Racial Residential Segregation in an Era of Increasing Income Inequality and Poverty Concentration

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Abstract

This project analyzes when patterns of residential mobility by race across neighborhoods reproduce, deepen, or alleviate patterns of segregation by both race and income. I implement a set of discrete-choice models of neighborhood mobility along multiple dimensions and use the predictions of the discrete choice models to explicitly connect household-level moves to aggregate patterns of residential segregation. I use restricted Decennial Census and American Community Survey data for the period between 1990 and 2014, geocoded down to the census tract level, to examine changes over time in the determinants of mobility of households across neighborhoods and to simulate levels of segregation by race and income given different counterfactual scenarios of household residential mobility by race and income. Preliminary results show that sorting by income across neighborhoods is not a major determinant of racial residential segregation, but households move in fundamentally different ways across neighborhoods depending on the race of the household head and the presence of children in public school in the household.

Introduction

Scholars of segregation have consistently pointed out that levels of racial residential segregation are much higher than levels of income segregation. Nevertheless, as levels of racial segregation have declined or stayed about the same, income segregation has increased over time and this increase has accelerated over the last decade (Bischoff and Reardon 2013). Even more troubling has been the increase in the number of high poverty neighborhoods as well as the percent

[1] Any opinions and conclusions expressed herein are those of the authors and do not necessarily represent the views of the U.S. Census Bureau. All results have been reviewed to ensure that no confidential information is disclosed. The author wishes to acknowledge Ben Jarvis for graciously providing Stata code and guidance with the implementation of the discrete choice models and simulations. This research was generously supported by the CUNY-PSC program and the CUNY Faculty Fellowship Publication Program.

of the minority population living in high poverty neighborhoods after 2000 (Jargowsky 2014; Kneebone and Holmes 2016). The concentration of poverty for the minority population in the United States has happened in an era of continued gentrification of central city neighborhoods, raising questions about whether even the modest progress towards racial integration would be erased by the restructuring of metropolitan patterns by both race and income since the turn of the century.

This project examines the interplay between racial and income segregation by modeling the determinants of household mobility by race and income into different types of destination neighborhoods. I use discrete choice models of residential mobility coupled with Decennial Census and American Community Survey data for the period between 1990 and 2014 to examine how the flows of households within metropolitan areas have changed over time and how those changes have combined to produce both gentrification and proliferation of poor neighborhoods. I also simulate under what conditions the current trends of increasing segregation by income across neighborhoods could be reversed.

Background

The relationship between racial socioeconomic inequality and residential segregation has received substantial attention in the social sciences. Previous research has found that high income African Americans on average live in less affluent areas than comparable white households (Alba, Logan, and Stults 2000). While non-poor blacks since the 1970s have been able to migrate to predominantly white neighborhoods, that movement has been accompanied by white flight, producing the re-segregation of these areas (Quillian 1999). Black residents who move out of poor neighborhoods are much more likely than whites to return to living in a poor neighborhood by either return migration or because their new neighborhoods become poorer around them (Quillian 2003). On the other hand, middle-class whites have been able to distance themselves from poverty better than the black middle class by either having the means to move out or by avoiding poor neighborhoods altogether (Patillo-McCoy 2000). Therefore, for the black population higher socioeconomic status does not translate into a less-poor neighbors in the same way as it does for the white population.

An additional pernicious outcome of the interplay between racial segregation and socioeconomic inequality is that racial segregation also appears to concentrate poverty (Massey

and Denton 1993). Most empirical studies which have tried to examine this argument have found no or mixed support for it (Korenman, Sjaastad, and Jargowsky 1995; Jargowsky 1997; Massey and Fischer 2000), but as Quillian (2012) points out, one needs to examine not only the patterning of race and poverty across neighborhoods, but also the exposure of poor minority households to middle-income and high-income white households in order to find a multiplicative effect of racial segregation on poverty concentration. For the black population in particular, racial residential segregation concentrates poverty because middle-class blacks are much less segregated from poor blacks in metropolitan areas with high poverty levels. For the Hispanic population, racial residential segregation concentrates poverty because poor Hispanics tend to have more poor non-Hispanic neighbors (Quillian 2012).

The relationship between racial residential segregation and the spatial concentration of households by income is complicated by the size of the local black population and the relative socioeconomic standing of the black and the white populations. For example, using empirically based agent based models, Bruch (2014) shows that an increase in income inequality across the black and the white population increases the exposure of poor blacks to black neighbors but decreases the exposure of affluent blacks to black neighbors. As Bruch (2014) points out, in moderate-to-highly segregated metropolitan areas, the predominant neighborhood options for high-income black households are either majority black neighborhoods or neighborhoods with high-income households. Therefore, high-income black households have limited choices of either living in a black neighborhood or living in an affluent neighborhood. On the other hand, as Bayer, Fang, and McMillan (2014) show, if there is a critical mass of highly educated black households in a metropolitan area, more middle-class black communities form. As these communities increase in number, so does the residential segregation between the white and the black population as middle-class black households in metropolitan areas with relatively more middle-class black communities have the option to move to a neighborhood that is not only middle-class but also predominantly black.

In sum, not only does racial residential segregation appear to exacerbate the concentration of poverty, but there also appear to be important processes of segregation that operate in different ways at the top and at the bottom of the income distribution. Moreover, racial segregation and segregation by income combine in complex interactive ways. Thus, it is both conceptually and methodologically difficult to disentangle the effects of one from the other. One needs to be

attentive to not only the structure of metropolitan areas but also to differences in how geographic mobility operates across income categories within race and across race within income categories.

The findings on the interplay between racial segregation, income segregation, and income equality are important for several reasons. Not only has income inequality grown dramatically over the last 40 years (Piketty 2013), but income inequality in the black population has grown more than income inequality in the white population (Autor, Katz, and Kearney 2006, 2008). Moreover, segregation by income has risen more within minority populations in the United States compared to the white population (Reardon and Bischoff 2011; Bischoff and Reardon 2014; Reardon and Bischoff 2016). Therefore, studies of racial and income segregation need to consider both the relative socioeconomic positions of white and minority populations in the United States and the availability of distinct types of neighborhoods within metropolitan areas to which households could realistically move. They also need to consider how the flows of households across neighborhoods by race and income have changed over time to produce a relatively small decrease in segregation by race but a relatively large increase in segregation by income.

Overview of empirical strategy

This project examines the interplay between income inequality and residential segregation by race and income by demonstrating how the flows of households into neighborhoods combine in ways to weaken, reproduce, or worsen segregation by race and income. Drawing inspiration from the literature on the determinants of geographic mobility of households across neighborhoods, I go a step further by aggregating the moves of households into neighborhood-level measures that I can then use to describe the spatial patterning of the population across metropolitan areas of differing racial compositions and differing income inequality both within and between the white, black, Hispanic, and Asian populations. I am able to do so because I use a discrete-choice approach to modeling residential mobility and because I have access to the complete sample data for the U.S. Decennial Census and the American Community Survey between 1990 and 2014.

Studying the mechanism of allocating individuals to neighborhoods is an important building block to understanding metropolitan-level changes in residential segregation over time. As Sampson and Sharkey (2008, p.2) note “individual decisions combine to create spatial flows that define the ecological structure of inequality.” Therefore, it is important to study neighborhood mobility using a realistic framework of how households make choices across possible neighborhood

destinations (Bruch and Mare 2012). This means that one needs to model neighborhood mobility using multiple neighborhood characteristics which interact with the characteristics of households who make decisions whether to move or where to move. This also means that one needs to model neighborhood mobility by constraining the available neighborhood options to ones that actually exist. This is precisely what discrete-choice models do. There have, however, been only a handful of studies which have used this methodology to study geographic mobility given the data and computational demands of the models. Bruch and Mare (2012) provide an accessible methodological description of discrete choice models using an empirical example from the LAFANS. Using data from the PSID, Quillian (2015) demonstrates that the sorting of households across neighborhoods based on race rather than income is what drives racial inequality in neighborhood income outcomes. Finally, Bayer et al. (2004) show that socioeconomic differences between the white and Hispanic and between the white and Asian population explain a large portion of segregation in the San Francisco Bay area. These findings do not hold for socioeconomic differences between the black and white populations.

This project takes discrete-choice models a step further by having access to the entire long-form sample of households in the 1990 and 2000 Decennial Censuses along with the entire sample of households in the 2006-2010 ACS and the 2010-2014 ACS. Having access to these data allows me to examine how the flows of people by race and income have changed over time in ways that deepen residential segregation by income. I can also examine changes in residential mobility that could explain the processes of gentrification and the proliferation of neighborhoods with high poverty rates. Finally, since the Census and the ACS have large samples of households, I can examine the residential mobility of relatively small slices of the population, such as high-income black, Hispanic, or Asian households. I can also compare trends across years and across metropolitan areas and conduct simulations of residential mobility which show what segregation levels by race and income would have been had the population moved in different ways across neighborhoods.

Methods and data

Discrete-choice models of residential mobility have been used in the statistical literature on migration since the 1970s (McFadden 1978). Intuitively, the use of discrete-choice models amounts to asking the question why a household moved to a specific destination neighborhood given all

possible other destinations to where that household could have moved. The dependent variable is a binary variable which takes the value of "1" for the actual destination neighborhood of each household and the value of "0" for all possible other destinations to which a household could have moved. The independent variables are the socioeconomic characteristics of the actual and potential neighborhood destinations of each household and interactions between household characteristics and neighborhood characteristics.

Estimation of discrete choice models

I use conditional logistic regression to estimate the discrete-choice models. I estimate the conditional logistic regressions using data on all households regardless of actual geographic mobility. In this setup, the choice that households are making is whether to stay put or to move to a different neighborhood given the household's socioeconomic characteristics and the characteristics of potential neighborhood destinations.

Formally, I model the probability that a household *i* chooses a particular neighborhood *j* in a metropolitan area *m* between year *t-1* and *t*. I assume that neighborhood *j* is drawn from a "choice set" of many possible neighborhood destination C_{imt}. C_{imt} is composed of all neighborhoods within that household's current metropolitan area with non-zero population in years *t* and *t-1*. The probability of choosing a particular neighborhood is a function of neighborhood covariates Z_{ijmt}, which interact with household-level covariates, X_{it}. These factors are assumed to contribute to a linear-in-parameters random utility function:

$$U_{itmj} = \beta Z_{ijmt} + \gamma Z_{ijmt} X_{it} + \epsilon_{ijmt},$$

where ϵ_{ijmt} is a random, household, neighborhood, and metropolitan-area specific term. Assuming that households choose the neighborhood with the highest total utility, the probability that household *i* chooses neighborhood *j* in metropolitan area *m* in year *t* is:

$$p_{ijmt} = \frac{exp\left(\beta Z_{ijmt} + \gamma Z_{ijmt} X_{it}\right)}{\sum_{k \in C_{imt}} exp(\beta Z_{ikt} + \gamma Z_{ikt} X_{it})}$$

I accumulate these probabilities across time and households in the following likelihood function:

$$L = \prod_{t} \prod_{i} \prod_{j} \prod_{m} \left(p_{ijmt}\right)^{y_{ijmt}}$$

The outcome variable, y_{ijmt}, takes the value of "1" if neighborhood *j* in metropolitan area *m* is the destination of household *i* in year *t* and "0" otherwise. I estimate β and γ using conventional maximum likelihood techniques.

Because every metropolitan area in the United States has at least a few hundred census tracts, estimating the likelihood function for each household in every Census year can be computationally cumbersome. Therefore, I sub-sample alternatives within each households' choice set, C_{imt}, where each household can only choose five percent of potential neighborhoods within their current metropolitan area. Using a sample of potential neighborhood destinations produces consistent estimates as long as the discrete choice models include an offset term equal to -1 times the log of the sampling fraction (Bruch and Mare 2012). The subsample of alternatives in C_{imt} is randomly selected for each household. Households can only choose other neighborhoods within the same metropolitan area.[2]

I estimate the discrete choice models using restricted Decennial Census data for the years 1990 and 2000 and five-year American Community Survey (ACS) data for 2010-2014. All discrete choice models are estimated separately by year.

Key variables

I code the dependent variable in the discrete-choice models using the migration histories of household heads for each census year. All Decennial Census datasets and the ACS include a question on when the household head moved into their current residence. I classify as movers all household heads who have moved into their current residence over the year prior to each Census or the ACS. I only consider this most recent mobility history of every household in order to avoid endogeneity between the dependent variable and the household-level independent variables. In this way, all household-level socioeconomic variables are measured as contemporaneously as possible with the decision to move to a different neighborhood. Moreover, I estimate all neighborhood-level independent variables only for the population that did not move in the year

[2] This restriction presents some conceptual challenges since a realistic choice-set of neighborhoods would represent three basic choices – to stay put, to move to a neighborhood in a different metropolitan area, or to move to a neighborhood within the current metropolitan area. My basic models account for the decision to stay put versus to move within the same metropolitan area, but do not explicitly model the decision to move to a neighborhood outside the current metropolitan area.

prior to each census. Therefore, these measures precede temporally the mobility behavior of households.

I include the following household-level independent variables in my model: the race and age of the household head, the marital status of the household head, the educational attainment of the household head, the presence of children in the household, household income, whether the household head is a newcomer to the metropolitan area, and distance to work. I include the following neighborhood-level independent variables in my model: neighborhood racial composition, neighborhood income level, neighborhood housing prices, and neighborhood distance to an established minority neighborhood. All household-level variables enter the model as interactions with the neighborhood-level variables.

Simulations using the estimated parameters of the discrete choice models

After I estimate the discrete-choice models, I generate predictions of the probabilities of households choosing a particular neighborhood in a particular metropolitan area. I use these probabilities to generate the counts of households who are expected to end up in each neighborhood in my dataset. I predict these counts based on the full set of estimated coefficients in my models and based on different counterfactual conditions where I change how important the socioeconomic aspects of each neighborhood are in determining the mobility behavior of different racial and income groups and where I change the mobility behavior of different racial and income groups. I conduct the following simulations of the expected counts of households in each neighborhood in my dataset:

1. Counts based on the full model
2. Counts based on a model where the coefficient on the racial composition of a neighborhood are set to 0
3. Counts based on a model where the coefficient on the income composition of a neighborhood is set to 0
4. Counts based on a model where the white population has the same mobility behavior as either the African American, Latino, or Asian populations
5. Counts based on a model where the African American, Latino, and Asian populations have the same mobility behavior as the white population

6. Counts based on a model where households in the bottom quartile of the income distribution have the same mobility behavior as households in the top quartile of the income distribution
7. Counts based on a model where African American, Latino, and Asian households in the top quartile of the income distribution have the same mobility behavior as white households into top quartile of the income distribution
8. Counts based on a model where white households in the top quartile of the income distribution have the same mobility behavior as either African American, Latino, or Asian households into top quartile of the income distribution[3]

Simulation 2 and 3 amount to eliminating race and income as a basis for sorting across neighborhoods. Simulations 5, 6, 7, and 8 amount to changing how important neighborhood racial and socioeconomic characteristics are for the mobility behavior of different racial/ethnic and income groups.

Once I generate the predicted counts of households in each census tract under each simulation scenario, I use these counts to compute the index of racial residential segregation between the white, black, Hispanic, and Asian populations. I also use these predicted counts to compute the index of segregation across the distribution of household income and the index of segregation across the distribution of household income by race. This analysis allows me to connect household-level migration patterns by race and income to metropolitan-level segregation by race and income.

I compute the dissimilarity index and the entropy index to examine segregation by race. I compute the Herfindahl index and the rank-order information theory index to examine segregation by race and income. For the formulas of each index, please see the Appendix.

Preliminary results and next steps

Tables 1 and 2 show preliminary conditional logistic regressions of the determinants of household geographic mobility by race and tenure. Table 1 shows results using the 1990 Decennial Census, while Table 2 shows results using the 2010-2014 ACS. All regressions are run separately by

[3] I will also experiment with analyses that use the top quintile and the top 10% of the income distribution.

tenure because renters and owners have very different probabilities of geographic mobility, with renters moving much more frequently than home owners.

Instability in a neighborhood's racial composition and in the neighborhoods around a focal neighborhood is an important correlate of the mobility decisions of white households. This shows that white household make mobility decisions based on expectations about the future socioeconomic composition of a neighborhood. Life course factors, such as the presence of children in public school, are important deterrents to integration for the white population. On the other hand, interracial relationships at the household level translate into integration at the neighborhood level.

For the black, Hispanic, and Asian homeowner population, the internal segregation of a tract between the white and non-white population decreases in-mobility. This pattern is opposite the one for the white population, showing that minority homeowners move to neighborhoods that are less internally segregated compared to the neighborhoods where white homeowners move to. The Asian and Hispanic population is also more likely to move into a neighborhood with a recent increase in the percent foreign born; however, if a Hispanic or Asian household speaks only English at home, that household is less likely to move to a neighborhood with higher levels of, respectively, Hispanic or Asian populations.

Tables 3 and 4 show Simulations 1 through 5 based on the discrete choice models in Tables 1 and 2. Specifically, Table 3 shows the observed and simulated index of dissimilarity based on alternative scenarios of mobility for the white population. Table 4 shows the observed a simulated index of dissimilarity based on alternative scenarios of mobility for the black, Hispanic, and Asian populations. Simulation 1, which predicts what residential segregation by race would be based on the full discrete choice model, shows that the models estimated in Tables 1 and 2 recreate current observed segregation levels very accurately. Simulation 2 shows that eliminating race as a basis for sorting across neighborhoods for the white population does not decrease racial residential segregation in an appreciable way. However, sorting by race is a powerful predictor of the segregation levels of minority households. Income sorting across neighborhoods is not a large source of racial residential segregation. Instead, the largest potential decrease in racial segregation could come from changing the mobility behavior of white households so that it matches the mobility behavior of minority households or changing the mobility behavior of minority households so that it matches the mobility behavior of white households.

Next steps in this project include re-estimating the models presented in Tables 1 and 2 within quartiles of the income distribution and for only the top ten percent of households in the income distribution. These additional models will allow me implement Simulations 6 through 8 described above. I also plan to run formal tests of equality of coefficients across models for different years and income groups and to graph predicted probabilities based on these models for easier interpretation of trends over time. Finally, following the results presented in Tables 3 and 4, I also plan to compute additional simulated segregation indexes that present not only segregation by race but also segregation by income and segregation by income and race.

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Table 1. Conditional logit regressions of geographic mobility by race and tenure, only households who moved in the last year, 1990 Census

VARIABLES	White Owners	White Renters	Black Owners	Black Renters	Hispanic Owners	Hispanic Renters	Asian Owners	Asian Renters
Tract: Percent black	0.007***	-0.007***	0.273***	0.193***	0.027***	0.031***	0.016	0.024**
	(0.001)	(0.001)	(0.004)	(0.002)	(0.005)	(0.002)	(0.013)	(0.008)
Tract: Percent Hispanic	0.032***	0.022***	0.020**	0.024***	0.216***	0.200***	0.034*	0.051***
	(0.002)	(0.001)	(0.007)	(0.002)	(0.005)	(0.002)	(0.015)	(0.010)
Tract: Percent Asian	-0.076***	-0.057***	-0.105***	-0.027***	-0.037***	-0.023***	0.119***	0.144***
	(0.003)	(0.002)	(0.011)	(0.003)	(0.009)	(0.004)	(0.013)	(0.009)
Tract: Percent black squared	0.000	0.000***	-0.004***	-0.003***	-0.000	-0.001***	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tract: Percent Hispanic squared	-0.001***	-0.001***	-0.000	-0.000***	-0.003***	-0.003***	-0.001	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Tract: Percent Asian squared	0.003***	0.001***	0.005***	0.001***	0.001*	0.000*	-0.002***	-0.003***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tract: Percent black cubed	-0.000***	-0.000***	0.000***	0.000***	0.000	0.000***	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tract: Percent Hispanic cubed	0.000**	0.000***	-0.000	0.000***	0.000***	0.000***	0.000	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tract: Percent Asian cubed	-0.000***	-0.000***	-0.000***	-0.000***	-0.000	-0.000	0.000*	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tract: Percent black within 2 miles	-0.002***	-0.005***	0.003***	0.001***	-0.001	-0.005***	-0.002	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)
Tract: Log of distance to tract that is at least 25% black	0.026***	0.037***	0.044***	0.040***	0.002	0.016***	0.004	0.015***
	(0.002)	(0.001)	(0.003)	(0.001)	(0.004)	(0.002)	(0.006)	(0.004)
Tract: Change in % black within 2mi over the last 5 years	-0.009***	-0.012***	0.036***	0.037***	0.020***	0.009***	0.012**	0.014***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)	(0.004)	(0.003)
Tract: Percent Hispanic within 2 miles	-0.004***	-0.004***	0.000	-0.001*	-0.006***	-0.001*	-0.001	-0.006***
	(0.000)	(0.000)	(0.002)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Tract: Change in % Hispanic within 2mi over the last 5 years	-0.011***	-0.006***	-0.007	-0.004	0.061***	0.036***	0.031***	0.023***
	(0.002)	(0.001)	(0.006)	(0.002)	(0.003)	(0.001)	(0.005)	(0.004)
Tract: Percent Asian within 2 miles	-0.001	-0.006***	0.005	0.011***	-0.001	-0.005***	0.012***	-0.001
	(0.001)	(0.001)	(0.004)	(0.002)	(0.003)	(0.001)	(0.002)	(0.001)
Tract: Change in % Asian within 2mi over the last 5 years	-0.022***	-0.006***	-0.038***	-0.013***	-0.019***	0.003	0.028***	0.076***
	(0.002)	(0.001)	(0.008)	(0.004)	(0.005)	(0.003)	(0.004)	(0.003)
Tract: Internal tract segregation	0.813***	0.473***	-1.527***	-0.013	-0.599***	0.164***	-1.976***	0.046
	(0.016)	(0.012)	(0.055)	(0.022)	(0.061)	(0.028)	(0.086)	(0.054)
Interaction: Percent black * Whether household is a mixed race couple	0.047***	0.041***	-0.079***	-0.046***	0.006	0.010*	-0.019	-0.000
	(0.004)	(0.003)	(0.009)	(0.005)	(0.007)	(0.004)	(0.013)	(0.009)
Interaction: Percent Hispanic * Whether household is a mixed race couple	0.075***	0.081***	0.012	0.025***	-0.085***	-0.050***	0.023	0.039***
	(0.005)	(0.003)	(0.015)	(0.007)	(0.007)	(0.004)	(0.015)	(0.010)
Interaction: Percent Asian * Whether household is a mixed race couple	0.042***	0.027***	-0.006	0.001	-0.015	-0.016**	-0.163***	-0.118***
	(0.006)	(0.004)	(0.020)	(0.009)	(0.011)	(0.006)	(0.015)	(0.010)
Interaction: Percent black * Whether household has children in a public school	-0.036***	-0.029***						
	(0.002)	(0.001)						
Interaction: Percent Hispanic * Whether household has children in a public school	-0.002	0.021***						
	(0.003)	(0.002)						

Interaction: Percent Asian * Whether household has children in a public school	-0.023***	-0.077***						
	(0.004)	(0.003)						
Interaction: Percent black * Whether household is a newcomer to metro area	-0.004*	0.023***	-0.070***	-0.035***	0.017***	0.025***	-0.001	0.006
	(0.002)	(0.001)	(0.005)	(0.002)	(0.005)	(0.002)	(0.007)	(0.004)
Interaction: Percent Hispanic * Whether household is a newcomer to metro area	-0.039***	-0.027***	0.038***	0.019***	-0.052***	-0.026***	-0.028***	-0.054***
	(0.002)	(0.001)	(0.009)	(0.003)	(0.005)	(0.002)	(0.008)	(0.005)
Interaction: Percent Asian * Whether household is a newcomer to metro area	0.067***	0.102***	0.111***	0.066***	0.078***	0.041***	0.022**	0.051***
	(0.003)	(0.002)	(0.012)	(0.004)	(0.009)	(0.004)	(0.007)	(0.005)
Interaction: Percent black * Whether household head is foreign born	-0.005	-0.024***	-0.005	-0.010**	-0.003	-0.031***	0.024*	-0.012
	(0.004)	(0.002)	(0.007)	(0.003)	(0.005)	(0.002)	(0.012)	(0.007)
Interaction: Percent Hispanic * Whether household head is foreign born	0.005	0.029***	0.078***	0.024***	0.024***	0.003	0.038**	0.013
	(0.005)	(0.003)	(0.010)	(0.005)	(0.005)	(0.002)	(0.014)	(0.009)
Interaction: Percent Asian * Whether household head is foreign born	0.125***	0.108***	0.122***	0.091***	0.032***	0.051***	0.067***	0.088***
	(0.005)	(0.003)	(0.016)	(0.007)	(0.009)	(0.004)	(0.012)	(0.008)
Tract: Percent foreign born	-0.015***	-0.010***	0.001	-0.003***	-0.005***	-0.002***	0.006***	-0.001
	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)
Tract: Change in percent foreign born	-0.004***	-0.008***	-0.015***	-0.009***	0.008***	0.006***	0.008***	0.014***
	(0.001)	(0.000)	(0.003)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
Tract: Ratio of household income to tract median housing value	-1.829***		-0.786***		-0.523***		-1.631***	
	(0.010)		(0.030)		(0.033)		(0.058)	
Tract: Household income minus median tract income (in thousands)	0.007***	0.020***	0.006***	0.018***	0.005***	0.022***	0.001	0.016***
	(0.000)	(0.000)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Interaction: Percent black * Household income	-0.000***	-0.001***	-0.000***	-0.001***	-0.000***	-0.001***	-0.000***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Interaction: Percent Hispanic * Household income	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Interaction: Percent Asian * Household income	0.001***	0.000***	0.001***	0.000*	0.000***	-0.000	-0.000	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tract: Median age of the household head	-0.009***	0.003***	-0.015***	0.012***	0.005*	0.011***	0.018***	0.003
	(0.001)	(0.000)	(0.003)	(0.001)	(0.002)	(0.001)	(0.003)	(0.002)
Tract: Percent of households with a head above the age of 65	0.000	-0.002***	0.008***	-0.000	-0.003	-0.002**	-0.009***	0.008***
	(0.000)	(0.000)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Tract: Percent single-headed households with children	-0.008***	0.013***	0.001	0.021***	0.000	0.014***	0.015***	0.023***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.002)	(0.001)	(0.002)	(0.001)
Tract: Percent employed household heads	-0.011***	0.005***	0.005*	-0.002**	-0.007**	-0.007***	0.014***	0.010***
	(0.001)	(0.000)	(0.002)	(0.001)	(0.002)	(0.001)	(0.004)	(0.002)
Tract: Percent household heads with a prof., manag., or tech. occupation	-0.012***	0.002***	-0.008***	0.001	-0.009***	0.001	0.002	0.004***
	(0.000)	(0.000)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
Tract: Percent households in poverty	-0.008***	-0.006***	-0.009***	0.003***	-0.014***	-0.008***	-0.014***	0.004***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.002)	(0.001)
Tract: Percent households headed by a person with a college degree	-0.004***	-0.000	-0.010***	-0.005***	-0.015***	-0.006***	-0.010***	0.008***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Tract: Percent single-family detached housing	0.002***	-0.006***	0.024***	-0.000	0.013***	-0.005***	0.018***	-0.007***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)
Tract: Percent units in rental housing of 50+ units	-0.035***	-0.001***	-0.023***	0.000*	-0.031***	-0.006***	-0.021***	-0.001*
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
Tract: Percent of housing units built in the last 10 years	0.016***	0.001***	0.015***	-0.007***	0.015***	-0.005***	0.011***	-0.009***

	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Central city	-0.199***	-0.122***	-0.075***	0.011	-0.058***	0.053***	-0.025	-0.024
	(0.005)	(0.003)	(0.019)	(0.008)	(0.016)	(0.008)	(0.021)	(0.015)
South	0.196***	0.020	0.222	0.034	0.235	0.488**	0.998**	0.178
	(0.025)	(0.019)	(0.162)	(0.066)	(0.304)	(0.183)	(0.333)	(0.210)
Tract: One-year household turnover	0.025***	0.044***	0.027***	0.051***	0.030***	0.045***	0.044***	0.052***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Tract: Log of total households	1.159***	1.079***	1.249***	1.179***	1.235***	1.101***	1.187***	1.078***
	(0.004)	(0.003)	(0.015)	(0.006)	(0.014)	(0.007)	(0.018)	(0.012)
Tract: Log of distance to work	-0.514***	-0.564***	-0.434***	-0.506***	-0.490***	-0.580***	-0.536***	-0.605***
	(0.001)	(0.001)	(0.004)	(0.002)	(0.004)	(0.002)	(0.006)	(0.004)
Tract: Ratio of household income to tract median housing value		-0.090***		-0.108***		-0.074***		-0.164***
		(0.001)		(0.002)		(0.002)		(0.004)
Interaction: Percent black * Household speaks only English at home					-0.004	-0.022***	0.049***	0.014*
					(0.007)	(0.003)	(0.011)	(0.007)
Interaction: Percent Hispanic * Household speaks only English at home					-0.070***	-0.091***	-0.021	-0.007
					(0.007)	(0.003)	(0.014)	(0.008)
Interaction: Percent Asian * Household speaks only English at home					-0.020	0.010*	-0.096***	-0.105***
					(0.011)	(0.005)	(0.012)	(0.008)
N (Households by Neighborhood Alternatives)	9,642,000	18,730,000	869,000	5,037,000	972,000	5,102,000	773,000	1,641,000
N (Households)	507,000	963,000	34,000	195,000	38,000	156,000	22,000	48,000
Log-likelihood	-2,335,000	-4,367,000	-157,000	-889,000	-183,000	-756,000	-114,000	-225,000

Notes: All regressions also include interactions between the second- and third-order polynomials of tract racial composition and all household-level variables. Full model specifications available from the author upon request. Standard errors in parentheses. Number of observations rounded according to Census disclosure rules.

*** p<0.001, ** p<0.01, * p<0.05

Table 2. Conditional logit regressions of geographic mobility by race and tenure, only households who moved in the last year, 2010-2014 ACS

VARIABLES	White Owners	White Renters	Black Owners	Black Renters	Hispanic Owners	Hispanic Renters	Asian Owners	Asian Renters
Tract: Percent black	0.005***	-0.004***	0.182***	0.125***	0.029***	0.024***	0.042***	0.012**
	(0.001)	(0.001)	(0.005)	(0.002)	(0.004)	(0.002)	(0.009)	(0.005)
Tract: Percent Hispanic	0.013***	0.008***	0.012*	0.011***	0.124***	0.100***	0.056***	0.040***
	(0.002)	(0.001)	(0.005)	(0.002)	(0.004)	(0.002)	(0.009)	(0.005)
Tract: Percent Asian	-0.032***	-0.020***	-0.054***	-0.009***	-0.021***	-0.016***	0.116***	0.136***
	(0.002)	(0.001)	(0.008)	(0.002)	(0.006)	(0.003)	(0.009)	(0.005)
Tract: Percent black squared	-0.000***	0.000	-0.002***	-0.002***	-0.000	-0.000***	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tract: Percent Hispanic squared	-0.000***	-0.000***	0.000	-0.000	-0.002***	-0.001***	-0.001**	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tract: Percent Asian squared	0.001***	0.000	0.002***	0.000*	0.000	0.000***	-0.002***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tract: Percent black cubed	-0.000**	-0.000***	0.000***	0.000***	-0.000	0.000	-0.000	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tract: Percent Hispanic cubed	-0.000*	0.000	-0.000**	-0.000	0.000***	0.000***	0.000	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tract: Percent Asian cubed	-0.000***	-0.000	-0.000*	-0.000*	-0.000	-0.000*	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tract: Percent black within 2 miles	-0.001*	-0.004***	0.001	0.003***	-0.001	-0.003***	-0.005***	0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)
Tract: Log of distance to tract that is at least 25% black	0.010***	0.019***	0.031***	0.028***	0.012***	0.016***	0.009	0.029***
	(0.002)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)	(0.005)	(0.003)
Tract: Change in % black within 2mi over the last 5 years	-0.014***	-0.020***	0.024***	0.035***	0.013***	0.010***	0.019***	0.001
	(0.001)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)	(0.004)	(0.003)
Tract: Percent Hispanic within 2 miles	-0.003***	-0.006***	-0.004**	-0.002***	0.001	0.003***	0.002*	-0.002***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)
Tract: Change in % Hispanic within 2mi over the last 5 years	-0.013***	-0.014***	-0.002	0.017***	0.027***	0.027***	0.009*	0.015***
	(0.001)	(0.001)	(0.005)	(0.001)	(0.003)	(0.001)	(0.004)	(0.002)
Tract: Percent Asian within 2 miles	-0.005***	-0.006***	-0.007*	0.001	-0.011***	-0.002*	0.018***	0.013***
	(0.001)	(0.000)	(0.003)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Tract: Change in % Asian within 2mi over the last 5 years	-0.017***	-0.001	-0.009	-0.009**	-0.002	-0.001	0.022***	0.053***
	(0.002)	(0.001)	(0.009)	(0.003)	(0.005)	(0.002)	(0.004)	(0.003)
Tract: Internal tract segregation	1.237***	0.757***	-0.474***	0.150***	-0.201**	0.275***	-0.525***	0.536***
	(0.022)	(0.015)	(0.074)	(0.025)	(0.062)	(0.027)	(0.087)	(0.049)
Interaction: Percent black * Whether household is a mixed race couple	0.031***	0.027***	-0.056***	-0.051***	-0.007	-0.001	0.005	0.005
	(0.004)	(0.002)	(0.009)	(0.005)	(0.006)	(0.003)	(0.010)	(0.007)
Interaction: Percent Hispanic * Whether household is a mixed race couple	0.051***	0.043***	0.004	0.023***	-0.039***	-0.016***	0.001	0.014
	(0.004)	(0.003)	(0.012)	(0.006)	(0.006)	(0.004)	(0.010)	(0.008)
Interaction: Percent Asian * Whether household is a mixed race couple	0.038***	0.009**	0.012	-0.014	-0.008	0.002	-0.114***	-0.067***
	(0.005)	(0.003)	(0.015)	(0.007)	(0.008)	(0.005)	(0.010)	(0.008)
Interaction: Percent black * Whether household has children in a public school	-0.037***	-0.037***						
	(0.003)	(0.002)						
Interaction: Percent Hispanic * Whether household has children in a public school	-0.018***	-0.007***						
	(0.003)	(0.002)						

Interaction: Percent Asian * Whether household has children in a public school	-0.004	-0.091***						
	(0.003)	(0.003)						
Interaction: Percent black * Whether household is a newcomer to metro area	-0.021***	0.006***	-0.023*	-0.014***	-0.009	0.009**	0.002	-0.002
	(0.003)	(0.001)	(0.009)	(0.003)	(0.007)	(0.003)	(0.010)	(0.004)
Interaction: Percent Hispanic * Whether household is a newcomer to metro area	-0.029***	-0.013***	-0.012	0.004	-0.053***	-0.033***	-0.029**	-0.035***
	(0.003)	(0.002)	(0.012)	(0.004)	(0.007)	(0.003)	(0.010)	(0.004)
Interaction: Percent Asian * Whether household is a newcomer to metro area	0.010*	0.050***	0.008	0.050***	0.025*	0.045***	0.013	0.044***
	(0.004)	(0.002)	(0.020)	(0.005)	(0.011)	(0.004)	(0.010)	(0.004)
Interaction: Percent black * Whether household head is foreign born	0.009*	-0.001	-0.010	0.001	-0.004	-0.013***	0.003	0.003
	(0.004)	(0.002)	(0.007)	(0.003)	(0.004)	(0.002)	(0.008)	(0.004)
Interaction: Percent Hispanic * Whether household head is foreign born	0.011*	0.008**	0.052***	0.035***	0.021***	0.019***	-0.007	-0.015**
	(0.004)	(0.003)	(0.009)	(0.004)	(0.005)	(0.002)	(0.008)	(0.005)
Interaction: Percent Asian * Whether household head is foreign born	0.100***	0.101***	0.101***	0.081***	0.003	0.020***	0.047***	0.034***
	(0.005)	(0.003)	(0.011)	(0.005)	(0.007)	(0.003)	(0.008)	(0.005)
Tract: Percent foreign born	-0.006***	-0.008***	0.003**	-0.001*	0.001	-0.000	0.005***	0.006***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)
Tract: Change in percent foreign born	-0.000	-0.005***	0.001	-0.001	0.005***	0.003***	0.003*	0.008***
	(0.001)	(0.000)	(0.002)	(0.001)	(0.001)	(0.000)	(0.002)	(0.001)
Tract: Ratio of household income to tract median housing value	-1.532***		-0.864***		-0.592***		-1.735***	
	(0.013)		(0.041)		(0.030)		(0.053)	
Tract: Household income minus median tract income (in thousands)	0.002***	0.008***	0.004***	0.015***	-0.001	0.009***	0.000	0.009***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
Interaction: Percent black * Household income	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Interaction: Percent Hispanic * Household income	-0.000***	-0.000***	-0.000	-0.000**	-0.000***	-0.000***	-0.000***	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Interaction: Percent Asian * Household income	0.000***	0.000***	0.001***	0.000***	0.000***	0.000***	0.000	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tract: Median age of the household head	0.007***	0.007***	0.013***	0.024***	0.006*	0.015***	0.016***	0.011***
	(0.001)	(0.001)	(0.003)	(0.001)	(0.002)	(0.001)	(0.003)	(0.002)
Tract: Percent of households with a head above the age of 65	0.004***	-0.005***	-0.002	-0.008***	-0.000	-0.006***	-0.003	0.001
	(0.000)	(0.000)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Tract: Percent single-headed households with children	-0.006***	0.001***	0.001	0.009***	-0.002*	0.006***	0.002	0.006***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.002)	(0.001)
Tract: Percent employed household heads	-0.004***	0.003***	-0.005**	-0.002***	-0.005***	-0.004***	-0.001	-0.000
	(0.001)	(0.000)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Tract: Percent household heads with a prof., manag., or tech. occupation	0.004***	0.003***	0.002	0.001*	0.003*	0.001	0.004**	0.007***
	(0.000)	(0.000)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tract: Percent households in poverty	-0.009***	-0.002***	-0.005***	0.000	-0.005***	-0.001	-0.006***	-0.003***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.002)	(0.001)
Tract: Percent households headed by a person with a college degree	-0.010***	-0.002***	-0.011***	-0.005***	-0.015***	-0.005***	0.000	0.006***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)
Tract: Percent single-family detached housing	0.003***	-0.009***	0.018***	-0.002***	0.009***	-0.006***	0.010***	-0.004***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
Tract: Percent units in rental housing of 50+ units	-0.026***	-0.000**	-0.021***	0.000	-0.027***	-0.003***	-0.018***	0.006***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
Tract: Percent of housing units built in the last 10 years	0.012***	-0.002***	0.019***	-0.003***	0.012***	-0.007***	0.014***	-0.011***

	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)
Central city	-0.142***	-0.041***	-0.080***	0.007	-0.073***	0.003	-0.085***	-0.043***
	(0.006)	(0.004)	(0.022)	(0.008)	(0.014)	(0.007)	(0.019)	(0.012)
South	0.073**	0.044*	0.077	0.163***	0.209	0.081	-0.142	0.465***
	(0.028)	(0.020)	(0.119)	(0.044)	(0.136)	(0.069)	(0.160)	(0.087)
Tract: One-year household turnover	0.024***	0.041***	0.028***	0.041***	0.029***	0.043***	0.027***	0.047***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)
Tract: Log of total households	0.678***	0.606***	0.739***	0.632***	0.684***	0.573***	0.680***	0.592***
	(0.006)	(0.004)	(0.020)	(0.007)	(0.015)	(0.007)	(0.019)	(0.011)
Log of distance to work	-0.543***	-0.583***	-0.502***	-0.537***	-0.564***	-0.655***	-0.588***	-0.646***
	(0.001)	(0.001)	(0.006)	(0.002)	(0.004)	(0.003)	(0.006)	(0.004)
Tract: Ratio of household income to tract median annual rent		-0.102***		-0.132***		-0.113***		-0.163***
		(0.001)		(0.003)		(0.003)		(0.004)
Interaction: Percent black * Household speaks only English at home					-0.000	-0.008**	0.012	-0.013**
					(0.006)	(0.002)	(0.009)	(0.005)
Interaction: Percent Hispanic * Household speaks only English at home					-0.045***	-0.050***	-0.006	-0.008
					(0.006)	(0.003)	(0.009)	(0.005)
Interaction: Percent Asian * Household speaks only English at home					-0.021**	0.003	-0.051***	-0.062***
					(0.008)	(0.003)	(0.009)	(0.005)
N (Households by Neighborhood Alternatives)	9,123,000	20,170,000	870,000	6,867,000	1,766,000	9,081,000	1,496,000	3,845,000
N (Households)	300,000	620,000	20,000	156,000	37,000	161,000	21,000	57,000
Log-likelihood	-1397000	-2892000	-101000	-787000	-198000	-854000	-121000	-298000

Notes: All regressions also include interactions between the second- and third-order polynomials of tract racial composition and all household-level variables. Full model specifications available from the author upon request. Standard errors in parentheses. Number of observations rounded according to Census disclosure rules.
*** p<0.001, ** p<0.01, * p<0.05

Table 3. Weighted average of the Index of Dissimilarity for all metro areas, simulations based on white mover households

	1990					2010-2014				
Index of Dissimilarity	Observed	Simulation 1: Full model	Simulation 2: Race coefficients set to 0	Simulation 3: Income coefficients set to 0	Simulation 4: Coefficients set to respective minority mobility model	Observed	Simulation 1: Full model	Simulation 2: Race coefficients set to 0	Simulation 3: Income coefficients set to 0	Simulation 4: Coefficients set to respective minority mobility model
Black/White	0.72	0.73	0.71	0.72	0.63	0.69	0.69	0.67	0.69	0.62
Hispanic/White	0.51	0.51	0.49	0.50	0.47	0.56	0.55	0.53	0.55	0.52
Asian/White	0.43	0.43	0.42	0.43	0.40	0.48	0.47	0.46	0.47	0.45

Table 4. Weighted average of the Index of Dissimilarity for all metro areas, simulations based on minority mover households

	1990					2010-2014				
Index of Dissimilarity	Observed	Simulation 1: Full model	Simulation 2: Race coefficients set to 0	Simulation 3: Income coefficients set to 0	Simulation 5: Coefficients set to white mobility model	Observed	Simulation 1: Full model	Simulation 2: Race coefficients set to 0	Simulation 3: Income coefficients set to 0	Simulation 5: Coefficients set to white mobility model
Black/White	0.72	0.73	0.65	0.75	0.61	0.69	0.70	0.64	0.70	0.60
Hispanic/White	0.51	0.52	0.46	0.53	0.42	0.56	0.56	0.52	0.57	0.48
Asian/White	0.43	0.43	0.38	0.43	0.36	0.48	0.48	0.45	0.48	0.43

Appendix. Formulas of indexes of segregation

The index of dissimilarity is defined by the following formula:

$$D = 1/2 \sum \left| \frac{N_{1i}}{N_1} - \frac{N_{2i}}{N_2} \right|,$$

where N_{1i} = population of group 1 in the *i*th tract, N_{2i} = population of group 2 in the *i*th tract, N_1 = total population of group 1 in the metropolitan area, and N_2 = total population of group 2 in the metropolitan area. The index value can be interpreted as the proportion of the minority (or majority) population, which would have to be redistributed so that each census tract would have the same composition as the metropolitan area as a whole (White 1983).

The multi-group entropy index is a measure of the evenness of the population across a metropolitan area. It is also known as the multi-group version of Theil's H or the multi-group information theory index. The entropy score for a particular census tract is defined by the following formula:

$$E_i = \sum_{r=1}^{r} (\prod_{ri}) \, ln \left[\frac{1}{\prod_{ri}} \right],$$

where $\prod_{ri}$ is the proportion of a racial/ethnic group in census tract *i*. The entropy index is the weighted average of each census tract's entropy score from the entropy score of the metropolitan area as a whole, expressed as a fraction of the total entropy of a metropolitan area (Massey and Denton 1988; Iceland 2004). A big advantage of the multi-group entropy index is that it can accommodate multiple racial/groups and can be decomposed into its within-tract and between-tract variance components (Iceland 2004).

The Herfindahl Index estimates the probability that two randomly selected people of a given race/ethnicity and income combinations in a metropolitan area will reside in different census tracts. The index in each metropolitan area is estimated by the following formula:

$$H = \sum_{t=1}^{k} P_t(1 - P_t),$$

where P is the proportion of people of a given race/ethnicity and income combination in census tract *t*. The index ranges from 0 to 1, where 0 indicates that every person of a given race/ethnicity and income combination in the metropolitan area lives in the same census tract, and 1 indicates that every person of a given race/ethnicity and income combination in the metropolitan area lives in a different census tract (Reardon and Firebaugh 2002). The Herfindahl index is an index of metropolitan fragmentation.

Finally, the rank-order information theory index is particularly good for measures of residential segregation by income because it does not confound changes in income inequality with changes in income segregation (Reardon 2011). It compares the variation in household income within census tracts with the variation in household incomes in the metropolitan area. It ranges from 0 to 1, with values of 0 indicating no segregation by income and values of 1 indicating complete segregation by income. Unlike the segregation indexes presented above, the magnitude of the rank-order theory index does not have an intuitive meaning, but changes over time and across metropolitan areas can be ordered by size (Reardon 2011). The formula for the rank-order information theory index is given by:

$$\Lambda^R = \int_0^1 \frac{f(p)}{\int_0^1 f(q)dq} \Lambda(p)dp,$$

where *f(p)* is a measure of variation between those with incomes above or below the 100 x p^{th} percentile of the income distribution, and $\Lambda(p)$ is the segregation between the same two groups.