Confined to the Inner Ring? Effects of Ecological Distance on Patterns of Minority Suburbanization in American Metropolitan Areas[*]

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Abstract

Much scholarly writing has argued that although racial and ethnic minorities have experienced increasing rates of suburbanization over the past several decades, much of this suburbanization has been confined to inner-ring suburbs that function more or less as extensions of central city ghettoes. However, there has been surprisingly little empirical investigation of this question. Most prior research treats "suburbs" as all tracts in a metropolitan area that are not in the central city, and does not account for the spatial location of those suburban places. In this study we used Geographic Information Systems software to code the "ecological distance" (or suburban "ring") of all Census Designated Places in some 250 metropolitan areas. We then use census data and multi-level modeling techniques to investigate patterns of white and minority suburbanization from 1970 to 2000. We examine inequality in the "first ring gap," or the difference between the average minority representation in the central city versus the first ring of suburbs, and in "ecological distance gradients," or the extent to which each successive suburban ring has a lower (or higher) percentage of each group. The results from this study should provide a detailed picture of the extent to which suburbs—and more importantly, which suburbs—have become more heterogeneous over time.

For nearly a century, social scientists have concerned themselves theoretically and empirically with processes of minority group assimilation. Perhaps the central *explanandum* of the Chicago School of Human Ecology was how disparate social groups proceed from initial stages of conflict to arrive eventually at a more or less equilibrium state of assimilation (Park and Burgess 1921). In this paper we examine trends from 1970 to 2000 in rates of suburbanization in U.S. metropolitan areas (MAs) for four large racial and ethnic groups. Access to suburban neighborhoods and resources has been noted by numerous authors as a key indicator of spatial assimilation, and has therefore been the focus of much sociological and urban demographic research (Alba and Logan 1991; Alba et al. 1999; Iceland 2009; Logan and Alba 1993; Logan et al. 1996; Logan, Stults, and Farley 1995; Massey and Denton 1988; Schneider and Phelan 1993; South and Crowder 1997; Stahura 1987; Timberlake, Howell, and Staight 2009).

Despite the contributions of this research, there are several limitations that we attempt to overcome in this paper. First, research typically has not examined recent trends in suburbanization beyond comparing changes between two censuses (but see Stahura 1987; Timberlake et al. 2009). This strategy limits the capacity of research to assess whether recent patterns continue or diverge from a longer trajectory of change. Second, and more importantly, most prior research has tended to treat "suburbs" as all residential locations in metropolitan areas that are not in central cities (e.g., Berube 2003; Lucy and Phillips 2003). The few studies that differentiate between types of suburbs have been limited to an examination of suburbs that are contiguous to central cities, often referred to as "inner-ring" suburbs (e.g., Hanlon 2008, 2009; Holiday and Dwyer 2009).

In this paper we attempt to surmount each of these limitations. We take a longer view in estimating trends in racial and ethnic variation in suburbanization by measuring temporal change as growth trajectories fit to data from the 1970 to 2000 U.S. censuses. We use multilevel modeling techniques to estimate levels and determinants of suburbanization for non-Hispanic whites, blacks, and Asians, and Hispanics of all races in 2000, as well as change from 1970 to 2000. In our framework, repeated observations of MAs are nested within those MAs. MA-specific intercepts and slopes are estimated, and then become outcome variables to be predicted by MA-level characteristics. Due to the greater number of data points on each MA, analyzing change over four U.S. censuses yields more stable estimates of trends than conventional comparisons between just two. This method also enables us to describe change more parsimoniously by estimating and predicting one MA-specific growth parameter, rather than multiple parameters representing changes between successive pairs of censuses.

We measure racial and ethnic inequality in two components of suburbanization: first, the extent to which there is variation in the difference between the percentage of each group in central cities versus first-ring suburbs. We refer to this difference as the "first ring gap," and expect that, given historically high levels of African American concentration in central cities, there will be a substantially greater dropoff from central city to first suburban ring for blacks than for Hispanics or Asians.

Second, we measure the steepness of each MA's "ecological distance gradient," or the extent to which each successive suburban ring has a lower (or higher) percentage of each group. We do this by using Geographic Information Systems (GIS) software to code the suburban ring of each suburban place. We use this measure rather than, for example, a measure of the distance "as the crow flies" between each suburb and the central city because we believe it better captures the social relationship suburbs have with their central cities than would be captured by linear distance. That is, a suburb that is 15 miles away from a central city may or may not have been insulated from minority suburbanization, either due to minority avoidance or the deployment of discriminatory mechanisms by the residents or their real estate agents (Turner et al. 2002). Suburbs contiguous to central cities are more likely to be targets for minority suburbanization; hence, if a suburb is far away from a central city (i.e., their geographic centroids are far apart) but still contiguous, we hypothesize that it will be more likely to have a larger minority population than a suburb that is the same distance away but separated by several rings of suburbs. For example, a resident of Orange Park, FL, the closest first ring suburb to Jacksonville, FL would be approximately 15 miles from the center of the central city of Jacksonville. By contrast, a resident of Boston, MA could be 15 miles away from the center of Boston and live in Reading, MA. Reading is, by our calculation, in the fourth ring of suburbs, meaning that one would have to travel from Reading through Stoneham, Medford, and Somerville in order to get to the city of Boston.

Based on scholarly focus on minority suburbanization in inner suburban rings, we expect ecological distance gradients to be positive for whites (who likely dominate residence in outer-ring suburbs) and negative or less positive for blacks, Hispanics, and Asians, reflecting their overrepresentation in inner-ring suburbs and lower proportions in outlying areas. We test two hypotheses about the causes of variation in these two types of suburbanization: first, that variation is related to the levels of acculturation or socioeconomic status (SES) of groups, and second, that it is related to the supply of housing in suburbs relative to central cities. Results from this analysis will indicate whether suburbanization has been driven by changes in the characteristics of racial/ethnic groups, or is simply due to the fact that the majority of urban growth in recent decades has been in the suburbs (Teaford 2008). That is, when more of the population lives in the suburbs, it is likely that all groups will experience increasing rates of suburbanization, and increasingly in further-out rings, net of changes in the characteristics of these groups. If true, this would suggest that suburbanization is not necessarily the positive locational outcome of assimilation processes as presumed by some prior research (Alba and Logan 1991; Logan and Alba 1993; Schneider and Phelan 1993). Rather, it may be that the residential locations of all groups are simply expanding outward as metropolitan areas become increasingly dominated by their suburban rings.

Theoretical Background

Building on the early work of Park and Burgess (1921), Gordon (1964) engaged in an expansive theoretical treatment of the concept of assimilation. In his formulation, assimilation occurs via an immigrant group's passing through a series of seven stages of incorporation with native-born members of a host society. In the first stage, which Gordon termed "acculturation," immigrants learn the language and adopt the cultural norms of the host society. Acculturation is relatively easy for an immigrant group to achieve; indeed, it is usually well under way by the second generation and completed by the third (Alba et al. 2002). The second stage, which Gordon called "structural assimilation," does not automatically occur through the passage of time, either intra- or intergenerationally. Rather, structural assimilation occurs when migrants and their offspring form close relationships with members of the host society. For Gordon, this is the key to assimilation overall, for once a group experiences structural assimilation, the remaining five steps automatically follow.

Drawing upon prior human ecological studies, Massey and Mullan (1984) argued that a necessary intervening step between acculturation and structural assimilation is a migrant group's residential contact with dominant group members, a process they labeled "spatial assimilation."

In their words, “if a group is not physically integrated within a society, structural assimilation, and consequently the subsequent stages of assimilation, will be exceedingly difficult” (p. 837). Following the work of numerous previous authors, we treat minority access to suburban residential locations, especially further-out suburban locations, as one indicator of a larger process of spatial assimilation (Alba and Logan 1991, 1993; Fischer 2008; Massey and Denton 1988). We compare minority suburbanization patterns to those for non-Hispanic whites to assess differences in the experiences of these four groups since 1970.

Changes in Group Characteristics

As suggested by Massey and Mullan’s (1984) claim that spatial assimilation is an intermediate step between acculturation and structural assimilation, it is reasonable to expect that as groups experience improving rates of English-language facility and socioeconomic status, they will convert these gains into increased representation in suburbs and further-flung suburbs at the aggregate level. Although frequently formulated at the household level (see, e.g., Alba and Logan 1991; Logan and Alba 1991, but see Iceland 2009; Timberlake and Iceland 2007), traditional spatial assimilation theory posits that minority groups experience a process towards residential contact with a society’s majority group in part by adopting the language and cultural practices of that group (Massey 1985; Massey and Denton 1985). Numerous empirical studies confirm that English language acquisition is positively associated with spatial assimilation, especially for Hispanics (Alba and Logan 1991; Alba et al. 1999; Logan and Alba 1993; Logan et al. 1996).

A second engine of spatial assimilation is socioeconomic mobility. Migrant groups tend to start at the bottom of the socioeconomic ladder, and therefore are only able to purchase residence in low-SES, and largely central city, neighborhoods. As these groups experience socioeconomic mobility, they convert increases in household SES into upward residential mobility, resulting in their occupying higher-status, suburban neighborhoods, perhaps including suburbs further out in a metropolitan area's place ecology. Empirical evidence from prior research provides general support for the spatial assimilation perspective, in that SES plays a moderate role in explaining suburban locational attainment for Blacks, Hispanics, and Asians (Alba and Logan 1991, Alba et al. 1999; Logan and Alba 1993; Logan et al. 1996). However, these findings vary by region, group, and measure of SES, preventing us from drawing definitive conclusions about the role of SES in suburban locational attainment.

In this paper we are simply testing the hypothesis that the primary cause of increases in group suburbanization rates has been changes in group characteristics, such as English language ability, income, and education. We evaluate the extent to which changes in group characteristics predict metropolitan area-level suburbanization while controlling for the relative share of total housing supply that is in the suburbs.

Housing Supply

The overall supply of and change in suburban housing stock should be associated with levels of and changes in suburbanization rates. Put simply, in cities with large amounts of suburban housing, all groups ought to be more suburbanized than in cities with relatively small suburban rings. In addition, in quickly growing suburbs there ought to be more housing available for racial and ethnic minorities, relative to cities with stagnant suburbs. Growing suburban housing supply could affect minority suburbanization patterns in one of two ways: first, minorities may move directly into areas where new housing is being built. Second, minorities may move into older housing stock abandoned by whites who seek newer housing and less dense land use in outlying suburbs. Either way, we hypothesize that minorities will be more suburbanized in MAs with large and growing suburban rings, relative to cities with smaller and less rapidly growing suburbs. Past research has investigated the household-level determinants of residence in the suburbs (e.g., Alba and Logan 1991; Logan and Alba 1993; South and Crowder 1997; Alba et al. 1999); however, these studies do not include measures of suburban housing supply.[1] This omission renders these studies unable to comment on the effects of changing urban structure on minority suburbanization patterns.

Coterminous with the growth of American suburban rings as residential locations has been an increase in the supply of suburban jobs (Kasarda 1989; Teaford 2008). It is likely that some of the apparent effect of growth in suburban housing supply on group suburbanization rates will be confounded with growth in the demand for labor in the suburbs. In addition, growth in suburban housing supply ought to result in lower suburban housing costs, both in the owner-occupied and rental markets. Hence, in this paper we control for the suburban shares of employment and affordable housing in 2000, as well as 1970 to 2000 change in these measures.

Ecological Context

A third set of predictors of residential patterns has been grouped under the rubric "ecological context" (Farley and Frey 1994; Timberlake and Iceland 2007) These are typically characteristics of metropolitan areas that attenuate or exacerbate the effects of spatial assimilation and housing market processes, and have independent effects in their own right. For example, effects of geographic region and MA age have long been noted. In particular, older metropolitan areas of the Northeast and Midwest regions have more established residential patterns and often had histories that included restrictive covenants and strict land-use regulations. Thus, these MAs may feature lower and closer-in rates of minority suburbanization and less

[1] South and Crowder (1997) include the city to suburb ratios of variables likely to be correlated with housing supply, such as population size, but these metropolitan area-level variables are not the focus of their analysis.

quickly growing levels of suburban housing supply, relative to newer MAs of the South and West, such as Phoenix, Denver, and Las Vegas. In addition, overall MA size, as well as size and growth of the minority population may affect minority residential patterns (Farley and Frey 1994; Logan et al. 2004).

Data

The data for this study come primarily from the 1970 through 2000 U.S. Decennial Censuses, concatenated in the Neighborhood Change Database (NCDB). The NCDB was developed by the Urban Institute in collaboration with GeoLytics, Inc (GeoLytics 2003). A unique feature of the NCDB is that all census tracts from 1970 to 1990 are matched to consistent Census 2000 boundaries. The chief benefit of this geographical matching is that comparisons over time are not hampered by changing tract, place, or metropolitan area boundaries. Thus, the NCDB allows us to compare geographic apples to apples over time.

There are two units of analysis in this study. First, we measure racial and ethnic distributions in three types of census places: census designated places, consolidated cities, and incorporated places. In the remainder of this paper, we refer to such units as "suburban places," differentiating between two other types of places: central cities, and population in metropolitan area tracts that are neither in central cities nor in suburban places. We collapsed this population into one unit per county, to which we refer in the remainder of the paper as "other county population units."[2]

[2] Because census tracts are not nested within places, we apportioned tract population to places by using the tract allocation factor on the MABLE/Geocorr2K Geographic Correspondence Engine (Missouri Census Data Center 2008). Briefly, the tract allocation factor indicates what proportion of a tract falls in a suburban place, a central city, or neither. For example, if a suburban place comprises 100% of two tracts and 50% of a third, then the population counts for that place will be the sum of the first two tracts, plus half of the third.

The second unit of analysis is the metropolitan area (MA), specifically the 246 MAs that were defined in all four censuses under consideration (a list of these MAs is available from the authors upon request).[3] Because MAs are the unit of analysis, we use unweighted statistics to estimate effects of MA-level characteristics on levels of minority suburbanization (but cf. Logan et al. 2004:6). Thus, the final sample comprises 10,502 place-level units, including 250 central cities[4], 600 other county population units, and 9,652 suburban places.

Measures

Dependent Variables

The dependent variables are the percentages of four racial/ethnic groups—non-Hispanic whites, blacks, and Asians, and Hispanics of all races—in each of the 10,502 places (again, comprising central cities, suburban places, and other county population units). We measured the ecological distance of each place by using GIS software (ArcGIS) and Census Bureau place-level shape files (U.S. Census Bureau 2008). We coded this variable 0 for all central cities and other county population units, 1 for places that are contiguous to central cities, 2 for places that are contiguous to first ring suburbs (but not to central cities), 3 for places that are contiguous to second-ring suburbs (but not to first-ring suburbs or central cities), and so on.

To code non-contiguous places, we used GIS to draw concentric circles (or "buffers"), which were calculated as the centroid of the most distant place from a central city, for each suburban ring. We then coded non-contiguous places that fell within each of these buffers as that

[3] The NCDB uses the 1999 Office of Management and Budget definitions of Metropolitan Statistical Areas (MSAs), such as Battle Creek/Kalamazoo, MI and Columbus, OH, and Primary Metropolitan Statistical Areas, which are two or more MSAs nested within larger Consolidated Metropolitan Statistical Areas (CMSAs). Examples of the latter type of MA would be such as Chicago, IL, Gary, IN, and Kenosha, WI, nested within the Chicago, IL/Gary, IN/Kenosha, WI CMSA.
[4] In several cases we treated contiguous central cities such as Kansas City, KS and MO and Minneapolis/St. Paul, MN as one central city, with one set of surrounding suburban places.

ring plus one, to account for the gap between the contiguous ring and the focal place. Non-contiguous places on the fringes of suburban rings were given the code of the highest ring, plus one.

The ecological distance variable can be thought of in one of two related ways. In simple geographic terms, it is the "ring" that a suburb occupies. More sociologically, it is the number of suburbs through which a resident would have to travel to reach the central city. If the "inner ring" hypothesis is true, it suggests that racial and ethnic minorities, specifically African Americans, will be disproportionately concentrated in inner ring suburbs, and will have fairly low representations in more far-flung rings.

Across all 246 MAs, the maximum number of rings for a MA was 31 (a collapsed New York/Nassau/Suffolk county MA); however, only six MAs had more than 8 rings of suburbs, and fully 91% of all suburban places fall in the first six rings. Figure 1 shows a map of the Chicago, IL PMSA (i.e., excluding Kenosha, WI and Gary, IN). Based on our coding scheme, Chicago has 15 rings, although 81% of Chicago's 291 places are in the first seven rings. Note that beyond the first 10 rings or so, there is a great deal of non-place territory. These tracts are the fringes of Chicago's exurban development, and largely comprise what we are calling "other county population." As we shall see in Figure 2, there has been substantial growth over time in the proportion of the population living in these metropolitan non-places.

(Figure 1 about here)

Independent Variables

Spatial assimilation. We test two group-level implications of spatial assimilation theory—that acculturation and increasing socioeconomic status lead to minority spatial assimilation, measured here as increasing representation in first-ring and further-out suburbs—by estimating effects of three metropolitan area-level variables on 2000 levels of and 1970 to 2000 change in group suburbanization. We operationalized acculturation as the MA-level percentage of Asians and Hispanics that speak English at least somewhat well. We measured socioeconomic status as the percentage of each of the groups who have more than a high school degree and the average income of each group (measured in 2000 thousands of dollars).

Housing supply. We measured 2000 levels of and 1970 to 2000 changes in suburban housing supply by taking the ratio of the total number of housing units in the suburban tracts of each MA to the total number of housing units in the central city. We reason that this ratio captures the extent to which the suburbs are more dominant and growing more rapidly than central cities. We expect this variable to be strongly associated with patterns of group suburbanization. For example, in 2000 this ratio in Memphis, TN was 0.64, meaning that there were 64 units of housing in the suburbs of Memphis per 100 units of housing in the central city. At the other end of this distribution, Atlanta, GA had a score of 7.56, indicating that there were nearly 8 times as many housing units in the suburbs of Atlanta than in its central city. Not surprisingly, in 2000, black suburbanization rates, for instance, were about 16% in Memphis and nearly 80% in Atlanta.

Ecological context. Following the examples of much prior research, we assess the impact of ecological context on levels of and changes in suburbanization. First, we control for the natural log of population size and percentage of each group to account for two well-known ecological relationships—larger cities and cities with larger minority populations tend to be more segregated, and may therefore evince lower rates of suburbanization. We control for region and age effects by including dummy variables for the census region of the MA and the period in which the central city of the MA passed 50,000 in population.

Decadal Rates of Change

In models predicting change from 1970 to 2000, we include measures of MA-level decadal rates of change in the time-varying covariates described above. For each MA, these rates of change r follow one of the following two formulae:

$$r_{1970,2000} = \left(\frac{\left[\sum_{t=1970}^{2000} \ln\left(\frac{Z_{t+10}}{Z_t}\right) PY_{t,t+10} \right]}{PY_{1970,2000}} \right) 100 \qquad \text{(1a)}$$

or

$$r_{1980,2000} = \left(\frac{\left[\sum_{t=1980}^{2000} \ln\left(\frac{Z_{t+10}}{Z_t}\right) PY_{t,t+10} \right]}{PY_{1980,2000}} \right) 100\,, \qquad \text{(1b)}$$

where Z is a MA-level characteristic measured in census years t and $t + 10$, $PY_{t,t+10}$ are person-years lived between census years t and $t + 10$, and $PY_{1970,2000}$ and $PY_{1980,2000}$ are person-years lived between 1970 or 1980 and 2000, respectively (Preston, Heuveline, and Guillot 2001:12). We used equation (1a) for all MAs with valid data from 1970 to 2000 on all variables and equation (1b) for variables that were not measured in the 1970 census. We estimated person-years with the following formula:

$$PY_{t,t+T} = \frac{(N_{t+T} - N_t)T}{\ln\left(\frac{N_{t+T}}{N_t}\right)}\,, \qquad \text{(2)}$$

where T is the length of the intercensal period (10, 20 or 30 years), and N_t and N_{t+T} are the populations of each MA in census year t and $t + T$, respectively (Preston et al. 2001:15). Equations (1a) and (1b) yield decadal rates of change in MA characteristic Z (in percent per decade), weighted by decade-specific rates of population growth to account for variations in the timing of that growth (i.e., early or late) over the 20- or 30-year period.

Methods

We use Hierarchical Linear Modeling (HLM) software and techniques to investigate change in racial/ethnic group suburbanization over time. The HLM linear growth model treats multiple observations of places as nested within both places and MAs, yielding estimates of 2000 levels of and average decadal change in racial and ethnic distributions in central cities, other county population units, first ring suburbs, and ecological distance gradients, or how steeply the white and minority population changes across successive suburban rings.

The linear growth model is appropriate because of the small number of observations (four) on each MA. With more time points, it would also be desirable to model non-linear trends; however, as noted by Raudenbush and Bryk (2002:163), the linear growth model "can provide a good approximation for more complex processes that cannot be fully modeled because of the sparse number of observations." Furthermore, there is little evidence that the observed racial/ethnic distributions followed appreciably non-linear trends, though the 1970 to 1990 trends we observe accelerated somewhat from 1990 to 2000 (see Figure 2 below).

These growth models are one of many types of "intercepts- and slopes-as-outcomes" models, in which racial and ethnic distributions in 2000 (intercepts) and MA-level change in those distributions (slopes) are estimated for each MA using level-1 repeated observations of places and level-2 measures of the ecological location of each place (i.e., central cities, other county population units, and suburban places).

Level-1 Model

In this analysis the level-1 model is specified for each racial/ethnic group as

$$Y_{tij} = \pi_{0ij} + \pi_{1ij}(CENSUS)_{tij} + e_{tij}\ , \tag{3}$$

where Y_{tij} is the observed racial/ethnic percentage in census year *t* in place *i* in MA *j*. We coded the *CENSUS* variable –3 for the 1970 census, –2 for 1980, –1 for 1990, and 0 for 2000. This makes the intercepts (the π_{0ij}) interpretable as the predicted level of suburbanization for place *i* in MA *j* in 2000. The *CENSUS* slopes (the π_{1ij}) are interpreted as the estimated per-decade change in the percentage of each racial/ethnic group in place *i* from 1970 to 2000.

Level-2 Model

At level 2, the π_{0ij} and π_{1ij} from equation (3) become outcomes to be predicted by place-level characteristics, namely the ecological location of each place, as in the following examples:

$$\pi_{0ij} = \beta_{00j} + \beta_{01j}(Otherpop)_{ij} + \beta_{02j}(Suburb)_{ij} + \beta_{03j}(Ecol)_{ij} + r_{0ij} \tag{4a}$$

$$\pi_{1ij} = \beta_{10j} + \beta_{11j}(Otherpop)_{ij} + \beta_{12j}(Suburb)_{ij} + \beta_{13j}(Ecol)_{ij} + r_{1ij} \tag{4b}$$

2000 estimates. In equation 4a, the β_{00j} are interpreted as the percentage of each racial/ethnic group in the central city in MA *j* in 2000. The β_{01j} are interpreted as the gap between the percentage of each racial/ethnic group in the central city and the average “other county population” in MA *j*. For example, in the Chicago MA, this would be the average difference between the percentage of each group in non-place tracts in the seven counties that make up the Chicago MA and the percentage in the city of Chicago. Similarly, the β_{02j} are interpreted as the gap between the percentage of each racial/ethnic group in the central city and the average percentage in the first ring of suburbs in MA *j* (hereafter, “first ring gaps”). Finally, the β_{03j} are interpreted as the steepness of the ecological distance gradient for MA *j*; that is, the extent to which the average percentage of each racial/ethnic group increases or decreases with respect to increases in the number of suburban rings.[5]

Estimates of 1970 to 2000 change. In equation 4b, the β_{10j} are interpreted as the per-decade (1970 to 2000) change in the percentage of each racial/ethnic group in central city *j*. The β_{11j} and β_{12j} are interpreted, respectively, as the per-decade change in the as the gap between the percentage of each racial/ethnic group in the central city and the average "other county population" and the gap between the percentage of each racial/ethnic group in the central city and the average percentage in the first ring of suburbs in MA *j*. Finally, the β_{13j} are interpreted as per-decade change in the steepness of the ecological distance gradient for MA *j*.

Level-3 Model

At level 3, we use MA-level measures of spatial assimilation, suburban housing supply, and ecological context to predict MA-level variation in the central city/suburban ring 1 gap in 2000 (the β_{02j} from eq. 4a), and change over time in those gaps (the β_{12j}). We also predict variation in the ecological distance gradients and their change over time (the β_{03j} and β_{13j} from eq. 4b).[6] An example of a level-3 model is shown below in equation 5:

$$\beta_{13j} = \gamma_{130} + \sum_{k=1}^{K} \gamma_{13k}\left(Z_{kj} - \overline{Z}_k\right) + u_{13j} \tag{5}$$

In this example, by grand-mean centering the covariates (i.e., each MA-level covariate is centered around the overall sample average), γ_{130} is interpreted as the covariate-adjusted average

[5] We employ this modeling strategy based on some preliminary analyses that showed that the largest central city/suburban difference occurs between the central city and the first ring of suburbs. That is, the gap between the central city and suburban ring 1 is much greater than the gap between suburban ring 1 and 2, 2 and 3, and so on. Thus, at level 2 we coded the "Suburb" variable 1 if a suburban place, 0 otherwise, and the "Ecol" variable 0 if a central city, an other county population unit, *or a suburban place in ring 1*, 1 if a suburban place in ring 2, …, *k* - 1 if a suburban place in ring *k*. This coding strategy yields the parameters of interest noted above; namely, the first ring gap, and the ecological distance gradient for each of the 246 MAs. See Raudenbusch and Bryk (2002:179) for a discussion of this coding strategy.

per-decade rate of change in the ecological distance gradients for the sample of MAs, the γ_{131} to γ_{13K} are effects of MA-level characteristics on those changes. For example, spatial assimilation theory might predict that in MAs where the socioeconomic status of minority groups has increased over time, the ecological distance gradients ought to get more positive (or at least less negative) over time, reflecting larger penetration of minorities into further-flung suburbs. On the other hand, if most of the minority suburbanization has been funneled into closer-in suburban rings, this would have the effect of tilting the ecological distance gradients downward, and would result in more negative gradients over time.

Findings

Descriptive Statistics

Dependent variables. In Panel A of Figure 2, the black curves represents observed percentages of the MA population in central cities, suburbs, and "other county population units." The brightly colored curves represent observed percentages of the four major racial/ethnic groups in those units. Note that in 2000, 10 percent fewer Americans lived in central cities than was true in 1970, a relative decline of about 24 percent. Although there was a small increase (3.1 percent absolute, 6.5 percent relative) in the percentage of metropolitan Americans living in suburban places, much larger absolute and relative increases occurred in the percentage living in "other county population units," or suburban non-places. This latter population increased from about 12.7 percent in 1970 to about 19.4 percent in 2000, yielding a relative increase of 53 percent over the three decade period. Although it is beyond the scope of this paper to investigate the effects of such population shifts, it is conceivable that the shift of population to communities with weak

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[6] While it would be possible to model the other two level-2 parameters, the percentage of each group in central cities and the gap between central cities and other county population, these are not of interest to us in this paper.

local governmental structures and low tax commitments is either indicative or perhaps has had some impact on Americans' views of government over the past three decades.

(Figure 2 about here)

Panel B of Figure 2 shows the predicted racial/ethnic percentages in central cities, first-ring suburbs[7], and other county population units. These estimates are derived from random coefficients models estimated in HLM, in which no level-3 covariates were included in the models (see equations 3 through 5). The figures on which Panel B is based can be calculated from the coefficients presented in Table A1.

Note that the predicted curves fairly accurately track their respective observed trends, with the exception of relatively non-linear increases in the percent Hispanic from 1990 to 2000, relative to the preceding decades. Panel B shows that the percent white has declined sharply in central cities, replaced by members of the three other racial/ethnic groups. Due to the increasing representation of non-whites in the U.S., white representation in first-ring suburbs has also been declining over time, though not as sharply as is true of central cities. Finally, in other county population units, where population growth has been greatest in the past several decades, the white percentage has declined the slowest, suggesting that these new suburbs have been more impervious to population change.

We also find that minority representation in central cities has grown rapidly over the past three decades. Although some scholars have stressed the increasing tendency of Hispanic and Asian immigrants to settle directly in suburbs (e.g., Logan, Alba, and Zhang 2002), our findings show that, on average and in both absolute and relative terms, these populations have grown more in central cities, with the exception of the relative increase of Asians in first-ring suburbs.

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[7] The percentages in all suburban places are not predicted because a major focus of this paper is the ecological distance gradient, or how minority populations decline in proportion with respect to increases in the suburban ring.

Figure 3 shows the cross-sectional distribution of population in central cities and successive rings of suburbs. These lines are composed from the γ_{000}, γ_{020}, and γ_{030} parameters in HLM random coefficients models shown in the top panel of Table A1. When the ecological distance of a place equals zero, the place is a central city. Hence, the average central city in 2000 was about 62 percent white, 21 percent black, 12 percent Hispanic, and 4 percent Asian. These figures can also be seen in the "2000" point in the left-hand section of Panel B, Figure 2. The average first-ring suburb is about 81 percent white, a substantial positive gap from the average central city. For blacks, the average first-ring suburb is about 14 percent less black than the average central city, or about 7 percent black. First-ring suburbs are also less Hispanic and Asian than central cities, but by a much lower margin than for blacks. The first ring gaps for Hispanics is only 3.5 percent, and it is only 1.2 percent for Asians. Of course, central cities are also less Hispanic and Asian on average, but the *relative* first ring gaps for these groups are still less than the gap for blacks (32 percent for Asians and 29 percent for Hispanics, compared to 66 percent for blacks).

Interestingly, after the first ring gap is accounted for, the ecological distance gradients for each of the three minority groups are about the same, roughly one-quarter of a percentage point per ring. These data yield the first major finding of this paper: that the "inner ring" trope for American minorities is highly overstated. We find that *the percentages of minorities in the seventh suburban ring is nearly the same as it is in the first*. The converse of this statement is that although the ecological distance gradient for whites is positive, it doesn't yield dramatically higher percentages of whites in relatively far-flung compared to relatively close-in suburban rings. Thus, the real line of demarcation in American metropolitan areas is still between the central city and the first ring of suburbs. Once this gap is taken into account, there is little further differentiation across suburban rings. Of course, within suburban rings there are still high degrees of residential segregation between whites and other groups. Nevertheless, whatever benefits may accrue to a group for having access to further-out suburbs, it does not appear as though, on average, racial/ethnic minorities are dramatically disadvantaged relative to whites, again, conditional upon attaining suburban residence.

(Figure 3 about here)

We believe that Figure 4 provides a visual explanation for the patterns we observe in Figure 3. We again show a map of the Chicago, IL PMSA. Places shaded in gray and black have successively larger African-American populations. Note that in the suburbs to the South, and to a lesser degree, the North and West, there are a large number of suburbs with relatively large black populations across successive rings. Indeed, suburbs with high percentages of black residents can be found all the way to the seventh ring of suburbs to the South and to the ninth ring to the North (compare Figure 4 with Figure 1). By contrast, there are a large number of first-ring suburbs in Chicago that have almost no blacks in them. Hence, our data reject the “inner-ring” hypothesis, that minorities are confined to inner-ring suburbs. Rather, we see a much more radial pattern of at least black suburbanization rather than a concentric circle pattern. In this regard, our findings are closer to the predictions of Hoyt (1939) than Park and Burgess (1921).

(Figure 4 about here)

Our final set of descriptive statistics on the dependent variables shows the change over time in the parameters of interest (also found in Table A1). Figure 5 shows change over time in the predicted percentage of each group in central cities and first-ring suburbs, and in the ecological distance gradients. Note that, as shown in Figure 2, the percentage of whites in central cities and first ring suburbs has declined, while increasing for the other three groups. In addition, the ecological distance gradient has gotten increasingly positive for whites, reflecting their increasingly dominant position in further out suburbs, relative to inner-ring suburbs. Our data suggest that as inner-ring suburbs have become increasingly minority, the relative location of the white population has shifted outward.

In contrast, the ecological distance gradients for the three minority groups have become increasingly negative, especially for blacks. Our finings indicate that blacks have experienced a 0.22 percent per decade decline in their ecological distance gradients from 1970 to 2000, that is, the gradients became increasingly negative over time. This is reflected in the change depicted for blacks in Figure 5. Note that the 1970 gradient (the pink line) slopes upward. This indicates that relative to the inner ring, blacks were more heavily represented in the outer ring suburbs. This is likely due to the fact that much rural territory in outlying counties of metropolitan areas featured high percentages of black residents, principally in the south. As the unfolded, note that the gradients become increasingly negative, indicating an increasing representation of African Americans in inner suburban rings relative to outer ones. A similar qualitative trend can be observed for Hispanics and Asians, though the magnitude of the change is not as noticeable as it is for blacks. Indeed, per-decade declines in the ecological distance gradient are one-third to two-fifths as strong for Hispanics (-0.07) and Asians (-0.09) as for blacks (-0.22).

(Figure 5 about here)

Independent variables. Table 1 presents descriptive statistics of the independent variables used in the analysis, broken down by racial/ethnic group when applicable. The figures in the left-hand panel are MA-level averages from Census 2000, while those in the right-hand panel are MA-level average decadal rates of change from 1970 to 2000.

Regarding the spatial assimilation variables, as of 2000 about 87% of Asians and 76% of Hispanics spoke English at least somewhat well. Those percentages had been increasing at an average rate of 13% per decade for Asians and decreasing by about 8% per decade for Hispanics. About 64% of Asians had greater than a high school degree in 2000, compared to 54% for whites, 37% for blacks, and 31% for Hispanics. This percentage increased by an average of 8% per decade for Asians, compared to 23% for whites, 29% for blacks, and 18% for Hispanics. Asian family incomes averaged about $58,000 in 2000, while incomes for whites, blacks, and Hispanics averaged $53,000, $36,000 and $40,000, respectively. Asians also experienced the greatest increase in income over the 1970 to 2000 period (9% per decade), while incomes for the other three groups increased more slowly during this period (about 2% per decade for whites and about 3.6% for blacks and Hispanics). Finally, our measure of suburban housing supply, the ratio of suburban to central city housing, shows an average of 1.89 in 2000. That ratio increased an average of 22% per decade, from a 1970 average of 0.97.

(Table 1 about here)

HLM Findings[8]

The estimates shown in Table A1 and in Figures 3 and 5 are averages for the whole sample of 246 MAs. However, there is variation around those averages, variation that can be explained with variation in the MA-level characteristics noted above. Tables 2 through 5 below are derived from intercepts and slopes as outcomes models like that depicted in equation 5 above. Although there are potentially four parameters that can be estimated from the models, we

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[8] The robust standard error estimates provided by the HLM software assume some kind of probability sample. In this paper, however, we analyzed repeated measures from all MAs that were defined in each census from 1970 to 2000. Hence, the standard errors (available from the authors upon request) should be interpreted as "estimates of parameter dispersion contaminated by measurement error" (Grodsky and Pager 2001:552). In other words, smaller standard errors indicate more consistent effects of the independent variables on minority suburbanization. Coefficients marked with an asterisk indicate that they are at least twice the size of their standard errors.

focus here on the gap between central cities and suburbs in the percentage of each group and on the ecological distance gradients. Tables 2 and 3 present cross-sectional estimates of the associations of the independent variables and 2000 estimates of the first ring gaps and ecological distance gradients, respectively. Tables 4 and 5 present estimates of the associations between changes over time in the time-varying covariates and variation across categories of region and age and changes in the first ring gaps and ecological distance gradients, respectively.

First ring gaps in 2000. Model 1 of Table 2 shows results from a 3-level hierarchical linear model, in which the dependent variables are the first ring gaps in 2000. The average first ring gap in 2000 was 18.6 percent for whites, meaning that on average across all 246 MAs, the first ring of suburbs was about 19 percent more white than the central cities of those MAs. In contrast, the first ring gaps for the three minority groups were negative, indicating that central cities have higher percentages of those groups than the first ring of suburbs (see also Figure 2B, Figure 3, Figure 5, and Table A1). In Model 1 we also predict MA-level variation in the first ring gaps with three measures of spatial assimilation: the percentage of good English speakers in the MA, the percentage of each group with at least a high school degree, and the average group household income in constant 2000 thousands of dollars.

(Table 2 about here)

Note that for every one point increase in the percentage of whites with greater than a high school degree, the first ring gap declines by nearly one-fifth of a percentage point. This association is consistent with several possible causal mechanisms, including the increasing preferences of highly educated whites for diverse central city neighborhoods (Florida 2002; Lloyd 2006) and the tendency of whites with high levels of education to reside in the central cities of MAs with large universities, such as Seattle, WA, Minneapolis/St. Paul, MN, or Ann

Arbor, MI (Farley and Frey 1994). MAs with higher average white incomes tend to have larger first ring gaps, likely indicating the general tendency of whites to convert high incomes into suburban living in American metropolitan areas. With the exception of a small negative association between percent greater than high school for Hispanics, we observe no other appreciable associations between the spatial assimilation variables and the first ring gaps.

In Model 2 we add our measure of relative suburban housing supply. On its own, this measure is not substantially associated with MA-level variation in the size of first ring gaps in 2000. In addition, the addition of this variable does little to alter the findings on the spatial assimilation variables. However, in Model 3, after adding our measures of ecological context, the housing supply variable is revealed to be associated with the 2000 first ring gaps. Specifically, controlling for population size, the percent of each group, region, and city age, MAs with larger suburban rings tend to have smaller first ring gaps for each group. This finding is consistent with earlier research (Timberlake et al. 2009) showing that larger suburban rings featured higher levels of minority suburbanization. We are finding that these higher levels can be detected in less racial and ethnic inequality in the size of first ring gaps in 2000.

The coefficients on the ecological context variables in Model 3 indicate that MAs with higher percentages of whites tend to have larger first ring gaps, whereas higher percentages of the other three groups have smaller gaps. We also find strong associations with region, such that white first ring gaps are substantially larger in the Northeast, Midwest, and South, relative to the West. For blacks, the negative first ring gaps are larger in the Northeast and Midwest, relative to the South and West. This is consistent with past research showing more open residential patterns for Blacks in newer MAs in the South and West (e.g., Farley and Frey 1994; Timberlake and

Iceland 2007). Similarly, first ring gaps tend to be larger (i.e., more negative) for Hispanics and Asians in the three non-West regions..

Ecological distance gradients in 2000. The coefficients in Table 3 indicate the magnitude of each group's ecological distance gradient, or the extent to which their representation in successively further out suburban rings increases or decreases. The intercepts in Model 1 indicate that the average percent white in suburban places increases by about two-thirds of a percent per suburban ring. These gradients are all negative and of similar magnitude for the three minority groups (declines of about one-quarter of one percent per increase in suburban ring), although the black gradient is measured less consistently than the Hispanic and Asian gradients.

(Table 3 about here)

In general, our measures of spatial assimilation are not strongly associated with the 2000 gradients, with the exception of Asians in Model 3. These positive coefficients indicate that in MAs with higher percentages of good English-speaking and well-educated Asians, the generally negative ecological distance gradients are flatter, or less negative. This suggest that in these MAs, suburban Asians live in more far-flung suburban rings than in MAs with a less acculturated and educated Asian population.

Our measure of suburban housing supply is largely unrelated to the steepness of the ecological distance gradients. Combined with our earlier findings on the effects of suburban housing supply on minority suburbanization (Timberlake et al. 2010), we conclude that although MAs with large supplies of suburban housing feature higher percentages of suburban minorities, these MAs do not have systematically different distributions of those minorities across their suburban rings.

Regarding the ecological context variables, we observe negative effects for whites and positive effects for Asians of MA population size. This effect is particularly strong for whites, indicating that, *ceteris paribus*, larger MAs feature less positive, and even negative ecological distance gradients for whites. Group percentage has negative effects on group gradients for whites, blacks, and Hispanics, and a small positive effect for Asians. One possible interpretation of this finding is that in MAs with relatively dominant percentages of the three largest racial/ethnic groups, those groups tend to monopolize inner-ring suburbs more than in MAs with smaller representations of those groups. In such MAs, groups may follow more radial patterns of suburbanization, such as those shown in Figure 4.

Controlling for all else in Model 3, our findings show more negative ecological distance gradients for northeastern relative to western MAs, and more positive gradients for Hispanics and Asians. We tentatively interpret this finding to reflect the longer-established patterns of residence in northeastern MAs, with whites monopolizing close-in suburban locations in the Northeast, relegating minorities to relatively far-flung locations. In contrast, western MAs tend to have less established residential patterns, enabling minorities to gain access to more ecologically advantageous inner-ring suburbs.

We believe the latter three sets of findings, relating to MA population size, group percentage, and region, are consistent with several possible explanations. One focuses on the relative historical monopolization of and current ecological advantage to residence in close-in versus far-flung suburbs. In very large MAs, especially those with high population and commuter traffic densities, it is advantageous to reside in closer-in suburbs, an advantage which whites have historically monopolized. Such patterns may have developed in northeastern and midwestern MAs more than in newer, less established MAs in the West. Hence, in western MAs and in MAs with higher percentages of blacks and Hispanics, minority groups have been more able to gain access to ecologically advantageous inner-ring suburbs. This would be reflected in the less positive ecological distance gradients for Hispanics in the West, relative to the Northeast.

A second explanation would relate more to the continued dominance of the West as a gateway region for newer immigrants from Latin America and Asia, and the relatively older (in terms of immigrant generation) population of those groups in the Northeast (with the exception of New York City), Midwest (with the exception of Chicago), and South. Hence, the relatively more positive ecological distance gradients for Hispanics and Asians in non-Western MAs could reflect their longer tenure in those regions, and relatively longer-term expansion into further-flung suburban rings. By contrast, a large proportion of Hispanics and Asians in the West are relatively recent immigrants, and the process of increasingly distant suburbanization for those groups may not have occurred in those MAs. This explanation is bolstered by the negative coefficients for blacks in the Midwest and South relative to the West. These coefficients indicate that the black ecological distance gradients are more positive in the West, which is consistent with past research showing that the West features more egalitarian housing patterns for blacks (Farley and Frey 1994; Timberlake and Iceland 2007).

1970 to 2000 change in first ring gaps. The "intercept" row in Table 4 shows that the average white first ring gap has been increasing at a rate of about 2.75 percent per decade. This is not necessarily intuitive, given that Figure 5A shows that both the percentage white in central cities and in first ring suburbs has been declining over time. Our data indicate simply that the former has been declining faster than the latter, yielding an overall increase over time in the first ring gaps for whites. We observe the same story for the three minority groups, but in the opposite direct. That is, the (already negative in 1970) first ring gaps have been increasing over time, at rates of -1.5 percent, -1.0 percent, and -0.3 percent for blacks, Hispanics, and Asians, respectively. These figures indicate the converse story to that for whites; namely, these groups have been experiencing increasing representations in both central cities and first suburban rings over time, but the increase in the former has been faster than the increase in the latter, leading to growing first ring gaps over time.

(Table 4 about here)

Data from the first and third rows of the bottom panel of Table A1 can be added to show the average per-decade increase in group percentages in the first suburban ring. These increases are -2.98 percent for whites (-5.70 + 2.72 = -2.98), 0.75 percent for blacks, 1.30 percent for Hispanics, and 0.70 percent for Asians. Relative to the average per-decade increase in group central city percentages, the increase in first ring percentages are about half as large for whites and Hispanics, about 70 percent as large for Hispanics, and only about one-third as large for blacks. That is, although the black percentage in first ring suburbs has been increasing at a rate of about three-quarters of a percent per decade, their representation in central cities has been increasing three times as fast (2.23 percent per decade).

The rest of the data in Table 4 are estimates of the effects of time-varying (such as the spatial assimilation measures and population size) and time-invariant (such as region and age) MA-level characteristics on per-decade changes in the first ring gaps. The data in Model 3 indicate that increases in the percentage well educated blacks and good English-speaking Hispanics are associated with less quickly increasing first ring gap for those groups. In addition, increases in average income have been converted into reductions in the increase in first ring gaps for Asians. We take these findings to be support for spatial assimilation theory, in that smaller increases in the first ring gaps over time amount to closer correspondence between the increasing minority central city populations and increasing suburban populations.

In terms of the ecological context variables, we find that MAs with increasing white populations had more rapidly increasing first ring gaps. We observe a similar, but much smaller effect for blacks. These findings may indicate a relationship between demographic might and the capacity for groups to exit central cities and enter first ring suburbs over time. Our findings for region are interesting in that they again show the uniqueness of the West. Note that the first ring gaps in the three other regions were growing faster for whites (in the positive direction) and the three minority groups (in the negative direction), relative to the West. This indicates that western MAs have over time become increasingly more egalitarian, or less differentiating between the central city and the first ring of suburbs.

1970 to 2000 change in ecological distance gradients. The "intercept" row in Table 5 presents average per-decade changes in the ecological distance gradients. Recall that when these gradients get more positive, this indicates increasing distribution of population into outlying suburban rings. When these gradients get more negative, this indicates increasing distribution of population in inner suburban rings. Not surprisingly, these gradients have been getting more positive for whites more negative for the other three groups. In fact, as shown in Figure 5B, the ecological distance gradient for blacks has gone from being slightly positive (likely reflecting the large black populations in formerly rural areas of the South), to slightly negative. The gradients for Hispanics and Asians, which in 1970 were almost undetectably negative, have gotten more negative over time. The increase in the negative gradients for blacks (about -0.22 percent per suburban ring per decade) has occurred at a faster rate than for the other two minority groups (about -0.07 and -0.09 percent per suburban ring per decade for Hispanics and Asians, respectively), indicating a greater tendency of black suburbanites to locate in inner-ring suburbs.

(Table 5 about here)

The region coefficients indicate that the positive increase in the white ecological distance gradients has been increasing at a faster rate in the West than in the other three regions, whereas the reverse is true for the other three groups, especially compared to the Northeast. This finding is consistent with our hypothesis that the ecological distance gradients are more unequal between whites and non-whites in the West than in the other regions. This is at first blush a counterintuitive finding; after all, much research has shown more open housing patterns in the West than in the other regions (Farley and Frey 1994; Timberlake and Iceland 2007). We suspect that what is driving these patterns is the sheer volume of new immigration to the West. Since settlement in outlying rings is a process that may take a generation or more to develop, the large number of first generation migrants in the West is slowing that process in relative terms, that is, relative to the Northeast for all non-whites and the three non-West regions for Hispanics and Asians.

Conclusions

In this paper we moved beyond simplistic notions of “suburbanization” to ask where groups are suburbanizing relative to the central city. We examined the hypothesis, implicit but untested in much urban demographic research, that racial and ethnic minorities are disproportionately clustered in inner suburban rings. Scholars have noted that these residential locations are disadvantaged because they tend to be older, declining industrial suburbs with relatively dilapidated housing stock and public amenities not dramatically different from many central city neighborhoods. Some scholars have noted that minority isolation in small suburbs with low tax bases may represent disadvantage relative to central city residence, where large tax bases may distribute higher levels of some public goods to minority central city residents. Although Hanlon (2009) has shown that inner-ring suburbs are quite diverse in terms of amenities, and therefore there is no necessary relationship between residence in an inner-ring suburb and a poor suburb, the fundamental question remains of where suburban minorities tend to be located.

In this paper we conceived of minority suburban location as composed of two patterns: first, the gap between minority percentage in the first ring of suburbs relative to the central city—what we called "first ring gaps—and second, the change in minority percentage across successive rings of suburbs—what we referred to as the "ecological distance gradient." We argued that this measure is superior to a distance-based measure, because it captures the ecological and sociological process of group diffusion outward from formerly tightly-packed central cities and older pre-World War II suburbs. Based on the insights of spatial assimilation theory, we reasoned that MAs with higher-socioeconomic status groups would both be more suburbanized and have steeper positive ecological distance gradients. We also reasoned that in MAs with large and growing suburban rings, there would be more housing opportunities for minorities in more far-flung rings. Finally, based on past research on the effects of ecological contextual variables on residential patterns, we controlled for several well-known correlates of residential inequality.

In general, we found some support for spatial assimilation, little support for the effects of suburban housing supply, and many interesting findings regarding ecological context. We found scattered effects of acculturation, education, and income on both first ring gaps and ecological distance gradients in 2000. We found several effects in the expected direction of changing socioeconomic status on changes in first ring gaps, but no effects on changes in ecological distance gradients. We found that MAs with larger relative supplies of suburban housing had smaller first ring gaps, consistent with the findings in Timberlake et al. 2010. Finally, we found large effects of region; specifically, that for Hispanics and Asians in all three non-West regions, ecological distance gradients were more positive, and had become more positive from 1970 to 2000. For blacks, the effect was observed in the West relative to the Midwest and South. We speculated that for blacks, this effect had to do with the more open residential patterns in the West relative to the Midwest and South (Farley and Frey 1994; Timberlake and Iceland 2007). For Hispanics and Asians, we speculated that the dramatic increase in new immigrants from Latin America and Asia have not yet had time to diffuse into outer-ring suburbs in western MAs to the extent that they have in the other three regions. Hence, although first ring suburban gaps are smaller for Hispanics and Asians in the West than in the other regions (reflecting the more open housing patterns there), ecological distance gradients are more negative in the West (reflecting more new immigration).

Finally, we found that despite some increase in the ecological distance gradients for all groups (positive for whites, negative for non-whites), in general there is less differentiation in group percentages across suburban rings than is perhaps commonly believed. Our preliminary findings show that minority settlement patterns, especially for blacks, tend to follow radial lines of development outward, across successively distant suburban rings. Thus, rather than minorities filling in all suburbs in the inner rings, they are pursuing limited paths of dispersal along selected radii. Further research would be needed to assess the reasons why certain radii are more available than others. We suspect it has to do both with the degree of minority domination of central city tracts on the first ring border, and with the pre-existing socioeconomic status of the suburbs into which minorities have increasingly settled.

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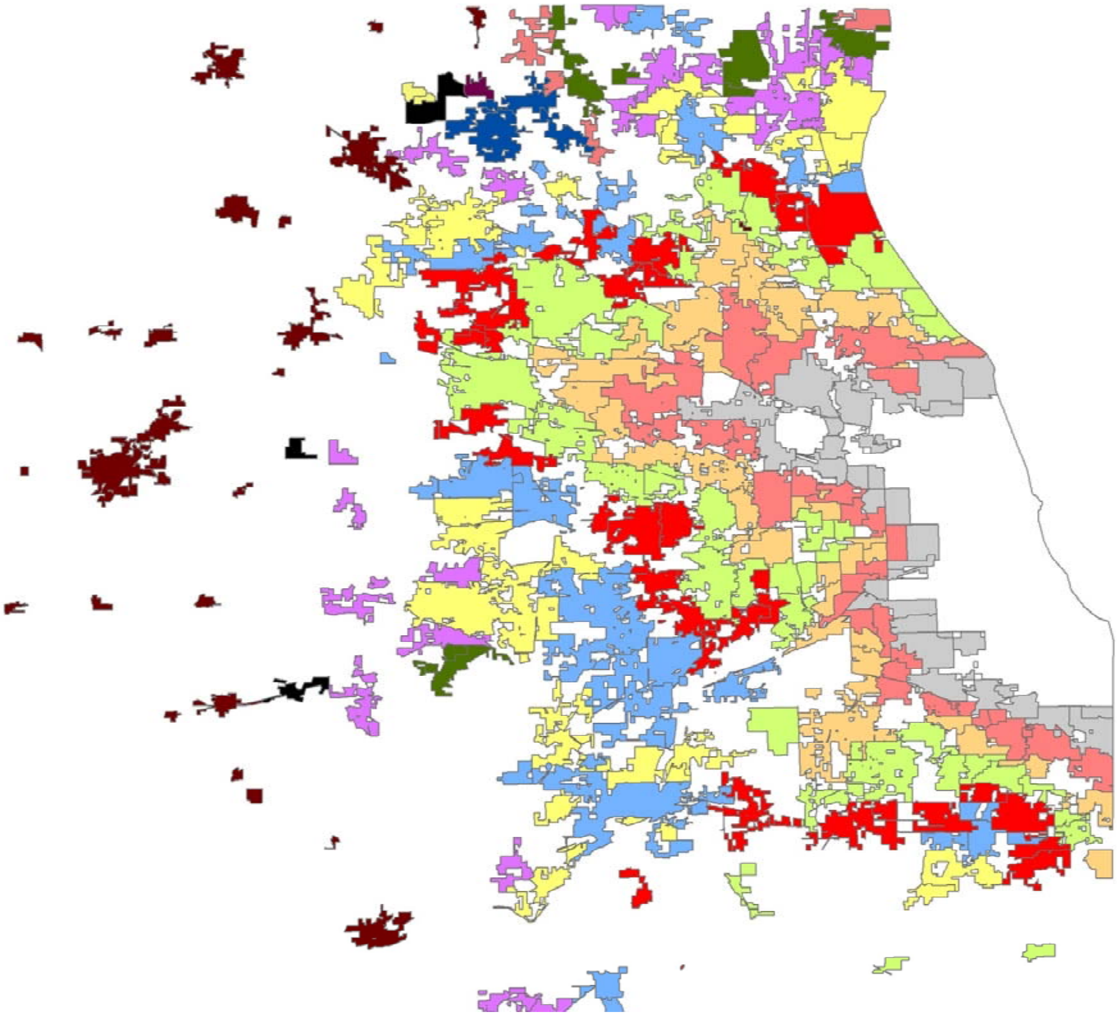

Figure 1. Coding of "Ecological Distance," Chicago PMSA, 2000

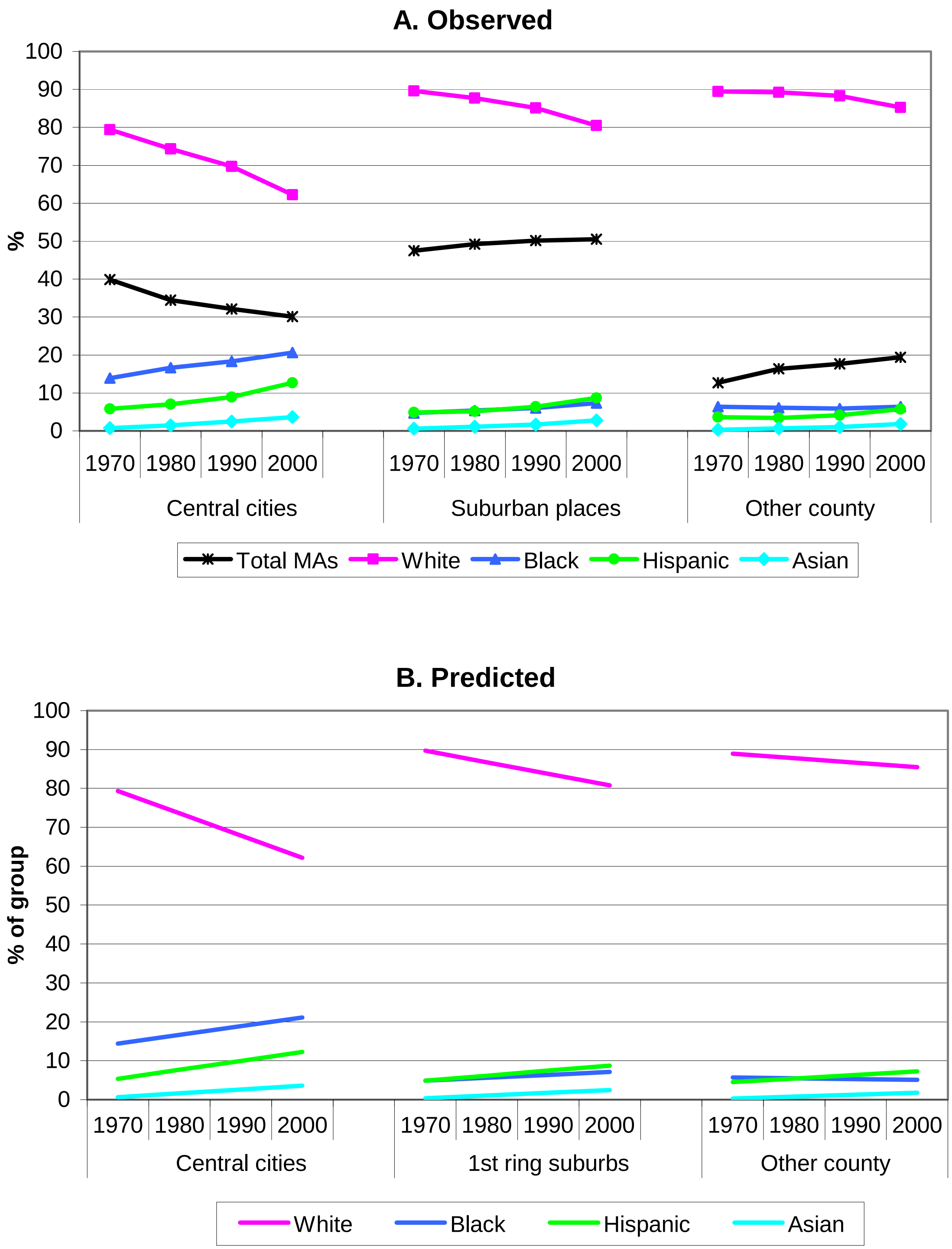

Figure 2. **Observed and Predicted Racial/Ethnic Distibutions in U.S. Metropolitan Areas, 2000**

Notes : Level-2 *n* = 10,502 , including 250 central cities, 600 metropolitan counties, and 9,652 suburban places. Level-3 *n* = 246 MAs. Predicted data come from HLM random coefficients models shown in Table 2.

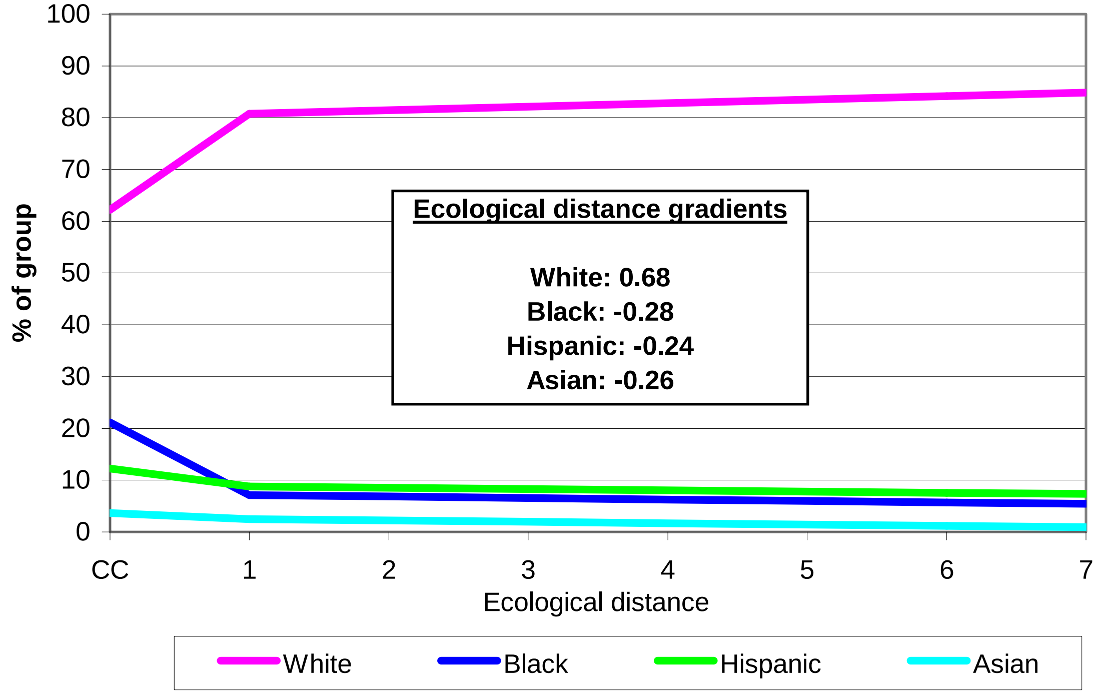

Figure 3. HLM Estimates of Racial/Ethnic Distributions in Central Cities and Seven Suburban Rings of U.S. Metropolitan Areas, 2000

Notes: Level-2 *n* = 10,502 , including 250 central cities, 600 metropolitan counties, and 9,652 suburban places. Level-3 *n* = 246 MAs. Data come from HLM random coefficients models shown in Table 2.

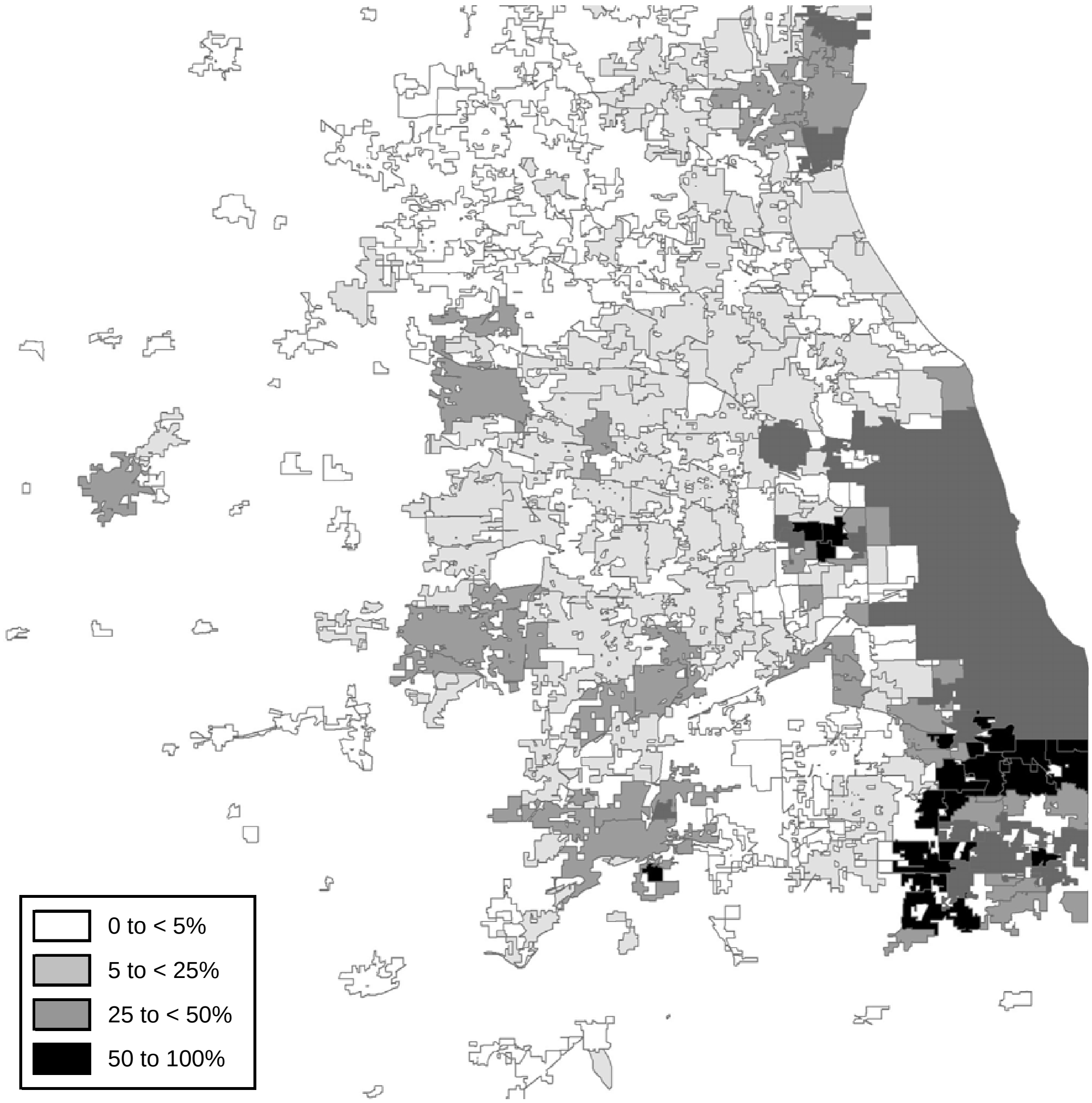

Figure 4. Percent Black in Central City and Suburbs, Chicago PMSA, 2000

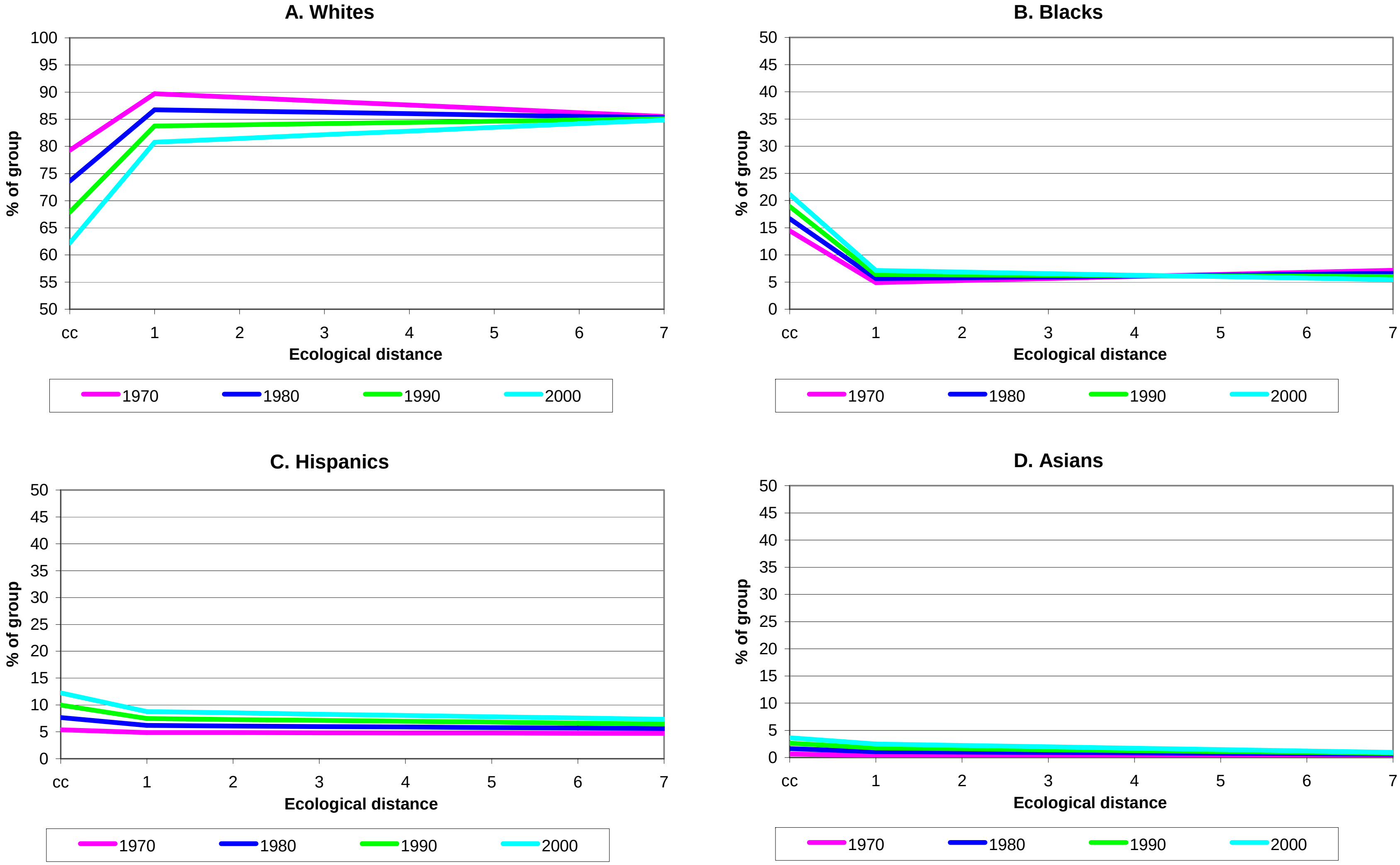

Figure 5. 1970 to 2000 Change in Racial/Ethnic Distributions in Central Cities and Seven Suburban Rings of U.S. Metropolitan Areas

Notes: Level-2 *n* = 10,502 , including 250 central cities, 600 metropolitan counties, and 9,652 suburban places. Level-3 *n* = 246 MAs. Data come from HLM random coefficients models shown in Table 2.

Table 1. Descriptive Statistics of the Independent Variables, 2000 and 1970 to 2000

	2000				1970 to 2000 change[a]			
Variables	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.
Spatial assimilation								
Percent good English speakers								
Hispanic	76.1	9.4	49.0	98.4	-7.8	7.8	-32.6	5.7
Asian	86.9	5.2	62.5	97.6	12.6	15.3	-15.9	89.3
Percent > high school								
White	54.2	9.3	31.0	79.6	21.9	6.0	4.7	43.0
Black	45.3	11.3	17.2	83.6	28.9	15.7	-42.3	121.3
Hispanic	36.8	11.8	11.1	79.9	17.7	19.7	-53.2	66.5
Asian	64.0	12.6	23.9	94.4	7.5	14.6	-30.8	84.9
Mean household income (in $000)								
White	52.7	9.8	34.3	105.7	2.3	5.2	-14.9	16.3
Black	36.1	7.2	20.9	68.6	3.7	9.9	-33.6	54.8
Hispanic	40.2	7.1	21.7	64.2	3.9	10.5	-61.9	49.2
Asian	58.7	14.7	20.2	122.4	8.7	18.2	-50.9	99.6
Relative housing supply								
Suburban:CC housing	1.89	1.65	0.08	9.15	22.0	16.1	-12.1	131.7
Ecological context								
MA population (in 000)	851	1,554	80	15,643	14.8	13.2	-7.6	110.5
Percent racial/ethnic group[b]								
White	74.5	17.6	4.9	97.6	-5.3	5.5	-37.2	3.4
Black	11.3	10.7	0.2	51.1	17.0	24.4	-21.9	143.6
Hispanic	10.5	15.6	0.4	94.4	39.4	23.0	-5.6	120.3
Asian	3.0	5.4	0.3	69.3	73.5	22.4	7.1	142.2
Region								
Northeast	0.18	0.38	0	1	—	—	—	—
Midwest	0.25	0.44	0	1	—	—	—	—
South	0.39	0.49	0	1	—	—	—	—
West	0.18	0.39	0	1	—	—	—	—
Age of MA								
Earlier than 1900	0.19	0.39	0	1	—	—	—	—
1900 to 1939	0.34	0.48	0	1	—	—	—	—
1940 to 1969	0.30	0.46	0	1	—	—	—	—
1970 or later	0.17	0.38	0	1	—	—	—	—

Notes : Sample size (MAs) is 246.

[a] These are person-year weighted rates of change (in % per decade) from 1980 to 2000, except for suburban:cc housing stock, MA population, and percent racial/ethnic group, which are from 1970 to 2000.

[b] Refers to the percentage of the group in each row.

Table 2. Fixed Effects from HLM Regressions of 2000 "First Ring Gaps" on Spatial Assimilation, Housing Supply, and Ecological Context Variables

	Model											
	1				2				3			
Parameter	White	Black	Hispanic	Asian	White	Black	Hispanic	Asian	White	Black	Hispanic	Asian
Intercept	18.58 *	-14.05 *	-3.49 *	-1.15 *	18.56 *	-14.09 *	-3.47 *	-1.15 *	18.59 *	-14.00 *	-3.55 *	-1.16 *
Spatial assimilation												
Percent English speakers	—	—	0.02	0.02	—	—	-0.02	0.02	—	—	-0.02	0.01
Percent > high school	-0.16 *	0.04	-0.03	-0.01 *	-0.13	0.05	-0.02	-0.01 *	0.06	0.06	0.04 *	-0.01
Mean household income (in $000)	0.27 *	-0.06	0.01	0.00	0.26 *	-0.07	0.01	0.00	0.20 *	0.02	-0.05	0.01 *
Relative housing supply												
Suburban:CC housing	—	—	—	—	0.63	0.07	-0.06	0.01	-1.13 *	0.75 *	0.28 *	0.08 *
Ecological context												
Log MA population	—	—	—	—	—	—	—	—	1.09	-0.50	-0.44	-0.07
Percent racial/ethnic group[a]	—	—	—	—	—	—	—	—	1.06 *	0.84 *	0.58 *	0.33 *
Northeast	—	—	—	—	—	—	—	—	7.34 *	-2.69 *	-3.94 *	-1.52 *
Midwest	—	—	—	—	—	—	—	—	5.81 *	-2.05 *	-2.81 *	-1.42 *
South	—	—	—	—	—	—	—	—	6.90 *	-0.10	-2.63 *	-0.89 *
1900 to 1939	—	—	—	—	—	—	—	—	3.47 *	-0.94	-1.62 *	-0.81 *
1940 to 1969	—	—	—	—	—	—	—	—	3.72 *	-1.26	-0.86	-1.23 *
1970 or later	—	—	—	—	—	—	—	—	2.24	-1.52	-0.07	-1.42 *

Notes: All covariates have been grand-mean centered. Level-2 N is 246. * indicates coefficient is at least twice the size of its standard error.

[a] Refers to the percentage of the group in the columnn heading.

[b] These are estimates of the level-2 variance in the intercepts from a HLM random-coefficients model (i.e., one with no level-2 covariates).

Table 3. Fixed Effects from HLM Regressions of 2000 Ecological Distance Gradients on Spatial Assimilation, Housing Supply, and Ecological Context Variables

	Model											
	1				2				3			
Parameter	White	Black	Hispanic	Asian	White	Black	Hispanic	Asian	White	Black	Hispanic	Asian
Intercept	0.67 *	-0.26	-0.24 *	-0.26 *	0.67 *	-0.22	-0.25 *	-0.27 *	0.64 *	-0.23	-0.18	-0.29 *
Spatial assimilation												
Percent English speakers	—	—	-0.01	0.00	—	—	0.01	0.00	—	—	-0.01	0.01 *
Percent > high school	-0.03	-0.02	0.00	0.00	-0.03	-0.03	0.00	0.00	-0.06	-0.02	0.00	0.00 *
Mean household income (in $000)	0.01	0.00	0.00	0.00	0.01	0.01	0.09 *	0.00	0.03	-0.03	0.01	0.00
Relative housing supply												
Suburban:CC housing	—	—	—	—	-0.02	-0.10	0.02	0.00	0.17	-0.16	-0.05	-0.01
Ecological context												
Log MA population	—	—	—	—	—	—	—	—	-0.40 *	0.05	0.03	0.05 *
Percent racial/ethnic group[a]	—	—	—	—	—	—	—	—	-0.10 *	-0.08 *	-0.04 *	0.01 *
Northeast	—	—	—	—	—	—	—	—	-1.57 *	0.20	0.60 *	0.45 *
Midwest	—	—	—	—	—	—	—	—	-0.30	-0.48	0.30	0.30 *
South	—	—	—	—	—	—	—	—	-0.64	-0.49	0.27	0.27 *
1900 to 1939	—	—	—	—	—	—	—	—	-0.79	-0.05	0.39 *	0.05
1940 to 1969	—	—	—	—	—	—	—	—	-1.51	0.39	0.20	0.15 *
1970 or later	—	—	—	—	—	—	—	—	-2.11 *	0.90	0.30	0.23 *

Notes: All covariates have been grand-mean centered. Level-2 N is 246. * indicates coefficient is at least twice the size of its standard error.

[a] Refers to the percentage of the group in the columnn heading.

[b] These are estimates of the level-2 variance in the intercepts from a HLM random-coefficients model (i.e., one with no level-2 covariates).

Table 4. Fixed Effects from HLM Regressions of 1970 to 2000 Change in First Ring Gaps on Spatial Assimilation, Housing Supply, and Ecological Context Variables

	Model											
	1				2				3			
Parameter	White	Black	Hispanic	Asian	White	Black	Hispanic	Asian	White	Black	Hispanic	Asian
Intercept	2.73 *	-1.50 *	-1.00 *	-0.29 *	2.73 *	-1.50 *	-0.99 *	-0.29 *	2.80 *	-1.52 *	-1.01 *	-0.30 *
Spatial assimilation												
Percent English speakers	—	—	0.01	0.00	—	—	0.00	0.00	—	—	0.03 *	0.00
Percent > high school	0.02	0.00	0.00 *	0.00	0.02	0.00	0.00	0.00	-0.02	0.01 *	0.00	0.00
Mean household income (in $000)	-0.03	0.00	0.00	0.00 *	-0.02	0.00	0.00	0.00 *	0.00	0.01	0.00	0.00 *
Relative housing supply												
Suburban:CC housing	—	—	—	—	0.00	0.00	0.00	0.00	0.01	-0.01	-0.01	0.00
Ecological context												
Log MA population	—	—	—	—	—	—	—	—	-0.01	0.02	0.00	0.00
Percent racial/ethnic group[a]	—	—	—	—	—	—	—	—	0.28 *	0.01 *	0.01	0.00
Northeast	—	—	—	—	—	—	—	—	2.08 *	-0.58 *	-1.41 *	-0.58 *
Midwest	—	—	—	—	—	—	—	—	1.67 *	-0.09	-0.84 *	-0.63 *
South	—	—	—	—	—	—	—	—	0.96 *	-0.04	-0.41	-0.45 *
1900 to 1939	—	—	—	—	—	—	—	—	1.16 *	-0.58	-0.32 *	-0.27 *
1940 to 1969	—	—	—	—	—	—	—	—	1.31 *	-0.98 *	-0.17	-0.47 *
1970 or later	—	—	—	—	—	—	—	—	1.41 *	-1.29 *	-0.05	-0.59 *

Notes : All covariates have been grand-mean centered. Level-2 N is 246. * indicates coefficient is at least twice the size of its standard error.

[a] Refers to the percentage of the group in the columnn heading.

[b] These are estimates of the level-2 variance in the intercepts from a HLM random-coefficients model (i.e., one with no level-2 covariates).

Table 5. Fixed Effects from HLM Regressions of 1970 to 2000 Change in Ecological Distance Gradients on Spatial Assimilation, Housing Supply, and Ecological Context Variables

	Model											
	1				2				3			
Parameter	White	Black	Hispanic	Asian	White	Black	Hispanic	Asian	White	Black	Hispanic	Asian
Intercept	0.45 *	-0.22 *	-0.07 *	-0.09 *	0.46 *	-0.21 *	-0.07 *	-0.09 *	0.40 *	-0.20 *	-0.07	-0.09 *
Spatial assimilation												
Percent English speakers	—	—	0.00	0.00	—	—	0.00	0.00	—	—	0.00	0.00
Percent > high school	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	-0.01	0.00	0.00
Mean household income (in $000)	0.02	-0.01	0.00	0.00	0.02	-0.01	0.00	0.00	0.00	-0.01 *	0.00	0.00
Relative housing supply												
Suburban:CC housing	—	—	—	—	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00
Ecological context												
Log MA population	—	—	—	—	—	—	—	—	0.01	-0.01	0.00	0.00
Percent racial/ethnic group[a]	—	—	—	—	—	—	—	—	0.03 *	-0.01 *	0.00	0.00 *
Northeast	—	—	—	—	—	—	—	—	-0.41 *	0.13	0.20	0.08 *
Midwest	—	—	—	—	—	—	—	—	-0.11	-0.13	0.12	0.05
South	—	—	—	—	—	—	—	—	-0.17	-0.03	0.08	0.07 *
1900 to 1939	—	—	—	—	—	—	—	—	-0.19	0.00	0.08	-0.02
1940 to 1969	—	—	—	—	—	—	—	—	-0.29	0.26	0.00	0.02
1970 or later	—	—	—	—	—	—	—	—	-0.36	0.15	-0.03	0.05 *

Notes : All covariates have been grand-mean centered. Level-2 N is 246. * indicates coefficient is at least twice the size of its standard error.

[a] Refers to the percentage of the group in the colunmn heading.

[b] These are estimates of the level-2 variance in the intercepts from a HLM random-coefficients model (i.e., one with no level-2 covariates).

Table A1. HLM Estimates of Parameters Relating to Racial/Ethnic Metropolitan Area Distributions in 2000 and 1970 to 2000 Change

	White			Black			Hispanic			Asian		
	Coeff.	SE	*t* -ratio	Coeff.	SE	*t* -ratio	Coeff.	SE	*t* -ratio	Coeff.	SE	*t* -ratio
2000												
Intercept, γ_{000}	62.19	1.40	44.5	21.14	1.20	17.6	12.26	1.05	11.7	3.62	0.40	9.1
Residual county population, γ_{010}	23.26	1.19	19.6	-16.05	1.02	15.8	-4.96	0.56	8.9	-1.87	0.24	7.9
1st ring suburbs, γ_{020}	18.59	1.07	17.4	-14.02	0.92	15.2	-3.49	0.55	6.3	-1.16	0.19	6.2
Ecological distance gradient, γ_{030}	0.68	0.23	3.0	-0.28	0.18	1.6	-0.24	0.07	3.3	-0.26	0.03	7.9
1970 to 2000 change												
Intercept, γ_{100}	-5.70	0.22	25.7	2.23	0.16	14.0	2.30	0.17	13.2	0.99	0.08	12.5
Residual county population, γ_{110}	4.54	0.24	18.7	-2.44	0.21	11.9	-1.36	0.15	9.0	-0.51	0.07	7.2
1st ring suburbs, γ_{120}	2.72	0.26	10.6	-1.49	0.20	7.4	-1.00	0.15	6.8	-0.29	0.06	5.2
Ecological distance gradient, γ_{130}	0.46	0.06	7.6	-0.22	0.04	5.1	-0.07	0.03	2.8	-0.09	0.01	8.8

Notes : Level-2 N = 10,502 , including 250 central cities, 600 metropolitan counties, and 9,652 suburban places. Data come from HLM random coefficients models.