Black estimates in absolute value. Given the average difference between high and low racially separated cities in 2010 was 20.3 percentage points, these estimates indicate large reductions in economic opportunities for Black residents, and little to no benefit of racial separation for non-Black residents.[5]

Next, I examine potential causes and consequences of census tract-induced racial separation. To explore mechanisms behind the negative impacts Black residents face, I focus on two hypotheses: The first tests for weakened labor market attachment among Black residents. I provide evidence that not only are there more *high paying* job opportunities in non-Black neighborhoods, but more job opportunities in general. Further, conditional on having a job, Black residents usually work fewer hours per week. Attributable are longer commute times, and heavier reliance on public transportation in more racially separated cities relative to non-Black residents. The second hypothesis tests that Blacks have worse outcomes in more racially separated neighborhoods because they have less contact with positive peer influences. My evidence suggests in predominantly Black neighborhoods there are fewer interactions with educated individuals and higher

[5]High racially separated cities are cities with a racial separation index greater than the mean.

likelihoods of incomplete families.

I conclude by examining the impact census tract-induced racial separation has on the ability to leave predominantly Black neighborhoods into adulthood. I find that a one percentage point increase in racial separation increases the proportion remaining in a predominantly Black childhood neighborhood into adulthood by 0.044 percentage points. This same increase reduces the proportion of individuals who move from a predominantly Black neighborhood in childhood to a neighborhood of affluence into adulthood by 0.245 percentage points relative to individuals who grew up in more integrated neighborhoods.[6]

Most broadly, this paper contributes to a large literature on the effects of racial or ethnic separation on economic outcomes (e.g., Cutler and Glaeser, 1997; Card et al., 2008; Cutler et al., 2008; Bayer and McMillan, 2012; Owens, 2016; Böhlmark and Willén, 2020). Seminal work by Cutler and Glaeser (1997) provide evidence of significant negative relationships between racial separation and economic outcomes for Black residents, as well as positive impacts for non-Black residents. Using data from the 1940 and 1950 Decennial Censuses, Collins and Margo (2000) find a reversed relationship for Black residents. Edin et al. (2003) and Cutler et al. (2008) empirically demonstrate there exists benefits for immigrants in ethnically concentrated areas. In contrast, my results suggest there are little-to-no benefits to separation for either minority or majority residents. I find there are large negative impacts on economic outcomes for Black residents in heavily racially separated cities, as well as no statistically significant impacts on labor market outcomes and small positive impacts on college-going rates for non-Black residents.

More narrowly focused, this paper contributes to understanding the link between urban racial separation and economic outcomes. The literature often focuses on the ways in which racial separation within schools, or within neighborhoods of limited

[6] A neighborhood of affluence is defined as a census tract in which the poverty rate is less than 10 percent in adulthood.

schooling lead to worse outcomes later in life. The work of Card and Rothstein (2007) and Hanushek et al. (2009) both find that the Black-white test score gap is higher in more racially separated cities and provide evidence that this gap is driven by neighborhood racial separation, rather than separation within schools themselves. Alternatively, Guryan (2004) finds that racial integration plans during the 1970s account for about half of the decline in dropout rates of Black students, and evidence suggests this may be driven through peer effects. Cutler and Glaeser (1997) deviate from this literature by instead focusing on transportation factors and peer influences in more racially separated cities. Additionally, Boustan and Margo (2009) examine whether employment decentralization isolated Black residents from work opportunities through the U.S. Postal Service. Using newly available data from Opportunity Insights, I not only causally test these mechanisms, but include more generally, labor market factors, a more robust channel of peer influences, and consequences for geographic mobility. Overall, my work provides strong empirical evidence of these mechanisms at play in contributing to economic inequality between races.[7]

The rest of this paper is organized as follows: Section 2 describes the data sources and their implementations; Section 3 formally introduces and discusses the measure of racial separation, as well as empirical evidence of a relationship with census tract delineation; Section 4 presents the main results and heterogeneous effects of census tract-induced racial separation. Section 5 explores different mechanism hypotheses and implications; Section 6 concludes.

[7] A recent discussion of these factors contributing to racial inequality is available in the New York Times: https://www.nytimes.com/2020/05/11/opinion/coronavirus-us-cities-inequality.html#click=https://t.co/nHFRil2tZe

2 Data Background and Usage

The datasets used in the analysis include individual data from the Decennial Censuses and American Community Survey (ACS), census tract data from the Longitudinal Tract Data Base (LTDB), and further-detailed census tract data from Opportunity Insights. In this section I describe each dataset and individual sampling criteria in further detail and place them into context of the analysis.

2.1 Decennial Census and American Community Survey Individual Data

Individual data used in the analysis come from the 1980 1% Decennial Census sample, 1990 1% Decennial Census sample, 2000 5% Decennial Census sample, and the 2010 1-year American Community Survey (ACS) sample available through IPUMS (Ruggles et al., 2019). To place my results in context with the literature (e.g., Cutler and Glaeser, 1997; Collins and Margo, 2000; Cutler et al., 2008), I limit my analysis to individuals ages 20 to 30, not incarcerated or institutionalized, exclude those born in a foreign country, and limit to those individuals who list one race or ethnicity: non-Hispanic white, non-Hispanic Black, Hispanic, Asian, and Native American.[8] Additionally, I focus on individuals that list a Metropolitan Statistical Area (MSA) as place of residence. Reasons for such restrictions include that theories of sorting most readily apply to young people in large urban areas, and issues of differential mobility patterns are minimized when focusing on people who have had the least amount of time to choose their place of residence (Cutler and Glaeser, 1997). Bayer et al. (2014) validate this idea empirically by showing the effects of sorting are reduced as individuals age because they become increasingly mobilized in choosing a location to live. The resulting main analysis sample consists of 1,592,503 observations in 1,019 MSAs over 40 years, spanning 1980 to 2010.[9]

[8] Hispanic refers to individuals who identify as Mexican, Puerto Rican, Cuban, or other Hispanic, and excludes those who list their race as white.

[9] All subsequent analyses are limited to these MSAs.

Statistics comparing individual outcomes between whites and Blacks are available in Table B.1.

2.2 Longitudinal Tract Data Base

Census tract-level data come from the Longitudinal Tract Data Base (LTDB) (Logan et al., 2014), and allow researchers to construct a variety of data that stem from full count and sample data in the 1980-2000 Decennial Censuses and the 2008-2012 ACS 5-year data file. These census tract-level data include variables on population, race, income, education, and workforce characteristics. The key advantage in using the LTDB lies in its choice of census tract boundaries. Datasets are available to reflect either longitudinally consistent boundaries fixed to a single point in time, or the use of temporally-dependent census tract boundaries. Additionally, because the data are provided as raw population counts I am able to construct the characteristic of interest through aggregation of count data, rather than weighting proportions to fit within larger levels of aggregation.[10] Using the Historical Delineation Files available from U.S. Census Bureau (2011), I aggregate the detailed raw census tract data up to the MSA in order to construct various city-level characteristics.[11] I merge these MSA-aggregated neighborhood characteristics to the individual data from IPUMS. MSA summary statistics are available in Table B.2.

2.3 Opportunity Insights Data

The last data used in this study come from Opportunity Insights, a collaborative between researchers at the Census Bureau, Harvard University, and Brown

[10]For example, I am able to construct census tract-level proportions using the raw census tract data. I can also aggregate the raw data to higher levels of geography, such as the MSA-level, without having to weight census tract proportions by their population, for instance.

[11]Census tracts are designed to fall entirely within counties, and counties fall entirely within MSA boundaries. Thus, census tracts aggregate nicely within MSAs.

University. The goal of Opportunity Insights focuses on reducing economic inequalities using anonymized tax data on millions of individuals. The data are publicly available at aggregated levels through the Opportunity Atlas and contain more than 7,000 variables.[12] I make use of census tract aggregated data which include variables on local job growth and opportunities by income level, incarceration rates, family completeness, geographic mobility, and intergenerational mobility measured in varying years from 2010-2015. The chosen variables reflect the unconditional mean, pooled by race and gender. It is important to also note that the Opportunity Insights data contain information on children born between 1978 and 1983, and measures outcomes for these individuals into adulthood. My interests in these variables lie within their geographic mobility tracking. With such measures, I estimate the longitudinal effects of racial separation on leaving disadvantaged childhood neighborhoods into adulthood, or moving to neighborhoods of affluence into adulthood.

3 Measuring Racial Separation

U.S. Census Bureau (2010) provides several indices of racial separation that capture to varying degrees evenness, exposure, concentration, and clustering; however, the most widely used measure in the literature is referred to as the Index of Dissimilarity.[13] In this section, I formally define the Index of Dissimilarity, discuss its properties and advantages, as well as empirically demonstrate how census tract delineation is related to urban racial separation. Mathematically, the Index of

[12]Each variable can be selected according to specific race, gender, and percentile rank in the parental national income distribution.

[13]Duncan and Duncan (1955) argued that the Index of Dissimilarity be the standard in measuring racial separation in a city as it largely encapsulates information presented in differing measures of separation. This measure has stood the test of time, and appears throughout recent work (e.g., Chetty and Hendren, 2018; Owens, 2016; Bayer et al., 2014; Ananat, 2011).

Dissimilarity of a particular MSA is defined as:

$$Index\,of\,Dissimilarity_{MSA} = \frac{1}{2}\sum_{i=1}^{N}\left|\frac{Black_i}{Black_{MSA}} - \frac{Non-black_i}{Non-black_{MSA}}\right|, \qquad (1)$$

where $Black_i$ and $Non\text{-}black_i$ are the number of residents in census tract i that are Black and non-Black, respectively. $Black_{MSA}$ and $Non\text{-}black_{MSA}$ are the respective Black and non-Black populations of the Metropolitan Statistical Area, MSA. The index ranges from zero to one, with values closer to one indicating higher levels of racial separation. A key feature of the Index of Dissimilarity is the interpretability of the decimal: this number reflects the proportion of the MSA that would need to relocate to create an equal distribution of racial composition among neighborhoods within the city of interest.[14]

Often measures of racial separation are based upon much smaller levels of analysis, such as the neighborhood, and aggregated to some larger measure, such as the city. The key advantage of such approach is the removal of endogenous sorting of households *within* the city. For example, measures of racial separation at more refined levels of aggregation suffer from Tiebout-like sorting of households. That is, households "vote with their feet" into neighborhoods that align with their preference distribution (Tiebout, 1956), and this influences neighborhood racial composition. Thus, creating one measure that reflects the cumulative unevenness of neighborhoods within a city overcomes the issue of intracity sorting.

I conclude this section by demonstrating that additional census tract delineation, or nested census tracts, are correlated with levels of racial separation across cities.

[14]Stated alternatively, this measure captures the cumulative racial unevenness within each neighborhood of the city.

To illustrate this relationship, I estimate the following regression:

$$Racial\,Separation_{ct} = \alpha_0 + \beta\,nested\,census\,tracts_{ct} + f(population_{ct}) + \epsilon_{ct} \quad (2)$$

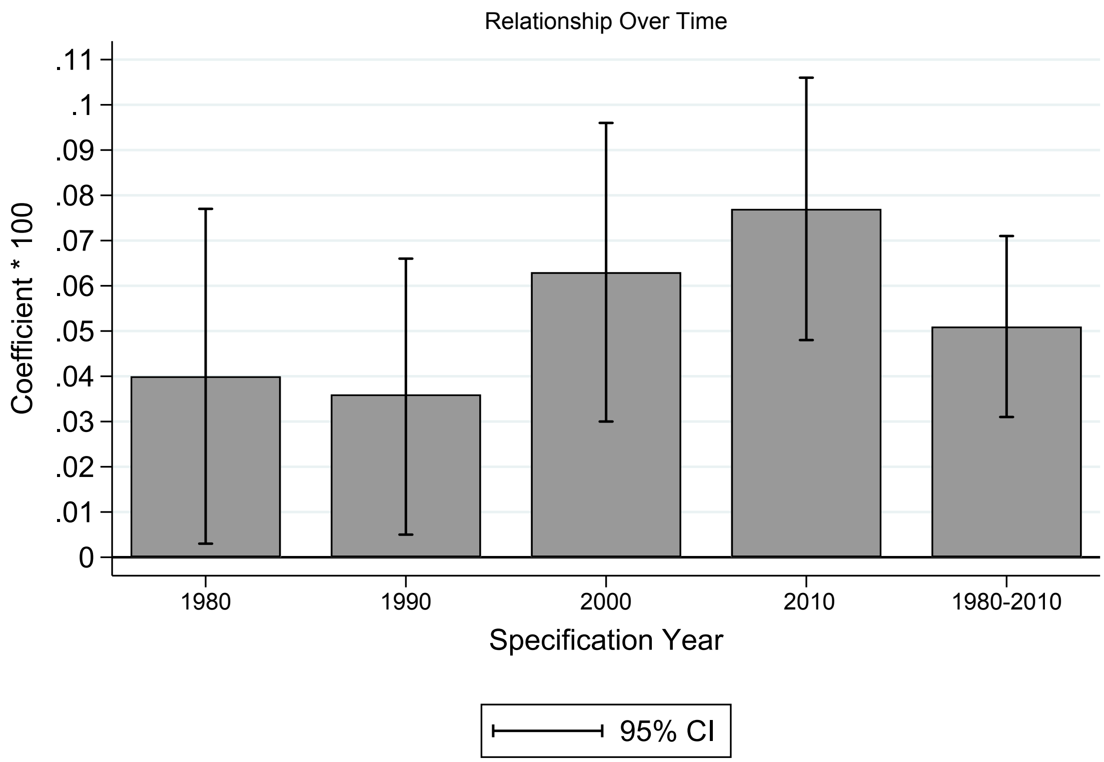
where $Racial\,Separation_{ct}$ is the Index of Dissimilarity for city c at time t, $nested\,census\,tracts_{ct}$ refers to the number of census tracts within city c at time t, $f(\cdot)$ is a quartic function of the population, and ϵ_{ct} is the error term. Standard errors are robust and clustered to the city level. β is the coefficient of interest and is interpreted as the percentage point change in racial separation as a result of an additional census tract, conditional on population counts.

Figure 1 illustrates the coefficient β from Equation 2. Further regression characteristics are presented in Table B.3. Each column is a separate regression of Equation 2 cross sectionally and over time from 1980 to 2010. Over time, the effect size on the correlation between the number of census tracts and levels of racial separation has increased dramatically. The final column of Equation 2 indicates that for each additional census tract over this period there is an average increase in racial separation of 0.051 percentage points.

4 Empirical Analysis: the Effect of Racial Separation

The goal of this section lies in estimating the impacts of census tract-induced racial separation on the economic opportunities one enjoys in life. I begin with a discussion of why the use of ordinary least squares (OLS) estimation is inappropriate for obtaining causal estimates of racial separation. Next, I present an alternative identification method using instrumental variables (IV). I provide a falsification exercise that further tests the accuracy of the instrument. I conclude by replicating, updating, and extending the results found in Cutler and Glaeser (1997).

Figure 1: Nested Census Tracts and Racial Separation



N=1,019 (1980-2010). Each column represents a separate regression estimated from Equation 2. The dependent variable in each specification is the level of racial separation within a city and is defined as the Index of Dissimilarity. The independent variable of interest is the number of census tracts that exist in each specification year. Each specification includes a quartic function in population, and standard errors are corrected for heteroskedasticity. Racial separation mean (1980-2010) = 50.59%

4.1 Discussion

In order to evaluate the impacts of racial separation on Black and non-Black individuals' economic opportunities, I adopt the following general econometric framework:

$$y_{ic} = \alpha + \beta_1 separation_c + \beta_2 black_i \times separation_c + X'_{ic}\beta + \epsilon_{ic} \tag{3}$$

where the dependent variable is the outcome of interest for individual i in city c, *separation* is the measure of racial separation formally defined as the Index of Dissimilarity, and *black* is an indicator that equals one if the individual is Black. The coefficient of interest, β_2, is interpreted as the differential effect of racial separation for Black individuals, relative to non-Black individuals. Some readers may also be interested in the effects of β_1 or $\beta_1 + \beta_2$ which reflect the differential effects of racial separation for non-Blacks, and the total effect of racial separation for Blacks, respectively. In general, two types of issues arise when estimation occurs within this framework. The first is that the level of racial separation in a city may be a function of poor outcomes, or more formally, reverse causality. The second stems from issues of selection bias whereby more and less successful individuals may sort *across* metropolitan areas. Both violate the restrictions necessary for causal inference.

4.2 Identification using Census Tracts

To estimate the causal impacts of racial separation, I require a treatment that randomizes the racial composition of neighborhoods, but is not related to the outcomes one enjoys in life except through its effect on separation. The ideal experiment would randomize individuals' residences at two levels across isolated cities: The first would randomize individuals across cities, and the second would

randomize individuals into neighborhoods. Randomization across cities would provide analysis as to how cumulative racial separation impacts economic opportunities, while the second would allow estimation of local racial composition impacts relative to neighborhoods close by.

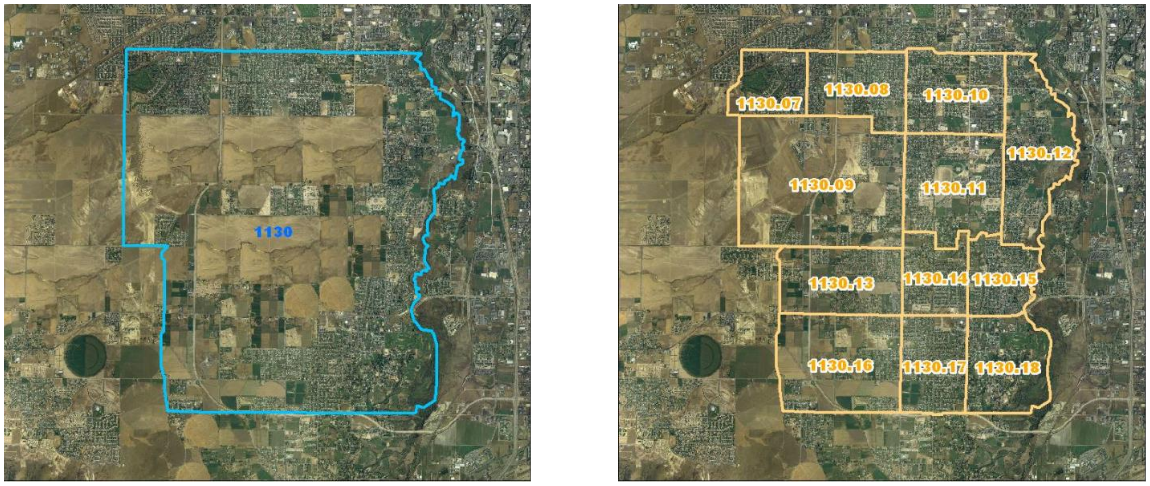
In the absence of such randomization, I rely on a strategy that makes use of plausibly exogenous variation in census tract boundaries for identification. Specifically, I use variation in the number of census tracts, conditional on population characteristics, as an instrument to estimate the impacts of racial separation. The assumption for causal inference using this identification strategy asserts that, conditional on population characteristics, the number of (or change in) census tracts (boundaries) is exogenous. That is, after accounting for population characteristics, there is not some potentially unidentifiable feature correlated with boundary arrangement that would also impact one's economic outcomes.

Before moving to the main estimation of racial separation, I provide a falsification test of the instrument. This exercise is similar to the relationship developed through Equation 2, and illustrated in Figure 1; however, instead of estimating the relationship between the number of census tracts and the level of racial separation constructed using contemporaneous census tract boundaries, I collapse census tracts to their original boundary "envelopes" and calculate the measure of racial separation using these outer shells. Figure 2 enhances the visualization of this exercise. Panel (a) illustrates the original census tract "envelope" and panel (b) shows the resulting census tract boundaries nested within the envelope after the 2000 Decennial Census.

To construct the measure of racial separation holding census tract envelopes fixed to their original boundary delineations, I collapse panel (b) census tract characteristics to their outer envelopes reflected in panel (a). Then, I estimate Equation 2 replacing the dependent variable, $Racial\,Separation_{ct}$, with the measure of racial separation calculated using the collapsed census tract envelopes. The

Figure 2: Census Tract Implementation and Delineation

(a) Original Census Tract "Envelope" (b) Updated Census Tract Delineation

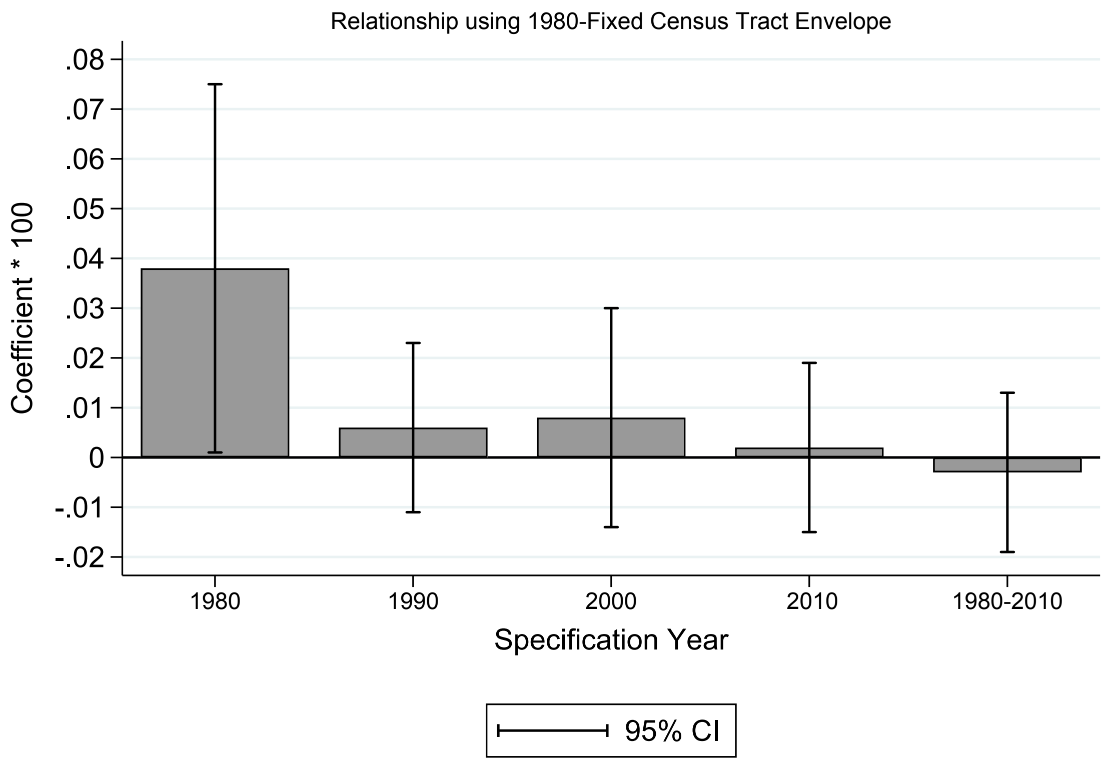


Source: U.S. Census Bureau (2013) This figure shows the evolution of census tract envelope 1130 of Salt Lake County, Utah at two points in time. Panel (a) is the original census tract "envelope" and was established in 1970. Panel (b) shows the updated census tract boundaries resulting from the 2000 Decennial Census.

intuition behind this test is as follows: If additional census tract delineation generates racial separation and the measure of racial separation is calculated using a fixed number of census tract envelopes, then there should be no correlation between the number of contemporaneous census tracts and the envelope-fixed racial separation index over time. Alternatively, if a relationship does exist within this framework, it could be argued that the number of census tracts instead reflect some unobservable characteristic that also induces racial separation, rather than the boundaries themselves.

Figure 3 illustrates the results of this falsification test. Further regression characteristics are presented in Table B.4. In 1980 there exists a positive relationship similar to that found in Figure 1, documenting the relationship between census tracts and racial separation. This makes sense because most census tract envelopes were created in 1980, and thus should be correlated with the level of racial separation if census tracts generate separation; however, beyond this point we

Figure 3: Falsification Test – Relation between Census Tracts and Racial Separation using Fixed Boundaries



N=895 (1980-2010). Each column represents a separate regression. The dependent variable in each specification is the level of racial separation within a city and is defined as the Index of Dissimilarity. This measure is calculated using fixed census tract envelopes that were established in either 1970 or 1980. The independent variable of interest is the number of census tracts that exist in each specification year. The sample includes MSAs that existed in 1980 and could be followed to 2010. Each specification includes a quartic function in population, and standard errors are corrected for heteroskedasticity. Racial separation mean (1980-2010) = 50.59%

would expect to see no relationship as boundaries are collapsed to their original shells while true boundaries evolve beyond this point in time.

4.3 IV Estimation

In the current empirical setting, I exploit variation in neighborhood boundaries to estimate the effect of census tract-induced racial separation on educational, labor market, and social outcomes. I adopt an instrumental variables approach using two-stage least squares (2SLS) where the number of census tracts instruments for cumulative levels of racial separation in a city. More formally, the first-stage of my IV estimation is:

$$s_{ct} = \alpha_0 + \alpha_1 n_{ct} + x'_{ct}\theta + \rho_c + \gamma_t + \nu_{ct}, \tag{4}$$

where the dependent variable s_{ct} is the level of racial separation in city c and year t. The instrument n_{ct} is the number of census tracts in city c and year t.[15] The vector x_{ct} contains city-level control variables, including population, percent Black, percent Hispanic, percent with a high school degree or less, percent manufacturing, unemployment rate, median HH income, percent married, and separation by skill level. ρ and γ are city and time fixed effects, respectively, and ν_{ct} is the error term. Using exogenous variation from the fitted values of Equation 4, second-stage estimation is a variation of Equation 3 correcting for issues of endogeneity:

$$y_{icbt} = \beta_0 + \beta_1 \hat{s}_{ct} + \beta_2 black_{icbt} * \hat{s}_{ct} + x'_{ict}\theta + \eta_c + \phi_b + \pi_t + \epsilon_{icbt}, \tag{5}$$

where y_{icbt} is the outcome of interest for individual i, born in state b, lives in city c, in year t. The remaining variables and fixed effects are analogous to those in

[15] In the resulting empirical analysis, I also use the number of census tracts interacted with the *black* indicator variable. The work of Cutler and Glaeser (1997) follows the strategy of interacting their instrument,as well.

Equation 4 with the inclusion of individual-level controls: age, sex, educational attainment, and birth-state fixed effects. Standard errors are corrected for heteroskedasticity and intra-MSA clustering.

Table 1: IV Estimates of the Effects of Racial Separation on Economic Opportunities

	(1) HS dropout	(2) College graduate	(3) ln(income)	(4) Idle	(5) Single motherhood
Separation	-0.0001	0.0011***	-0.0003	0.0001	0.0002
	(0.0001)	(0.0001)	(0.0004)	(0.0001)	(0.0006)
Black*separation	0.0016***	-0.0060***	-0.0024***	0.0011***	0.0038***
	(0.0001)	(0.0001)	(0.0003)	(0.0001)	(0.0004)
Mean of dep. var.	11.64%	22.24%	$24,997.51	6.24%	31.61%
R^2	0.034	0.127	0.223	0.047	0.1859
N	1592503	1592503	1378543	1305801	123236

The first-stage coefficient from Equation 4 is 0.001 (std. error $<$0.000) and is significant at the 1% level. HS dropout is an indicator variable that equals 1 if the individual completed less than grade 12 in 1980, and in later years equals 1 if the individual completed grade 12, or less, and did not receive a diploma. College graduate is an indicator variable that equals 1 if the individual completed at least 4 years of college in 1980, and in later years equals 1 if the individual has a bachelor's degree or higher. Income is defined as earned income, and is conditional on being in the labor force with nonnegative earnings. Idleness is an indicator variable that equals 1 if the individual is in the labor force, but neither going to school nor employed. Single motherhood is an indicator that equals 1 if the female is not currently married, and has ever had a child in 1980 or 1990. In 2010 single motherhood refers to females who are not currently married and have had a child in the last year. Single motherhood data are not available for 2000. Separation is defined as the Index of Dissimilarity, and the interaction term includes an indicator if the individual is Black. Individual controls include sex, age, and educational attainment. City-level controls include population, percent Black and its interaction, percent Hispanic, percent with a high school degree or less, percent manufacturing and its interaction, unemployment rate, median HH income, percent married, segregation by skill level, birth place state FE, and year and region FE. Standard errors are corrected for heteroskedasticity and intra-MSA clustering.

Coefficients statistically significant at ***1%, **5%, and *10% levels.

Table 1 presents the results of estimating Equation 5 in the spirit of Cutler and Glaeser (1997). Appendix Table B.5 presents OLS estimation results. In terms of educational attainment, a one percentage point increase in racial separation reduces the probabilities of a Black individual completing high school or college by 0.16 and 0.60 percentage points, respectively. Further, after accounting for differences in education, and conditional on being employed, a one percentage point increase in racial separation reduces a Black individual's annual earnings by 0.24 percent, and

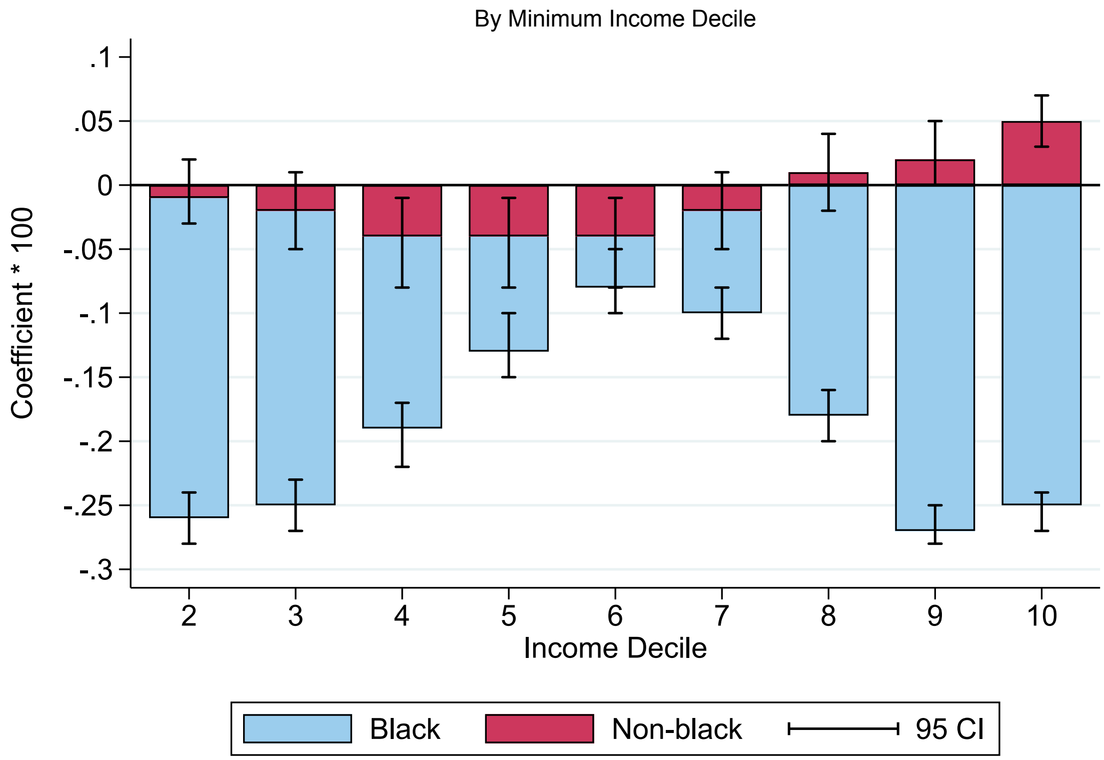
increases the probability of idleness in the labor market by 0.11 percentage points compared to non-Black individuals. Lastly, Column (5) suggests racial separation increases the probability of single motherhood for Black females relative to non-Black females. In the context of Cutler and Glaeser (1997), I find that the effects of racial separation for non-Black individuals become largely insignificant after accounting for issues of endogeneity. Given the average difference between high and low racially separated cities in 2010 was 20.3 percentage points, these estimates indicate large reductions in economic opportunities for Black residents, and little to no benefit of racial separation for non-Black residents.

4.4 Heterogeneous Effects

Previous work has been limited in answering questions of heterogeneous impacts – Are negative impacts of racial separation driven by concentrated declines in outcomes for the worst-off individuals, or do these effects remain as we move across outcome distributions? In order to answer questions of this type, I estimate regressions separating income and education according to various thresholds. I begin by estimating Equation 5 where the dependent variable is replaced as a series of increasing income decile thresholds within the national income distribution for individuals ages 20 to 30.

Figure 4 illustrates the results of this first heterogeneity exercise. Each column is a separate regression where the dependent variable is an indicator for being in at least the specified income decile along the x-axis. Coefficients are multiplied by 100 so that effect sizes have an interpretation of hundredths of a percentage point. The figure suggests that not only does racial separation reduce the likelihoods a Black young person reaches the highest income decile, but the estimate in column 1 suggests a one percentage point increase in racial separation reduces the probability a Black individual moves beyond the first income decile by 0.26 percentage points

Figure 4: Effect of Racial Separation on the Probability of Moving Up the Income Distribution



N=1,591,735. Each column is a separate regression where the dependent variable is an indicator for at being in at least the specified income decile along the x-axis. Estimates indicate the percentage point change in the probability of reaching at least the specified decile in the income distribution among those ages 20-30. Regressions include all controls specified in Equation 5. Standard errors are corrected for heteroskedasticity and intra-MSA clustering.

relative to a non-Black individual. Further, a one percentage point increase in racial separation reduces the probability a Black young person (ages 20-30) earns more than the median income earner in the national income distribution by 0.12 percentage points. These negative impacts illustrate the significant inequalities Black residents face in the labor market at a result of increased separation by race, relative to non-Black individuals.

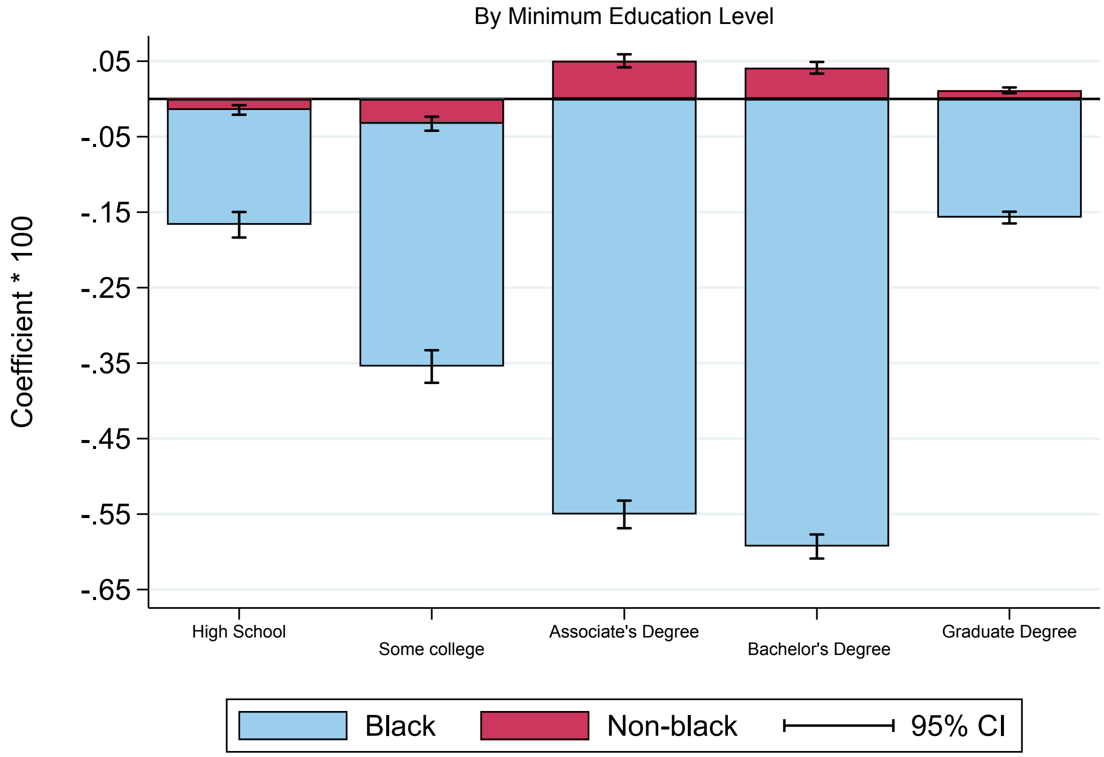
To disaggregate the effects of racial separation by skill level, I examine impacts on differing levels of educational attainment. Specifically, I estimate versions of Equation 5 where the dependent variable is an indicator if the individual has reached at least the specified level of education: high school graduate, some college, associate's degree, bachelor's degree, and graduate degree.

Figure 5 presents the impacts of racial separation on increasing levels of educational attainment. While the effects of racial separation not only impact the probability that Black individuals complete some college, these negative impacts remain even for those who go on to receive graduate education – likely two distinct groups in terms of underlying abilities. To summarize the total effect across the skills distribution, at the lowest levels of educational attainment, separation by race is harmful regardless of race. At higher levels of attainment, results suggest racial separation reduces the likelihood of Black individuals becoming more skilled – negative estimates are an order of magnitude larger in absolute value for Black students compared to non-Black students.

5 Mechanism Analysis of Tract-Induced Racial Separation

The goal of this section is to consider potential causes and consequences of census tract-induced racial separation. To explore mechanisms behind the negative impacts Black residents face, I focus on two hypotheses: The first tests for weakened labor market attachment among Black residents. The second hypothesis tests that

Figure 5: Effect of Racial Separation on the Probability of Completing School



N=1,592,503. Each column is a separate regression and estimates the percentage point change in the probability of completing at least that level of education. Regressions include all controls specified in Equation 5. Standard errors are corrected for heteroskedasticity and intra-MSA clustering. In 1980: high school is defined as having completed grade 12; some college is defined as having completed one year of post-secondary education; associate's degree is defined as having completed two years of college; bachelor's degree is defined as completing four years of college; graduate degree is defined as 6 years of college.

Blacks have worse outcomes in more racially separated neighborhoods because they have less contact with positive peer influences. I conclude by examining the impact census tract-induced racial separation has on the ability to leave predominantly Black neighborhoods into adulthood.

I begin by estimating a variant of Equation 5 where the unit of analysis is the neighborhood rather than the individual. More formally, I adopt the following

econometric framework:

$$y_{nc} = \gamma_0 + \gamma_1 \hat{s}_c + \gamma_2 black_{nc} * \hat{s}_c + x_c^{'}\theta + \epsilon_{nc} \quad (6)$$

where the dependent variable y_{nc} is the outcome of interest for neighborhood n in city c, $\hat{s}_c$ is the fitted value of racial separation estimated from Equation 4 in city c, $black_{nc}$ is an indicator variable that is used within two specifications: the first equals 1 if neighborhood n is "predominantly" Black reflecting a Black resident proportion of 75 percent or greater. The second specification defines $black_{nc}$ equal to 1 if the neighborhood is "heavily" Black, or at least 90 percent Black. My IV estimation strategy is now estimating the impact of cumulative racial separation in predominantly Black neighborhoods, relative to less-Black neighborhoods. Standard errors are corrected for heteroskedasticity and intra-MSA clustering. A majority of the dependent variables in this analysis come from newly available Opportunity Insights data and are available on a cross-sectional basis, and thus, my analysis is limited to cross-sectional evidence.

To evaluate labor market attachment for Black individuals, I examine whether there are fewer local job opportunities for Black residents relative to those who live in less-Black neighborhoods. Local job opportunities consist of those falling within 5 miles of the neighborhood of interest. I restrict this measure further to consider only high paying local job opportunities, defined as local jobs with monthly earnings of at least $3,333 (2010 dollars). Lastly, I consider whether Black individuals face increased costs of getting to their jobs, conditional on being employed, as a result of increased separation.

Table 2 presents the first set of results in testing for weakened labor market attachment among predominantly Black neighborhoods. Panel (a) refers to neighborhoods with a Black residency of at least 75 %, while panel (b) re-estimates

Table 2: Separation and Job Availability in Predominantly Black Neighborhoods

Panel (a): Predominantly Black neighborhoods

	(1) # of jobs	(2) # of high paying jobs	(3) Annual job growth
Separation	104.3951***	138.0593**	-0.0004***
	(39.3711)	(67.7192)	(0.0000>)
≥75% Black*separation	-1728.3485***	-1493.4829***	0.0005***
	(553.4968)	(341.7891)	(0.0002)
Mean of dep. var.	138,514.6	71,646.09	1.65%
R^2	0.255	0.216	0.020
N	50211	50211	49789

Panel (b): Heavily Black neighborhoods

	(4) # of jobs	(5) # of high paying jobs	(6) Annual job growth
Separation	171.8717***	102.4362***	-0.0004***
	(63.7431)	(36.8704)	(0.0000>)
≥90% Black*separation	-3964.8218***	-2592.5179***	0.0005
	(700.1144)	(439.3370)	(0.0003)
R^2	0.255	0.216	0.019
N	50211	50211	49789

Estimates use only the most recent data in the analysis, 2010. Neighborhood-level jobs data come from Opportunity Insights. The variable # of jobs refers to the total number of jobs in own and neighboring tracts whose centroids fall within a 5 mile radius from own tract centroid in 2015. The variable # of high paying jobs restricts # of jobs to those with earnings greater than $3,333 per month in 2015. Annual job growth refers to the average annualized job growth rate over the time period 2004 to 2013. Separation is defined as the Index of Dissimilarity in 2010, and the interaction term includes an indicator if the neighborhood is greater than or equal to 75% and 90% in the respective panels. 2010 city-level controls include population, percent Black and its interaction term, percent Hispanic, percent with high school degree or less, percent in manufacturing and its interaction, unemployment rate, median HH income, percent married, and separation by skill level. Standard errors are corrected for heteroskedasticity and intra-MSA clustering.

Coefficients statistically significant at ***1%, **5%, and *10% levels.

Equation 6 using increased requirements on neighborhood characterization.[16] Taken together, columns (1) and (2) indicate that not only are there fewer *high paying* local job opportunities in predominantly Black neighborhoods, but fewer job opportunities in general. Put into perspective, an individual moving from a city of low separation into a predominantly Black neighborhood in a city of high racial separation can expect about a 25 percent reduction in local job opportunities, on average.[17] While Panel (a) suggests some evidence of increased job growth in predominantly Black neighborhoods, these estimates become insignificant when focusing on heavily Black neighborhoods.

Table 3 is estimated from Equation 5 and includes the sample of individuals who are employed and not working from home. Results reinforce the evidence found in Table 2 that fewer local job opportunities result in increased commuting costs. Black residents face significantly longer travel times to work, and are more likely to rely on public transportation as a result of increased racial separation, relative to non-Black individuals. These negative impacts are further reflected in the reduction in the usual hours worked per week for Black individuals, even after accounting for experience and education factors. To summarize Tables 2 and 3, my evidence suggests that racial separation reduces labor market attachment by placing fewer jobs in predominantly Black communities and forcing Black residents to more heavily rely on public transportation to commute to further away jobs.

To evaluate peer influences for Black individuals, I examine whether predominantly Black neighborhoods have differential likelihoods of interacting with educated individuals, relative to less Black-neighborhoods. I restrict this measure further to consider the likelihood of interacting with *Black* educated individuals in predominantly Black neighborhoods. Lastly, I examine whether predominantly

[16] About five percent of the sample falls with the category of a "heavily" Black neighborhood.

[17] High racial separation refers to a city with an Index of Dissimilarity above the mean. The average difference between cities of high racial separation and low separation in 2010 was 20.3 percentage points. This reduction is based on an average number of local job opportunities found in Table 2.

Table 3: Separation and Individual Transportation Factors

	(1) Hours worked/week	(2) Travel time	(3) Motor vehicle	(4) Public transit
Separation	-0.0078***	-0.0219***	0.0015***	-0.0013***
	(0.0015)	(0.0026)	(0.0000>)	(0.0000>)
Black*separation	-0.0471***	0.2293***	-0.0041***	0.0049***
	(0.0039)	(0.0081)	(0.0001)	(0.0001)
Mean of dep. var.	39.93 hours	21.91 minutes	88.18%	6.04%
R^2	0.075	0.081	0.094	0.127
N	968424	968424	952705	952705

Estimates use the full panel of data from 1980 to 2010 and are estimated from Equation 5. Hours worked/week is defined as the usual hours worked per week in the previous year. Travel time is defined as the usual number of minutes it took to get from home to work last week, and is topcoded at 120 minutes. Individuals that recorded times greater than the top code were given the state average travel time for those greater than 120 minutes. Motor vehicle is an indicator that equals 1 if the means of transportation to work is a non-public auto vehicle, truck, van, or motorcycle. Public transit is an indicator that equals 1 if the means of transportation to work is public transportation including bus, streetcar, trolley bus/car, subway/elevated, railroad, taxicab, or ferryboat. All estimates are conditional on being in the labor force, not in school, and columns (3) and (4) are also conditional on not working at home. Separation is defined as the Index of Dissimilarity, and the interaction term includes an indicator if the individual is Black. Individual controls include sex, age, educational attainment., and birth state fixed effects. City-level controls include population, percent Black and its interaction, percent Hispanic, percent with a high school degree or less, percent manufacturing and its interaction, unemployment rate, median HH income, percent married, separation by skill level, and year and region FE. Standard errors are corrected for heteroskedasticity and intra-MSA clustering.

Coefficients statistically significant at ***1%, **5%, and *10% levels.

Black neighborhoods are less likely to have complete families and more individuals incarcerated as a result of increased separation.

Before discussing the results of the peer influences hypothesis, I formally construct the measure of interaction among neighborhood groups.[18] This measure is fully developed in U.S. Census Bureau (2010) and is defined as:

$$Education\,Exposure\,Index_n = \sum_{n=1}^{N} \left(\frac{Black_n}{Black_{MSA}}\right) * \left(\frac{Educ_n}{Pop_n}\right) - \left(\frac{Educ_{MSA}}{Pop_{MSA}}\right) \quad (7)$$

where the first term is the proportion of Black residents in neighborhood n relative to the total MSA, the second is the proportion of college educated individuals in neighborhood n, and the final term is the proportion of college educated individuals in the MSA as a whole. The product of the first two captures the probability that Black and college educated individuals interact within neighborhood n, while the subtraction of the MSA proportion of college educated individuals removes differences in general education levels across MSAs. An index greater than zero indicates that Blacks differentially live in neighborhoods with high levels of college educated individuals, while a negative index indicates that Blacks differentially live in neighborhoods with less educated people. The average Education Exposure Index constructed from Equation 7 is -19.75 indicating that Black individuals differentially live in neighborhoods with fewer educated individuals.

The results in Table 4 are used to evaluate the peer influences hypothesis. Column (1) reflects a more general version of the Education Exposure Index found in Equation 7. This measure removes the first term in Equation 7, and reflects the differential proportion of college educated living in neighborhood n. Column (2) reflects the index found in Equation 7. Together, columns (1) and (2) indicate that not only are predominantly Black neighborhoods less likely to have educated individuals, but increased racial separation reduces the likelihood of interaction

[18] A similar measure is found in Cutler and Glaeser (1997).

Table 4: Separation and Peer Influences in Predominantly Black Neighborhoods

Panel (a): Predominantly Black neighborhoods

	(1) Ed. exposure	(2) Weighted ed. exposure	(3) Father present	(4) Incarcerated
Separation	0.0257***	-0.0708***	0.0382***	-0.0076***
	(0.0061)	(0.0010)	(0.0053)	(0.0008)
≥75% Black*separation	-0.1661***	-0.0258***	-0.3166***	-0.0010
	(0.0131)	(0.0017)	(0.0169)	(0.0031)
Mean of dep. var.	0.02	-19.75	77.86 %	1.57 %
R^2	0.053	0.863	0.377	0.261
N	49840	49840	49577	49511

Panel (b): Heavily Black neighborhoods

	(5) Ed. exposure	(6) Weighted ed. exposure	(7) Father present	(8) Incarcerated
Separation	0.0206***	-0.0717***	0.0175***	-0.0061***
	(0.0061)	(0.0010)	(0.0059)	(0.0008)
≥90% Black*separation	-0.2256***	-0.0266***	-0.3508***	0.0082
	(0.0192)	(0.0024)	(0.0254)	(0.0051)
R^2	0.034	0.863	0.271	0.181
N	49840	49840	49577	49511

Estimates use only the most recent data in the analysis, 2010. Neighborhood-level peer effects data come from Opportunity Insights. Ed. exposure is a demeaned index measure of interaction. A positive Ed. exposure refers to a neighborhood that has a higher than average percent of college educated. Weighted ed. exposure is demeaned and weighted by the Black population in a given neighborhood relative to the entire city. A positive weighted ed. exposure indicates a neighborhood where Blacks differentially live in a more educated neighborhood. Father present refers to the percent of children who have a male claimer. Incarcerated refers to the percent in a federal detention center, federal prison, state prison, local jail, residential correctional facility, military jail, or juvenile correctional facility. Separation is defined as the Index of Dissimilarity in 2010, and the interaction term includes an indicator if the neighborhood is greater than or equal to 75% and 90% in the respective panels. 2010 city-level controls include population, percent Black and its interaction term, percent Hispanic, percent with high school degree or less, percent in manufacturing and its interaction, unemployment rate, median HH income, percent married, and separation by skill level. Standard errors are corrected for heteroskedasticity and intra-MSA clustering.

Coefficients statistically significant at ***1%, **5%, and *10% levels.

between Black and college educated individuals. Further, increased racial separation in predominantly Black neighborhoods largely impacts the proportion of households with a father present – a one percentage point increase in racial separation reduces the proportion of complete families in predominantly Black neighborhoods by 0.32 percentage points, relative to less-Black neighborhoods.

To conclude this section, I estimate the impacts that census tract-induced racial separation has on both economic and geographic mobilities. Opportunity Insights provides data on the proportions of children born between 1978 and 1983 who remain in one of their childhood neighborhoods into adulthood. Additionally, they provide proportions who leave one of their childhood neighborhoods in exchange for a neighborhood with a poverty rate of less than 10 percent into adulthood. I apply my IV strategy using 1980 census tract-induced variation to measure the effects of 1980 racial separation levels on these longitudinal geographic mobility variables, after accounting for present day levels of separation. Lastly, I estimate the impacts that census tract-induced racial separation has on the probability of a predominantly Black neighborhood generating economic mobility to the top of the national income distribution.

Table 5 presents the results of childhood census tract-induced racial separation on economic and geographic mobilities in predominantly Black neighborhoods. Appendix Table B.6 presents these results for heavily Black neighborhoods. A one percentage point increase in childhood racial separation increases the proportion remaining in a predominantly Black childhood neighborhood into adulthood by 0.044 percentage points, relative to less-Black childhood neighborhoods. Additionally, childhood racial separation reduces the proportion growing up in predominantly Black childhood neighborhood that move into neighborhoods of affluence in adulthood. Columns (3) and (4) further verify the relationship found in Figure 4, depicting the heterogeneous impacts of advancing up the income

Table 5: Separation and Geographic and Economic Mobility in Predominantly Black Neighborhoods

	Geographic Mobility		Economic Mobility	
	(1) % remaining in childhood census tract into adulthood	(2) % that move into affluent neighborhood in adulthood	(3) Probability of reaching top 1% of income earners	(4) Probability of reaching top 20% of income earners
Separation	-0.0199	0.0773	0.0258***	0.3408***
	(0.0183)	(0.0583)	(0.0051)	(0.0264)
≥75% Black*separation	0.0438**	-0.2445***	-0.0367***	-0.2164***
	(0.0204)	(0.0236)	(0.0018)	(0.0119)
Mean of dep. Var.	19.36%	49.16%	1.16%	21.04%
R^2	0.156	0.257	0.064	0.194
N	45368	45368	45379	45379

Census tract-level data come from Opportunity Insights, and consist of data collected for individuals born between 1978-1983. In columns (1) and (2), childhood refers to individuals up to age 23. Since columns (1) and (2) refer to data based upon childhood census tracts, estimates are calculated using 1980 racial separation levels with the number of 1980 census tracts as the instrument, 1980 controls, and present day levels of separation. Columns (3) and (4) refer to the estimated probability of an individual in a given tract reaching the respective percentile of the national income distribution (among children born in the same cohort) in 2014-2015. Columns (3) and (4) are estimated using 2010 racial separation levels, census tract count, and controls. Separation is defined as the Index of Dissimilarity, and the interaction term includes an indicator if the neighborhood is greater than or equal to 75% Black. City-level controls include population, percent Black and its interaction term, percent Hispanic, percent with high school degree or less, percent in manufacturing and its interaction, unemployment rate, median HH income, percent married, and segregation by skill level. Standard errors are corrected for heteroskedasticity and intra-MSA clustering.

Coefficients statistically significant at ***1%, **5%, and *10% levels.

distribution. Both columns indicate that census tract-induced racial separation in predominantly Black neighborhoods reduces the probability of the neighborhood serving as an engine to drive economic mobility.

6 Conclusion

While the United States is the most diverse it's ever been, urban America continues to be racially and economically divided. A longstanding literature has attributed economic disparities between races to this urban racial inequality; however, less focus has been placed on the link through which racial separation impacts economic opportunities for minority residents, and whether these effects impact minorities differentially.

This paper makes several contributions to this literature. First, by leveraging variation in census tract boundaries from the 1980 to 2010 Decennial Census boundary updates, I estimate heterogeneous impacts of urban racial separation on several economic outcomes of interest. Second, using this variation in census tract delineation paired with detailed neighborhood data through Opportunity Insights, I push two hypotheses further in explaining the negative impacts that minority residents face through increased racial separation. Lastly, I document the impact that racial separation has on geographic and economic mobilities for individuals growing up in predominantly black neighborhoods.

My first key set of results suggest that the negative impacts of racial separation are not driven by effects concentrated among the worst-off individuals, instead these impacts remain across both the income and skills distributions. Potential channels for the resulting negative relationships include reduced labor market attachment for Black individuals, as well as reduced positive peer influences in predominantly Black neighborhoods. Results suggest that not only are there fewer job opportunities in these neighborhoods, but that Black residents rely more heavily on public

transportation to commute to further away jobs, as a result of increased racial separation. Lastly, I empirically demonstrate that increased racial separation in predominantly Black neighborhoods reduces the probability of the neighborhood serving as a driver of economic mobility into adulthood.

To my knowledge, this is the first paper to use census tract boundaries in measuring urban racial separation. Several related papers have used historical and geographic features as instruments to measure how neighborhood racial composition affects outcomes of interest, and this work contributes a new identification approach that can be applied both spatially and temporally. Future work should consider alternative impacts of census tract-induced racial separation, and ultimately how census tract delineation may play a role in shaping neighborhood dynamics.

Chapter 3

THE LANDSCAPE OF HIGHER EDUCATION ENROLLMENT: EVIDENCE FROM THE EXPANSION OF THE FOR-PROFIT SECTOR

1 Introduction

Every year the federal government spends billions of dollars financing higher education. In the 2014-2015 school year alone, the federal government subsidized over $30 billion to degree granting 4-year institutions Goodwin et al. (2015). These programs, the largest being the Pell Grant program, are targeted at students who are faced with borrowing constraints and would otherwise be unlikely to attend an institution of higher education at all in the absence of financial assistance. The goal of these higher education government programs is to not only encourage students to enroll in higher education, but for these students to complete a degree in higher education. In the early 2000s, the expansion of for-profit sector of higher education attracted many of these marginal students induced to enroll by these subsidies. The subsidization of higher education appears efficient in the sense that costs of attending appear small relative to the returns to college; however, this is based on average returns to a higher education degree. Deming et al. (2016) and Cellini and Turner (2019) provide evidence suggesting there may be large penalties for attending a for-profit institution of higher education. Thus, institutional quality may play a large role in determining just how large the labor market returns to

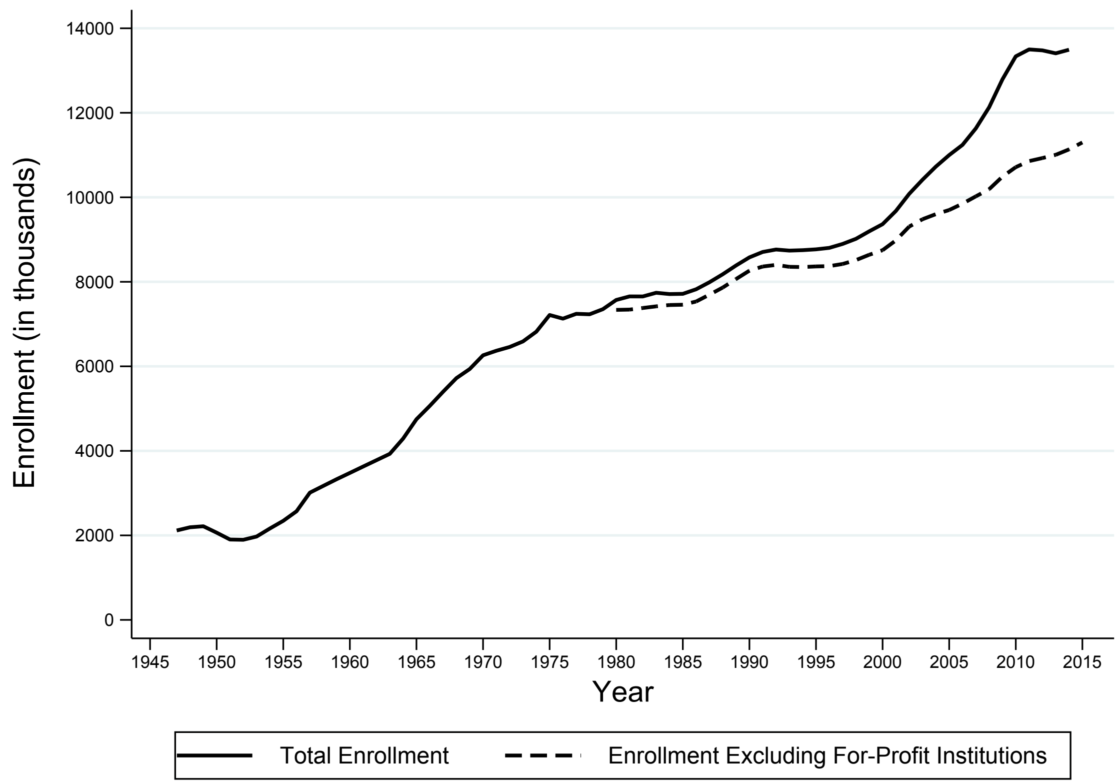
higher education really are. Furthermore, many of these marginal students are failing to graduate creating inefficiencies in the subsidization of higher education.

This paper documents the changing landscape of enrollment and graduation rates throughout the distribution of institution quality from 2001 to 2011. Because there were large increases within the for-profit sector over this period (illustrated in Figure 1), it can be difficult to capture individual schools that were opened between 2001 and 2011 and provide a consistent quality ranking of higher education. My unique approach accounts for schools that did not exist prior to 2001 by grouping institutions into specific ventiles of the quality distribution rather than assessing individual institutions themselves.[1] This allows me to capture recently opened institutions as well as a consistent landscape of institution quality. I conclude by decomposing aggregate graduation rates across various portions of the institution quality distribution. This exercise captures how the changing enrollment landscape across higher education contributed to changes in aggregate graduation rates.

Numerous studies have examined the impact of financial aid on student outcomes (e.g., Angrist et al. (2017); Denning et al. (2019); Dynarski (2003)). Most of these studies rely on an experimental design or exploit a change in policy in order to evaluate the causal effect of financial aid on attainment and earnings. For example, Angrist et al. (2017) find that randomly-selected scholarship winners were 13 percentage points more likely to be enrolled in college four years after award receipt. Furthermore, enrollment effects were larger for groups with historically low college attendance. In terms of completions, Angrist et al. (2017) find that scholarship receipt is likely to increase bachelor's degree completion within five years. Additionally, Denning et al. (2019) show that grant aid targeting disadvantaged students, who attend public universities in Texas generates significant attainment and earnings gains. The authors further show that tax receipts from these future

[1] The institution quality measure is constructed from early career returns of the institution.

Figure 1: Total Higher Education Enrollment: 1947-2015



Time period is from 1947-2015. The solid line indicates enrollment in primarily baccalaureate and above granting institutions including both for-profit and not-for-profit institutions. The dashed line indicates enrollment in primarily baccalaureate and above granting institutions excluding for-profit institutions. Data are from the National Center for Education Statistics (NCES) and Integrated Postsecondary Education Data System (IPEDS). (accessed December 4, 2016).

higher-wage earners are sufficiently large that the government should fully recover its financial investment in ten years.

Current research is less extensive in providing the "big picture" in higher education enrollment and completion. That is, while much of the previous literature estimates the impact of financial aid on enrollment and completion, these studies are often restricted to individuals within a particular type or group of institutions. In this research, I provide the changing landscape of enrollment and completions over the rapid expansion of the for-profit sector in higher education. I am able to capture almost 90 percent of 4-year, primarily bachelor degree granting institutions. Specifically, I construct a measure of quality using the median early-career wage for graduates from each institution and examine how enrollments and graduation rates have evolved over this period. Furthermore, using a shift-share decomposition analysis, I am examine how the changing landscape of enrollment in higher education has contributed to the change in aggregate U.S. graduation rates. Overall, I find that in the lowest quality institutions, enrollment grew by over 100 percent from 2001 to 2011, also where graduation rates have fallen almost five percentage points. Additionally, in the lowest quartile of institution quality, 74 percent of the decline in graduation rates is due to the changing enrollment composition across the distribution over this period.

The rest of this paper is organized as follows: Section 2 presents a brief overview of the literature as it relates to enrollment and graduation rates in higher education. Section 3 highlights the data and empirical strategy used in my descriptive analysis. Section 4 illustrates the landscape of higher education as well as the decomposition analysis surrounding aggregate graduation rates. Section 5 concludes.

2 Related Literature

Morey (2004) argues that there were two main contributors to the rapid rise of

the for-profit sector of higher education in the early 21st century. She explains how the globalization of economic, cultural, political, and intellectual institutions, and the increasing interdependence of nations overhauled the landscape of higher education. Globalization coupled with the revolution in technological change only accelerated this change in the rise of the for-profit sector. Specifically, as globalization occurred there was increased demand for accessible and career-oriented adult education at the postsecondary level to fill the needs of corporations as they expanded to international markets. She also notes how attractive for-profit higher education is. That is, many of their degree granting programs are offered online and have freed education from being time and place bound. Furthermore, Morey (2004) explains how many who attend for-profit higher education realize they are not receiving a degree from a "brand name" institution, and that this fact is overlooked in order to fulfill the degree requirements for a career objective. Lastly, Morey (2004) research documents how the for-profit sector is able to respond to changing consumer demands in terms of level of degrees offered, accessibility through distance education, and the award of credit for life experiences to speed up the time to completion.

Webber and Ehrenberg (2010) document how the impact of decreased median instructional spending relative to other categories of expenditures (research, public service, academic support, etc.) has affected graduation and persistence in American higher education. Using institutional level panel data, the authors find that several categories other than instructional spending affect student outcomes, but this effect varies by socioeconomic background and the average test scores of the students at that institution. Specifically, their analysis shows that the marginal effect of increasing student service expenditures by $100 per student increases graduation rates by 0.6 percentage points for institutions with initial graduation rates lower than 50 percent. In terms of instructional expenditures, a $100 increase

per student results in only a 0.2 percentage point increase. Webber and Ehrenberg (2010) conclude by arguing that the reallocation of $100 per student from instructional expenditures to student service expenditures would increase the institution graduation rate by more than 0.5 percentage points for institutions in the lowest 20 percent of the distribution in terms of graduation rates.

Chung (2012) investigates whether students self-select into the U.S. for-profit higher education, whether the choice is accidental, or due to reasons external (geographic exposure, tuition pricing, etc.) to the student. Using the National Educational Longitudinal Study of 1988 as her primary data source, Chung (2012) finds that students do, in fact, self-select into for-profit higher education and that the choice of for-profit higher education is affected by community college tuition and the exposure to for-profit institutions within the county. She also finds that the probability of a student choosing a for-profit college is heavily influenced by the student's socioeconomic background and parental involvement in the student's schooling. Overall, the analysis of Chung (2012) includes a rich set of covariates that indicates it's the most disadvantaged students, in terms of non-cognitive skills, lower parental involvement, and lower family resources, that are self-selecting into these for-profit institutions of higher education.

3 Data Background and Empirical Design

3.1 Data

The data used in this analysis come from three sources. The primary source is the Integrated Postsecondary Education Data System (IPEDS). The IPEDS is the National Center for Education Statistics' (NCES) core postsecondary education data collection program. It's designed to house information on all institutions that participate in Title IV federal student aid programs. The sample consists of U.S. public, private not-for-profit, and private for-profit 4-year or above institutions with

a degree granting status of primarily baccalaureate or above. Variables from IPEDS on these institutions consist of enrollment and graduation rates within 6-years of degree start. Graduation rates are selected to reflect the enrollment cohort of the respective year. As Figure 1 illustrates a dramatic increase in for-profit enrollment starting at 2001, this is the base year of the analysis. IPEDS has provisional data available for graduates from the 2016-2017 academic year reflecting the most recent 6-year graduation rates for the 2011 cohort. Thus, the 2001 and 2011 enrollment cohorts for institutions are used in this study.

The two other sources of data are used to construct the measure of institution quality. My primary source of wage data come from data used in Chetty et al. (2017) available from Opportunity Insights[2]. In this data, median individual earnings in 2014 are available at the institution level for individuals who attended college between ages 19 to 22 in the mid 2000s. While this data captures a majority of the institutions used in the analysis, I also use wage data from the U.S. Department of Education's College Scorecard[3] to expand the sample size. College Scorecard collects median wage information for graduates of the institution who entered 10 years prior. So, the data currently available through College Scorecard reflect median wages of the 2006 cohort by institution. Comparisons between Opportunity Insights and College Scorecard were done to ensure within institution median wages were similar.

Table 1 provides institution descriptive statistics. The total sample consists of 2,096 institutions[4].The growth in public and private, not-for-profit (NFP henceforth) institutions is minimal in comparison to the growth in private, for-profit (FP henceforth) institutions from 2001 to 2011 with growth of these types of institutions being just over 70 percent. Observe that in 2001 average undergraduate enrollment in NFP institutions was larger than that of FP institutions. In 2011, not

[2]https://opportunityinsights.org/data/

[3]collegescorecard.ed.gov

[4]Military institutions were removed from the analysis due to the Iraq War beginning in 2003. They include: U.S. Airforce Academy, U.S. Coast Guard Academy, U.S. Merchant Marine Academy, U.S. Military Academy, and U.S. Naval Academy.

Table 1: Institution Descriptive Statistics

N=2096	2001	2011
Public, 4-year+	N=553	N=562
% missing wage data		0
Average undergraduate enrollment	8795	10357
Growth of institution type (%)		1.6
Share of type	30.3	28
Private, not-for-profit, 4-year+	N=1124	N=1198
% missing wage data		10.5
Average undergraduate enrollment	1867	2130
Growth of institution type (%)		6.6
Share of type	61.6	59.6
Private, for-profit, 4-year+	N=147	N=250
% missing wage data		4.8
Average undergraduate enrollment	1247	3112
Growth of institution type (%)		70.1
Share of type	8.1	12.5

% missing wage data refers to the percent of institutions within each type for which median early career earnings for graduates was unable to be recorded. Average undergraduate enrollment refers to the average number of undergraduate students that attend that type of institution.Growth of institution type refers to the growth in the number of institutions reported from 2001 to 2011. Share of type refers to the proportion of the specified type relative to the whole sample.

only did the growth of FP institutions outpace those of NFPs, but the average undergraduate enrollment at FP institutions also increased to over 3,000 students per institution compared to just over 2,000 students in NFP institutions. Lastly, observe the percent missing median wage information. With such complete information, I am able to construct a comprehensive picture of enrollment and completions in 4-year or above institutions with a degree granting status of primarily baccalaureate or above.

3.2 Empirical Methodology

In this analysis, I start by creating a measure of institution quality based on the median early-career wage for graduates from each institution. Each institution is grouped into a ventile according to its median wage. Thus, each bin represents five percent of the quality distribution. With bins on the left side of the scale representing the lowest quality institutions, or those institutions with the lowest median wages, and the bins on the right side of the scale representing the highest quality institutions, or those with the highest median wages. For example, the 5th ventile represents schools in the 20th to 25th percentiles, the 10th ventile representing those in the 45th to 50th percentiles, the 15th ventile representing the 70th to 75th percentiles, and the 20th ventile representing institutions in the 95th to 100th percentile of the median wage distribution.

To capture the change in enrollment from 2001 to 2011, I employ the following empirical strategy:

$$\%\, change\, in\, enrollment\, for\, ventile\, j = \frac{\sum_{i=1}^{k} enrollment_i^{2011} - \sum_{i=1}^{k} enrollment_i^{2001}}{\sum_{i=1}^{k} enrollment_i^{2001}} \tag{1}$$

where j is the respective ventile (i.e., $j = 1, 2, \ldots, 20$) and summing from i^{th} to k^{th}

schools in the ventile. This formation is the percent change in enrollment at each ventile, rather than by each institution. There is a distinct advantage to calculating the growth in enrollment this way. Consider calculating the growth in enrollment in each institution and averaging the growth for all of the institutions in each ventile. In this way, the growth in enrollment may be embellished by small institutions. For example, suppose an institution had an undergraduate enrollment of 100 in 2001 and 1000 in 2011. While these numbers are relatively small in magnitude, it would show a 900 percent growth in enrollment contributing to the average institutional growth in enrollment by ventile. By calculating the percent change in enrollment by ventile, I reduce the sensitivity in changes in enrollment of small institutions. Furthermore, by using a current variable for the institutional quality ranking, I allow for the creation of institutions. For example, suppose that 10 new schools were opened in 2004. When calculating the percent change in enrollment by ventile, the first term in the numerator will capture these new schools and receive a value of zero in the second numerator term and denominator. Thus, this measure allows for new institutions created between the end points to be evaluated in the analysis.

This analysis requires two assumptions. The first being that institutions do not dramatically increase their institution quality from 2001 to 2011. That is, a school that was of low quality in 2001 is still of low quality in 2011. If this assumption is violated, then the descriptive analysis does not reflect an accurate distribution of institution quality. On the contrary, I do allow for some variation in quality from 2001 to 2011. Observe that institutions are allowed for movement *within* ventiles. This assumption restricts movement *across* ventiles. For example, suppose institution i was on the lower bound of ventile 1 in 2001. Over time, institution i improves its quality through means of attracting better students, increased instructional spending, etc. The furthest institution i can move is to the upper-bound of ventile 1. It is unlikely that institutions are able to shift the median

wages of their graduates sufficiently enough over this period to be placed into a different quality ventile. Nonetheless, a robustness exercise could be preformed in which the number of quality bins is reduced allowing for greater movement with each percentile bin.

Assumption two requires that median wages of the institution's graduates are a reflective measure of institution quality. Individuals who attend college do so in order to earn higher future wages as a result of educational advancements. This assumption does not seem too far-fetched. The measure of quality is a reflection as to why individuals chose to complete their education at the institution within in each ventile. A potential way this assumption may be violated is if wages grow at differential rates. Consider for example, an individual who attended a low quality institution, that is one with low median early-career wages. It could be that the individual from the low quality institution experiences greater wage growth later in life, and enjoys wages that eventually surpass those of a graduate from a high quality institution. In plainest terms, it may be that it requires a longer time horizon to realize the true quality of the institution an individual attended. Nonetheless, in terms of available institution wage data, I am restricted to the median early-career wage data by institution. Table 2 provides descriptive statistics for the institution quality measure including the average-median salary, percent change in average-median salary, and the average share of individuals with no labor earnings by institution for each ventile.

Interestingly, between the lowest five percent and the highest 95 percent of institutions, there is over a $50,000 change in early career wages. Furthermore, there is almost a 30 percent increase in the average-median salary in moving from the 95th percentile to the 100th percentile. It appears there is a large and distinct advantage to graduating from the highest quality institutions. Whether this is due to some institution-specific characteristics, the students attending these institutions,

Table 2: Ventile Descriptive Statistics

Ventile	2014 avg. salary ($)	% change	Share with no labor earnings	Ventile	2014 avg. salary ($)	% change	Share with no labor earnings
1	22,240		16.8	11	40,484	2.9	9.7
2	27,372	23.1	13.5	12	41,698	3.0	9.3
3	29,767	8.7	12.2	13	43,463	4.2	9
4	31,788	6.8	12.8	14	45,161	3.9	8.7
5	33,516	5.4	11	15	46,711	3.4	8.9
6	34,644	3.4	11.5	16	48,583	4.0	8.2
7	35,416	2.2	11.6	17	50,694	4.3	8.1
8	36,667	3.5	10.1	18	54,984	8.5	8
9	38,090	3.9	10.1	19	60,535	10.1	7.8
10	39,348	3.3	9.5	20	78,607	29.9	6.8

N=1,888. 2014 average salary is the average of the median salary for the respective ventile. % change is average median-salary change by ventile. Share with no labor earnings is the average share of individuals who completed a degree with no labor earnings at each institution.

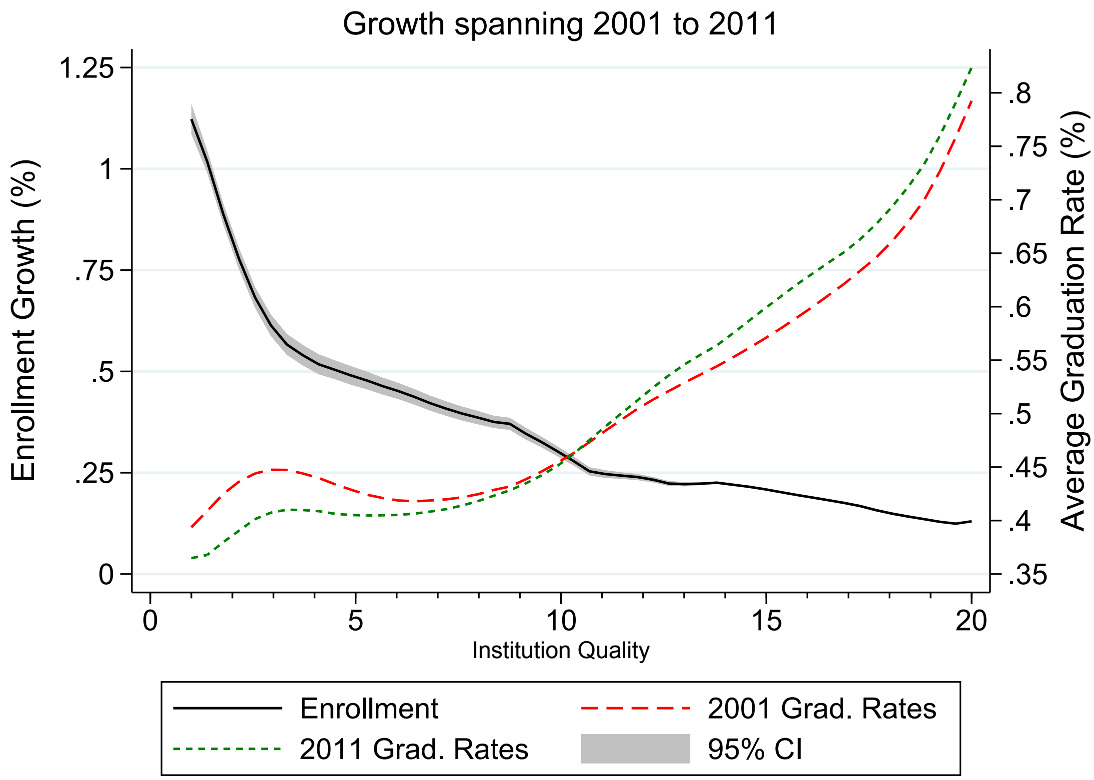
or a combination of the two is beyond the scope of this paper. The average share of individuals with no labor earnings is also quite distinct. From the lowest quality institutions to the highest the average share with no labor earnings changes by over ten percentage points from 16.8 percent to 6.8, respectively. Again, whether this is due to some institution-specific characteristics, the students attending these institutions, or a combination of the both is beyond the scope of the current analysis; however, it seems there is some penalty, or difficulty, for individuals who complete their education from the lowest quality institutions in finding work.

4 Empirical Analysis: Illustrating the Landscape of Higher Education

4.1 Visual analysis

In this section, I present the total change in undergraduate enrollment on the left y-axis and 6-year undergraduate graduation rates on the right y-axis in terms of a measure of institution quality, the median early-career salary in 2014 from graduates of the mid 2000s at each institution. I apply a local third degree polynomial smoothing function to enrollment and graduation rate variables. Figure 2 presents the smoothed changes in undergraduate enrollment and 6-year

Figure 2: Landscape of Higher Education

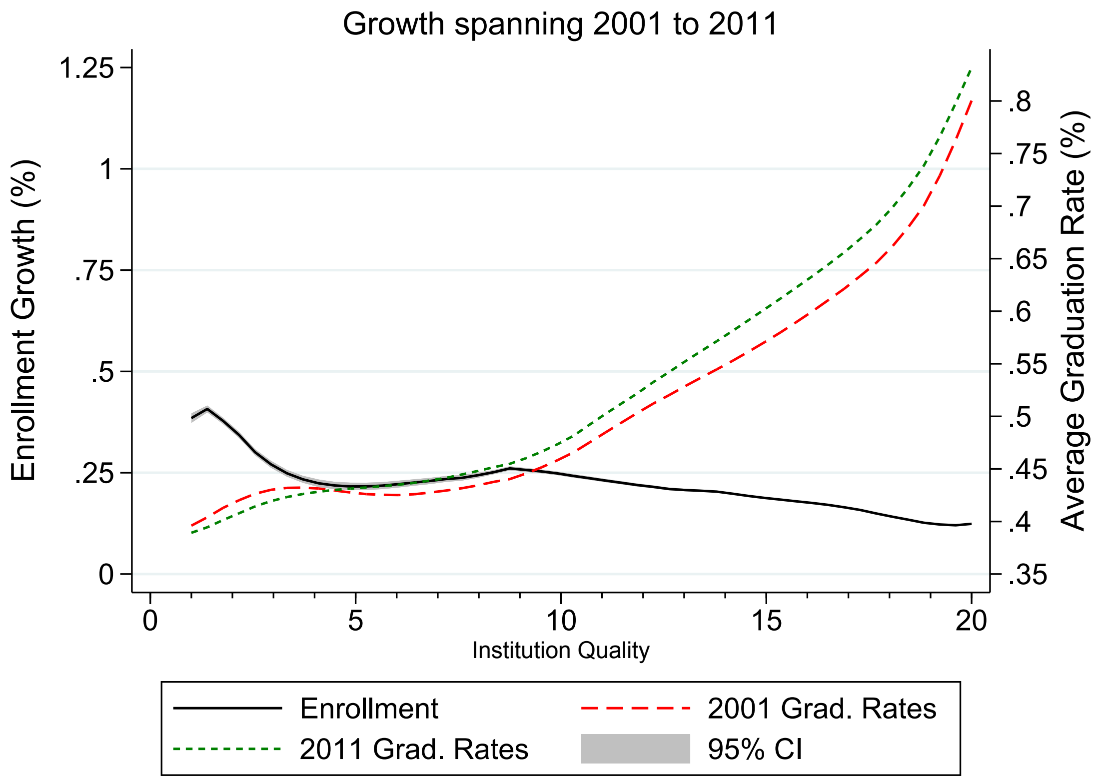


This figure includes both for-profit and not-for-profit institutions (N=1,888). The x-axis ranks institutions into ventiles according to their median early-career wage for graduates. The left y-axis reflects the growth in enrollment at primarily baccalaureate degree granting institutions and above. The right y-axis reflects the average graduation rate for each ventile. The solid black line reflects enrollment growth from 2001 to 2011, and is smoothed using a third degree polynomial function. The long-dashed red line and short-dashed green line reflect 2001 and 2011 cohort graduation rates, respectively, and are smoothed using a third degree polynomial function.

graduation rates for all 4-year or above public, NFP, and FP institutions with a degree granting status of primarily baccalaureate or above. Figure 3 presents the same graph excluding FP institutions.

Figure 2 illustrates that the lowest quality institutions have captured an extremely large share of the growth in undergraduate enrollment over this period of rapid expansion in the for-profit sector. Specifically, for institutions in the lowest five percent of the distribution enrollment has grown over 100 percent while for those in the highest portion of the distribution have experienced growth in

Figure 3: Landscape of Higher Education Excluding For-Profit Institutions



This figure excludes for-profit institutions, and holds remaining institutions in their original bins from Figure 2 (N=1,642). The x-axis ranks institutions into ventiles according to their median early-career wage for graduates. The left y-axis reflects the growth in enrollment at primarily baccalaureate degree granting institutions and above. The right y-axis reflects the average graduation rate for each ventile. The solid black line reflects enrollment growth from 2001 to 2011, and is smoothed using a third degree polynomial function. The long-dashed red line and short-dashed green line reflect 2001 and 2011 cohort graduation rates, respectively, and are smoothed using a third degree polynomial function.

enrollment of just more than 10 percent. Additionally, where enrollment has been the greatest, graduation rates have declined almost five percentage points in the lowest quality institutions. 2011 average graduation rates by ventile have decreased for almost the lowest 50 percent of institutions while for the highest quality institutions, graduation rates have increased over 4 percentage points.

Figure 3 illustrates that FP institutions are driving a large share of the growth in enrollment in the lowest portion of the institution quality distribution while having

virtually no effect for the highest quality institutions. While the growth in the lowest quality institutions is almost 30 percentage points higher relative to those of the highest quality, an interesting result emerges upon the removal of the FP institutions. Graduation rates while still having declined for the lowest quality institutions, the point in which 2011 6-year graduation rates equal and surpass 2001 6-year graduation rates is significantly shifted to the left when FP institutions are removed. In Figure 2, graduation rates do not equalize until almost the 50th percentile in the distribution, while in Figure 3 this equalization occurs in the 20th to 25th percentiles indicating that FP institutions are contributing significantly to the decline in graduation rates.

4.2 Decomposing the Change in Enrollment and Aggregate Graduation Rates

In this section, I decompose the aggregate change in U.S. 6-year graduation rates from 2001 to 2011. I focus on two distinct aspects. The first component is how the changing enrollment composition *across* the institution quality distribution contributed to the aggregate change in U.S. graduation rates. The second component is how the *within* institution graduation rate contributed to the aggregate change in the U.S. graduation rates. I first complete this exercise for the full sample of institutions and then by institution quality quartile. In the following, I present the shift-share decomposition framework.

The aggregate U.S. graduation rate, G, at time t can be defined as:

$$G_t = \sum_j e_{j,t} g_{j,t} \tag{2}$$

Where $e_{j,t}$ is the share of enrollment at institution j at time t and $g_{j,t}$ is the 6-year graduation rate at institution j for cohort t. Differencing the aggregate graduation

rate:

$$G_{2011} - G_{2001} = \sum_j e_{j,2011} g_{j,2011} - \sum_j e_{j,2001} g_{j,2001} \tag{3}$$

Now adding and subtracting the following term, $\sum e_{j,2001} g_{j,2011}$, yields:

$$G_{2011} - G_{2001} = \sum_j e_{j,2011} g_{j,2011} - \sum_j e_{j,2001} g_{j,2001} + \sum_j e_{j,2001} g_{j,2011} - \sum_j e_{j,2001} g_{j,2011} \tag{4}$$

Rearranging terms yields:

$$G_{2011} - G_{2001} = \underbrace{\sum_j (e_{j,2011} - e_{j,2001}) g_{j,2011}}_{(1)} + \underbrace{\sum_j (g_{j,2011} - g_{j,2001}) e_{j,2001}}_{(2)} \tag{5}$$

Where term (1) captures the change in U.S. aggregate graduation rates from 2001 to 2011 due to changing enrollment composition across the institution quality distribution holding graduation rates fixed in 2011. Term (2) captures the change in U.S. aggregate graduation rates from 2001 to 2011 due to the within institution graduation rate changing holding enrollment fixed in 2001. Table 3 presents the results of this exercise.

The first column presents the results of the shift-share decomposition exercise for the full sample. The aggregate U.S. graduation rate increased 1.7 percentage points from 2001 to 2011. Term (1) in the full sample, denoted by value -3.9, is interpreted as follows: holding institution graduation rates fixed in 2011, the change in the composition of enrollment across the institution quality distribution decreased the aggregate U.S. graduation rate by 3.9 percentage points. While term (1) contributed in decreasing the aggregate graduation rate over this period, term (2) more than fully offset this decline and is interpreted as follows: holding enrollment

Table 3: Decomposition Analysis of Aggregate Graduation Rates from 2001 to 2011

		By quartile of distribution			
	Full sample	1	2	3	4
Panel (a): Aggregate Characteristics					
2001 aggregate G.R. (%)	52.6	36.3	39.1	50.5	68
2011 aggregate G.R. (%)	54.3	30.4	41.1	55.9	72.8
Aggregate difference (PP)	1.7	-5.9	2.0	5.4	4.8
Panel (b): G.R. change due to changing enrollment composition (Term 1 in Equation 5)					
Total (PP)	-3.9	-9.1	-2.2	-1.1	-1.4
Total Share (%)	41.1	74.0	34.9	15.1	18.4
Panel (c): G.R. Change due to within institution g.r. rates changing (Term 2 in Equation 5)					
Total (PP)	5.6	3.2	4.1	6.2	6.2
Total (%)	58.9	26.0	65.1	84.9	81.6

Panel (a) presents the aggregate graduation rates (G.R.) for 2001 and 2011 cohorts, as well as the resulting difference from 2001 to 2011. Panel (b) isolates the change in aggregate graduation rates due to changes in enrollment from 2001 to 2011, holding graduation rates fixed to 2011, and reflects Term 1 in Equation 5. Panel (c) reflects the change in aggregate graduation rates as a result of changing graduation rates (g.r.) within institutions, holding enrollment fixed to 2001, and reflects Term 2 in Equation 5. Total (PP) indicates the total percentage point change in aggregate graduation rates from 2001 to 2011 due to the isolated term of interest. Total share (%) indicates how much each term contributed to the total percentage point change from 2001 to 2011. The first column reflects the entire institution quality distribution while the remaining columns reflect the respective quartile of the distribution.

fixed in 2001, the within institution graduation rate increased the aggregate graduation rate from 2001 to 2011 by 5.6 percentage points. Examining the decomposition by quartile, 74 percent of the decline in aggregate graduation rates in quartile one were due to the changing composition of enrollment across the institution quality distribution, while the remaining 26 percent was due to an increase in within institution graduation rates. Observe the gradient moving from the lowest quartile to highest quartile in these two types of changes. We see that at the low end the changing composition contributed significantly to the decline in the aggregate graduation rates, while at the high end changing enrollment composition had little effect on the aggregate graduation rate. In the highest quartile, within institution changes to the graduation rate contributed over 80 percent to the change in the aggregate graduation rate.

5 Conclusion

Every year the government spends billions of dollars financing higher education. The goal of such spending is to not only enroll financially constrained students, but to graduate these students as well. In order to critically evaluate the successes and failures of higher education, it needs to be clear where students are enrolling, and whether federal subsidization of higher education is efficient in realizing the returns to a college education.With the expansion of the for-profit sector in the 2000s students have increasingly more options on where to attend an institution of higher education. The literature suggests there may be large penalties for attending a for-profit college, and thus institutional quality may play an important role in determining just how large the returns really are.

This paper documents the changing landscape of enrollment and graduation rates across a measure of institution quality during the rapid expansion of the for-profit sector from 2001 to 2011. My unique approach focusing on specific segments of the institution quality distribution, rather than institutions themselves, allows me to capture recently opened schools while also providing a consistent ranking of institution quality over this period. I conclude this work by decomposing aggregate graduation rates across various segments of the institution quality distribution. This exercise accounts for how the changing enrollment composition across the landscape of higher education contributed to the decline in aggregate rates for the lowest quality institutions while increasing them at the highest institutions.

My first set of key results documents the significant increase in enrollment at institutions of the lowest quality from 2001 to 2011. These institutions, primarily composed of for-profits, grew more than 100 percent in ten years – also where graduation rates have decreased by almost 5 percentage points. The removal of FP institutions shifts the equalization of 2001 and 2011 cohort graduation rates almost

5 ventiles, or 25 percentage points, higher in the institution quality distribution. At the same time, graduation rates in the highest quality institutions have increased almost four percentage points in the span of a decade.

Further analysis suggests that aggregate graduation rates decreased primarily as a result of the changing enrollment landscape. 74 percent of the decline in aggregate graduation rates of the lowest quality institutions can be explained by the changing enrollment composition *across* the institution quality distribution. Alternatively , in the highest quality institutions, aggregate graduation rates increased primarily due to higher graduation rates *within* these institutions. This suggests that as enrollment expands institutions may become more selective in who they enroll, these institutions receive a better applicant pool, or a result of better matching between enrollee and institution.

In the current setting, I am unable to tell whether the decline in aggregate graduation rates is due to the institutions themselves, or the types of students they are enrolling. It may be that these significant increases in enrollment are composed of the lowest quality students and a majority of these enrollees are failing to graduate because they are of "poor" learning quality. Alternatively, it could be that these institutions do not have the resources to effectively facilitate learning and prevent students from falling through the cracks after taking on such large increases in enrollment. One potential exercise would be to focus on the evolving landscape of test scores across the institution quality distribution. Intuition suggests that as the applicant pool increases in higher education, test scores of the institutions of lowest quality will fall over time, while the highest quality, or most selective institutions, will enroll students who have better test scores. If we see that test scores have, in fact, decreased in the lowest quality institutions this may suggest that the decline in graduation rates is due to student quality rather than institution quality.

Nonetheless, these results have important implications for policy makers. In

order to effectively distribute financial aid, it needs to be clear where it needs to go. While previous research has documented the positive impacts of financial aid on enrollment and persistence, less is known about financial aid impacts among the lowest quality institutions. If students continue to enroll in these institutions and graduate without realizing the potentially reduced labor market returns, potential policies could redirect and inform these students of alternative options.

References

Aaronson, Daniel, Daniel Hartly, and Bhashkar Mazumder. Forthcoming. “The effects of the 1930s HOLC "redlining" maps.” *American Economic Journal: Economic Policy.*

Abedin, Shanti, Cathy Cloud, Debby Goldberg, Jorge Soto, and Morgan Williams. 2017. “The 2017 fair housing trends report.”Technical report, National Fair Housing Alliance.

Ananat, Elizabeth Oltmans. 2011. “The wrong side (s) of the tracks: The causal effects of racial segregation on urban poverty and inequality.” *American Economic Journal: Applied Economics* 3 (2): 34–66.

Angrist, Joshua, David Autor, Sally Hudson, and Amanda Pallais. 2017. “Evaluating post-secondary aid: Enrollment, persistence, and projected completion effects.”Technical report, National Bureau of Economic Research.

Bayer, Patrick, Hanming Fang, and Robert McMillan. 2014. “Separate when equal? Racial inequality and residential segregation.” *Journal of Urban Economics* 82 32–48.

Bayer, Patrick, and Robert McMillan. 2012. “Tiebout sorting and neighborhood stratification.” *Journal of Public Economics* 96 (11-12): 1129–1143.

Bayer, Patrick, Robert McMillan, Alvin Murphy, and Christopher

Timmins. 2016. "A dynamic model of demand for houses and neighborhoods." *Econometrica* 84 (3): 893–942.

Böhlmark, Anders, and Alexander Willén. 2020. "Tipping and the effects of segregation." *American Economic Journal: Applied Economics* 12 (1): 318–47.

Boustan, Leah Platt, and Robert A Margo. 2009. "Race, segregation, and postal employment: New evidence on spatial mismatch." *Journal of Urban Economics* 65 (1): 1–10.

Card, David, Alexandre Mas, and Jesse Rothstein. 2008. "Tipping and the dynamics of segregation." *The Quarterly Journal of Economics* 123 (1): 177–218.

Card, David, and Jesse Rothstein. 2007. "Racial segregation and the black–white test score gap." *Journal of Public Economics* 91 (11-12): 2158–2184.

Cellini, Stephanie Riegg, and Nicholas Turner. 2019. "Gainfully employed? Assessing the employment and earnings of for-profit college students using administrative data." *Journal of Human Resources* 54 (2): 342–370.

Chetty, Raj, John N Friedman, Emmanuel Saez, Nicholas Turner, and Danny Yagan. 2017. "Mobility report cards: The role of colleges in intergenerational mobility."Technical report, National Bureau of Economic Research.

Chetty, Raj, and Nathaniel Hendren. 2018. "The impacts of neighborhoods on intergenerational mobility II: County-level estimates." *The Quarterly Journal of Economics* 133 (3): 1163–1228.

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

Chetty, Raj, Nathaniel Hendren, and Lawrence F Katz. 2016. "The effects of exposure to better neighborhoods on children: New evidence from the moving to opportunity experiment." *American Economic Review* 106 (4): 855–902.

Chung, Anna S. 2012. "Choice of for-profit college." *Economics of Education Review* 31 (6): 1084–1101.

Collins, William J., and Robert A. Margo. 2000. "Residential segregation and socioeconomic outcomes: When did ghettos go bad?" *Economics Letters* 69 (2): 239–243.

Cutler, David M., and Edward L. Glaeser. 1997. "Are ghettos good or bad?" *The Quarterly Journal of Economics* 112 (3): 827–872.

Cutler, David M., Edward L. Glaeser, and Jacob L. Vigdor. 2008. "When are ghettos bad? Lessons from immigrant segregation in the united states." *Journal of Urban Economics* 63 (3): 759–774.

Dawkins, Casey. 2013. "The spatial pattern of low income housing tax credit properties: Implications for fair housing and poverty deconcentration policies." *Journal of the American Planning Association* 79 (3): 222–234.

Deming, David J, Noam Yuchtman, Amira Abulafi, Claudia Goldin, and Lawrence F Katz. 2016. "The value of postsecondary credentials in the labor market: An experimental study." *American Economic Review* 106 (3): 778–806.

Denning, Jeffrey T, Benjamin M Marx, and Lesley J Turner. 2019. "ProPelled: The effects of grants on graduation, earnings, and welfare." *American Economic Journal: Applied Economics* 11 (3): 193–224.

Dillman, Keri-Nicole, Keren Mertens Horn, and Ann Verrilli. 2017. "The

what, where, and when of place-based housing policy's neighborhood effects." *Housing Policy Debate* 27 (2): 282–305.

Duncan, Otis Dudley, and Beverly Duncan. 1955. "A methodological analysis of segregation indexes." *American Sociological Review* 20 (2): 210–217.

Dynarski, Susan M. 2003. "Does aid matter? Measuring the effect of student aid on college attendance and completion." *American Economic Review* 93 (1): 279–288.

Edin, Per-Anders, Peter Fredriksson, and Olof Åslund. 2003. "Ethnic enclaves and the economic success of immigrants—Evidence from a natural experiment." *The Quarterly Journal of Economics* 118 (1): 329–357.

Ellen, Ingrid Gould, and Keren Mertens Horn. 2018. "Points for place: Can state governments shape siting patterns of low-income housing tax credit developments?" *Housing Policy Debate* 28 (5): 727–745.

Farrell, Chad R, and Barrett A Lee. 2011. "Racial diversity and change in metropolitan neighborhoods." *Social Science Research* 40 (4): 1108–1123.

Fischer, Will. 2018. "Low-income housing tax credit could do more to expand opportunity for poor families." *Washington, DC: Center on Budget and Policy Priorities.*

Galiani, Sebastian, Alvin Murphy, and Juan Pantano. 2015. "Estimating neighborhood choice models: Lessons from a housing assistance experiment." *American Economic Review* 105 (11): 3385–3415.

Goodwin, Maya, Kenneth Hillary, Philip Oliff, Mark Robyn, Ingrid Schroeder, Anne Stauffer, and Justin Theal. 2015. "Federal and state funding of higher education."Technical report, The PEW Chariatable Trusts.

Guryan, Jonathan. 2004. “Desegregation and black dropout rates.” *American Economic Review* 94 (4): 919–943.

Hanushek, Eric A, John F Kain, and Steven G Rivkin. 2009. “New evidence about brown v. board of education: The complex effects of school racial composition on achievement.” *Journal of Labor Economics* 27 (3): 349–383.

Hollar, Michael, and Kurt Usowski. 2007. “Low-income housing tax credit qualified census tracts.” *Cityscape* 9 (3): 153–159.

Hoxby, Caroline M. 2000. “Does competition among public schools benefit students and taxpayers?” *American Economic Review* 90 (5): 1209–1238.

Jubara, Amalea, Jonathan Schroeder, and Yaxuan Zhang. 2021. “Mapping block-level segregation: The twin cities’ black population, 1980-2010.” IPUMS Blog, February.

Kennedy, Anthony. 2015. “Texas department of housing & community affairs v. the inclusive communities project, inc.” *Opinion of the United States Supreme Court* 6.

Logan, John R., Brian Stults, and Zengwang Xu. 2014. “Longitudinal Tract Database [dataset].” http://www.s4.brown.edu/us2010/Researcher/Bridging.htm.

Manson, Steven, Jonathan Schroeder, David Van Riper, and Steven Ruggles. 2019. “IPUMS National Historical Geographic Information System: Version 14.0 [Database].” Minneapolis, MN: IPUMS.

Morey, Ann I. 2004. “Globalization and the emergence of for-profit higher education.” *Higher education* 48 (1): 131–150.

Nagaraj, Abhishek, and Scott Stern. 2020. “The economics of maps.” *Journal of Economic Perspectives* 34 (1): 196–221.

Office of Policy Development and Research. 2013. "HUD desingates low-income housing tax credit qualified census tracts for 2013."Technical report, U.S. Department of Housing and Urban Development.

Owens, Ann. 2016. "Inequality in children's contexts: Income segregation of households with and without children." *American Sociological Review* 81 (3): 549–574.

Reid, Carolina K. 2019. "Rethinking opportunity in the siting of affordable housing in California: Resident perspectives on the low-income housing tax credit." *Housing Policy Debate* 29 (4): 645–669.

Ruggles, Steven, Sarah Flood, Ronald Goeken, Josiah Grover, Erin Meyer, Jose Pacas, and Matthew Sobek. 2019. "IPUMS USA: Version 9.0 [dataset]." Minneapolis, MN: IPUMS, 2019.

Scally, Corianne, Amanda Gold, and Nicole DuBois. 2018. "The low-income housing tax credit: How it works and who it serves."Technical report, Urban Institute.

Sharkey, Patrick. 2016. "Neighborhoods, cities, and economic mobility." *RSF: The Russell Sage Foundation Journal of the Social Sciences* 2 (2): 159–177.

Tax Policy Center. 2017. "Tax policy center briefing book." *Tax Policy Center.*

Tiebout, Charles M. 1956. "A pure theory of local expenditures." *Journal of Political Economy* 64 (5): 416–424.

U.S. Census Bureau. 1994. *Geographic areas reference manual.* US Dept. of Commerce, Economics and Statistics Administration, Bureau of the Census.

U.S. Census Bureau. 2002. "Measuring America: The Decennial Censuses from

1790 to 2000." Retrieved from https://www.census.gov/history/pdf/measuringamerica.pdf.

U.S. Census Bureau. 2008. "2010 Participant statistical areas program participant information."Technical report, U.S. Department of Commerce.

U.S. Census Bureau. 2010. "Racial and Ethnic Residential Segregation in the United States: 1980-2000." Retrieved from https://www.census.gov/hhes/www/housing/resseg/pdf/app.pdf.

U.S. Census Bureau. 2011. "Historical Delineation Files." Retrieved from https://www.census.gov/geographies/reference-files/time-series/demo/metro-micro/historical-delineation-files.html.

U.S. Census Bureau. 2013. "Census Tract Education." Retrieved from https://www2.census.gov/geo/pdfs/education/CensusTracts.pdf.

U.S. Const. art. I, § 2.. 1787. "Constitution of the United States."

Webber, Douglas A, and Ronald G Ehrenberg. 2010. "Do expenditures other than instructional expenditures affect graduation and persistence rates in American higher education?" *Economics of Education Review* 29 (6): 947–958.

Appendix A

Table A.1: DID Effects of Census Tract Splits on Neighborhood Composition

	(1) % Black	(2) % White
Treatment	-2.644***	4.164***
	(0.206)	(0.234)
Post × Treatment	0.262***	-0.164**
	(0.050)	(0.067)
Mean of dep. variable	14.21%	70.94%
R^2	0.228	0.259
N	456926	456926

The unit of analysis is the 2000 census tract envelope (N=456,926). Coefficients are estimated from the following regression: $y_{ict} = \beta_0 + \beta_1 post_t + \beta_2 treatment_i + \beta_3(post_t \times treatment_i) + x'_{it}\theta + \epsilon_{ict}$, and have been multiplied by 100 for ease of interpretation. The variable $post_t$ indicates whether y is measured after the 2010 Decennial Census, and $treatment_i$ indicates whether census tract envelope i receives further delineation in the 2010 Census. Additional controls include a quadratic function in neighborhood population, city fixed effects, and a linear time trend. Standard errors are robust and clustered to the census tract level. Estimation is restricted to 2000 census tract envelopes that have a neighborhood population of at least 2,000 residents and a city population of at least 100,000. This captures 88.7 percent of neighborhoods covering 303 unique MSAs.

Table A.2: Long-Run Impacts of Census Tract Splits on Neighborhood Composition

	(1) % Black	(2) % White
Treatment	1.818***	-0.326
	(0.344)	(0.444)
Mean of dep. variable	9.29%	75.92%
R^2	0.457	0.642
N	38,242	38,242

The unit of analysis is the original census tract envelope (N=38,242). Coefficients are estimated from the regression specified in equation 3. Treatment is an indicator that equals 1 if the unit is observed in the relative year $0 \leq k \leq 30$, and thus reflects the average percentage point effect over this period. Additional controls include a quadratic function in neighborhood population and city fixed effects. Standard errors are robust and clustered to the census tract envelope level. Estimation is restricted to census tract envelopes that have a neighborhood population of at least 1,200 residents.

Table A.3: Evidence of the LIHTC in Census Tract Delineation

	(1) Multiple LIHTC-Funded Projects	(2) Multiple LIHTC-Funded Projects
Treatment	-0.069***	
	(0.004)	
Post × Treatment	0.016***	
	(0.005)	
Number of splits		-0.024***
		(0.001)
Post × Number of splits		0.006***
		(0.001)
Mean of dep. var.	64.32%	64.32%
R^2	0.021	0.022
N	71708	71708

The unit of analysis is the 2000 census tract envelope and is conditional on the envelope ever receiving an LIHTC-funded project from 2007 to 2016 (N=71,708). Coefficients are estimated from regressions specified in equations X and Y. Additional controls include a quadratic function in neighborhood population, city fixed effects, and a linear time trend. The dependent variable of interest in each column is an indicator that equals 1 if the census tract envelope received more than 1 LIHTC-funded project. Standard errors are robust and clustered to the census tract level.

Appendix B

Table B.1: Microdata Characteristics

	Total (Age 20 - 30)			
	1980		2010	
Variable	White	Black	White	Black
A.Education				
High school graduate	87.5%	76.3%	93.6%	86.7%
College graduate	19.7%	8.8%	31.8%	14.6%
Avg. years of schooling	14	13	15	14
B. Work and income				
Idle	7.0%	16.4%	11.2%	25.9%
Earnings	$28,835	$22,045	$30,316	$19,349
Usual hours worked/week	40.1	38.6	39.3	36.6
C. Social				
Single mother	19.1%	54.7%	31.8%	70.3%
N	1,592,503			

High school graduate in 1980 is defined as having reached 12th grade. College graduate is defined as having completed at least 4 years of college in 1980, and is defined as having at least completed a bachelor's degree in 2010. Average years of schooling includes kindergarten. K-12th grade indicates 13 years of schooling. Idleness is conditional on being in the labor force, and is defined as unemployed and not in school. Earnings data are for people who are in the labor force, not enrolled in school, and have nonnegative earnings. Usual hours worked per week are for people who are in the labor force and not enrolled in school. Single mother refers to females that are not currently married and have ever had a child in 1980, and in 2010, refers to females that are not currently married and have had a child in the last year.

Table B.2: City Characteristics

Variable	1980 Mean	1980 Min.	1980 Max.	2010 Mean	2010 Min.	2010 Max.
Population (1000s)	685.7	89.0	8275.0	836.0	98.7	9818.6
A. Race/Ethnicity						
Non-Hispanic white	82.6%	31.3%	98.7%	68.4%	3.3%	95.6%
Non-Hispanic Black	10.7%	0.5%	40.9%	12.8%	0.2%	56.4%
Hispanic	4.8%	0.3%	61.9%	13.6%	1.0%	95.8%
Asian	1.2%	0.2%	59.9%	3.9%	0.6%	68.4%
B. Measures of separation						
Separation by race	62.0%	30.4%	87.9%	44.1%	15.7%	76.7%
Separation by education	34.6%	18.2%	54.8%	35.3%	20.5%	53.9%
Number of neighborhoods	164	21	2,476	196	23	2,475
C. Monetary characteristics						
Median home value	$130,506	$74,136	$368,446	$176,053	$75,851	$730,827
Median Household income	$47,735	$32,466	$78,226	$51,967	$31,881	$97,378
Median income per person	$20,063	$13,954	$33,559	$25,924	$13,928	$49,744
D. Labor market characteristics						
High school diploma or less	67.9%	48.3%	84.2%	42.8%	22.3%	65.5%
Unemployment rate	6.7%	2.1%	15.2%	9.4%	3.9%	16.4%
Share in manufacturing	22.7%	3.2%	51.9%	11.0%	2.0%	31.6%
Total number of cities			237			257

Separation measures are in terms of the Index of Dissimilarity. This refers to the percent of the population that would need to move within the city in order to create an equal distribution with respect to the specified characteristic. Neighborhoods are defined as a census tract. All monetary variables are expressed in 2010 dollars. City is defined as the Metropolitan Statistical Area (MSA).

Table B.3: The Relationship Between Census Tracts and Racial Separation Over Time

Year	(1) Racial Separation (1980)	(2) Racial Separation (1990)	(3) Racial Separation (2000)	(4) Racial Separation (2010)	(5) Racial Separation (1980-2010)
Num. of census tracts	0.040**	0.036**	0.063***	0.077***	0.051***
	(0.019)	(0.015)	(0.017)	(0.015)	(0.010)
Mean of dep. var.	62.00%	55.99%	49.11%	44.13%	52.53%
Std. dev. of dep. var.	12.29%	12.81%	13.44%	12.50%	14.42%
R^2	0.188	0.160	0.222	0.195	0.137
N	237	249	276	257	1019

The dependent variable in each specification is the level of racial separation within a city and is defined as the Index of Dissimilarity. Each specification includes a quartic function in population, and standard errors are corrected for heteroskedasticity.

Coefficients statistically significant at ***1%, **5%, and *10% levels.

Table B.4: Falsification Test of the Instrument

Year	(1) Racial Separation (1980)	(2) Racial Separation (1990)	(3) Racial Separation (2000)	(4) Racial Separation (2010)	(5) Racial Separation (1980-2010)
Num. of census tracts	0.038**	0.006	0.008	0.002	-0.003
	(0.019)	(0.009)	(0.011)	(0.009)	(0.008)
Mean of dep. var.	60.93%	53.24%	47.05%	39.61%	50.59%
Std. dev. of dep. var.	12.60%	13.46%	13.69%	12.32%	15.19%
R^2	0.165	0.107	0.103	0.082	0.063
N	237	231	219	208	895

The dependent variable in each specification is the level of racial separation within a city and is defined as the Index of Dissimilarity. This measure is calculated using census tract envelopes that were established in either 1970 or 1980. The sample includes MSAs that existed in 1980 and could be followed to 2010. Each specification includes a quartic function in population, and standard errors are corrected for heteroskedasticity.

Coefficients statistically significant at ***1%, **5%, and *10% levels.

Table B.5: OLS Estimates of the Effects of Racial Separation on Economic Opportunities

	(1) HS dropout	(2) College graduate	(3) ln(income)	(4) Idle	(5) Single motherhood
Separation	0.0002***	0.0004***	0.0008***	0.0001***	0.0004***
	(0.0000>)	(0.0000>)	(0.0001)	(0.0000>)	(0.0002)
Black*separation	0.0014***	-0.0034***	-0.0035***	0.0010***	0.0051***
	(0.0000>)	(0.0000>)	(0.0001)	(0.0000>)	(0.0002)
Mean of dep. var.	11.64%	22.24%	$24,997.51	6.24%	31.61%
R^2	0.031	0.120	0.219	0.046	0.185
N	1592503	1592503	1378543	1305801	123236

HS dropout is an indicator variable that equals 1 if the individual completed less than grade 12 in 1980, and in later years equals 1 if the individual completed grade 12, or less, and did not receive a diploma. College graduate is an indicator variable that equals 1 if the individual completed at least 4 years of college in 1980, and in later years equals 1 if the individual has a bachelor's degree or higher. Income is defined as earned income, and is conditional on being in the labor force with nonnegative earnings. Idleness is an indicator variable that equals 1 if the individual is in the labor force, but neither going to school nor employed. Single motherhood is an indicator that equals 1 if the female is not currently married, and has ever had a child in 1980 or 1990. In 2010 single motherhood refers to females who are not currently married and have had a child in the last year. Single motherhood data are not available for 2000. Separation is defined as the Index of Dissimilarity, and the interaction term includes an indicator if the individual is Black. Individual controls include sex, age, and educational attainment. City-level controls include population, percent Black and its interaction, percent Hispanic, percent with a high school degree or less, percent manufacturing and its interaction, unemployment rate, median HH income, percent married, segregation by skill level, birth place state FE, and year and region FE. Standard errors are corrected for heteroskedasticity and intra-MSA clustering.

Coefficients statistically significant at ***1%, **5%, and *10% levels.

Table B.6: Separation and Geographic and Economic Mobility in Heavily Black Neighborhoods

	Geographic Mobility		Economic Mobility	
	(1) % remaining in childhood census tract into adulthood	(2) % that move into affluent neighborhood in adulthood	(3) Probability of reaching top 1% of income earners	(4) Probability of reaching top 20% of income earners
Separation	-0.0249	0.1848***	0.0211***	0.3052***
	(0.0183)	(0.0596)	(0.0050)	(0.0267)
≥90% Black*separation	0.0143	-0.2782***	-0.0401***	-0.2738***
	(0.0270)	(0.0284)	(0.0020)	(0.0173)
Mean of dep. Var.	19.36%	49.16%	1.16%	21.04%
R^2	0.151	0.216	0.054	0.171
N	45368	45368	45379	45379

Census tract-level data come from Opportunity Insights, and consist of data collected for individuals born between 1978-1983. In columns (1) and (2), childhood refers to individuals up to age 23. Since columns (1) and (2) refer to data based upon childhood census tracts, estimates are calculated using 1980 racial separation levels with the number of 1980 census tracts as the instrument, and 1980 controls. Columns (3) and (4) refer to the estimated probability of an individual in a given tract reaching the respective percentile of the national income distribution (among children born in the same cohort) in 2014-2015. Columns (3) and (4) are estimated using 2010 racial separation levels, census tract count, and controls. Separation is defined as the Index of Dissimilarity, and the interaction term includes an indicator if the neighborhood is greater than or equal to 90% Black. City-level controls include population, percent Black and its interaction term, percent Hispanic, percent with high school degree or less, percent in manufacturing and its interaction, unemployment rate, median HH income, percent married, and segregation by skill level. Standard errors are corrected for heteroskedasticity and intra-MSA clustering.

Coefficients statistically significant at ***1%, **5%, and *10% levels.