RESEARCH REPORT

The Cost of Segregation

National Trends and the Case of Chicago, 1990–2010

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Executive Summary

This study asks whether regional economic and racial segregation have negative effects not only on people with lower incomes or racial and ethnic minorities, but on all residents and the region as a whole. We analyze the 100 most-populous commuting zones (CZs, which correspond generally with metropolitan areas) from 1990 to 2010 and consider five CZ-level outcomes: median household income, per capita income, proportion of residents ages 25 and older with bachelor's degrees, life expectancy, and homicide rate. If higher levels of segregation are associated with worse CZ outcomes, efforts to reduce economic and residential segregation could benefit all residents across metropolitan areas. We find that higher levels of economic segregation are associated with lower incomes, particularly for black residents. Further, higher levels of racial segregation are associated with lower incomes for blacks, lower educational attainment for whites and blacks, and lower levels of safety for all area residents.

We use our research on the 100 most-populous CZs to assess how racial and economic segregation contribute to quality-of-life outcomes in the Chicago metropolitan area. Challenges in Chicago—from depopulation to rising homicides—indicate a need to focus on segregation's effects on the region's prosperity. The Chicago case also illustrates the cost of segregation and provides a model for conducting similar cost estimates in other regions. Our research on 100 CZs and the Chicago metro area produced three major findings:

- The nation is changing in its spatial patterns, but remains starkly segregated by race and income.
- There is a real cost to segregation, which varies by race and ethnicity.
- Chicago continues to struggle as a highly segregated metro area, which has major effects for all residents.

BOX 1

Data, Measures, and Methods

Data: Our analysis uses data on the 100 most-populous commuting zones (CZs) in 1990 from the 1990, 2000, and 2010 Censuses and the 2008–12 American Community Survey (which we refer to as 2010, the central year of these five-year estimates). This leaves a sample of 300 observations.

Economic segregation: We use the Generalized Neighborhood Sorting Index, which measures how many people of similar incomes "clump" together within a metropolitan region.

Racial segregation: We measure black-white and Latino-white racial segregation using a spatial proximity (SP) index. This measures how groups cluster into enclaves within a region. In supplemental analyses, we use a dissimilarity (D) index, which measures "evenness," or the distribution of a population group across a region. Although the D index is the most widely used measure of racial segregation, the SP index better accounts for larger spatial patterns within a region.

Method: We estimate linear fixed effects models to assess relationships between CZ outcomes and segregation while considering other differences between CZs that vary over time (e.g., inequality, population size, demographics).

We focus on statistically significant relationships (at the 10 percent level) in our preferred model using SP indexes. We conclude with suggestive findings (significant at the 20 percent level in models using the SP index or at the 10 percent level in models using the D index) that merit further investigation.

1. The Nation Is Changing in Its Spatial Patterns, but Remains Starkly Segregated by Race and Income

Economic Segregation

- Economic segregation declined during the 1990s, but increased after 2000. Between 1990 and 2000, economic segregation decreased in 92 CZs. From 2000 to 2010, in contrast, economic segregation increased in 72 CZs. Larger metro areas tend to be more segregated than less populous metros.

Racial Segregation

- Black-white segregation in the 100 most-populous CZs dropped, on average, from 1990 to 2010, while Latino-white segregation increased.
- In general, blacks and whites tend to be more segregated from one another than Latinos and whites.

Combined Economic and Racial Segregation

- Regions that are more racially segregated are more economically segregated. The relationship between the two is stronger when measuring black-white segregation and weaker when measuring Latino-white segregation. If we know a CZ is economically segregated, it is likely to have high levels of black-white segregation, but it is less clear whether it will have high levels of Latino-white segregation.

2. There Is a Real Cost to Segregation, Which Varies by Race and Ethnicity

Income

- When we look at segregation's effects on racial groups, we see the clearest story emerge for blacks.
    - » Higher levels of economic segregation are associated with lower median and per capita income for blacks.
    - » Higher levels of black-white segregation are associated with lower black per capita income.
- Neither economic segregation nor racial segregation is significantly related to white or Latino median or per capita income.

Education

- Higher levels of black-white segregation are associated with lower levels of bachelor's degree attainment for both blacks and whites.

Health

- Higher levels of Latino-white segregation are associated with lower life expectancies for all a CZ's residents.

Crime

- Higher levels of black-white segregation are associated with higher homicide rates.

3. Chicago Continues to Struggle as a Highly Segregated Metro Area, Which Has Major Effects for All Residents

- Chicago's combined racial and economic segregation is among the highest in the nation, landing it fifth in the nation in 2010 (it ranked first in 2000 and fourth in 1990). When looking at both black-white and Latino-white segregation, only Chicago and Newark have remained in the top 10 in both measures since 1990.
- Blacks and whites generally do not reside in close proximity to one another in Chicago: whites are spread throughout the region except in the south and west sides, while blacks are heavily concentrated in the south and west sides and the southern suburbs.
- Latinos tend to live in the city's southwest and northwest neighborhoods, with multiple suburban clusters throughout the region.
- If Chicago could reduce its level of economic segregation to the median level of the 100 most-populous CZs, we estimate the following:
  - Black per capita income would increase 2.7 percent (or $527), with an aggregate increase of $772 million.
- If Chicago could reduce its level of black-white racial segregation to the median level of the 100 most-populous CZs, we estimate the following:
  - Black per capita income would increase 12.4 percent (or $2,455), with an aggregate increase of $3.6 billion.
  - The educational attainment rate for black and white residents would increase, with approximately 83,000 more adults completing a bachelor's degree. Of these graduates, 78 percent would be white and 22 percent would be black.
  - The homicide rate would be 4.6 (instead of 6.6) per 100,000 people. In other words, the homicide rate would be 30 percent lower if Chicago's black-white segregation fell to the

median level. In actual numbers, that decrease in segregation would have reduced the number of homicides in Chicago in 2010 from 553 down to 386, a decrease of 167. If the relationship between black-white segregation and homicides at the regional level holds true for Chicago, there would have been 229 fewer homicides in Chicago in 2016 (533 instead of 762) if segregation in the region was at the median level.

- If Chicago could reduce its level of black-white segregation *and* economic segregation to the median level of the 100 most-populous CZs, black per capita income would increase 15.1 percent (or $2,982), with an aggregate increase of $4.4 billion.

Discussion: Segregation and Regional Outcomes

Our strongest and most consistent finding is that higher levels of economic segregation are associated with lower incomes, particularly for black residents. Further, higher levels of racial segregation are associated with lower incomes for blacks, lower educational attainment for whites and blacks, and lower levels of safety for all area residents.

Economic and racial segregation, economic growth, educational attainment, life expectancy, and crime evolve in complex ways. Precisely measuring relationships between segregation and CZ outcomes poses challenges, especially when working with only 300 observations. We have highlighted statistically significant findings, and those findings are largely consistent with those obtained using alternative measures of racial segregation.

The results in our preferred and alternative models also lead us to speculate about associations that merit further exploration. We find suggestive evidence of other economic costs to a region's residents, regardless of race or ethnicity. But not all findings regarding racial segregation across both models point in consistent directions. Future research could explore these issues further.

Our results indicate a complex relationship between segregation and CZ outcomes. These findings will inform our future work on the cost of segregation in Chicago. That work will include a projected baseline scenario for the region absent interventions to address economic and racial segregation and a vision incorporating potential policies to address segregation.

The Cost of Segregation, 1990–2010

Over the past 30 years, income inequality and economic residential segregation have risen across the United States, becoming a major point of interest in understanding individual and societal outcomes. Growing concern with economic inequality and segregation parallels a long-standing focus on racial inequality and segregation, which have not been eliminated despite decades of struggle to implement policies to promote racial equity. Fifty years after the civil rights movement, our nation remains racially segregated in ways that disproportionately harm communities of color. But does this harm affect entire metropolitan regions? Does separating households by income and race diminish earnings potential for all people who live and work in the same metropolitan area? Does it diminish the region's vibrancy?

Evidence shows segregation harms people who live in high-poverty, racially segregated neighborhoods and harms metropolitan areas at large (Benner and Pastor 2015; Chetty et al. 2014; Chetty, Hendren, and Katz 2016; Li, Campbell, and Fernandez 2013; Nightingale 2012; Sharkey 2016). This report examines the status of and the relationships between economic and racial residential segregation[1] on regional outcomes, capturing how segregation relates to residents' economic performance, educational attainment, health, and safety. We analyze the 100 most-populous commuting zones (CZs, which correspond generally with metropolitan areas) from 1990 to 2010.

We assess the relationship between segregation and the income and education-related outcomes for the total population and separately for non-Latino whites, non-Latino blacks, and Latinos. This analysis uses data from the 1990, 2000, and 2010 Censuses and the 2008–12 American Community Survey (which we refer to as 2010, the central year). We also examine the relationship between segregation and two additional outcomes (life expectancy and homicide rates) for the whole population, but not separately by race and ethnicity because of data limitations. Life expectancy data come from the Institute for Health Metrics and Evaluation, and homicide data are from the US Department of Justice Uniform Crime Reporting Program.

We hypothesize that a region's economic and racial segregation negatively affect not only people with low income or racial and ethnic minorities, but all residents of the region and the region as a whole. If higher levels of segregation are associated with worse outcomes for entire CZs, efforts to reduce economic and racial segregation could benefit all residents across metropolitan areas.

In addition to examining the 100 most-populous CZs, our research determines how much racial and economic segregation affect outcomes throughout the Chicago metropolitan area. Chicago has consistently ranked among the country's most racially and economically diverse metropolitan areas.

Challenges in Chicago—from depopulation to rising homicides—indicate a need to focus on segregation's effects on the region's prosperity. We document Chicago over time, compare it with other metropolitan regions, and estimate the effect on regional outcomes if Chicago had the median level of economic or racial segregation. By illustrating the costs of segregation in Chicago and situating Chicago within the broader context of the 100 most-populous CZs, this study provides a model for investigating costs in other regions. This report also aims to inform an initiative led by Chicago's Metropolitan Planning Council to increase integration at the city, county, and regional levels. The Metropolitan Planning Council will release a companion report for Chicago's local audiences expanding on our findings.

Background: Linking Segregation to Regional Outcomes

People in the United States live in neighborhoods segregated by race and income. Economic segregation has increased substantially, notably in the 1980s and since 2000. Economic segregation among people of the same race has also increased. Racial segregation has been slowly declining, but remains high. While segregation has well-documented negative effects on low-income people and communities of color, its effects on all residents across a region are not as well understood. Income inequality, metropolitan area size, and local demographics (e.g., racial composition, age composition, and educational profile) influence the level and trend[2] in segregation (Bischoff and Reardon 2014). Patterns are shifting within metropolitan areas as some suburbs experience sharp increases in poverty and racial diversity (Kneebone and Berube 2013; Raphael and Stoll 2010). These changes in metropolitan regional development and their potential impact on economic growth lead to questions about the relationship between residential segregation and regional prosperity.

Segregation persists for many reasons. In part, market processes create inequity. The wealth of people in the highest echelons does not necessarily benefit working-class people during periods of economic expansion. Furthermore, government policies tend to benefit people with wealth, such as homeowners who receive federal tax benefits. Even income-based policies to increase investment in cities and neighborhoods have not reduced concentrated poverty in minority neighborhoods. Finally, places with majority-white, affluent populations tend to remain segregated because of exclusionary policies that hinder economic mobility options, such as caps on multifamily rental housing. Enduring patterns of segregation make fostering a more inclusive metropolis difficult.

Many mechanisms lead to contemporary institutionalized economic and racial segregation. Rising income inequality is a key driver of economic and racial segregation. Income inequality has been on the rise since the 1980s. American workers in the bottom 50 percent have not experienced income growth in 35 years, but those in the top 1 percent earn 81 times more than the average worker (Piketty, Saez, and Zucman 2016). This growing income inequality has the most detrimental consequences for communities of color because these communities are disproportionately represented in the middle- to lower-income spectrum. Furthermore, a dramatic gap in household income and wealth exists along racial lines, borne out of policies and institutional practices that have caused differential access to asset-building opportunities (Roithmayr 2014). As recently as 2013, white households' median net worth was more than 10 times greater than Latino and black households' (Annie E. Casey Foundation 2016). Furthermore, the assets needed for financial mobility, such as a college fund and homeownership, are more likely to be obtained and generationally inherited by whites than nonwhites. Finally, racial and ethnic minorities face barriers to accessing rental and for-sale housing in middle-income and majority-white neighborhoods, in part because of discrimination (Turner et al. 2013). Income inequality, racial wealth gaps, barriers to housing mobility, and inherited spatial organization of entire metropolitan areas exacerbate residential segregation.

Economic Segregation

Economic segregation is higher today than it was in 1970 (Florida and Mellander 2016; Logan and Stults 2011; Reardon and Bischoff 2011). The share of Americans living in middle-income neighborhoods dropped from 65 percent in 1970 to 42 percent in 2009, and the share of families living in neighborhoods defined as either rich or poor has grown rapidly (Bischoff and Reardon 2014). While economic segregation is increasing, high-poverty neighborhoods and the people living in them have grown in recent years, and the trend is noteworthy in communities of color (Jargowsky 2015; Kneebone and Holmes 2015). Since 2000, the number of people living in areas of concentrated poverty has nearly doubled, from 7.2 million to 13.8 million in 2013 (Jargowsky 2015). Approximately 14.4 percent of the US population lived in high-poverty neighborhoods between 2009 and 2013, with blacks[3] and Latinos disproportionately likely to do so (Jargowsky 2015). Relatedly, the proportion of families living in high-income neighborhoods has risen (Reardon and Bischoff 2016).

Income segregation rose during and after the Great Recession, with middle-class, mixed-income neighborhoods becoming less common after 2007, and high-poverty and high-affluence neighborhoods becoming more common (Reardon, Fox, and Townsend 2015). About a third of households in the largest

117 metropolitan areas live in neighborhoods of either concentrated poverty or concentrated affluence (Reardon and Bischoff 2016). The growth of affluent neighborhoods has exceeded the growth of disadvantaged neighborhoods, with double the proportion of residents living in these isolated areas since the 1970s. These affluent neighborhoods are increasingly geographically distant even from moderate-income neighborhoods (Pendall and Hedman 2015; Bischoff and Reardon 2014).

Racial Segregation

Segregation between white households and black households remains stubbornly high, as the country grapples with the legacy of discriminatory legal, regulatory, and economic structures and practices (Jackson 1985; Massey and Denton 1993; Hirsch 1998; O'Connor 1999; Sugrue 1996). Differences in income, wealth, educational attainment, and occupational status are not enough to explain away the high level of black-white residential segregation (Logan 2013). Regions with few black households have seen greater levels of racial integration in the past 30 years. In contrast, the metro areas with the largest black populations (e.g., Detroit, Milwaukee, and Chicago) have been challenged by enduring patterns of racial segregation, with only modest declines since the 1980s (Logan and Stults 2011; Massey and Tannen 2015).

Racial segregation between Latinos and whites has historically been lower than between blacks and whites. But like blacks, Latinos have been subject to discriminatory rules, laws, and practices (Logan 2011). Latino-white segregation has remained stable since 1970, but has increased in metro areas with large concentrations of undocumented migrants (Hall and Stringfield 2014). Metro areas with the largest Latino populations (e.g., Los Angeles, New York, and Newark) tended to remain substantially segregated, while others (e.g., Las Vegas and Washington, DC) have seen increasing segregation alongside rapid Latino population growth. Empirical analysis has generally concluded that Latinos' segregation from whites can be explained mainly by differences in race (i.e., dark-skinned Latinos experience higher segregation from whites than light-skinned ones do), income, educational attainment, and nativity (Lichter, Parisi, and Taquino 2015).

While whites tend to live in neighborhoods with few nonwhites, this, too, has slowly been changing. In 1980, the average white person lived in a neighborhood where 88 percent of the population was white; by 2010, the average white person was living in a neighborhood that was 75 percent white (Logan and Stults 2011).

The Relationship between Economic and Racial Segregation

It is difficult to understand how racial and socioeconomic segregation interact. Research demonstrates that economic segregation differs by race and ethnicity. White households are increasingly living in poorer neighborhoods compared with 30 years ago, when they lived in more mixed-income areas (Firebaugh and Farrell 2016). Black and Latino families are also increasingly living in economically segregated communities. This trend toward increased income segregation among racial minorities means that low-income black and Latino families had fewer middle-class neighbors of the same race in 2009 compared with 1980 (Bischoff and Reardon 2014). Furthermore, black and Latino households (including upper-income households) tend to remain segregated from whites, living in high-poverty neighborhoods (Firebaugh and Farrell 2016; Intrator, Tannen, and Massey 2016). Black households experience lower likelihoods of spatial assimilation with whites than Latinos or Asians (Intrator, Tannen, and Massey 2016).

The Effects of Segregation

Evidence suggests that metropolitan regions' spatial patterns affect the socioeconomic mobility and life chances of different segments of the population. Neighborhoods of origin also shape opportunities for socioeconomic advancement. The concentration of social, economic, and environmental resources and hazards shape neighborhoods, and structural arrangements of affluence and poverty perpetuate systems of advantage and disadvantage (Sampson 2012; Sharkey 2013). High degrees of segregation based on race and class result in stratifying access to education and other public services, opportunities for social interaction, labor market prospects, and health outcomes.

Advantages for people living in highly segregated neighborhoods include greater access to resources, such as safer streets, higher home values, quality municipal services, and better schools. Ellen, Steil, and De la Roca (2016) show that white households living in more segregated regions tend to confer greater benefits over time. Whites in racially segregated metropolitan areas have higher wages, complete college at higher rates, and attain higher-status occupations than whites in desegregated areas. Segregation undermines these same outcomes for Latinos and blacks.

Research demonstrates the relationship between neighborhoods of origin and later socioeconomic outcomes, such as the associations of neighborhood disadvantage with cognitive and academic outcomes for youth (Sharkey 2013). Concentrated poverty, one form of economic segregation, is related to long-term negative outcomes for people who live in high-poverty neighborhoods (Chetty,

Hendren, and Katz 2016). Intergenerational mobility varies across metro areas, whereby children growing up in metros with higher levels of racial and economic segregation are less likely to advance economically (Chetty et al. 2014). In particular, blacks living in hypersegregated areas are exposed to elevated levels of crime and violence, pervasive joblessness, lower levels of educational attainment, low collective efficacy, and chronic physical and psychological health conditions (Massey and Tannen 2015). Children with more exposure to distressed neighborhoods have worse educational outcomes, such as high school graduation and academic test performance, than other children (Burdick-Will et al. 2011; Wodtke, Harding, and Elwert 2011). Racial segregation and inequity are also negatively associated with wealth building among people of color, impairing their capacity to become homeowners or start small businesses (Shapiro, Meschede, and Osoro 2013).

While the current literature considers individual- and neighborhood-level segregation, there remains a need to understand how segregation affects the prosperity of everyone in a metropolitan area. Dreier and coauthors (2014) argue that the "vicious circle of sprawl and economic segregation…imposes significant costs on all parts of metropolitan areas," including taxpayers living in more privileged parts of metro areas who must pay for public services such as criminal justice and public health systems (58). Evidence suggests metropolitan areas with higher levels of residential segregation by race and by skill level have slower economic growth (Li, Campbell, and Fernandez 2013) or shorter periods of economic growth (Benner and Pastor 2015) than areas with low levels of segregation. But other work has found a positive relationship between economic segregation and outcomes such as wages, output per capita, income, size of the technology sector, educational attainment, and size of the "creative class" (Florida and Mellander 2016).

This literature provides preliminary explanations for why metropolitan areas with high levels of inequality suffer economic impairment, but more research is needed. We argue that by considering both economic and racial segregation, we can shed light on how various types of segregation affect regional economic and social outcomes.

Measuring Segregation: Data, Definitions, and Methods

Measures of Segregation

Measures of economic segregation quantify how many low- and high-income households live near one another in a geographic area, in our case, a commuting zone. To analyze economic segregation, we use the Generalized Neighborhood Sorting Index (GNSI). The GNSI (described in appendix B) measures how many people of similar incomes "clump" together within a metropolitan region, how many poor households tend to live in neighborhoods made up of mostly other poor households, and how many rich households tend to live in neighborhoods made up of other richer households. The GNSI compares the variation in income across a region's *neighborhoods* with the variation in income across *households*. We use census tracts as proxies for neighborhoods, and the GNSI accounts for income distributions in adjacent tracts, to incorporate an extra measure of the proximity of richer and poorer neighborhoods to one another. The GNSI ranges from 0 (perfect integration) to 1 (perfect segregation).

For racial segregation, we focus on the spatial proximity (SP) index, a measure of "clustering," or how much groups cluster into enclaves within a region. The SP index is the average of intra-group proximity for a minority and majority population group, weighted by each group's share of the total population. This index equals 1.0 if there is no difference in clustering, and it exceeds 1.0 if members of one group live closer to one another than to another group. It can be less than 1.0 if members of one group live nearer to members of the other group than to their own group (this outcome generally only occurs with small minority groups).[4] An alternative measure of segregation, the D index, measures "evenness," or the distribution of a population group across a region. Although the D index is the most widely used measure of racial segregation, the SP index better accounts for larger spatial patterns that the D index cannot (Massey and Denton 1988). Because we can intuit how clustering can lead to deleterious effects (e.g., a racial group clustered in a part of a region without good access to jobs or transportation or with harmful environmental factors), we believe this measure is more suited to this analysis.[5] Nevertheless, we present results using the D index in appendix C.

For our measures of racial segregation, we again take the census tract as the proxy for neighborhood. Tracts, while not a perfect measure of a true neighborhood, have a small scale and relative stability.

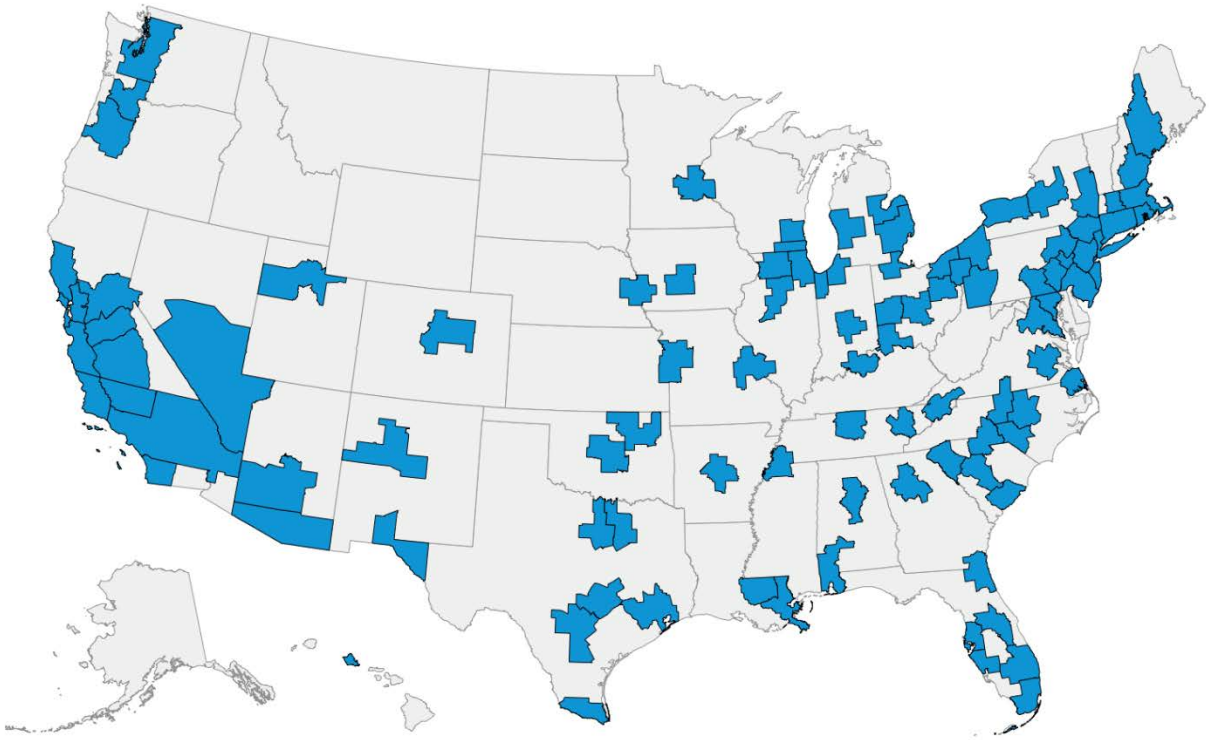
Defining and Selecting Regions for Analysis: The Commuting Zone

We analyze the 100 most-populous commuting zones as of the 1990 Census (figure 1). Commuting zones are groups of counties whose commuters work in a unified regional labor market. They better reflect a regional economy than do arbitrarily drawn political units such as counties or municipalities. Unlike metropolitan areas, CZs include rural areas and cover the entire United States.[6]

Our data on these 100 CZs comes from the 1990, 2000, and 2010 Censuses and the 2008–12 American Community Survey (which we refer to as 2010, the central year of these five-year estimates). This provides a sample of 300 observations (100 CZs * 3 years) for most of our models. Models for homicide rates only use data from 2000 and 2010, so those models have 200 observations.

FIGURE 1

Commuting Zones Included in Our Analysis



Methods of Analysis

Segregation's effects can ripple through a community in many ways. We consider the relationship between segregation and CZ outcomes across multiple domains. Segregation that keeps workers away from employers can exact an economic toll on a region. We measure this toll by examining income. We consider a CZ's household median income and per capita income. In addition to CZ average income, we assess relationships between segregation and income separately by race and ethnicity, as segregation's effects may be felt differently by whites, blacks, and Latinos. Segregation may also manifest in school-based outcomes, perhaps through more resource-constrained schools in low-income, segregated neighborhoods. To assess that relationship, we focus on a CZ's share of adults ages 25 and older who have attained a four-year college degree. We consider outcomes for all by race and ethnicity. Further, segregation may contribute to crime rates, as isolation may breed distrust and disrespect and as people in isolated resource-constrained neighborhoods turn to criminal activity for material support. Because many crimes are not reported consistently across jurisdictions, we focus on homicide rates. Finally, because segregation can influence health outcomes through multiple mechanisms (e.g., lack of access to health care facilities, increased pollution because of longer commutes), we examine the relationship between segregation and life expectancy. The outcomes we consider are

- median household income,
- per capita income,
- proportion of residents ages 25 and older with bachelor's degrees,
- life expectancy, and
- homicide rate.

Comparing segregation and CZ outcomes, however, may present a misleading picture of the relationships because other features may be related to segregation and the outcomes considered. We examine the relationships in a multivariate regression framework. We hold constant the following CZ features:

- Inequality (measured by the Gini coefficient)
- Population size (the natural log of population)
- Share of the population that is white
- Share of all employment in the manufacturing sector

- Age of the population (share under age 25 and share ages 25 to 54)
- The year these factors are measured

Holding these variables constant allows us isolate segregation's effects on our outcomes of interest. Inequality is closely related to segregation, but because our research questions are about inequality's spatial manifestation, we need to make sure our findings speak to segregation apart from inequality. We focus on other variables for several reasons. We want to control for population size because larger metropolitan regions, on average, have higher incomes. Larger metro regions also generally occupy more land and offer households greater diversity in the neighborhoods and jurisdictions where they might live. Manufacturing has historically provided well-paying middle-skill jobs and could influence incomes. Furthermore, incomes vary by age and race, so we need to account for differences in age and racial composition across metropolitan regions.

Another significant concern is that the outcomes are determined by the same historical economic and social processes that influence segregation. Historical factors and factors we cannot observe are hard to quantify. The quality of race relations may mean some CZs have higher (or lower) levels of segregation and better (or worse) outcomes. For example, a region could be a major destination for migrants because of well-paying jobs, but could still constrain those migrants into particular enclaves. This would mean higher incomes, but higher segregation. Because we are interested in understanding whether there would be better average outcomes with less segregation *within that context*, we need to account for preexisting differences between CZs that are difficult to capture with conventional data. To do this, we estimate fixed effects models, which involves adding an indicator variable for each CZ. The estimates are based on variation in segregation and outcomes within each CZ over time and then averaged over the 100 CZs.[7]

We estimate models of the following type

$$Y_{it} = \alpha + \beta_1 GNSI_{it} + \beta_2 SP(BW)_{it} + \beta_3 SP(LW)_{it} + \lambda X_{it} + \delta C_i + \varepsilon_{it}$$

where Y_{it} represents the outcome considered (e.g, median income) in the ith CZ in year t. GNSI, SP(BW), and SP(LW) measure economic, black-white, and Latino-white segregation, respectively, by CZ and year. X represents the other factors (e.g., inequality, share of manufacturing jobs) we take into account, and C represents the indicator variables (fixed effects) for the CZs. α, β, λ, and δ are the estimators of the relationships between these factors and the outcomes we consider, and ε is a random error term. If segregation has deleterious effects on a CZ's residents' economic well-being, educational attainment, safety, and health, we would expect the estimated coefficients on the segregation measures (the βs) to

be negative. Finally, for Chicago, we use results from our regression analysis to estimate how outcomes in the Chicago region would change if segregation levels there had been at the median of the 100 CZs in our analysis.

Plan of Analysis

The remainder of this report has three major sections. The first discusses levels and trends in racial and economic segregation from 1990 through 2010. The second presents our multivariate analysis of segregation's effects on various outcomes. The third discusses Chicago over time and compared with other metropolitan regions. The next section focuses on correlations and compares CZs with one another but does not control for other outcomes. The subsequent section will address how other factors (e.g., racial composition or population size) affect outcomes. Although much of our analysis discusses economic and racial segregation separately, the analysis combines the two into a single model and measures the effects of one form of segregation while holding the other form constant. Finally, although our discussion of the Chicago region is mostly contained within the third analysis section, we use it as an example in the other sections.

Results I: Economic and Racial Segregation over Time

Economic Segregation

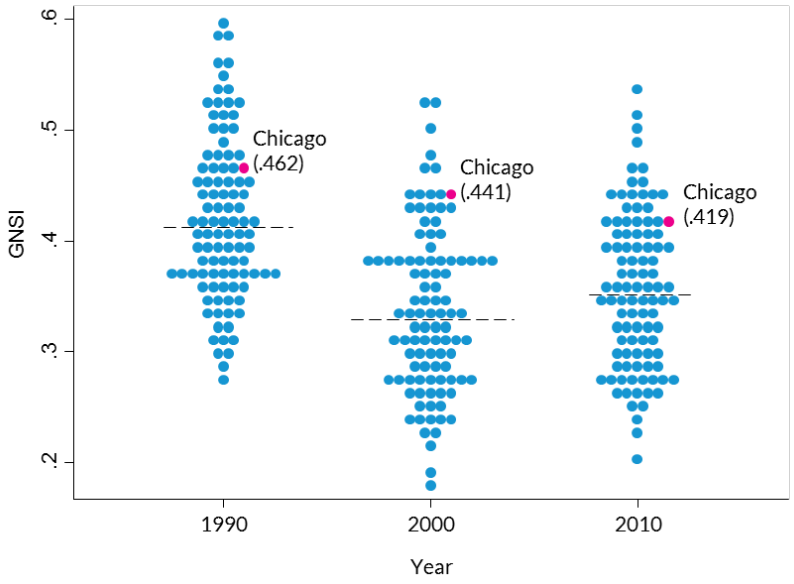
Economic segregation in the 100 most-populous CZs, as measured by the GNSI, has varied over time. Figure 2 shows distribution dot plots for 1990, 2000, and 2010. These represent the 100 CZs as dots, sorted according to their GNSI for a given year, with the median represented by a red dotted line (given 100 CZs, 50 are above the line, and 50 are below).

Regional economic segregation declined during the 1990s, but grew after 2000. Between 1990 and 2000, economic segregation, as measured by the GNSI, increased in 8 CZs and decreased in 92. The median GNSI fell from 0.413 to 0.331, and the GNSIs for the most segregated and least segregated CZs dropped as well. From 2000 to 2010, in contrast, the GNSI increased in 72 CZs and fell in 28, with the median climbing to 0.353. The CZ with the median level of segregation in 1990 would have been at or above the 25 percent threshold in 2000 and 2010. Metropolitan Chicago illustrates how the change

within a CZ can relate to overall change. Chicago's level of economic segregation dropped at a consistent rate in the 1990s and the 2000s, but its segregation relative to other CZs changed notably because its drop in the 1990s was small compared with the general trend, and its drop in the 2000s came during an overall increase.

FIGURE 2

GNSI Distribution by Year



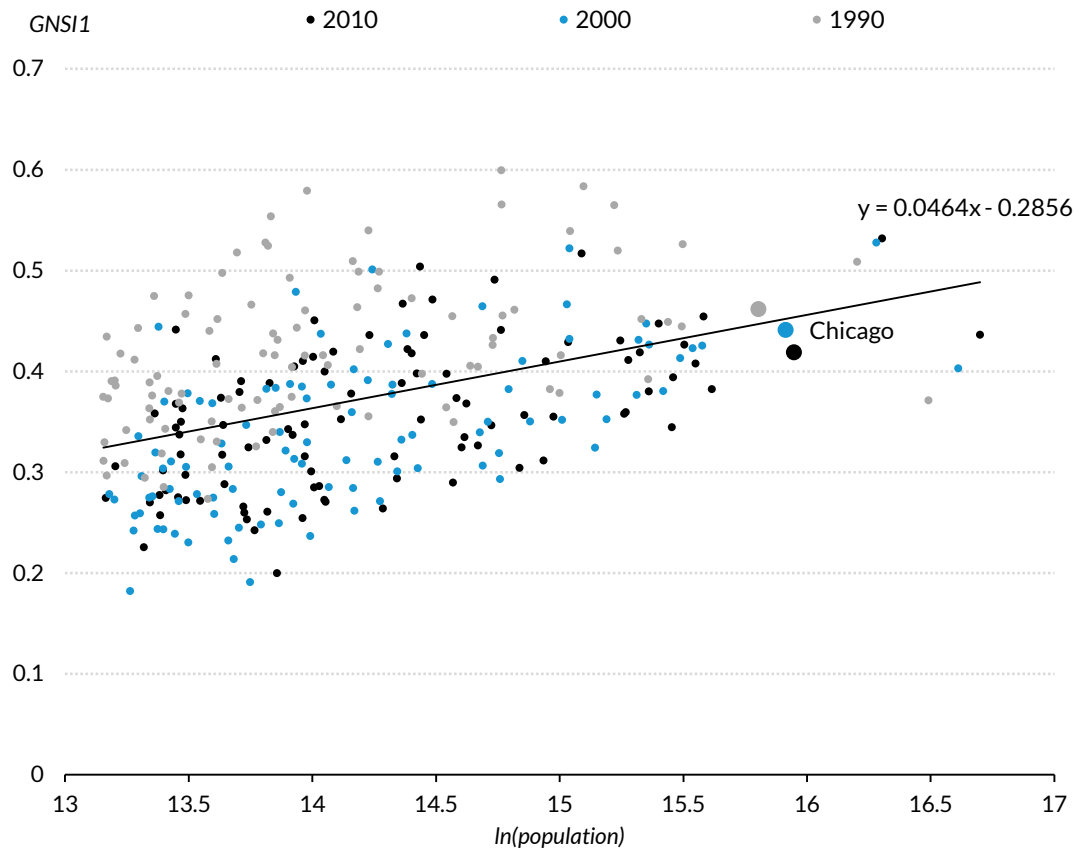
Source: Authors' calculations from the 1990 and 2000 Censuses and the 2008–12 American Community Survey (for 2010 income data).
Notes: GNSI = Generalized Neighborhood Sorting Index. Chicago represented with magenta; median represented with dashed line.

A dozen commuting zones—spanning all regions of the United States—have consistently remained in the top quarter of CZs ranked by economic segregation between 1990 and 2010: New York City, New York; Charlotte, North Carolina; Kansas City, Missouri; Philadelphia, Pennsylvania; Louisville, Kentucky; San Francisco, California; Nashville, Tennessee; Dallas, Texas; St. Louis, Missouri; Washington, DC; Austin, Texas; and Richmond, Virginia (listed in descending order of segregation in 2010). Seventeen CZs have consistently ranked among the 25 least segregated (e.g., Modesto, California; Brownsville, Texas; Portland, Maine; Racine, Wisconsin; Harrisburg, Pennsylvania; and Eugene, Oregon).

The level of economic segregation is positively related to a CZ's population: larger CZs are more segregated (figure 3).

FIGURE 3

Economic Segregation and CZ Population Size, GNSI versus ln(population)



Source: Authors' calculations from the 1990 and 2000 Censuses and the 2008–12 American Community Survey (for 2010 income data).
Notes: CZ = commuting zone. GNSI = Generalized Neighborhood Sorting Index. Each dot represents one of the 100 most-populous CZs in a year. We highlight Chicago using larger dots. R^2 = 0.1787; adjusted R^2 = 0.1851.

Racial Segregation

In general, black-white segregation is higher than Latino-white segregation (figures 4 and 5). The median black-white SP index was 1.374, and the median Latino-white SP index was 1.177. Nevertheless, 27 CZs had higher levels of Latino-white segregation than black-white segregation. The SP index compares the average distance between members of one group (e.g., clustering) with another group.

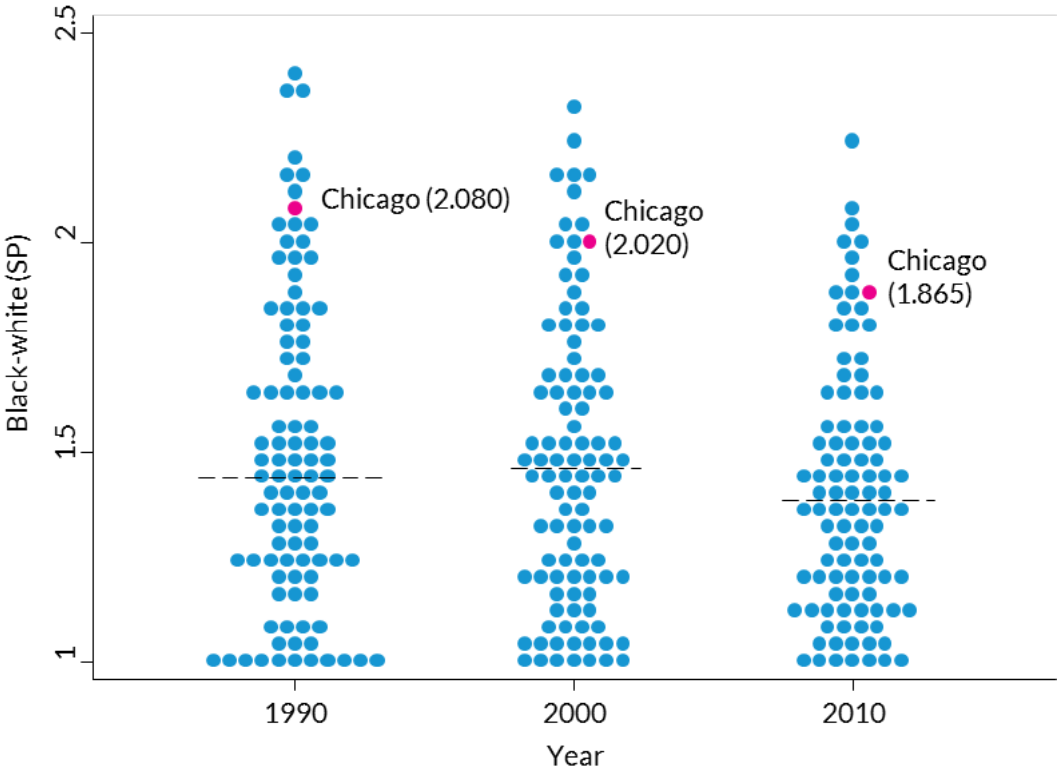
In 2010, the CZ with the highest level of black-white segregation was Milwaukee, Wisconsin (with an SP index of 2.251), and the CZ with the lowest black-white SP index (1.004) was Eugene, Oregon. Black-white segregation may be low there because blacks make up only 1 percent of Eugene's population. In 2010, Reading, Pennsylvania, had the highest Latino-white SP index (2.554), and Mobile, Alabama, had the lowest (1.007). The relative rankings of racial segregation have remained comparatively more consistent than have rankings of economic segregation, as several CZs remained among the 10 most segregated in black-white or Latino-white segregation:

- Black-white segregation
  - » Milwaukee, Wisconsin; Newark, New Jersey; Saginaw, Michigan; Birmingham, Alabama; Detroit, Michigan; Cleveland, Ohio; and Chicago, Illinois, have remained in the top 10 (ranked in descending order by 2010 level)
  - » Eugene, Oregon; Brownsville, Texas; Albuquerque, New Mexico; Salt Lake City, Utah; Santa Rosa, California; Santa Barbara, California; Tucson, Arizona; Modesto, California; and Scranton, Pennsylvania, have remained in the bottom 10 (ranked in ascending order)
- Latino-white segregation
  - » Reading, Pennsylvania; Springfield, Massachusetts; Bridgeport, Connecticut; Philadelphia, Pennsylvania; Newark, New Jersey; and Chicago, Illinois, have remained in the top 10 (ranked in descending order by 2010 level)
  - » Dayton, Ohio; Johnson City, Tennessee; Baton Rouge, Louisiana; and Cincinnati, Ohio, have remained in the bottom 10 (ranked in ascending order).
- Only Newark, New Jersey, and Chicago, Illinois, have remained in the top 10 for both indicators since 1990. No CZs were in the bottom 10 in both indicators between 1990 and 2010.

The median black-white SP index also dropped from 1.439 in 1990 to 1.374 in 2010, while the median Latino-white SP index increased from 1.043 to 1.177. There are also outliers (i.e., values 1.5 times more than the level at the top 25 percent or 1.5 times less than the level at the bottom 25 percent) when using the SP index. For black-white segregation, Milwaukee, Wisconsin, is an outlier in 2010, and several CZs are outliers for the Latino-white SP index in all three years.

FIGURE 4

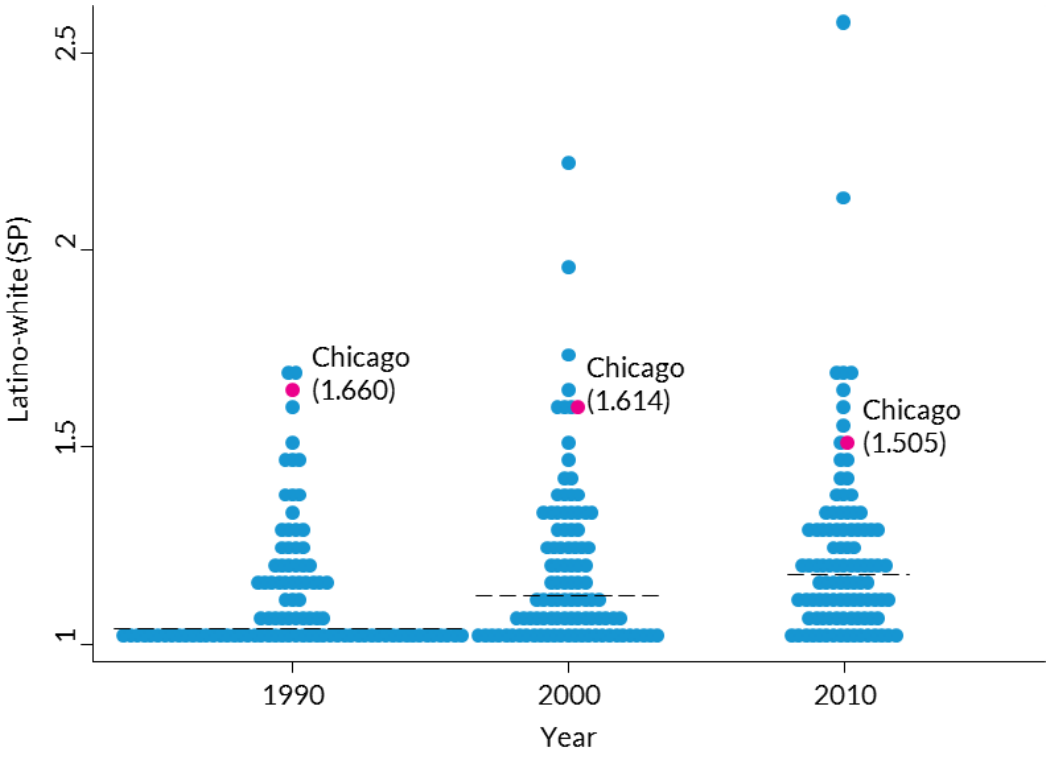
Black-White Racial Segregation (SP Index)



Source: Data from the 1990, 2000, and 2010 Decennial Censuses, calculated using the Geo-Segregation Analyzer. See Philippe Apparicio, Éric Fournier, and Denis Apparicio, "Geo-Segregation Analyzer: An Open-Source Software for Calculating Residential Segregation Indices," Geo-Segregation Analyzer, accessed March 17, 2017, http://geoseganalyzer.ucs.inrs.ca/.
Notes: SP = spatial proximity. Chicago represented with magenta; median represented with dashed line.

FIGURE 5

Latino-White Racial Segregation (SP Index)



Source: Data from the 1990, 2000, and 2010 Censuses, calculated using the Geo-Segregation Analyzer. See Philippe Apparicio, Éric Fournier, and Denis Apparicio, "Geo-Segregation Analyzer: An Open-Source Software for Calculating Residential Segregation Indices," Geo-Segregation Analyzer, accessed March 17, 2017, http://geoseganalyzer.ucs.inrs.ca/.
Notes: SP = spatial proximity. Chicago represented with magenta; median represented with dashed line.

Economic and Racial Segregation Compared

Regions with higher levels of racial segregation are generally more economically segregated. The relationship between the two segregation types is stronger when measuring black-white segregation and weaker when measuring Latino-white segregation (table 1). A highly economically segregated CZ is likely to have high levels of black-white segregation, but only somewhat likely to have high levels of Latino-white segregation. The strength of these relationships varies, growing between 1990 and 2000 and then falling between 2000 and 2010 (table 2). The strength of the relationship between the GNSI and the SP index rose from 1990 to 2000 and fell from 2000 to 2010. Reducing racial segregation may reduce economic segregation and vice versa.

TABLE 1

Economic and Racial Correlation Matrix (Combined Years)

	GNSI	Black-white spatial proximity	Latino-white spatial proximity
GNSI	1.000		
Black-white spatial proximity	0.300	1.000	
Latino-white spatial proximity	0.107	0.265	1.000

Source: Authors' calculations from the 1990, 2000, and 2010 Censuses and the 2008–12 American Community Survey (for 2010 income data).
Note: GNSI = Generalized Neighborhood Sorting Index.

TABLE 2

Economic and Racial Correlation Matrix, by Year

		1990	2000	2010
Black-white	GNSI/spatial proximity	0.301	0.344	0.257
Latino-white	GNSI/spatial proximity	0.150	0.279	0.185

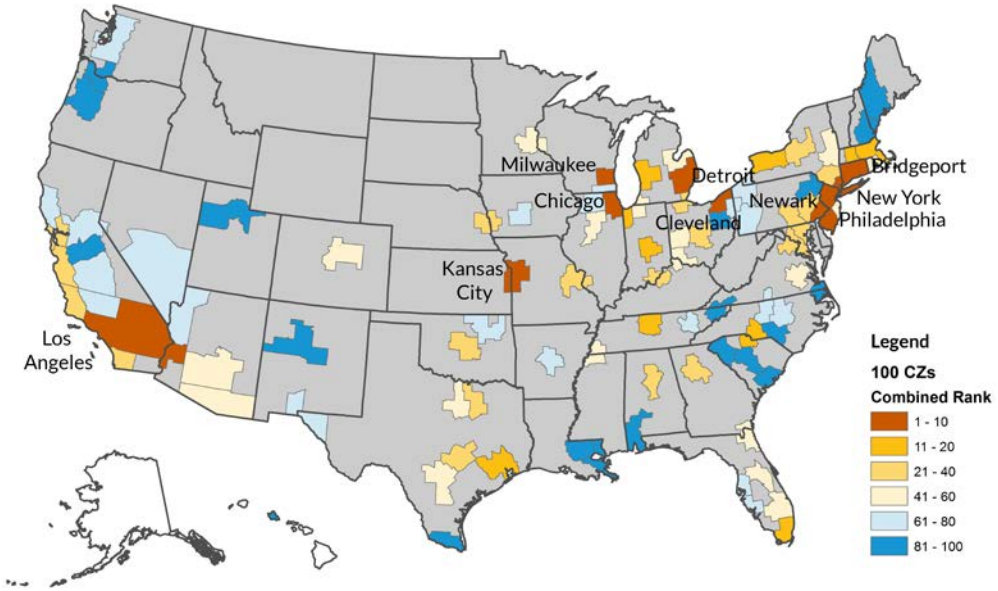
Source: Authors' calculations from the 1990, 2000, and 2010 Censuses and the 2008–12 American Community Survey (for 2010 income data)..
Note: GNSI = Generalized Neighborhood Sorting Index.

Given the relationship between economic and racial segregation, it is useful to understand patterns in how CZs are segregated across multiple measures. To illustrate this, we sum the individual rankings for all 100 CZs across the three measures of segregation: economic, black-white, and Latino-white, and then create a composite rank based on those ordinal properties (appendix table A.3).[8]

In 2010, the 10 CZs with the highest composite segregation rankings were (in order) Philadelphia, Pennsylvania; Bridgeport, Connecticut; New York City, New York; Milwaukee, Wisconsin; Chicago, Illinois; Cleveland, Ohio; Newark, New Jersey; Los Angeles, California; Kansas City, Kansas and Missouri; and Detroit, Michigan (figure 6). The top 10 CZs have been stable over time (although individual rankings have shifted somewhat). The top 10 CZs in 2000 included all these CZs (and because of a tied ranking, included Boston, which ranked ninth). Six of the top 10 in 1990 remained in the top ten in 2010, with Bridgeport, Los Angeles, Kansas City, and Detroit moving in to the 10 in 2010, replacing Gary, Indiana; Houston, Texas; Washington, DC; and Dallas, Texas.

FIGURE 6

CZs by Combined Segregation Measures Rank, 2010



Source: Authors' calculations from the 2010 Census and the 2008–12 American Community Survey.
Notes: CZ = commuting zone. Top 10 CZs named.

Results II: The Cost of Segregation

We examine how segregation influences CZ economic well-being, educational attainment, safety, and health. Average levels of our outcome measures by year and race or ethnicity (when available) appear in table 3. Median household income and per capita income (adjusted for inflation) rose between 1990 and 2000 and fell between 2000 and 2010. Median household income overall and for blacks and Latinos remained below its 1990 level, even in 2010. Whites, however, had higher median household incomes in 2010 than in 1990. Per capita incomes in 2010 exceeded their 1990 levels overall and for whites and blacks, but not for Latinos. Whites consistently have higher incomes than blacks and Latinos, and although blacks have lower household incomes than Latinos, their per capita incomes are similar. (Black households have fewer members on average than Latino households.) Bachelor's degree (BA) attainment increased over the 20-year period, reaching almost 30 percent by 2010, with whites more likely to hold BAs than blacks and Latinos. The share of whites with BAs is more than double the share of Latinos with BAs. Homicide rates declined between 2000 and 2010, falling from 5.33 to 4.90 homicides per 100,000 people. And consistent with national trends, life expectancy in the 100 most-populous CZs rose from 75.2 years in 1990 to 78.5 years in 2010.

TABLE 3

Table of Means: Selected Outcome Variables for the 100 Most-Populous CZs

		Median income (adj. $)	Per capita income (adj. $)	Share with BA (%)	Homicide rate (per 100,000)	Life expectancy
All	1990	58,707	27,308	20.3	NA	75.2
	2000	61,991	30,660	24.4	5.33	76.7
	2010	56,390	28,695	28.4	4.90	78.5
White	1990	62,320	31,005	22.7	NA	NA
	2000	67,888	35,993	27.9	NA	NA
	2010	63,523	34,916	32.7	NA	NA
Black	1990	38,780	17,110	12.1	NA	NA
	2000	43,202	20,774	14.7	NA	NA
	2010	37,624	18,909	18.2	NA	NA
Latino	1990	48,846	17,933	14.5	NA	NA
	2000	49,373	18,237	13.6	NA	NA
	2010	42,186	16,158	14.9	NA	NA

Sources: Income and BA share from 1990, 2000, and 2010 Censuses and 2008–12 five-year American Community Survey; Life expectancy data come from Institute for Health Metrics and Evaluation; Homicide data from Uniform Crime Reporting Program (ICPSR 2006, 2014).
Notes: BA = bachelor's degree. CZ = commuting zone. Data are for the 100 most-populous CZs in 1990.

Next, we present the findings of our multivariate analysis, which analyzes the relationships between economic and racial segregation and CZ outcomes, while controlling for other relevant factors. Because our models incorporate both measures of segregation, we can discuss the effects of one measure, holding the other constant. We run the models (where possible) for the overall population, whites, blacks, and Latinos.

We use the GNSI to measure economic segregation, and we use the SP index to measure racial segregation.[9] The models consider other differences across CZs (e.g., inequality and population size) and use data on the 100 most-populous CZs from 1990, 2000, and 2010 (models for homicide rates only use data from 2000 and 2010).

Several interesting findings emerge from our analysis, although the strength of our results varies by outcome and race or ethnicity. We focus on statistically significant findings, but because we have at most 300 observations (100 CZs in each of three years) and are taking several factors into account, we cannot measure all these relationships with great precision. We note interesting and suggestive relationships that do not rise to conventional levels of statistical significance. Our key findings include the following:

- Higher levels of economic segregation are associated with lower median and per capita income and lower levels of bachelor's degree attainment across CZs for blacks.

- Higher levels of black-white segregation are associated with lower per capita income for blacks, lower educational attainment for both blacks and whites, and higher homicide rates.

Median Income

For the overall population, our models show no significant relationship between economic segregation and median household income, but our findings vary by race and ethnicity (table 4). We find no significant associations between median income and economic segregation for whites and Latinos, but blacks living in CZs with higher levels of economic segregation have lower median household incomes than those living in less economically segregated areas. To understand the relationship's magnitude, we consider what black median income would have been in 2010 had economic segregation remained at its 1990 level. Black median household incomes would have been 1.7 percent lower in 2010 had economic segregation remained as high as it was in 1990. Although our findings overall and for whites and Latinos are not measured precisely enough to consider them statistically significant, they all imply that higher levels of economic segregation are associated with lower median income.

Neither black-white nor Latino-white segregation are significantly associated with median household income. Even if any of the estimated relationships were statistically significant, they would have been small in magnitude. Racial and ethnic segregation cannot explain the variation in CZ median incomes overall or for any racial or ethnic group. The large differences in the median incomes of whites and blacks and Latinos in table 3 reflect factors other than racial segregation.

Other factors relate to median income at the CZ level. For example, higher levels of inequality are associated with lower median incomes. On average, the Gini coefficient, which we use to measure inequality, rose by 0.034 between 1990 and 2000, an increase associated with a 6.6 percent decline in median income. Commuting zones with larger populations and a greater proportion of manufacturing jobs also have higher median incomes. Finally, median incomes were higher in 2000 than in 1990 and 2010, consistent with the performance of the economy as a whole.

TABLE 4

Segregation and Median Household Income

	All	White	Black	Latino
Economic segregation (GNSI)	-0.0523	-0.1327	-0.2849*	-0.0251
	(0.0831)	(0.1019)	(0.1194)	(0.1062)
Black-white segregation (SP)	0.0318	0.0456	-0.0680	0.0738
	(0.0365)	(0.0389)	(0.0793)	(0.0831)
Latino-white segregation (SP)	0.0097	-0.0657	-0.0168	-0.0103
	(0.0240)	(0.0411)	(0.0428)	(0.0942)
Inequality	-1.9387*	-1.6810*	-5.9609*	-3.8957*
	(0.5155)	(0.6108)	(0.9230)	(0.9104)
ln(population)	0.1022*	0.1524*	0.1178	-0.0438
	(0.0408)	(0.0674)	(0.0752)	(0.0830)
Percent white	0.1261	-0.2633	-0.7096*	-1.0558*
	(0.2033)	(0.2394)	(0.3012)	(0.2872)
Percent manufacturing	0.6238*	0.4988*	0.5906*	0.7829*
	(0.1314)	(0.1710)	(0.3042)	(0.2913)
Percent < age 25	-0.5476	-0.6270	-1.1521	-1.5861*
	(0.5405)	(0.6600)	(0.9062)	(0.7650)
Percent ages 25 to 54	0.7315*	1.1703*	0.2735	1.2814
	(0.3939)	(0.5331)	(0.8172)	(0.7940)
Year = 2000	0.0667*	0.0562*	0.0812*	-0.0185
	(0.0153)	(0.0195)	(0.0276)	(0.0283)
Year = 2010	0.0272	0.0247	-0.0352	-0.1362*
	(0.0340)	(0.0415)	(0.0531)	(0.0541)
Intercept	9.9502*	9.4619*	12.2376*	13.5578*
	(0.8197)	(1.3119)	(1.4889)	(1.4277)

Source: Authors' tabulations from the 1990, 2000, and 2010 Censuses and the 2008–12 American Community Survey (for 2010 income data). Percent manufacturing from the Bureau of Labor Statistics' Quarterly Census of Employment and Wages.
Notes: GNSI = Generalized Neighborhood Sorting Index. SP = spatial proximity. * indicates significance at the 10 percent level.

Per Capita Income

Our models show no significant relationship between economic segregation and per capita income overall, but our findings vary by race and ethnicity (table 5). We find no significant associations between per capita income and economic segregation for whites and Latinos, but blacks living in CZs with higher levels of economic segregation have lower per capita income than those living in less economically segregated areas. We estimate that the per capita income of black people would have been 2.4 percent lower in 2010 than it actually was had economic segregation remained as high as it was in 1990. Again, while our findings overall and for whites and Latinos are not measured precisely enough to consider them statistically significant, they imply that higher levels of economic segregation are associated with lower per capita income.

Racial segregation has no significant association with per capita income overall, but findings vary by race and ethnicity. For whites and Latinos, we do not find a significant relationship between racial segregation and per capita income, but black per capita income is significantly lower in areas with higher levels of black-white segregation. We estimate that black per capita income would have been 1.5 percent lower in 2010 than it actually was had black-white segregation remained as high as it was in 1990. Although not statistically significant, our estimates suggest that Latino per capita income is lower in CZs with greater levels of Latino-white segregation and that white per capita incomes may be higher in CZs with greater levels of black-white and Latino-white segregation. Nevertheless, in addition to being statistically insignificant, the implied size of those associations is small.

Note that our models show that black per capita income is significantly lower in areas with higher levels of both economic and black-white segregation. This finding shows how different types of segregation work together to impede black residents' earnings.

Our models also show that per capita income is higher in CZs with lower levels of inequality, larger populations, a larger share of white people, and a greater share of manufacturing jobs. Per capita incomes was higher in 2000 and 2010 than in 1990, even when considering other factors.

TABLE 5

Segregation and Per Capita Income

	All	White	Black	Latino
Economic segregation (GNSI)	-0.0358	-0.0664	-0.4017*	-0.2169
	(0.0930)	(0.0698)	(0.1595)	(0.1439)
Black-white segregation (SP)	0.0244	0.0315	-0.2363*	0.1357
	(0.0351)	(0.0325)	(0.1107)	(0.1016)
Latino-white segregation (SP)	0.0236	0.0196	-0.0595	-0.0427
	(0.0255)	(0.0230)	(0.0476)	(0.1188)
Inequality	-0.85*	-0.6501	-4.095*	-2.994*
	(0.4561)	(0.4205)	(1.0351)	(1.2007)
ln(population)	0.0611*	0.0238	0.1065	-0.2835*
	(0.0360)	(0.0406)	(0.0732)	(0.1384)
Percent white	0.5525*	-0.2896*	-0.4251	-1.6349*
	(0.1800)	(0.1625)	(0.3658)	(0.4376)
Percent manufacturing	0.4313*	0.5326*	0.2775	0.6329
	(0.1226)	(0.1156)	(0.4240)	(0.4124)
Percent < age 25	-1.3085*	-1.4302*	1.1644	-2.5756*
	(0.4835)	(0.4333)	(1.4132)	(1.1982)
Percent ages 25 to 54	0.8383*	0.3590	0.4569	1.0822
	(0.3844)	(0.3951)	(1.1029)	(1.1867)
Year = 2000	0.1354*	0.1239*	0.173*	-0.0405
	(0.0131)	(0.0121)	(0.0396)	(0.0437)
Year = 2010	0.1248*	0.0958*	0.1121*	-0.1534*
	(0.0288)	(0.0267)	(0.0647)	(0.0885)
Intercept	9.2547*	10.7116*	10.1074*	16.4979*
	(0.7678)	(0.7937)	(1.6496)	(2.5084)

Source: Authors' tabulations from the 1990, 2000, and 2010 Censuses and the 2008–12 American Community Survey (for 2010 income data). Percent manufacturing from the Bureau of Labor Statistics' Quarterly Census of Employment and Wages.
Notes: GNSI = Generalized Neighborhood Sorting Index. SP = spatial proximity. * indicates significance at the 10 percent level.

Share of the Population with a Bachelor's Degree

We find no significant association between economic segregation and the share of a CZ's population with a bachelor's degree, but our findings vary by race and ethnicity (table 6). We find no significant associations between BA attainment and economic segregation for whites and Latinos, but blacks living in CZs with higher levels of economic segregation are less likely to attain a BA than those living in less economically segregated areas. We estimate that the proportion of a CZ's black residents with a BA would have been 0.5 percentage points higher in 2010 than it actually was had economic segregation remained as high as it was in 1990. Our findings overall and for whites and Latinos are statistically indistinguishable from zero, and the implied relationships are trivial.

Racial segregation, on the other hand, is significantly associated with BA attainment, but the relationship is complex. Commuting zones with greater levels of black-white segregation have a lower proportion of adult residents with a BA. In addition, greater levels of black-white segregation are associated with lower BA attainment among whites and blacks. We estimate that the proportions of a CZ's white and black residents with a BA would have been almost 0.3 percentage points higher in 2010 than it actually was had black-white segregation remained as high as it was in 1990. In contrast, we find that higher levels of Latino-white segregation are associated with higher levels of BA attainment, but the associations are insignificant when racial and ethnic groups are considered separately. The estimates by race and ethnicity are statistically insignificant and vanishingly small.

Nevertheless, blacks living in regions with higher levels of both black-white racial segregation and economic segregation are less likely to attain a BA than those living in less segregated areas. These types of segregation present barriers to black residents' educational attainment.

We also find that the share of a CZ's adults with a BA tends to be higher in CZs with more inequality, a larger proportion of white residents, and a greater percentage of manufacturing jobs. Over time, the share of CZ residents with a BA has risen (as it has for the nation).

TABLE 6

Segregation and Share of Adults Ages 25 and Older with a Bachelor's Degree

	All	White	Black	Latino
Economic segregation (GNSI)	0.0193	0.0111	-0.0777*	0.0170
	(0.0196)	(0.0246)	(0.0347)	(0.0538)
Black-white segregation (SP)	-0.0351*	-0.0404*	-0.0409*	0.0290
	(0.0110)	(0.0128)	(0.0197)	(0.0304)
Latino-white segregation (SP)	0.021*	0.0079	-0.0158	-0.0111
	(0.0108)	(0.0116)	(0.0124)	(0.0282)
Inequality	0.7525*	0.7628*	0.1257	-0.0942
	(0.1317)	(0.1652)	(0.1512)	(0.3818)
ln(population)	-0.0009	-0.0037	0.0262	-0.1049*
	(0.0151)	(0.0192)	(0.0185)	(0.0395)
Percent white	0.1828*	-0.0176	-0.1278*	-0.5342*
	(0.0666)	(0.0801)	(0.0707)	(0.1508)
Percent manufacturing	0.1308*	0.2068*	-0.0322	0.2132*
	(0.0462)	(0.0580)	(0.0665)	(0.1091)
Percent < age 25	0.3928*	0.3028*	0.2062	-0.8955*
	(0.1335)	(0.1784)	(0.1922)	(0.4441)
Percent ages 25 to 54	0.434*	0.3551*	0.1084	0.2910
	(0.1246)	(0.1649)	(0.2125)	(0.3400)
Year = 2000	0.0495*	0.0509*	0.0080	-0.0298*
	(0.0042)	(0.0052)	(0.0059)	(0.0138)
Year = 2010	0.1103*	0.1099*	0.0357*	-0.0266
	(0.0086)	(0.0108)	(0.0098)	(0.0294)
Intercept	-0.5521*	-0.2590	-0.2031	2.1941*
	(0.2915)	(0.3528)	(0.3674)	(0.8034)

Source: Authors' tabulations from the 1990, 2000, and 2010 Censuses and the 2008–12 American Community Survey (for 2010 income data). Percent manufacturing from the Bureau of Labor Statistics' Quarterly Census of Employment and Wages.
Notes: GNSI = Generalized Neighborhood Sorting Index. SP = spatial proximity. * indicates significance at the 10 percent level.

Life Expectancy

Economic segregation is not significantly associated with life expectancy, but our estimates suggest higher levels of economic segregation are associated with slightly longer life expectancy. Commuting zones with higher levels of black-white segregation tend to have lower life expectancy (although the relationship is not statistically significant), and CZs with higher levels of Latino-white segregation tend to have lower life expectancy (the relationship is statistically significant) (table 7). Had the level of Latino-white segregation remained at its 1990 level, life expectancy would have been about a month and a half longer in 2010 than it actually was.

Other factors are related to life expectancy at the CZ level, but the pattern of significant results is surprising. Life expectancy is longer in CZs with more inequality, but shorter in zones with higher

proportions of white residents. Commuting zones with a greater proportion of manufacturing jobs tend to have longer life expectancy. Finally, life expectancy is longer in 2000 and 2010 than in 1990.

TABLE 7

Segregation and Life Expectancy in Years

	All groups
Economic segregation (GNSI)	1.6766
	(1.0868)
Black-white segregation (SP)	-0.6320
	(0.4012)
Latino-white segregation (SP)	-1.0627*
	(0.5195)
Inequality	25.1071*
	(5.6885)
ln(population)	-0.4338
	(0.5742)
Percent white	-7.4254*
	(2.1107)
Percent manufacturing	5.6944*
	(1.9180)
Percent < age 25	-2.3484
	(7.4412)
Percent ages 25 to 54	5.6672
	(6.1622)
Year = 2000	1.1973*
	(0.2391)
Year = 2010	2.6473*
	(0.4840)
Intercept	75.9982*
	(10.7190)

Source: Authors' tabulations from the 1990, 2000, and 2010 Censuses and the 2008–12 American Community Survey (for 2010 income data). Percent manufacturing from the Bureau of Labor Statistics' Quarterly Census of Employment and Wages. Life expectancy data come from the Institute for Health Metrics and Evaluation.
Notes: GNSI = Generalized Neighborhood Sorting Index. SP = spatial proximity. * indicates significance at the 10 percent level.

Homicide Rate

Economic segregation is not significantly associated with homicide rates, but higher levels of black-white segregation are significantly associated with higher homicide rates (table 8). We estimate that in a typical CZ, there would be one more homicide per 100,000 residents in 2010 than actually occurred had black-white segregation remained as high as it was in 1990. Latino-white segregation is not significantly associated with homicide rates, but the direction of our estimate suggests that higher levels of Latino-white segregation are associated with lower homicide rates. Among other factors, only

population size is significantly associated with homicide rates, with more-populous CZs having fewer homicides per 100,000 residents than smaller CZs.

TABLE 8

Segregation and Homicides per 100,000 Population

	All groups
Economic segregation (GNSI)	2.8682
	(4.2088)
Black-white segregation (SP)	4.0114*
	(1.7171)
Latino-white segregation (SP)	-1.3003
	(2.3977)
Inequality	17.9302
	(19.1997)
ln(population)	-8.0622*
	(1.9918)
Percent white	-3.2837
	(9.0881)
Percent manufacturing	11.8123
	(8.4060)
Percent < age 25	24.4411
	(23.3114)
Percent ages 25 to 54	20.6799
	(16.9425)
Year = 2010	1.6509*
	(0.9856)
Intercept	90.1177*
	(35.0421)

Source: Authors' tabulations from the 1990, 2000, and 2010 Censuses and the 2008–12 American Community Survey (for 2010 income data). Percent manufacturing from the Bureau of Labor Statistics' Quarterly Census of Employment and Wages. Homicide data from the Uniform Crime Reporting Program (ICPSR 2006, 2014).
Notes: GNSI = Generalized Neighborhood Sorting Index. SP = spatial proximity. * indicates significance at the 10 percent level.

Caveats and Sensitivity Analyses

Various contemporaneous and historical factors influence the relationships between economic segregation, racial segregation, and CZ outcomes. Accounting for those factors and isolating the associations between segregation and the outcomes we consider can be challenging. Our ability to detect statistically significant associations is limited by available data. We have at most 300 observations. In addition, how we measure key factors (e.g., racial segregation) and how we believe the factors in our model interact (e.g., that segregation has the same effect on outcomes in large and small CZs) can also affect the relationships we find. Our results represent our best effort to measure

segregation and take into account factors that influence both segregation and the economic, educational, safety, and health outcomes we examine.

To see how sensitive our findings are to our modeling decisions, we estimated several alternative models. Most notably, we measured black-white and Latino-white segregation using a dissimilarity index rather than our preferred spatial proximity index. Those results appear in appendix C.[10] Those results are largely consistent with our main findings in direction and magnitude, but not always in statistical significance. Our main finding is that economic segregation impedes CZ residents' economic progress, particularly black residents. The results in our preferred and alternative models lead us to speculate about other associations that merit further exploration. In particular, our estimates lead us to speculate that in addition to the negative associations between racial segregation and outcomes for blacks, racial segregation may also be harmful to Latinos' income and educational attainment, but white income may be higher in CZs with higher levels of racial segregation.

Results III: What Does This Mean for Chicago?

In this section, we explore Chicago's case in three subsections. The first discusses the level and trends of segregation in the Chicago region and touches on how that segregation plays out on the ground. The second section compares segregation levels in Chicago with other CZs. The third section uses findings from our regression analysis to estimate the costs of segregation in the CZ if its segregation levels were lower. We do this by comparing Chicago's level of segregation with the level of the median CZ. Future research may use specific CZs for comparison. The Chicago commuting zone includes Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will counties.[11]

Segregation in Chicago

Chicago has consistently ranked among the country's most economically segregated CZs (table 9).[12] In 1990, it was the 26th most segregated among the 100 most-populous CZs. By 2000, it was the 9th most segregated, and in 2010, it ranked 20th. In 2010, the median CZs (Minneapolis, Minnesota, and Grand Rapids, Michigan) had GNSIs of about 0.353. New York City was the most economically segregated CZ with a GNSI of 0.531, and Eugene, Oregon, was the least segregated with a GNSI of 0.199.

TABLE 9

Segregation by Year: GNSI and SP Indexes, Chicago

	1990		2000		2010	
Economic segregation (GNSI)	0.462	(26)	0.441	(9)	0.419	(20)
Black-white (SP)	2.080	(8)	2.020	(9)	1.865	(10)
Latino-white (SP)	1.660	(3)	1.614	(5)	1.505	(9)

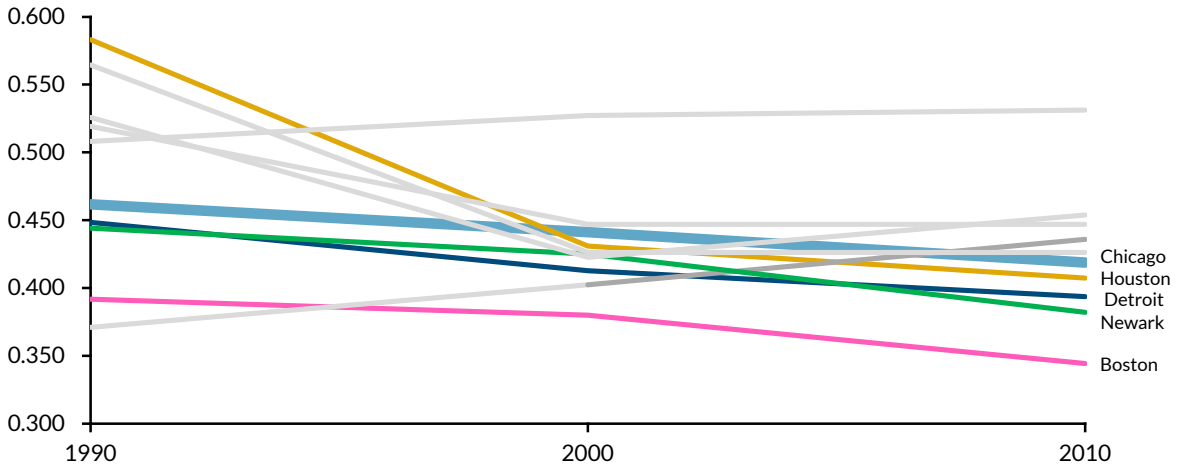
Source: 1990, 2000, and 2010 Decennial Censuses and 2008–12 American Community Survey. Economic segregation based on authors' calculations. Racial segregation calculated using the Geo-Segregation Analyzer. See Philippe Apparicio, Éric Fournier, and Denis Apparicio, "Geo-Segregation Analyzer: An Open-Source Software for Calculating Residential Segregation Indices," Geo-Segregation Analyzer, accessed March 17, 2017, http://geoseganalyzer.ucs.inrs.ca/.
Notes: GNSI = Generalized Neighborhood Sorting Index. SP = spatial proximity. Chicago's rankings out of the 100 most-populous commuting zones in parentheses.

Although the Chicago CZ has consistently had high levels of economic segregation, that level has decreased from 0.462 in 1990 to 0.441 in 2000 to 0.419 in 2010. The change from 1990 to 2010 represents a decrease of 0.043, somewhat less than the decline at the median of 0.058.[13] Further, compared with other CZs, the drop during the 1990s was comparatively small (87 of the 100 CZs had larger GNSI decreases). In contrast, the drop during the 2000s was comparatively large (only 9 of the 100 CZs had larger drops than Chicago). Nevertheless, even taking these drops into account, in 2010, Chicago's economic segregation would need to decrease by 0.066 to be on par with the median commuting zone. Over 20 years, 66 CZs had larger drops in economic segregation than Chicago. Compared with the 10 most-populous CZs in 1990, trends in Chicago are roughly in line with decreases in other CZs (figure 7A). Segregation in Los Angeles and New York City increased in both periods, while in Philadelphia, San Francisco, and Washington, DC, segregation decreased between 1990 and 2000 but then increased or stopped dropping between 2000 and 2010 (figure 7C).

FIGURE 7A

Economic Segregation, 1990–2010, 10 Most-Populous Commuting Zones in 1990

Commuting zones with decreasing segregation in both periods

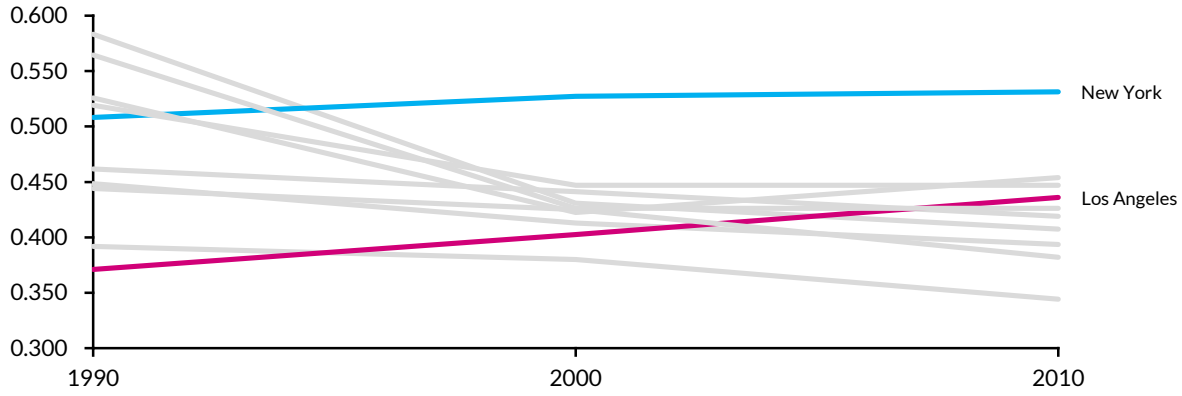


Source: Authors' calculations from 1990, 2000, and 2010 Censuses and 2008–12 American Community Survey estimates for 2010 Generalized Neighborhood Sorting Index.

FIGURE 7B

Economic Segregation, 1990–2010, 10 Most-Populous Commuting Zones in 1990

Commuting zones with increasing segregation in both periods

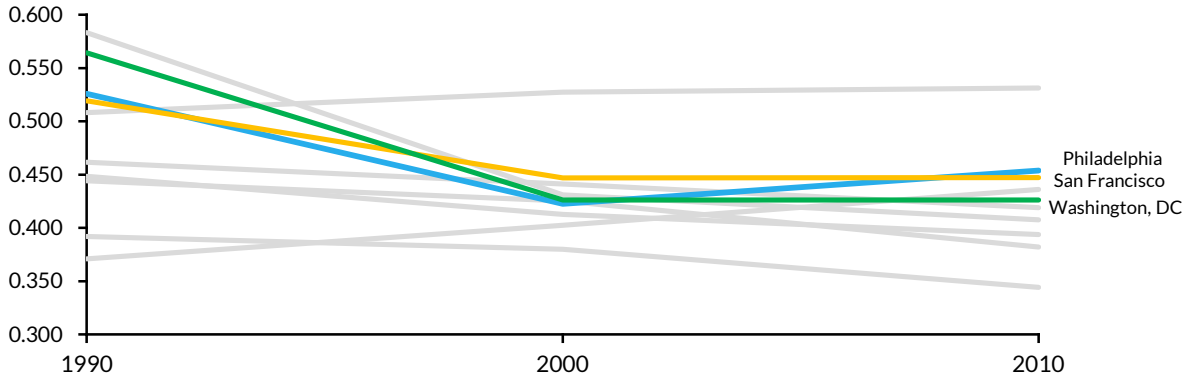


Source: Authors' calculations from 1990, 2000, and 2010 Censuses and 2008–12 American Community Survey estimates for 2010 Generalized Neighborhood Sorting Index.

FIGURE 7C

Economic Segregation, 1990–2010, 10 Most-Populous Commuting Zones in 1990

Commuting zones with changing segregation trends



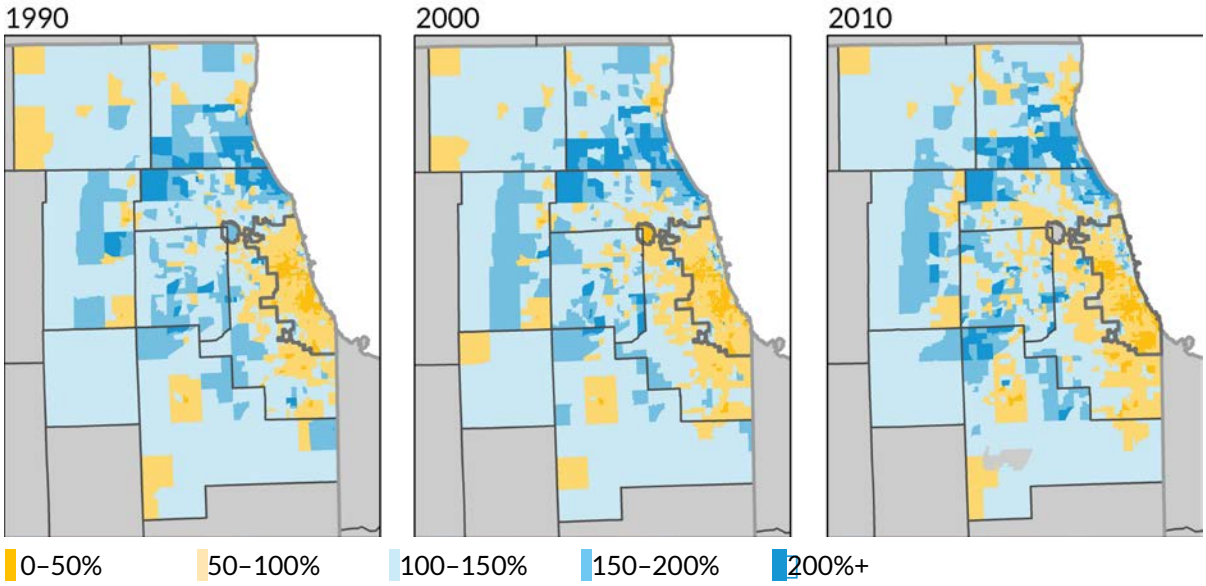
Source: Authors' calculations from 1990, 2000, and 2010 Censuses and 2008–12 American Community Survey estimates for 2010 Generalized Neighborhood Sorting Index.

Within the Chicago CZ, the pattern of economic segregation has remained relatively consistent. Figure 8 shows how median household income in individual census tracts compare with that of the whole CZ. The poorest tracts (with median household income less than half the area median) are shaded in dark orange, while the wealthiest tracts (with median household income twice the area median) are shaded in dark blue. Tracts with the lowest relative median income have clustered in the southern and western portions of the city and suburbs since the 1990s, and the southern portion of the city and the southern suburbs have seen noticeable increases in the number of these tracts. Areas of affluence have consistently been located in the northern and northwestern suburbs, with another region in the southwestern suburbs also increasingly visible.

The patterns of racial and ethnic segregation in Chicago have been extensively analyzed and discussed. Chicago has remained one of the 10 most–racially segregated CZs—whether measuring black-white or Latino-white—in the United States since 1990 (table 9). While Chicago remains among the most racially segregated regions, the absolute level of black-white and Latino-white racial segregation has dropped since 1990. For blacks, Chicago's drop was 19th largest of the 100 most-populous CZs, although its rank has remained relatively stable (dropping from the 8th most segregated to the 10th most). The drop compared with other CZs has been more striking for Latinos, where Chicago had the second-largest drop of the 100 most-populous CZs (and has dropped from the third most segregated to the ninth most), even as the region's Latino population grew between 1990 and 2010.

FIGURE 8

Median Tract Household Income as Percentage of Median Commuting Zone Income, Chicago Region



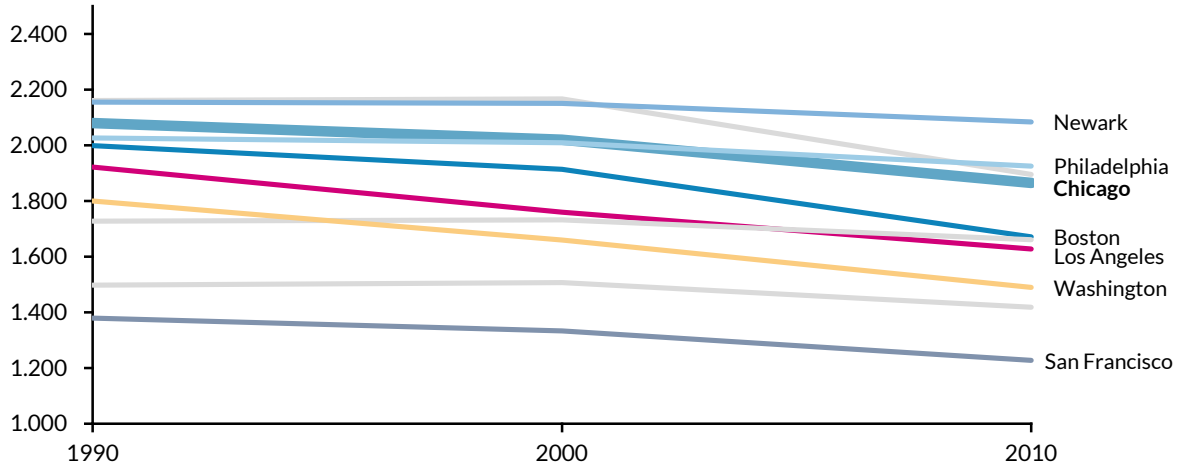
Source: Authors' calculations from the 1990 and 2000 Censuses and the 2008–12 American Community Survey (for 2010 income data).
Notes: Map uses 2000 and 2010 census tract boundaries from the 2010 vintage TIGER/Line shapefiles and 1990 census tract boundaries retrieved from the National Historical Geographic Information System.

For black-white segregation, the drop in Chicago between 1990 and 2010 took place in other large CZs, and in 2010, Chicago, Newark, Philadelphia, and Detroit were clustered with relatively high SPs (figures 9a and 9b). For Latino-white segregation, however, Chicago's downward trajectory counters that of most other large CZs (figures 10a and 10b). Besides Chicago, only in Los Angeles did Latino-white segregation decline in both the 1990s and the 2000s .That said, Chicago started as the most-segregated large CZ and remains comparatively highly segregated.

FIGURE 9A

Black-White Racial Segregation, 1990–2010, 10 Most-Populous Commuting Zones in 1990

Commuting zones with decreasing black-white segregation trends in both periods

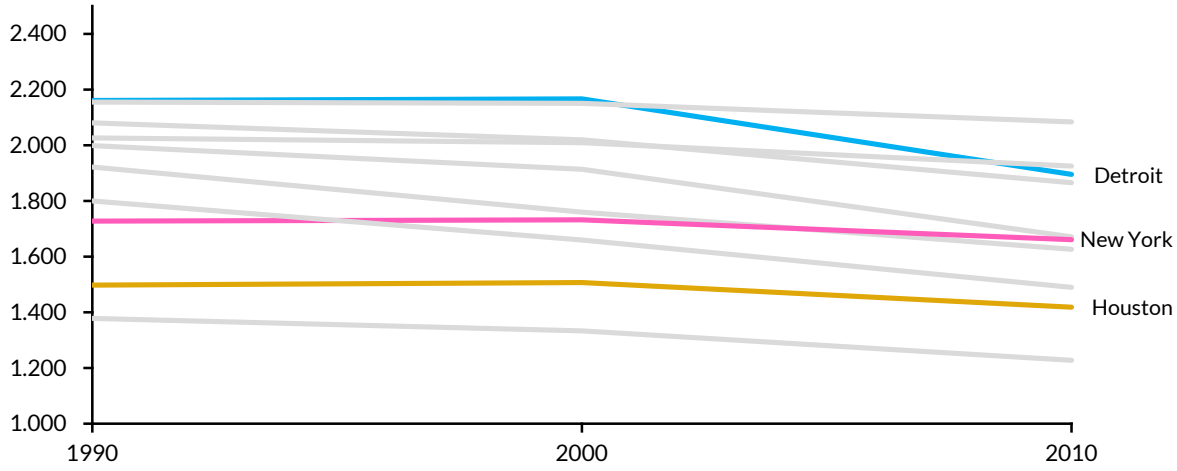


Sources: 1990, 2000, and 2010 Censuses, calculated using the Geo-Segregation Analyzer. See Philippe Apparicio, Éric Fournier, and Denis Apparicio, "Geo-Segregation Analyzer: An Open-Source Software for Calculating Residential Segregation Indices," Geo-Segregation Analyzer, accessed March 17, 2017, http://geoseganalyzer.ucs.inrs.ca/.
Note: SP = spatial proximity.

FIGURE 9B

Black-White Racial Segregation, 1990–2010, 10 Most-Populous Commuting Zones in 1990

Commuting zones with changing black-white segregation trends

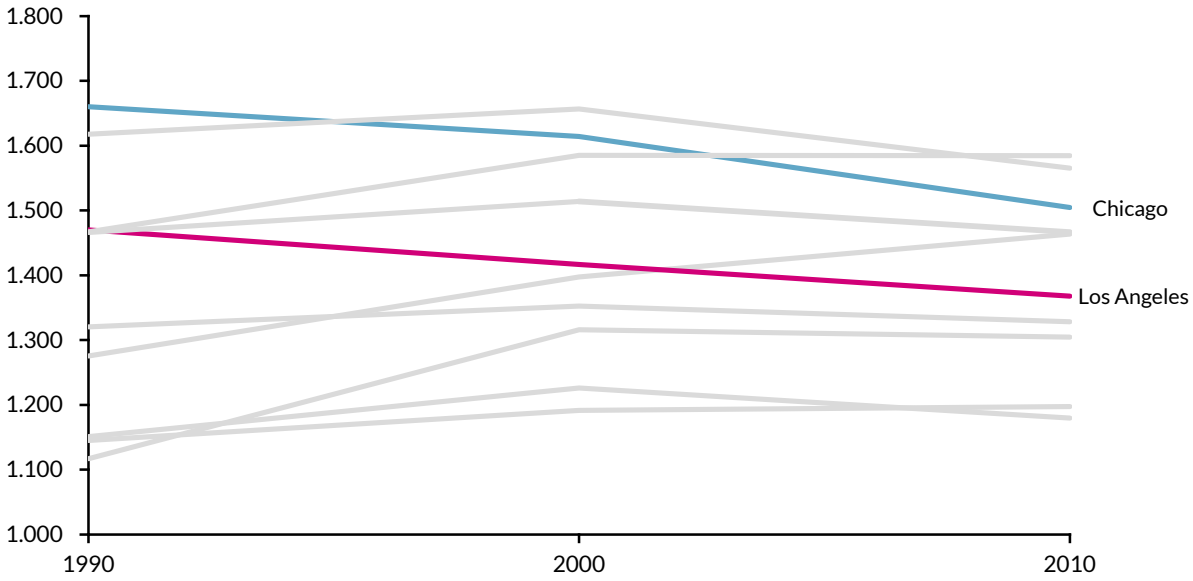


Sources: 1990, 2000, and 2010 Censuses, calculated using the Geo-Segregation Analyzer. See Philippe Apparicio, Éric Fournier, and Denis Apparicio, "Geo-Segregation Analyzer: An Open-Source Software for Calculating Residential Segregation Indices," Geo-Segregation Analyzer, accessed March 17, 2017, http://geoseganalyzer.ucs.inrs.ca/.
Note: SP = spatial proximity.

FIGURE 10A

Latino-White Racial Segregation, 1990–2010, 10 Most-Populous Commuting Zones in 1990

Commuting zones with decreasing Latino-white segregation trends in both periods

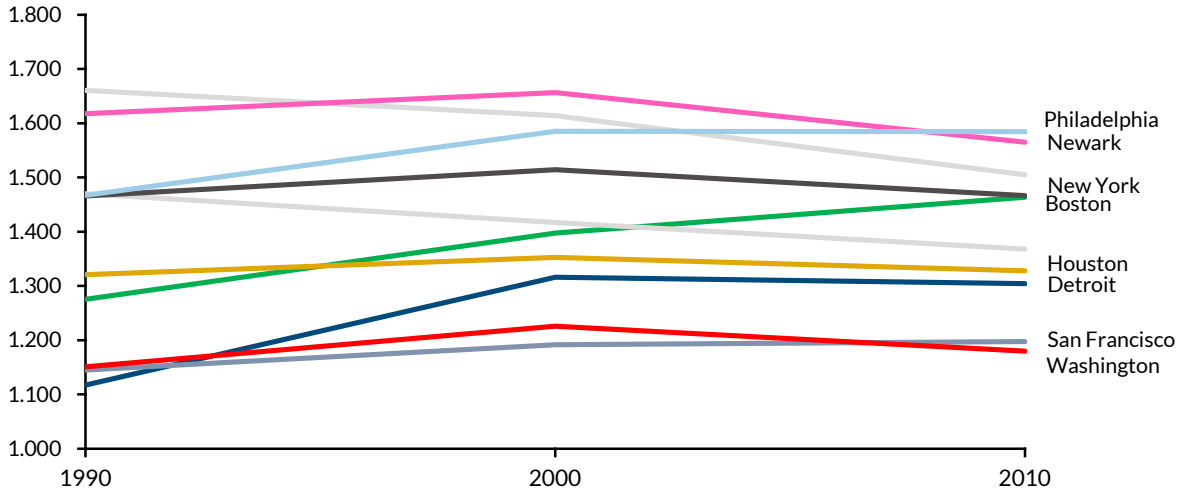


Sources: 1990, 2000, and 2010 Censuses, calculated using the Geo-Segregation Analyzer. See Philippe Apparicio, Éric Fournier, and Denis Apparicio, "Geo-Segregation Analyzer: An Open-Source Software for Calculating Residential Segregation Indices," Geo-Segregation Analyzer, accessed March 17, 2017, http://geoseganalyzer.ucs.inrs.ca/.
Note: SP = spatial proximity.

FIGURE 10B

Latino-White Racial Segregation, 1990–2010, 10 Most-Populous Commuting Zones in 1990

Commuting zones with increasing or changing Latino-white segregation trends

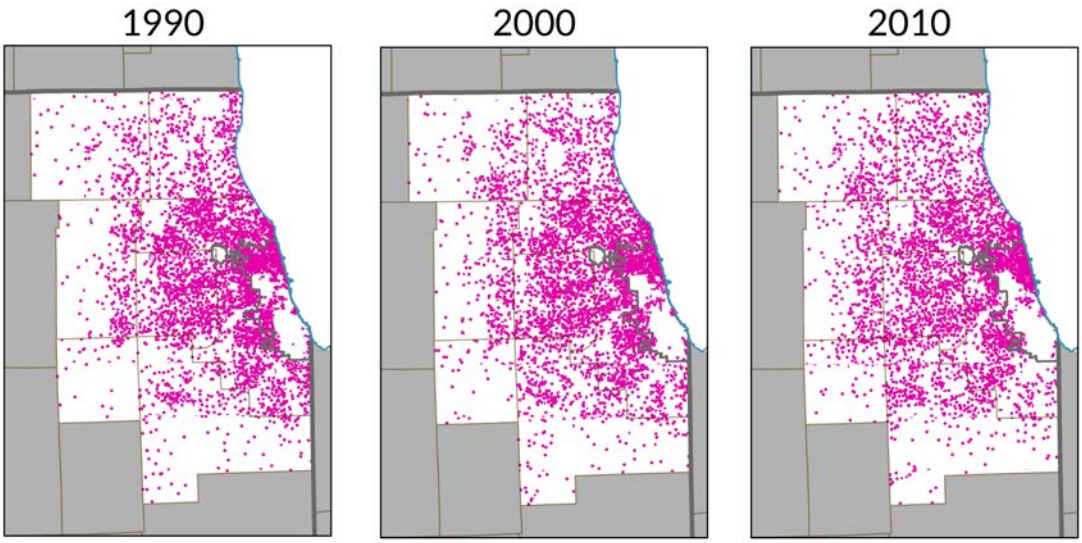


Sources: 1990, 2000, and 2010 Censuses, calculated using the Geo-Segregation Analyzer. See Philippe Apparicio, Éric Fournier, and Denis Apparicio, "Geo-Segregation Analyzer: An Open-Source Software for Calculating Residential Segregation Indices," Geo-Segregation Analyzer, accessed March 17, 2017, http://geoseganalyzer.ucs.inrs.ca/.
Note: SP = spatial proximity.

Figures 11, 12, and 13 show how the region's racial and ethnic distribution has shifted between 1990 and 2010. The heaviest density of whites (figure 11) has remained on the city's north side and inner suburbs, and whites have been spread throughout the lower-density suburbs. Whites have also been nearly absent from the city's west and south sides (with some exceptions, such as Hyde Park), and between 1990 and 2010, the number of whites living in Chicago's southwestern neighborhoods fell sharply.

FIGURE 11

White Population by Tract, 1990–2010



Sources: 1990, 2000, and 2010 Censuses.
Notes: 1 dot = 1,000 people. Dots are randomly assigned within each census tract.

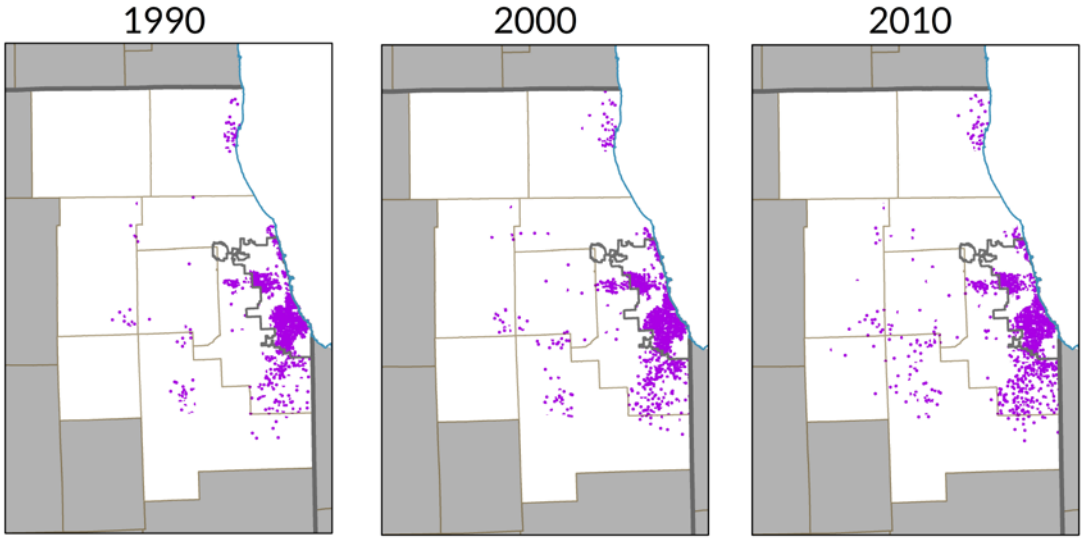
In contrast with whites, blacks are heavily concentrated in certain parts of the region, notably the south and west sides, the suburbs directly south of the city, and certain municipalities west of the city (figure 12). The patterns for Latinos are different (figure 13). While the largest population clusters remain in the city's southwest and northwest neighborhoods, there are multiple suburban clusters throughout the region.

The region's Latino population has seen the largest growth and the most dispersion since 1990. In 1990, Latinos were concentrated in the city's northwest and southwest neighborhoods, with a few smaller clusters scattered around the region. By 2010, the Latino population had increased, but it tended to be clustered within certain municipalities (e.g., Aurora and Elgin in Kane County).

As Chicago has become less economically and racially segregated, patterns of residential location have remained relatively consistent. The 1990 maps show patterns similar to the 2010 maps, except the Latino population, which has grown and dispersed throughout the region over the past 20 years.

FIGURE 12

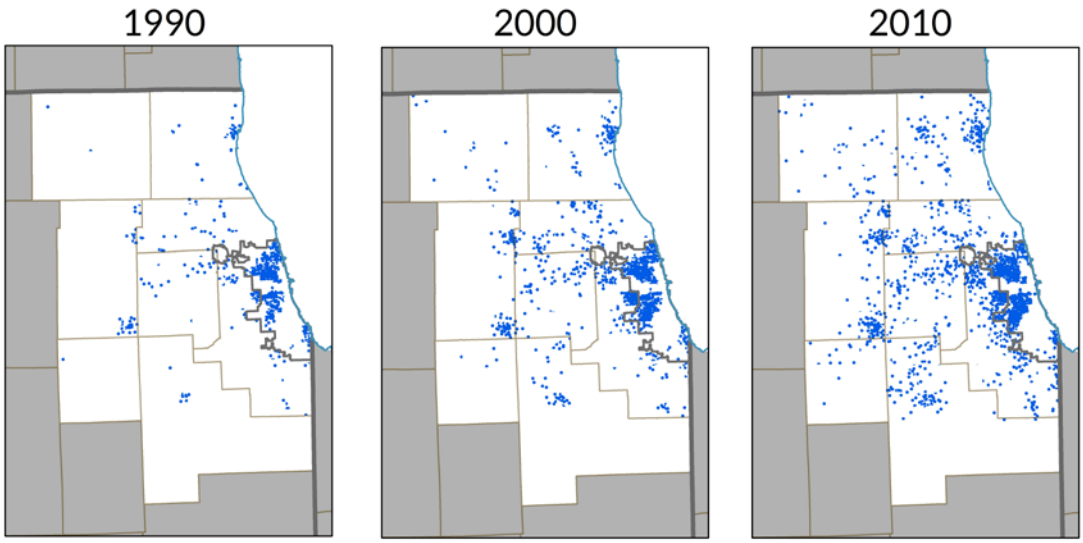
Black Population by Tract, 1990–2010



Sources: 1990, 2000, and 2010 Censuses.
Notes: 1 dot = 1,000 people. Dots are randomly assigned within each census tract.

FIGURE 13

Latino Population by Tract, 1990–2010



Sources: 1990, 2000, and 2010 Censuses.
Notes: 1 dot = 1,000 people. Dots are randomly assigned within each census tract.

Chicago's Cost of Segregation

To demonstrate the cost of segregation for the Chicago region, this section estimates the effect on outcomes if Chicago had the median level of economic or racial segregation. We estimate how outcomes would change if Chicago's

- GNSI in 2010 was 0.353 instead of 0.419 (in line with Grand Rapids, Michigan, and Minneapolis, Minnesota),
- black-white segregation (SP) was 1.371 instead of 1.865 (in line with Memphis, Tennessee, and Little Rock, Arkansas), and
- Latino-white segregation (SP) was 1.175 instead of 1.505 (in line with Tampa, Florida, and Fresno, California).

These decreases represent a 19 percent drop in economic segregation, a 36 percent drop in black-white segregation, and a 28 percent drop in Latino-white segregation. For comparison, between 1990 and 2010, Chicago's economic segregation and Latino-white segregation dropped 10 percent, and its black-white segregation dropped 11 percent (figure 14).

The large prospective drop to the median for black-white segregation (compared with the GNSI or Latino-white indicators) has several implications. In estimates, it means that while the *size* of the relationship between black-white segregation could be smaller than for economic segregation, our estimated comparatively large drop for black-white segregation may make the effect seem larger. This is the case for the effect of black per capita income. Applying these estimates to Chicago means the levels of black-white segregation would have to fall further and more whites and blacks would need to change where they live to reach the median than would the locations of Latinos and whites to address Latino-white segregation or high- and low-income residents to address economic segregation.

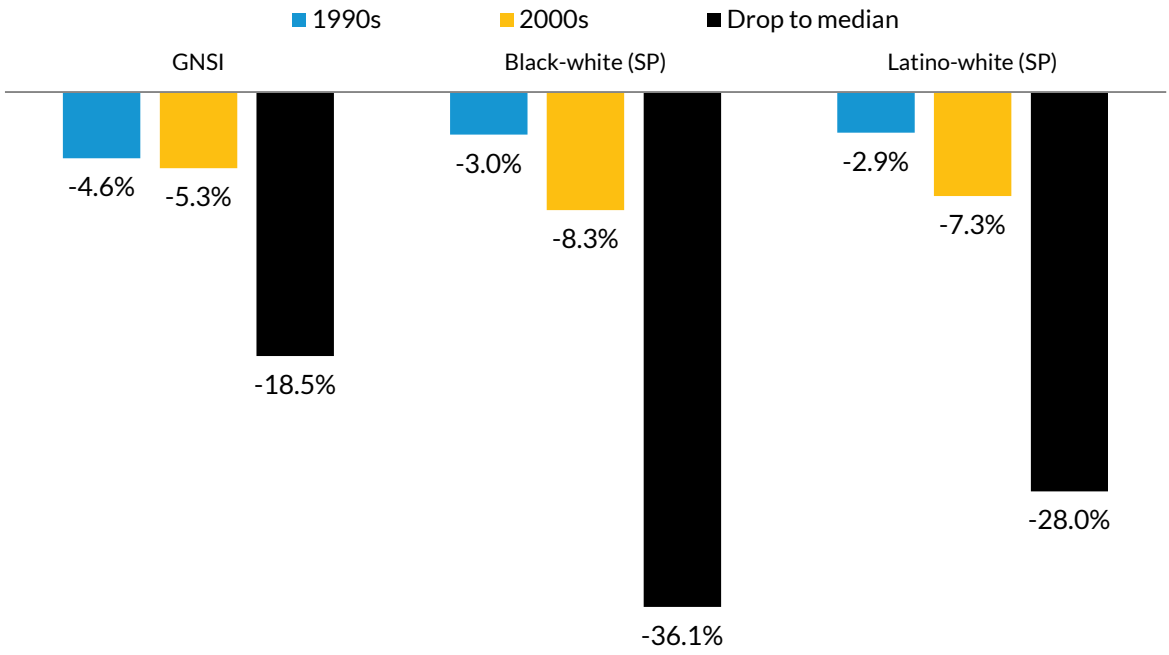
To illustrate an intervention's scope, if the decreases in Chicago from the 1990s and 2000s continue at the current pace, Chicago will reach the median (2010) level of economic segregation between 2040 and 2050, the median level of Latino-white segregation between 2050 and 2060, and the median level of black-white segregation between 2060 and 2070.

We account for the uncertainty in these estimates by reporting the estimates produced by the coefficient and those produced at the high and low ends of the 95 percent confidence intervals.

FIGURE 14

Changes in Segregation Levels in the Chicago Commuting Zone

1990 to 2010 actual and prospective decrease to level of median commuting zone in 2010



Sources: 1990, 2000, and 2010 Censuses and 2008–12 American Community Survey. Economic segregation based on authors' calculations. Racial segregation calculated using the Geo-Segregation Analyzer. See Philippe Apparicio, Éric Fournier, and Denis Apparicio, "Geo-Segregation Analyzer: An Open-Source Software for Calculating Residential Segregation Indices," Geo-Segregation Analyzer, accessed March 17, 2017, http://geoseganalyzer.ucs.inrs.ca/.
Notes: GNSI = Generalized Neighborhood Sorting Index. SP = spatial proximity.

With median levels of **economic** segregation, models estimate the following:

- Black median household income would increase 1.9 percent, or $707 (with a 95 percent confidence interval range of $118 to $1,305).
- Black per capita income would increase 2.7 percent, or $527 (with a 95 percent confidence interval range of $111 to $952). Given approximately 1.5 million black people in the region, this would produce an aggregate increase of $772 million (with a 95 percent confidence interval range of $162 million to $1.40 billion).

With median levels of **black-white** racial segregation, models estimate the following:

- Black per capita income would increase 12.4 percent, or $2,455 (with a 95 percent confidence interval range of $164 to $5,009). Given approximately 1.5 million black people in the region,

this would produce an aggregate increase of $3.60 billion (with a 95 percent confidence interval range of $240 million to $7.34 billion).

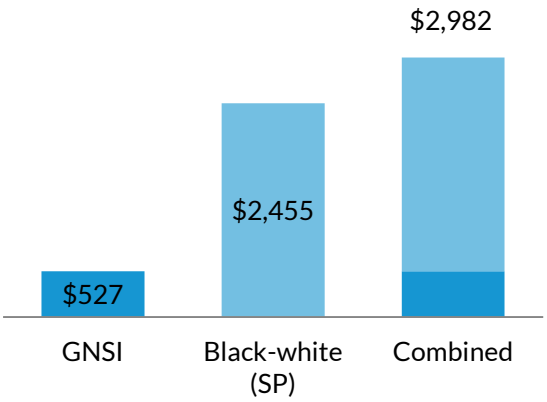
- The homicide rate would be 4.6 (instead of 6.6) per 100,000 people, with a confidence interval between 2.9 and 6.3 homicides per 100,000 people (in 2010). In other words, the homicide rate would be 30 percent lower if Chicago's black-white segregation fell to the median level. In actual numbers, that decrease in segregation would have reduced the number of homicides in 2010 from 553 to 386, a decrease of 167 (with a confidence interval range between 528 and 244 homicides, representing drops of 25 and 309 homicides, respectively). If this relationship holds true for the city and the region, Chicago in 2016 would have had 229 fewer homicides (533 instead of 762).
- Bachelor's degree attainment would increase 2 percent for both whites and blacks (with a 95 percent confidence range between 0.7 percent and 3.3 percent for whites and between 0.1 percent and 4.0 percent for blacks). Accounting for the regional population ages 25 and older, this would translate to 64,698 more whites with a BA and 18,554 more blacks with a BA, for a total of roughly 83,000 (83,252) more people with a BA.

The significant relationship between per capita income and the two measures of segregation is additive for blacks: if *both* the GNSI and the black-white segregation measures were the median amount, the associated increase in black per capita income would be 15.1 percent, or $2,982 (figure 15), and the aggregate increase would be $4.4 billion.

FIGURE 15

Additive Effects: Economic and Racial Segregation and Black Per Capita Income

Estimated income increase given a drop of segregation to level of median (2010) commuting zone



Source: Authors' tabulations based on analysis of 1990, 2000, and 2010 Censuses and the 2008–12 American Community Survey (for 2010 income data).
Notes: GNSI = Generalized Neighborhood Sorting Index. SP = spatial proximity. Relationship between black-white segregation and black median income is not statistically significant and is not included here.

Although we did not find any statistically significant relationships between **Latino-white** segregation and our outcomes of interest, the effect of Latino-white segregation on white median income comes close enough to that level to merit a note. In Chicago, it indicates that white median income would increase 2.2 percent, or $1,642, if Chicago had the median level of Latino-white segregation. Given the greater uncertainty in this estimate, the 95 percent confidence interval range extends from a possible gain of 5.0 percent ($3,730) to a possible loss of 0.5 percent ($391).

Conclusion and Next Steps

Our strongest and most consistent finding is that higher levels of economic segregation are associated with lower incomes, particularly for black residents. Higher levels of racial segregation are associated with lower incomes for blacks, lower educational attainment for whites and blacks, and lower levels of safety for all area residents.

Economic and racial segregation, economic growth, educational attainment, life expectancy, and crime evolve in complex ways. Precisely measuring the relationships between segregation and CZ outcomes poses challenges, especially when working with only 300 observations. We have highlighted

statistically significant findings, and those findings are largely consistent with those obtained using alternative measures of racial segregation.

The results in our preferred and alternative models lead us to speculate about associations that merit further exploration. In particular, our estimates lead us to consider that economic segregation and Latino-white segregation may be associated with lower incomes for whites and Latinos. Further, economic segregation may be detrimental to the incomes of all a region's residents, regardless of race or ethnicity. In addition, black-white segregation may be associated with higher incomes for whites, and Latino-white segregation may be associated with lower BA attainment for Latinos, but higher BA attainment for whites and blacks. Again, these are speculations about possible relationships we cannot fully assess with our data but which could be the subject of future research.

Chicago is a notable case. Although it has remained one of the country's most economically and racially segregated regions, segregation levels have been dropping. This presents an opportunity and challenge. We may expect that steady, if small, decreases in segregation continue, outcomes associated with lower levels of segregation may improve. But the rate of those declines has been relatively small, and levels remain stubbornly high, especially for black and Latino segregation. Understanding how policy levers may address the issue and increase the rate of change may help stakeholders better understand those interventions' effects on residents' lives in the region.

These findings will inform future work on the cost of segregation in Chicago. That work will include a projected baseline scenario for the region absent interventions designed to address economic and racial segregation, as well as a vision incorporating potential policies to address segregation.

Appendix A. Segregation in the 100 Most-Populous Commuting Zones

TABLE A.1

GNSI and Spatial Proximity

	GNSI			Black-white spatial proximity			Latino-white spatial proximity		
	1990	2000	2010	1990	2000	2010	1990	2000	2010
Albany, NY	0.360	0.280	0.336	1.328	1.489	1.522	1.015	1.055	1.107
Albuquerque, NM	0.389	0.278	0.259	1.012	1.009	1.011	1.147	1.149	1.160
Allentown, PA	0.443	0.319	0.363	1.064	1.126	1.195	1.190	1.457	1.675
Atlanta, GA	0.461	0.376	0.380	1.832	1.652	1.435	1.033	1.202	1.301
Austin, TX	0.517	0.387	0.422	1.223	1.194	1.119	1.149	1.215	1.214
Bakersfield, CA	0.386	0.370	0.346	1.146	1.101	1.118	1.197	1.223	1.217
Baltimore, MD	0.451	0.376	0.418	1.894	1.790	1.631	1.005	1.022	1.061
Baton Rouge, LA	0.377	0.274	0.253	1.466	1.521	1.482	1.002	1.004	1.020
Birmingham, AL	0.466	0.383	0.405	2.048	2.152	1.944	1.004	1.028	1.088
Boston, MA	0.392	0.380	0.344	1.999	1.914	1.671	1.276	1.397	1.463
Bridgeport, CT	0.416	0.522	0.516	1.812	1.789	1.796	1.677	1.724	1.663
Brownsville, TX	0.369	0.248	0.272	1.006	1.004	1.006	1.061	1.043	1.025
Buffalo, NY	0.404	0.339	0.326	1.952	2.059	1.988	1.264	1.370	1.383
Canton, OH	0.343	0.271	0.317	1.285	1.359	1.383	1.003	1.003	1.012
Charleston, SC	0.390	0.256	0.337	1.232	1.173	1.102	1.004	1.013	1.053
Charlotte, NC	0.493	0.402	0.503	1.427	1.423	1.343	1.011	1.134	1.245
Chicago, IL	0.462	0.441	0.419	2.080	2.020	1.865	1.660	1.614	1.505
Cincinnati, OH	0.472	0.387	0.397	1.625	1.622	1.540	1.002	1.006	1.021
Cleveland, OH	0.565	0.382	0.441	2.206	2.104	1.871	1.197	1.315	1.298
Columbia, SC	0.363	0.305	0.317	1.243	1.234	1.224	1.003	1.009	1.028
Columbus, OH	0.498	0.386	0.436	1.512	1.493	1.422	1.003	1.017	1.054
Dallas, TX	0.599	0.432	0.430	1.448	1.346	1.305	1.272	1.338	1.294
Dayton, OH	0.415	0.329	0.347	1.989	1.985	1.798	1.003	1.005	1.015
Denver, CO	0.397	0.349	0.356	1.281	1.236	1.201	1.220	1.262	1.240
Des Moines, IA	0.434	0.335	0.344	1.259	1.267	1.186	1.011	1.076	1.110
Detroit, MI	0.449	0.413	0.394	2.161	2.167	1.896	1.117	1.316	1.304
El Paso, TX	0.475	0.305	0.388	1.035	1.064	1.062	1.144	1.078	1.063
Erie, PA	0.318	0.243	0.277	1.328	1.412	1.511	1.041	1.084	1.133
Eugene, OR	0.273	0.190	0.199	1.008	1.006	1.004	1.022	1.108	1.178
Fayetteville, NC	0.309	0.243	0.275	1.097	1.097	1.105	1.025	1.020	1.038
Fort Worth, TX	0.463	0.337	0.368	1.435	1.334	1.278	1.218	1.263	1.269
Fresno, CA	0.460	0.284	0.315	1.147	1.115	1.111	1.148	1.185	1.176
Gary, IN	0.395	0.283	0.350	2.362	2.058	1.811	1.397	1.338	1.306
Grand Rapids, MI	0.404	0.285	0.352	1.945	1.920	1.678	1.105	1.396	1.415
Greensboro, NC	0.363	0.339	0.315	1.444	1.516	1.447	1.003	1.077	1.125
Greenville, SC	0.332	0.245	0.261	1.204	1.198	1.143	1.005	1.048	1.113
Harrisburg, PA	0.325	0.249	0.254	2.130	1.976	1.854	1.229	1.343	1.502
Honolulu, HI	0.497	0.213	0.242	1.045	1.045	1.043	1.037	1.041	1.055
Houston, TX	0.583	0.431	0.407	1.498	1.507	1.419	1.320	1.352	1.328
Indianapolis, IN	0.406	0.391	0.467	1.827	1.691	1.564	1.005	1.061	1.151
Jacksonville, FL	0.371	0.373	0.377	1.848	1.682	1.509	1.003	1.009	1.027
Johnson City, TN	0.296	0.181	0.225	1.070	1.095	1.097	1.000	1.003	1.016

	GNSI			Black-white spatial proximity			Latino-white spatial proximity		
	1990	2000	2010	1990	2000	2010	1990	2000	2010
Kansas City, KS-MO	0.482	0.437	0.471	1.977	1.825	1.558	1.091	1.240	1.291
Knoxville, TN	0.474	0.378	0.412	1.629	1.618	1.344	1.003	1.004	1.019
Las Vegas, NV-AZ	0.372	0.310	0.324	1.222	1.121	1.111	1.086	1.244	1.273
Little Rock, AR	0.417	0.275	0.297	1.557	1.505	1.373	1.002	1.020	1.088
Los Angeles, CA	0.371	0.402	0.436	1.922	1.760	1.627	1.470	1.417	1.368
Louisville, KY	0.524	0.387	0.450	1.710	1.657	1.551	1.001	1.004	1.032
Manchester, CT	0.364	0.236	0.270	1.010	1.032	1.088	1.033	1.153	1.266
Memphis, TN	0.553	0.385	0.400	1.480	1.422	1.368	1.002	1.047	1.154
Miami, FL	0.378	0.352	0.411	1.393	1.498	1.442	1.017	1.414	1.312
Milwaukee, WI	0.498	0.377	0.388	2.404	2.339	2.251	1.392	1.971	2.119
Minneapolis, MN	0.426	0.350	0.355	1.364	1.395	1.283	1.032	1.166	1.165
Mobile, AL	0.390	0.259	0.257	1.775	1.693	1.570	1.004	1.006	1.007
Modesto, CA	0.294	0.230	0.288	1.016	1.023	1.021	1.075	1.122	1.121
Monmouth-Ocean, NJ	0.418	0.478	0.414	1.509	1.460	1.375	1.059	1.087	1.085
Nashville, TN	0.527	0.437	0.436	1.650	1.566	1.420	1.004	1.131	1.291
New Orleans, LA	0.365	0.312	0.286	1.469	1.454	1.296	1.017	1.030	1.065
New York, NY	0.508	0.527	0.531	1.728	1.732	1.661	1.466	1.514	1.466
Newark, NJ	0.444	0.425	0.382	2.156	2.151	2.084	1.617	1.657	1.565
Oklahoma City, OK	0.437	0.308	0.419	1.269	1.212	1.173	1.060	1.234	1.415
Omaha, NE	0.456	0.368	0.390	1.566	1.498	1.399	1.039	1.179	1.259
Orlando, FL	0.416	0.300	0.334	1.350	1.402	1.491	1.025	1.119	1.194
Peoria, IL	0.374	0.278	0.305	1.755	1.874	1.984	1.008	1.016	1.048
Philadelphia, PA	0.526	0.423	0.454	2.027	2.009	1.926	1.467	1.585	1.585
Phoenix, AZ	0.405	0.352	0.357	1.063	1.058	1.060	1.145	1.290	1.331
Pittsburgh, PA	0.455	0.318	0.346	1.633	1.629	1.505	1.006	1.010	1.013
Portland, ME	0.285	0.238	0.272	1.015	1.059	1.218	1.002	1.015	1.025
Portland, OR-WA	0.422	0.304	0.289	1.413	1.230	1.071	1.005	1.026	1.049
Poughkeepsie, NY	0.350	0.283	0.324	1.395	1.517	1.398	1.152	1.285	1.371
Providence, RI	0.355	0.271	0.264	1.187	1.218	1.234	1.231	1.608	1.676
Racine, WI	0.311	0.242	0.270	1.331	1.329	1.314	1.083	1.128	1.170
Raleigh, NC	0.416	0.359	0.352	1.482	1.469	1.303	1.002	1.085	1.094
Reading, PA	0.340	0.268	0.284	1.385	1.450	1.430	1.698	2.241	2.554
Richmond, VA	0.539	0.427	0.417	1.527	1.489	1.377	1.003	1.024	1.099
Rockford, IL	0.341	0.274	0.282	1.525	1.479	1.455	1.055	1.115	1.128
Sacramento, CA	0.349	0.293	0.311	1.153	1.185	1.174	1.134	1.185	1.205
Saginaw, MI	0.373	0.272	0.274	2.366	2.237	2.049	1.141	1.141	1.167
Salt Lake City, UT	0.443	0.261	0.293	1.009	1.007	1.013	1.031	1.097	1.128
San Antonio, TX	0.509	0.332	0.373	1.345	1.208	1.186	1.397	1.314	1.234
San Diego, CA	0.433	0.410	0.409	1.259	1.256	1.190	1.276	1.337	1.322
San Francisco, CA	0.519	0.447	0.447	1.379	1.334	1.227	1.145	1.192	1.197
San Jose, CA	0.454	0.464	0.490	1.046	1.039	1.032	1.285	1.355	1.316
Santa Barbara, CA	0.411	0.444	0.441	1.019	1.022	1.015	1.192	1.298	1.338
Santa Rosa, CA	0.329	0.296	0.358	1.009	1.015	1.015	1.015	1.080	1.120
Sarasota, FL	0.352	0.370	0.379	1.208	1.157	1.135	1.018	1.056	1.107
Scranton, PA	0.304	0.232	0.265	1.014	1.017	1.040	1.001	1.012	1.201
Seattle, WA	0.382	0.324	0.359	1.239	1.142	1.116	1.007	1.021	1.053
South Bend, IN	0.376	0.303	0.301	1.531	1.521	1.451	1.028	1.128	1.183
Springfield, MA	0.380	0.310	0.367	1.642	1.673	1.628	1.522	1.603	1.684
St. Louis, MO	0.539	0.466	0.429	2.043	1.845	1.733	1.005	1.013	1.029
Syracuse, NY	0.374	0.321	0.342	1.666	1.798	1.833	1.045	1.113	1.198
Tampa, FL	0.364	0.306	0.304	1.549	1.430	1.365	1.140	1.160	1.174
Toledo, OH	0.407	0.328	0.373	1.839	1.804	1.711	1.052	1.068	1.074
Tucson, AZ	0.440	0.382	0.410	1.017	1.017	1.019	1.247	1.287	1.279

	GNSI			Black-white spatial proximity			Latino-white spatial proximity		
	1990	2000	2010	1990	2000	2010	1990	2000	2010
Tulsa, OK	0.451	0.347	0.331	1.376	1.341	1.309	1.007	1.059	1.186
Virginia Beach, VA	0.431	0.313	0.300	1.258	1.200	1.183	1.005	1.011	1.015
Washington, DC	0.564	0.426	0.426	1.800	1.660	1.490	1.151	1.226	1.180
West Palm Beach, FL	0.579	0.501	0.398	1.425	1.334	1.242	1.038	1.109	1.197
Youngstown, OH	0.330	0.258	0.271	1.651	1.600	1.472	1.077	1.078	1.095

Source: Authors' calculations from 1990, 2000, and 2010 Censuses and 2008–12 American Community Survey estimates for 2010 GNSI.
Note: GNSI = Generalized Neighborhood Sorting Index.

TABLE A.2

Dissimilarity

	Black-white dissimilarity			Latino-white dissimilarity		
	1990	2000	2010	1990	2000	2010
Albany, NY	0.636	0.640	0.631	0.358	0.391	0.371
Albuquerque, NM	0.377	0.319	0.308	0.403	0.395	0.362
Allentown, PA	0.560	0.542	0.491	0.606	0.624	0.580
Atlanta, GA	0.690	0.660	0.599	0.343	0.511	0.500
Austin, TX	0.532	0.517	0.499	0.410	0.451	0.430
Bakersfield, CA	0.558	0.520	0.526	0.554	0.538	0.523
Baltimore, MD	0.717	0.683	0.654	0.300	0.357	0.398
Baton Rouge, LA	0.573	0.579	0.549	0.257	0.290	0.316
Birmingham, AL	0.713	0.703	0.673	0.289	0.428	0.435
Boston, MA	0.668	0.653	0.618	0.583	0.611	0.582
Bridgeport, CT	0.685	0.675	0.655	0.615	0.612	0.574
Brownsville, TX	0.362	0.480	0.410	0.408	0.420	0.395
Buffalo, NY	0.746	0.733	0.696	0.553	0.549	0.494
Canton, OH	0.636	0.612	0.598	0.285	0.206	0.279
Charleston, SC	0.464	0.432	0.410	0.273	0.319	0.392
Charlotte, NC	0.528	0.524	0.529	0.329	0.495	0.472
Chicago, IL	0.840	0.810	0.767	0.619	0.612	0.572
Cincinnati, OH	0.757	0.735	0.691	0.253	0.287	0.367
Cleveland, OH	0.819	0.775	0.731	0.524	0.549	0.492
Columbia, SC	0.505	0.479	0.493	0.378	0.369	0.360
Columbus, OH	0.678	0.638	0.627	0.283	0.372	0.419
Dallas, TX	0.631	0.599	0.563	0.496	0.534	0.518
Dayton, OH	0.756	0.722	0.665	0.287	0.273	0.300
Denver, CO	0.657	0.652	0.636	0.458	0.494	0.485
Des Moines, IA	0.637	0.570	0.512	0.342	0.473	0.458
Detroit, MI	0.857	0.836	0.738	0.382	0.430	0.403
El Paso, TX	0.418	0.417	0.398	0.481	0.461	0.453
Erie, PA	0.654	0.647	0.642	0.552	0.536	0.523
Eugene, OR	0.404	0.379	0.314	0.346	0.402	0.393
Fayetteville, NC	0.345	0.341	0.357	0.432	0.374	0.348
Fort Worth, TX	0.629	0.615	0.588	0.442	0.474	0.455
Fresno, CA	0.538	0.549	0.529	0.443	0.443	0.430
Gary, IN	0.902	0.852	0.780	0.519	0.485	0.437
Grand Rapids, MI	0.754	0.702	0.677	0.423	0.496	0.481
Greensboro, NC	0.516	0.511	0.522	0.251	0.461	0.434
Greenville, SC	0.486	0.456	0.439	0.272	0.393	0.399
Harrisburg, PA	0.754	0.737	0.630	0.527	0.527	0.474
Honolulu, HI	0.434	0.414	0.369	0.324	0.328	0.319
Houston, TX	0.657	0.660	0.622	0.490	0.545	0.538
Indianapolis, IN	0.746	0.723	0.665	0.260	0.440	0.472
Jacksonville, FL	0.561	0.523	0.516	0.224	0.265	0.276
Johnson City, TN	0.521	0.484	0.456	0.212	0.225	0.266
Kansas City, KS-MO	0.734	0.714	0.615	0.396	0.461	0.447
Knoxville, TN	0.601	0.575	0.549	0.267	0.261	0.352
Las Vegas, NV-AZ	0.517	0.442	0.418	0.294	0.425	0.426
Little Rock, AR	0.603	0.607	0.585	0.232	0.345	0.394
Los Angeles, CA	0.671	0.648	0.622	0.564	0.583	0.570
Louisville, KY	0.697	0.645	0.582	0.239	0.340	0.387
Manchester, CT	0.408	0.400	0.409	0.312	0.398	0.388
Memphis, TN	0.665	0.664	0.630	0.325	0.467	0.510
Miami, FL	0.686	0.691	0.661	0.263	0.564	0.548

	Black-white dissimilarity			Latino-white dissimilarity		
	1990	2000	2010	1990	2000	2010
Milwaukee, WI	0.832	0.836	0.816	0.553	0.576	0.551
Minneapolis, MN	0.621	0.598	0.525	0.355	0.465	0.425
Mobile, AL	0.629	0.600	0.580	0.255	0.243	0.288
Modesto, CA	0.485	0.424	0.409	0.379	0.400	0.390
Monmouth-Ocean, NJ	0.661	0.638	0.536	0.343	0.377	0.362
Nashville, TN	0.611	0.580	0.559	0.241	0.458	0.479
New Orleans, LA	0.673	0.680	0.627	0.323	0.365	0.390
New York, NY	0.827	0.826	0.807	0.664	0.667	0.637
Newark, NJ	0.755	0.729	0.705	0.633	0.614	0.584
Oklahoma City, OK	0.596	0.548	0.512	0.332	0.439	0.466
Omaha, NE	0.719	0.678	0.619	0.391	0.481	0.479
Orlando, FL	0.581	0.550	0.515	0.297	0.394	0.415
Peoria, IL	0.747	0.739	0.729	0.400	0.419	0.408
Philadelphia, PA	0.754	0.718	0.695	0.624	0.610	0.572
Phoenix, AZ	0.503	0.454	0.439	0.487	0.520	0.493
Pittsburgh, PA	0.707	0.689	0.658	0.294	0.293	0.289
Portland, ME	0.431	0.432	0.583	0.245	0.249	0.254
Portland, OR-WA	0.633	0.514	0.454	0.247	0.346	0.346
Poughkeepsie, NY	0.531	0.510	0.474	0.414	0.387	0.365
Providence, RI	0.605	0.572	0.535	0.579	0.645	0.601
Racine, WI	0.664	0.608	0.577	0.429	0.423	0.383
Raleigh, NC	0.432	0.426	0.432	0.223	0.394	0.392
Reading, PA	0.636	0.606	0.529	0.660	0.660	0.617
Richmond, VA	0.576	0.556	0.543	0.302	0.402	0.454
Rockford, IL	0.688	0.628	0.590	0.439	0.441	0.396
Sacramento, CA	0.585	0.596	0.579	0.403	0.429	0.429
Saginaw, MI	0.824	0.764	0.733	0.450	0.430	0.415
Salt Lake City, UT	0.479	0.400	0.375	0.328	0.418	0.415
San Antonio, TX	0.563	0.528	0.490	0.519	0.496	0.460
San Diego, CA	0.581	0.555	0.512	0.452	0.506	0.496
San Francisco, CA	0.649	0.640	0.609	0.412	0.471	0.472
San Jose, CA	0.492	0.470	0.458	0.512	0.550	0.534
Santa Barbara, CA	0.457	0.492	0.487	0.406	0.443	0.438
Santa Rosa, CA	0.351	0.355	0.341	0.246	0.328	0.329
Sarasota, FL	0.685	0.620	0.536	0.401	0.479	0.419
Scranton, PA	0.594	0.569	0.565	0.373	0.477	0.494
Seattle, WA	0.563	0.529	0.503	0.227	0.304	0.324
South Bend, IN	0.687	0.668	0.617	0.349	0.422	0.393
Springfield, MA	0.685	0.672	0.653	0.643	0.641	0.634
St. Louis, MO	0.777	0.746	0.728	0.231	0.282	0.306
Syracuse, NY	0.711	0.695	0.667	0.456	0.476	0.440
Tampa, FL	0.697	0.646	0.562	0.453	0.444	0.407
Toledo, OH	0.750	0.722	0.673	0.374	0.337	0.310
Tucson, AZ	0.443	0.415	0.376	0.520	0.508	0.486
Tulsa, OK	0.625	0.601	0.579	0.253	0.390	0.445
Virginia Beach, VA	0.493	0.452	0.452	0.298	0.310	0.305
Washington, DC	0.655	0.641	0.633	0.414	0.471	0.489
West Palm Beach, FL	0.736	0.642	0.555	0.441	0.445	0.422
Youngstown, OH	0.746	0.721	0.676	0.472	0.467	0.449

Sources: 1990, 2000, and 2010 Censuses, calculated using the Geo-Segregation Analyzer. See Philippe Apparicio, Éric Fournier, and Denis Apparicio, "Geo-Segregation Analyzer: An Open-Source Software for Calculating Residential Segregation Indices," Geo-Segregation Analyzer, accessed March 17, 2017, http://geoseganalyzer.ucs.inrs.ca/.

TABLE A.3

Segregation Rankings, 1990–2010

	GSNI			Black-white spatial proximity			Latino-white spatial proximity			Combined rank		
	1990	2000	2010	1990	2000	2010	1990	2000	2010	1990	2000	2010
Albany, NY	81	74	61	64	45	29	66	70	68	85	74	54
Albuquerque, NM	62	75	94	95	97	98	31	45	56	76	84	94
Allentown, PA	37	55	45	85	80	69	26	10	5	47	45	32
Atlanta, GA	27	34	38	21	30	41	56	37	26	22	21	23
Austin, TX	13	25	18	75	75	78	29	36	40	27	38	40
Bakersfield, CA	63	38	55	82	83	79	24	35	39	64	56	65
Baltimore, MD	32	35	21	18	20	21	75	79	78	33	36	34
Baton Rouge, LA	67	79	97	48	36	35	92	98	93	82	83	87
Birmingham, AL	24	28	29	9	4	6	81	76	72	26	23	24
Boston, MA	59	31	57	12	14	19	15	13	12	14	9	14
Bridgeport, CT	48	2	2	23	21	15	2	3	6	11	3	2
Brownsville, TX	75	89	86	100	100	99	45	73	90	88	97	99
Buffalo, NY	55	47	64	15	7	4	17	15	15	16	12	12
Canton, OH	86	82	67	66	58	48	86	99	99	93	90	82
Charleston, SC	60	87	60	74	77	84	80	86	81	86	93	87
Charlotte, NC	19	21	3	52	53	55	68	47	36	39	31	20
Chicago, IL	26	9	20	8	9	10	3	5	9	4	1	5
Cincinnati, OH	23	24	32	35	32	28	93	93	92	50	49	51
Cleveland, OH	4	30	11	4	6	9	23	23	27	3	10	6
Columbia, SC	80	64	68	72	68	66	84	92	88	92	86	85
Columbus, OH	16	26	13	42	44	43	85	83	80	41	52	40
Dallas, TX	1	12	15	49	59	58	16	20	28	9	15	22
Dayton, OH	50	51	54	13	11	14	90	95	97	52	58	59
Denver, CO	57	44	49	67	67	68	21	30	37	43	43	52
Des Moines, IA	40	49	58	70	65	72	69	65	66	69	69	74
Detroit, MI	34	18	33	5	3	8	38	22	25	13	7	10
El Paso, TX	21	63	36	89	86	88	34	62	77	42	80	77
Erie, PA	93	92	83	65	55	30	51	60	59	84	79	63
Eugene, OR	100	99	100	99	99	100	62	56	50	97	94	96
Fayetteville, NC	95	91	84	83	84	83	60	82	85	93	95	97
Fort Worth, TX	25	48	43	51	62	62	22	29	33	19	42	42
Fresno, CA	28	71	69	81	82	81	30	39	51	39	75	77
Gary, IN	58	73	53	3	8	13	9	19	24	10	20	18
Grand Rapids, MI	56	70	51	16	13	18	39	14	14	25	19	12
Greensboro, NC	79	46	70	50	39	39	88	64	62	87	49	62
Greenville, SC	89	90	93	78	74	76	74	71	65	95	89	89
Harrisburg, PA	92	88	96	7	12	11	20	18	10	29	29	28
Honolulu, HI	18	98	98	88	89	90	54	74	79	55	96	98
Houston, TX	2	13	28	44	40	45	12	17	20	8	13	19
Indianapolis, IN	53	22	6	22	25	25	79	67	58	54	28	17
Jacksonville, FL	73	36	40	19	26	31	91	91	89	72	52	55
Johnson City, TN	97	100	99	84	85	85	100	100	95	98	100	100
Kansas City, KS-MO	20	10	5	14	17	26	40	32	29	12	10	9
Knoxville, TN	22	32	24	34	33	54	89	97	94	43	61	63
Las Vegas, NV-AZ	72	60	65	76	81	82	41	31	32	77	63	67
Little Rock, AR	46	77	76	37	41	51	97	81	73	70	76	76
Los Angeles, CA	74	20	12	17	22	23	6	11	17	18	8	8
Louisville, KY	11	23	8	28	29	27	98	96	86	38	48	35
Manchester, CT	77	95	89	96	91	86	55	44	34	90	88	81
Memphis, TN	6	27	30	46	54	52	96	72	57	47	52	43

	GSNI			Black-white spatial proximity			Latino-white spatial proximity			Combined rank		
	1990	2000	2010	1990	2000	2010	1990	2000	2010	1990	2000	2010
Miami, FL	66	41	25	56	42	40	65	12	23	73	18	14
Milwaukee, WI	17	33	35	1	1	1	11	2	2	2	6	4
Minneapolis, MN	43	43	50	60	57	61	57	42	55	55	44	60
Mobile, AL	61	85	95	25	24	24	82	94	100	63	77	84
Modesto, CA	98	97	79	92	92	93	44	51	63	91	92	90
Monmouth-Ocean, NJ	45	4	23	43	49	50	47	58	74	36	26	48
Nashville, TN	9	11	14	31	35	44	83	48	30	31	17	14
New Orleans, LA	76	58	80	47	50	60	64	75	76	73	70	83
New York, NY	15	1	1	27	23	20	8	9	11	6	4	3
Newark, NJ	35	16	37	6	5	2	4	4	8	5	2	6
Oklahoma City, OK	39	61	19	68	71	75	46	33	13	52	62	24
Omaha, NE	29	39	34	36	43	46	52	41	35	27	32	27
Orlando, FL	49	67	62	61	56	33	61	52	46	65	65	46
Peoria, IL	70	76	72	26	15	5	70	84	84	59	65	58
Philadelphia, PA	10	17	7	11	10	7	7	8	7	1	5	1
Phoenix, AZ	54	42	48	86	88	89	32	26	19	66	56	53
Pittsburgh, PA	30	56	56	33	31	32	73	90	98	37	67	71
Portland, ME	99	94	87	93	87	67	94	85	91	99	98	93
Portland, OR-WA	44	65	78	54	69	87	75	77	83	67	80	94
Poughkeepsie, NY	84	72	66	55	38	47	27	28	16	59	40	38
Providence, RI	82	81	92	79	70	64	19	6	4	70	58	55
Racine, WI	94	93	90	63	64	56	42	49	53	80	78	75
Raleigh, NC	47	40	52	45	48	59	95	59	71	73	47	69
Reading, PA	88	83	81	57	51	42	1	1	1	45	37	37
Richmond, VA	7	14	22	40	46	49	87	78	69	35	40	45
Rockford, IL	87	78	82	41	47	37	48	53	60	68	68	67
Sacramento, CA	85	69	71	80	76	74	37	40	41	81	73	71
Saginaw, MI	71	80	85	2	2	3	35	46	54	23	35	47
Salt Lake City, UT	36	84	77	97	98	97	58	57	61	78	90	90
San Antonio, TX	14	50	42	62	72	71	10	24	38	14	46	49
San Diego, CA	41	19	27	69	66	70	14	21	21	32	22	29
San Francisco, CA	12	7	9	58	63	65	33	38	44	21	23	29
San Jose, CA	31	6	4	87	90	92	13	16	22	34	27	29
Santa Barbara, CA	51	8	10	90	93	95	25	25	18	59	33	36
Santa Rosa, CA	91	68	47	98	96	96	67	61	64	96	87	79
Sarasota, FL	83	37	39	77	78	77	63	69	67	89	72	70
Scranton, PA	96	96	91	94	94	91	99	88	42	100	99	86
Seattle, WA	64	53	46	73	79	80	71	80	82	83	82	80
South Bend, IN	68	66	74	39	37	38	59	50	48	59	52	55
Springfield, MA	65	59	44	32	27	22	5	7	3	20	16	11
St. Louis, MO	8	5	16	10	16	16	77	87	87	17	23	32
Syracuse, NY	69	54	59	29	19	12	50	54	43	47	34	26
Tampa, FL	78	62	73	38	52	53	36	43	52	51	58	66
Toledo, OH	52	52	41	20	18	17	49	66	75	30	38	39
Tucson, AZ	38	29	26	91	95	94	18	27	31	46	51	49
Tulsa, OK	33	45	63	59	60	57	72	68	47	58	64	61
Virginia Beach, VA	42	57	75	71	73	73	78	89	96	78	85	92
Washington, DC	5	15	17	24	28	34	28	34	49	7	14	21
West Palm Beach, FL	3	3	31	53	61	63	53	55	45	24	30	43
Youngstown, OH	90	86	88	30	34	36	43	63	70	57	70	73

Appendix B: Measures of Segregation

Measuring Economic Segregation

There are several ways to measure economic isolation. Dissimilarity indexes measuring racial and ethnic segregation can easily be modified to measure income-based segregation. D indexes, however, generally require splitting the population into two distinct groups (e.g., whites and blacks). Measuring income-based segregation using a conventional D index approach requires making a somewhat arbitrary decision about what income level should be used to split the population into two groups (i.e., poor and nonpoor). The Residential Income Segregation Index is not a conventional D index and captures the concentration of both high-income and low-income households, but it relies on arbitrary cutoffs to define high and low income. Indexes based on income distribution throughout a metro area, such as the Neighborhood Sorting Index (NSI), the Centile Gap Index (CGI), and the Rank-Order Information Theory Index (ROITI), measure how many similar types of people "clump" together across a metropolitan area (Jargowsky and Kim 2005; Reardon and Bischoff 2011; Watson 2009).[14]

All three indexes allow us to assess how many poorer households tend to live in neighborhoods composed of mostly other poor households. In practice, the NSI compares the income variation across all neighborhoods in a metro area with the income variation across all households in that metro area. If households are segregated across neighborhoods by income, the income variation across neighborhoods will be similar to the income variation across households, and the NSI will equal almost 1. If all neighborhoods are perfectly economically integrated (i.e., each neighborhood is a microcosm of the entire metro area) the NSI will be almost 0. Because the NSI is based on relative variances in income, measured income segregation will be influenced by the metro area's overall inequality. The CGI and ROITI consider the relative income rank of residents in a neighborhood compared with their income rank in the greater metro area to measure income segregation. Because those two segregation indexes are based on percentile rankings rather than relative variances, they are not influenced by the metro area's overall inequality. The NSI captures how much a metro area's richer and poorer residents cluster together and how big the gap is between the rich and poor. The CGI and ROITI purely capture how much richer and poorer residents intermingle regardless of how big the income gap.

A major shortcoming of those indexes is that they consider neighborhoods without regard to their location relative to other neighborhoods. Consider the following example in which rich and poor households are perfectly segregated across neighborhoods:

Metro A

Poor	Poor	Rich	Rich
Poor	Poor	Rich	Rich

Metro B

Poor	Rich	Rich	Poor
Poor	Rich	Rich	Poor

In metro A, half the poor neighborhoods border only other poor neighborhoods. In metro B, even though the poor and the rich live in segregated neighborhoods, all poor neighborhoods border rich neighborhoods. Although each index would have the same value for metros A and B, the poor in metro B are likely to be less isolated than those in metro A.

The Generalized Neighborhood Sorting Index (GNSI, a variant of the NSI) and the Spatial Information Theory Index (SITI, a variant of the ROITI) can mitigate that problem. (The CGI cannot be adjusted for proximity.) The GNSI weights the NSI by a factor that accounts for incomes in nearby neighborhoods (Jargowsky and Kim 2005). The SITI does not recognize neighborhood boundaries and is instead based on households within a specific radius (e.g., 500 meters). Because census tract boundaries capture neighborhood boundaries (especially those defined by physical structures, such as railroad tracks and highways) better than an arbitrarily defined distance, the GNSI is preferable for our purposes. We used a version of the GNSI that measures metro-wide income isolation at the neighborhood (census tract) level while taking into account income levels in contiguous neighborhoods.[15]

Income data is generally available in binned ranges for a geographical area, rather than at the household level with precise latitude and longitude (Jargowsky and Kim 2005). We used the working definition discussed in Jargowsky and Kim (2005) for calculating the GNSI of expansion order k = 1:

$$GNSI_k \equiv \sqrt{\frac{\sum_{n=1}^{N} h_n(m_{kn} - M^2)/H}{\sum_{i=1}^{H}(y_i - M^2)/H}}$$

where

H = number of households in the CZ;

M = mean income of the CZ;

N = number of census tracts in CZ;

h_n = number of households in census tract n;

y_i = income of household i;

m_{kn} = mean household income in kth order expansion from census tract n.

To calculate the variance in mean household income at the CZ level, we used binned household income data available in the 1990 and 2000 long-form Census and 2008–12 American Community Survey. While the 2000 and 2010 data contained the same 16 income groups, the 1990 data contained 25 groups. We matched the 1990 breaks to the 2000 and 2010 breaks, resulting in 15 income groups in 1990.[16] Assuming a Gaussian distribution of income, we used R's survival package to estimate CZ income variance from this interval-censored tract-level data.[17]

To calculate the variance in first-order expansion neighborhood income, we calculated a Queen contiguity matrix for each CZ using R's spdep package. We used the highest-resolution census tract shapefiles available from the Census Bureau's TIGER/Line (2000 and 2010) and the National Historical Geographic Information System (1990) for the contiguity calculation. Then, we calculated mean income for each tract and its immediately contiguous neighbors, m_{1n}, by summing aggregate household income and dividing by the number of households in those tracts.

Measuring Racial Segregation

Our analysis explored two measures of racial segregation: the spatial proximity index, a measure of "clustering," and the dissimilarity index, a measure of "evenness." Given our focus on regional spatial

patterns, we believe the SP index is most appropriate for our goals. The SP index model used as the basis for our work is as follows:

$$\frac{\left(XP_{xx} + YP_{yy}\right)}{TP_{tt}}$$

$$\text{where } P_{gg} = \sum_{i=1}^{n}\sum_{j=1}^{n}\left[\frac{\left(g_i g_j c_{ij}\right)}{G^2}\right]$$

$$\text{and } \{g, G\} = \{x, X\}, \{y, Y\}, \{t, T\}$$

X = sum of all xi (total minority population)

Y = sum of all yi (total majority population)

P = ratio of X to T (proportion of the metropolitan area's minority population)

T = sum of all t_i (total population)

xi = minority population of area i

yi = majority population of area i

c_{ij} = exponential transform of - d_{ij} [= exp(-d_{ij})]

Source: Iceland and Weinberg (2002).

The dissimilarity index is as follows:

$$\frac{\sum_{i=1}^{n}\left[t_i\left|(p_i - P)\right|\right]}{[2TP(1-P)]}$$

where:

n = number of areas (census tracts) in the metropolitan area

t_i = total population of area i

p_i = ratio of xi to ti (proportion of area's minority population)

P = ratio of X to T (proportion of the metropolitan area's minority population)

T = sum of all ti (total population)

Source: Iceland and Weinberg (2002).

Appendix C: Alternate Analysis

Our core analysis focuses on the spatial proximity (SP) index, but we also analyzed the effects of racial segregation measured by the dissimilarity (D) index.

The D index, the most widely used measure of racial segregation, is the percentage of a group's population that would have to change location for each neighborhood to have the same share of that group as the overall region. Like the GNSI, the D index ranges from 0 (perfect integration) to 1 (perfect segregation).

Significant findings using the D index are as follows:

- Higher levels of black segregation are associated with
  - higher median income for whites,
  - lower BA attainment for blacks, and
  - higher life expectancy.
- Higher levels of Latino segregation are associated with
  - lower median and per capita income and lower BA attainment for Latinos,
  - higher per capita income for blacks, and
  - higher BA attainment for the total population, whites, and blacks.

TABLE C.1

Segregation and Household Median Income

	A: Using the Dissimilarity Index for Racial Segregation			
	All	**White**	**Black**	**Latino**
Economic segregation	-0.0689	-0.1832*	-0.2765*	0.0205
	(0.0816)	(0.1002)	(0.1064)	(0.1010)
Black-white segregation	0.1390	0.5392*	-0.2250	0.0314
	(0.1063)	(0.2426)	(0.3778)	(0.2844)
Latino-white segregation	0.0918	-0.0609	0.1329	-0.6046*
	(0.0652)	(0.0792)	(0.0968)	(0.1202)
Inequality	-1.8876*	-1.5449*	-5.9595*	-4.1247*
	(0.4860)	(0.5626)	(0.9437)	(0.9210)
ln(population)	0.0861*	0.1576*	0.1048	0.0386
	(0.0425)	(0.0615)	(0.0774)	(0.0678)
Percent white	0.0982	-0.1935	-0.7253*	-0.9491*
	(0.2070)	(0.2487)	(0.2953)	(0.2549)
Percent manufacturing	0.6083*	0.5918*	0.5999*	0.8091*
	(0.1394)	(0.1698)	(0.3052)	(0.2543)
Percent < age 25	-0.5127	-0.2304	-1.4259*	-1.2043
	(0.5218)	(0.6344)	(0.7912)	(0.7314)
Percent ages 25 to 54	0.7769*	1.3807*	0.1236	1.463*
	(0.4101)	(0.4950)	(0.7880)	(0.6993)
Year = 2000	0.0638*	0.0699*	0.0703*	0.0122
	(0.0166)	(0.0213)	(0.0312)	(0.0278)
Year = 2010	0.0282	0.0669	-0.0550	-0.1035*
	(0.0349)	(0.0478)	(0.0629)	(0.0546)
Intercept	10.0914*	8.7361*	12.5571*	12.4871*
	(0.7893)	(1.3304)	(1.4762)	(1.2688)

Source: Authors' tabulations from the 1990, 2000, and 2010 Censuses and the 2008–12 American Community Survey (for 2010 income data). Percent manufacturing from the Bureau of Labor Statistics' Quarterly Census of Employment and Wages.
Note: * indicates significance at the 10 percent level.

TABLE C.2

Segregation and Per Capita Income

	A: Using the Dissimilarity Index for Racial Segregation			
	All	**White**	**Black**	**Latino**
Economic segregation	-0.0556	-0.0847	-0.3684*	-0.1381
	(0.0908)	(0.0677)	(0.1405)	(0.1152)
Black-white segregation	0.1385	0.1537	-0.7215	0.1826
	(0.1028)	(0.1067)	(0.5537)	(0.2818)
Latino-white segregation	0.0966	0.0684	0.2327*	-1.2874*
	(0.0663)	(0.0658)	(0.1150)	(0.2255)
Inequality	-0.7769*	-0.5889	-4.1117*	-3.4107*
	(0.4185)	(0.3894)	(1.1087)	(1.0071)
ln(population)	0.0441	0.0104	0.0936	-0.1068
	(0.0375)	(0.0431)	(0.0742)	(0.1025)
Percent white	0.5281*	-0.3095*	-0.4100	-1.3713*
	(0.1813)	(0.1695)	(0.3804)	(0.3662)
Percent manufacturing	0.4094*	0.514*	0.3385	0.729*
	(0.1265)	(0.1184)	(0.4398)	(0.3130)
Percent < age 25	-1.2234*	-1.3295*	0.4851	-1.6374
	(0.4510)	(0.4106)	(1.3475)	(1.0141)
Percent ages 25 to 54	0.8867*	0.4207	0.0171	1.4986
	(0.3928)	(0.4177)	(1.1492)	(0.9962)
Year = 2000	0.1337*	0.1235*	0.1508*	0.0290
	(0.0140)	(0.0132)	(0.0494)	(0.0376)
Year = 2010	0.1284*	0.1011*	0.0669	-0.0696
	(0.0290)	(0.0285)	(0.0843)	(0.0765)
Intercept	9.3833*	10.7846*	10.6319*	13.9608*
	(0.7306)	(0.8298)	(1.7340)	(1.8372)

Source: Authors' tabulations from the 1990, 2000, and 2010 Censuses and the 2008–12 American Community Survey (for 2010 income data). Percent manufacturing from the Bureau of Labor Statistics' Quarterly Census of Employment and Wages.
Note: * indicates significance at the 10 percent level.

TABLE C.3

Segregation and Share of Adults Ages 25 and Older with a Bachelor's Degree

	A: Using the Dissimilarity Index for Racial Segregation			
	All	**White**	**Black**	**Latino**
Economic segregation	0.0084	-0.0064	-0.0679*	0.0501
	(0.0190)	(0.0241)	(0.0320)	(0.0419)
Black-white segregation	-0.0296	0.0257	-0.155*	-0.0356
	(0.0375)	(0.0397)	(0.0924)	(0.0628)
Latino-white segregation	0.0862*	0.0755*	0.0494*	-0.3965*
	(0.0210)	(0.0248)	(0.0240)	(0.0792)
Inequality	0.8223*	0.8548*	0.1058	-0.2480
	(0.1306)	(0.1662)	(0.1638)	(0.2792)
ln(population)	-0.0120	-0.0129	0.0231	-0.0493
	(0.0148)	(0.0189)	(0.0185)	(0.0333)
Percent white	0.1815*	-0.0022	-0.1319*	-0.4575*
	(0.0610)	(0.0755)	(0.0744)	(0.1423)
Percent manufacturing	0.1232*	0.219*	-0.0221	0.2371*
	(0.0421)	(0.0543)	(0.0720)	(0.0882)
Percent < age 25	0.4184*	0.378*	0.0302	-0.6788*
	(0.1374)	(0.1764)	(0.1954)	(0.2921)
Percent ages 25 to 54	0.4003*	0.3382*	0.0155	0.3802
	(0.1224)	(0.1558)	(0.2040)	(0.3192)
Year = 2000	0.0475*	0.051*	0.0022	-0.0102
	(0.0044)	(0.0056)	(0.0077)	(0.0108)
Year = 2010	0.1106*	0.1164*	0.0236	-0.0070
	(0.0097)	(0.0124)	(0.0150)	(0.0209)
Intercept	-0.4557	-0.2907	-0.0529	1.4891*
	(0.2839)	(0.3519)	(0.3899)	(0.5891)

Source: Authors' tabulations from the 1990, 2000, and 2010 Censuses and the 2008–12 American Community Survey (for 2010 income data). Percent manufacturing from the Bureau of Labor Statistics' Quarterly Census of Employment and Wages.
Note: * indicates significance at the 10 percent level.

TABLE C.4

Segregation and Life Expectancy

	A: Dissimilarity Index
Economic segregation	1.1551
	(1.1306)
Black-white segregation	4.1098*
	(1.6830)
Latino-white segregation	-1.1741
	(0.8992)
Inequality	26.9288*
	(5.6786)
ln(population)	-0.2178
	(0.5359)
Percent white	-5.8964*
	(2.1048)
Percent manufacturing	7.3929*
	(1.9642)
Percent < age 25	1.9562
	(7.6048)
Percent ages 25 to 54	6.9020
	(5.9200)
Year = 2000	1.3895*
	(0.2586)
Year = 2010	3.1799*
	(0.5314)
Intercept	64.6813*
	(10.6374)

Source: Authors' tabulations from the 1990, 2000, and 2010 Censuses and the 2008–12 American Community Survey (for 2010 income data). Percent manufacturing from the Bureau of Labor Statistics' Quarterly Census of Employment and Wages. Life expectancy data come from the Institute for Health Metrics and Evaluation.
Note: * indicates significance at the 10 percent level.

TABLE C.5

Segregation and Homicide Rate

	A: Dissimilarity Index
Economic segregation	2.9758
	(4.3009)
Black-white segregation	4.9913
	(4.5010)
Latino-white segregation	-0.4318
	(5.4603)
Inequality	11.9070
	(18.7466)
ln(population)	-7.8745*
	(2.0372)
Percent white	-6.3051
	(9.0158)
Percent manufacturing	10.3819
	(7.8649)
Percent < age 25	19.7128
	(24.5188)
Percent ages 25 to 54	24.9472
	(18.6559)
Year = 2010	1.3542
	(1.0532)
Intercept	93.5332*
	(35.2070)

Source: Authors' tabulations from the 1990, 2000, and 2010 Censuses and the 2008–12 American Community Survey (for 2010 income data). Percent manufacturing from the Bureau of Labor Statistics' Quarterly Census of Employment and Wages. Homicide data from the Uniform Crime Reporting Program (ICPSR 2006, 2014).
Note: * indicates significance at the 10 percent level.

Notes

1. *Segregation* is the uneven geographic distribution of households of different income levels and racial and ethnic backgrounds within a metropolitan area. Both economic and racial segregation denote how many families of different backgrounds live in different neighborhoods.
2. *Level* refers to the measure of segregation at a particular time, and *trend* refers to how levels change over time. In our analysis, we measure trends from 1990 through 2010.
3. We use the term *black* to stand for people identifying themselves as black, African American, and African, except Latinos with African origin (e.g., Dominicans or Brazilians), who are usually classified as Latino when exclusive-origin groups are used.
4. To calculate the spatial proximity index, we use the Geo-Segregation Analyzer tool. See Philippe Apparicio, Éric Fournier, and Denis Apparicio, "Geo-Segregation Analyzer: An Open-Source Software for Calculating Residential Segregation Indices," Geo-Segregation Analyzer, accessed March 17, 2017, http://geoseganalyzer.ucs.inrs.ca/.
5. For a discussion of racial segregation measures, see Iceland and Weinberg (2002).
6. See "Commuting Zones and Labor Market Areas," US Department of Agriculture, Economic Research Service, last updated October 3, 2016, http://www.ers.usda.gov/data-products/commuting-zones-and-labor-market-areas.aspx and Nichols, Martin, and Franks (2015).
7. Another way to address the problem of segregation and outcomes being jointly determined is to measure segregation and the other factors with a lag. This would measure the relationship between past economic segregation and current outcomes. But simply measuring segregation and other factors with a lag does not account for historical factors and factors we cannot observe that affect segregation and outcomes. To address those potential sources of bias, we analyzed the relationship between the change in outcomes and past changes in segregation and other metro-wide factors. This "change" approach addresses potential omitted variable bias in the "level" approach described above. The downside of the change approach is that it reduces the sample size to 100 and may amplify the "noise" in the data (i.e., the relationships may not be estimated precisely).
8. Because our measures of economic and racial segregation are based on different scales, we did not compute a combined rank based on the actual segregation index numbers.
9. Findings using the dissimilarity (D) index of segregation are in appendix C. The effects of racial segregation using the D index are often different. We believe the spatial proximity (SP) index better measures segregation for our analysis, but the relatively low levels of Latino-white segregation in many commuting zones (CZs) makes teasing out the effects of the SP index of Latino-white segregation difficult. Although the D index may be a more useful measure for Latinos, we focus on the SP index to simplify our discussion.
10. In addition to the alternative models shown in the appendix, we also estimated models focused on how historical changes in segregation were associated with future changes in the outcomes we consider. Again, we find broadly similar results to those reported here. Those results are available from the authors upon request.
11. Although the official US Department of Agriculture definition also includes Grundy County in the Chicago CZ, we exclude it from this analysis, as it lies outside the Chicago metropolitan planning area. Metropolitan planning areas are regions within which federally regulated transportation planning processes must be carried out. See "MPO Policy Committee," Chicago Metropolitan Agency for Planning, accessed February 21, 2017, http://www.cmap.illinois.gov/about/involvement/committees/policy-committees/mpo-policy-committee.
12. See appendix A for segregation indexes for all 100 CZs analyzed here.

13. Reardon and Bischoff (2016) show a small decline in economic segregation as measured by the Rank-Order Information Theory Index in Chicago between 2007 and 2012.
14. See Appendix A for a technical discussion of neighborhood sorting indexes.
15. We prefer the GNSI to other indexes of economic isolation such as the dissimilarity index used by Florida and Mellander (2016) and the Residential Income Segregation Index used by Fry and Taylor (2012) because the GNSI allows us to consider divisions between neighborhoods and the proximity of rich and poor neighborhoods. It better captures economic isolation than the measures used elsewhere.
16. The highest-income group in 2000 and 2010 was $200,000 or more and was $150,000 or more in 1990.
17. Methods laid out in Quillian and Lagrange (2013).

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