THE CHANGING STRUCTURE OF SCHOOL SEGREGATION: MEASUREMENT AND EVIDENCE OF MULTIRACIAL METROPOLITAN-AREA SCHOOL SEGREGATION, 1989–1995*

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In this paper we examine aggregate patterns and trends in segregation among white (non-Hispanic), black, Hispanic, and Asian public school students in 217 metropolitan areas during the period 1989–1995. We first describe a set of methodological tools that enable us both to measure the mutual segregation among multiple racial groups and to partition total metropolitan-area school segregation into geographic and racial components. Then we use these tools to examine patterns and trends in metropolitan-area school segregation. We find that the average levels of multiracial school segregation have been unchanged from 1989 to 1995, but that this stability masks important shifts in the geographic and racial components making up average levels of total metropolitan school segregation. In particular, segregation between non-Hispanic white students and all other students has increased, on average, while segregation among black, Hispanic, and Asian student groups has declined. In addition, the contribution to average levels of total metropolitan segregation due to between-district segregation has grown, whereas the relative contribution of within-district segregation has declined.

In the past few decades, the United States has become increasingly racially and ethnically diverse. Moreover, the U.S. population, including racial and ethnic minority groups, is concentrated increasingly in metropolitan areas. Eighty percent of the U.S. population lived in metropolitan areas in 1995, and two-thirds of these metropolitan residents in suburban areas (Littman 1998). Roughly three-quarters of all white non-Hispanic residents and seven-eighths of all nonwhite and Hispanic residents lived in metropolitan areas. As of the 1990 census, 13% of metropolitan-area residents were black, 10.5% were Hispanic, and 3.5% were Asian (U.S. Bureau of the Census 1992).

The intersection of increasing racial and ethnic diversity with metropolitanization has led to a broadening of the social arena in which important racial issues in U.S. society are played out. Issues of segregation and equal opportunity that focused almost exclusively on black/white dynamics in urban areas in the 1960s and 1970s must now be addressed throughout the metropolis, and with increasing attention to its multiracial and multiethnic composition.

Despite these obvious trends, we know little about how growing racial diversity in metropolitan areas affects patterns of segregation and diversity in our public schools. To what extent do white (non-Hispanic), black, Hispanic, and Asian students attend school together or separately? And to what extent does the segregation that exists among schools derive from patterns of non-Hispanic white students' separation from nonwhite and Hispanic students, and to what extent does it derive from patterns of separation among nonwhite and Hispanic students? Moreover, to what extent are school segregation patterns in metropolitan areas due to between-district residential segregation patterns, and to what extent are they due to within-district school assignment practices? Finally, as metropolitan areas grow larger and more diverse, how are these patterns of racial diversity and segregation among schools changing?

In this paper we address these questions by examining aggregate patterns and trends in racial segregation among white, black, Hispanic, and Asian public school students in census-defined metropolitan areas during the period 1989–1995.[1] The paper is divided into two parts. In the first section we describe a set of methodological tools that enable us both to measure segregation levels in multiple racial groups and to partition total metropolitan-area segregation into geographic and racial-group components. Although we describe the use of these tools specifically as they apply to the analysis of metropolitan-area school segregation, they apply equally well to the analysis of any type of multiple-group segregation.

Then, after this methodological discussion, we use these tools to describe aggregate patterns and trends in metropolitan-area school segregation during 1989–1995. Because no study has yet examined these patterns or trends

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1. Native Americans are excluded from the analyses reported here because their numbers in most metropolitan areas are very small. We use the terms *white*, *black*, and *Asian* in this paper to refer to non-Hispanic members of these racial groups; Hispanic persons may belong to any race. Also, although "Hispanic" is an ethnic rather than a racial category, we use the term *race* throughout this paper for brevity's sake to refer to the categories "white," "black," "Hispanic," and "Asian." Moreover, we use the term *Hispanic* (rather than *Latino/Latina*) to be consistent with the racial/ethnic categories reported in the Common Core of Data.

in the aggregate, this paper contributes a necessary overview of metropolitan multiracial segregation and allows us to identify both promising and troubling patterns and trends in metropolitan school segregation. In future work we plan to investigate in greater detail the causes and consequences of these patterns and trends.

CHANGES IN THE CONTEXT AND CHARACTER OF RACIAL SCHOOL SEGREGATION

Discussions of race and segregation in the United States generally incorporate only dichotomous racial categorizations such as white/black, white/Hispanic, or white/minority. In part, this is the case because most of the conventional techniques for measuring levels of segregation in a population are limited to assessing segregation between two groups at a given time. This methodological tradition developed during the 1950s, 1960s, and 1970s, when segregation indices were designed to measure levels of segregation between black and white populations (see, for example, Duncan and Duncan 1955; Taeuber and Taeuber 1965). Because blacks and whites were the only racial groups of significant size in the United States at that time, sociologists and demographers felt little need to develop measures of segregation that could accommodate more than two groups at once. A dichotomous world required only dichotomous measures of segregation.

The racial and ethnic social order of the United States, however, is no longer dichotomous (if it ever was), and two-group descriptions of segregation and diversity ultimately may oversimplify complex issues. As the United States becomes increasingly multiracial and multiethnic, it is important to see how these changes in population demographics affect the distribution of students among public schools. As society becomes more diverse, are schools becoming more diverse as well? Or do the changing demographics result—via residential and educational sorting mechanisms—in an increasingly balkanized and more unequal educational system?

The most rapid changes in racial and ethnic diversity in the United States are occurring in metropolitan areas. Table 1 reports changes between the 1989–1990 and the 1995–1996 school years in the racial composition of public schools in 217 of 323 U.S. metropolitan statistical areas (MSAs). Although black, Hispanic, and Asian students made up only 37% of the total enrollment in these MSAs in 1989, growth in minority enrollment accounted for four-fifths of the total enrollment growth between 1989 and 1995. The total white public school enrollment in these MSAs increased by less than 4% over the eight-year period, while the total combined black, Hispanic, and Asian student enrollment increased by 23%. The minority enrollment growth occurred equally in city and in suburban schools, but the white enrollment growth was due entirely to suburban growth; in fact, white enrollment in urban schools declined between 1989 and 1995.

Despite the magnitude of these changes in both the proportion and the distribution of black, Hispanic, and Asian students in metropolitan-area schools, nobody has conducted a large-scale study of the school segregation patterns among multiple racial groups in metropolitan areas. Even though multiracial contexts have become more prevalent and more important in understanding schooling and the social environment, educational sociologists have rarely incorporated a multiracial perspective into discussions of school segregation.

Nor has the school segregation literature comprehensively addressed the metropolitan context of school segregation. In fact, the most thorough discussions of the patterns and contexts of multiracial segregation are found in demographic and sociological research on *residential* segregation in metropolitan areas (see, for example, Denton and Massey 1988, 1991; Frey and Farley 1996; Krivo and Kaufman 1999; Massey and Denton 1987, 1989a, 1989b, 1992; Miller and Quigley 1990). This literature generally has shown high levels of white/black residential segregation and lower levels of white/Hispanic and white/Asian segregation in metropolitan areas. Residential white/black segregation appears to be declining, however, while Hispanic and Asian residents have become progressively more segregated from whites in recent decades.

Residential segregation, however, does not necessarily correspond closely to educational segregation. School districts, particularly large urban districts and the countywide districts in parts of the South and the West, can greatly exac-

TABLE 1. METROPOLITAN-AREA PUBLIC SCHOOL ENROLLMENT, 1989–1995

	1989	1995	Change 1989–1995	Percentage Change 1989–1995
Metro				
Total (millions)	23.1	25.6	+2.5	+10.7
Minority	8.4	10.4	+1.9	+22.9
White	14.7	15.3	+0.5	+3.7
% minority	36.5	40.5	+4.0	
City				
Total (millions)	9.8	10.5	+0.7	+7.1
Minority	5.6	6.5	+0.9	+16.1
White	4.2	4.0	–0.2	–5.0
% minority	57.0	61.8	+4.8	
Suburb				
Total (millions)	13.3	15.1	+1.8	+13.4
Minority	2.8	3.9	+1.0	+36.3
White	10.5	11.2	+0.7	+7.1
% minority	21.3	25.6	+4.3	

Source: Authors' tabulations of 1989–1995 NCES Common Core of Data.

Notes: Table 1 includes data from 217 MSAs for which the CCD contains both city and suburban school data for both 1989 and 1995. Native American students are excluded from the total and minority counts in this table. MSA boundaries are those defined by the OMB in 1993 (Slater and Hall 1994).

erbate or ameliorate residential segregation patterns through segregative or integrative school assignment policies. In addition, because the school-age population is more racially diverse than the total population of metropolitan areas (containing fewer white students and more students from other groups), school segregation patterns do not necessarily mirror residential patterns.

The few studies that have examined school segregation in a multiracial context (as well as almost all studies of residential multiracial segregation) have simply used pairwise measures of segregation—white/black and white/Hispanic—to describe segregation among multiple racial/ethnic groups (see Clotfelter 1998; Orfield, Bachmeier, et al. 1997; Orfield, Glass, et al. 1993). These studies show gradual increases in the levels of white/black and white/Hispanic school segregation in the 1990s. The use of dichotomous segregation indices, however, fails to capture the extent of segregation among minority groups. Certainly the historical position of whites in the United States and the persistent patterns of inequality between white and nonwhite groups make segregation between white students and students from other groups an important focus of segregation research. Yet other, more subtle dynamics may be at work, which could be illuminated with a more general description of segregation among multiple groups. Our goal in this paper is to employ multiple-group measures of segregation to examine these more subtle patterns in metropolitan areas of the United States.

To accomplish this, we use a set of methodological tools for measuring segregation that enable us to partition the total segregation among multiple racial groups into components that indicate what portion of the total segregation is due to segregation between whites and members of other groups and what portion is due to segregation among the groups other than white. In addition, we can use these tools to partition total metropolitan segregation into geographic components indicating the portion of segregation due to segregation in the central city, in the suburbs, and between central cities and suburbs. These tools enable us to examine segregation separately among all racial groups, as well as between whites and other groups and among all groups other than white, in both the central city and the suburbs. Such an analysis will give a broader description of the patterns of racial separation and integration than is possible with pairwise indices alone.

MEASURING MULTIRACIAL METROPOLITAN SEGREGATION

The study of multiracial segregation requires a set of methodological tools capable of describing the mutual segregation among multiple groups. Reardon (1998) describes five such indices of multiple-group segregation, including several that are generalized forms of common pairwise indices. One of these five, Theil's entropy index of segregation (H), can be decomposed into components representing the share of total multiple-group segregation attributable to segregation among different combinations of racial groups (Theil 1972). Because of this property, we rely on H for the analyses presented in this paper.[2]

Because H is not yet common in segregation research, we briefly describe its properties and interpretation. (For several examples of its use, see Kulis 1997; Miller and Quigley 1990; White 1987.) Essentially, H is a measure of *how diverse individual schools are, on average, compared with the diversity of their metropolitan-area school enrollment as a whole.* A metropolitan area in which each school has exactly the same level of diversity as the district as a whole is considered perfectly unsegregated; here the index takes a value of 0. Conversely, a district in which each school has no diversity (all schools are monoracial; no student attends a school with any member of another racial group) is considered completely segregated, and the index equals its maximum value of 1.

Diversity here is defined mathematically in such a way that a population has a minimum diversity of 0 if only a single racial group is present; maximum diversity is obtained only when each racial group is equally present in the population. In Theil's index, the measure of diversity is the entropy (E) of a population. E is defined as

$$E = \sum_{r=1}^{n} Q_r \ln \frac{1}{Q_r}, \tag{1}$$

where Q_r is the proportion of the population made up of racial group r. E reaches its maximum value of $\ln(n)$ when each group is represented equally in the population (that is, when $Q_r = 1/n$ for all r), and its minimum value of 0 when only one racial group is present.[3]

To calculate H we first calculate the diversity E_i of each school and the diversity E of the district (or metropolitan area) as a whole. The entropy index of segregation is then defined as

$$H = \frac{\sum_{i=1}^{k} \frac{t_i}{T}(E - E_i)}{E}, \tag{2}$$

where T and t_i are respectively the enrollment of the district (or metropolitan area) as a whole and of school i.[4] H can be

2. Reardon (1998), however, conducted empirical comparisons between H and the other four multigroup segregation measures and found that correlations among the five ranged from .85 to .96. In Massey and Denton's (1988) terminology, this is the case because each of the five indices measures the same "evenness" dimension of segregation—the extent to which racial groups are distributed evenly among schools. Because of the empirical similarity of the five measures, our descriptions of the relative level of multiracial segregation among metropolitan areas would have been very similar, had we chosen any of the other measures. None of the other measures, however, has a mathematical form that allows for a decomposition into between-group components.

3. The definition of E requires that we define

$$0 \times \ln(1/0) = \lim_{q \to 0}[q \ln(1/q)] = 0.$$

In addition, E can be calculated by using logarithms to any base; using base n, where n is the number of groups in the population, would have the effect of multiplying E by a factor of $\log_n(e)$, and would constrain E between 0 and 1. We use the natural logarithm for simplicity.

4. H is independent of our choice of a logarithmic base in the calculation of E, because any change in base would multiply both the numerator and the denominator of H by the same constant.

viewed as the weighted average difference between the diversity of the district as a whole and each school's diversity, taken as a proportion of the diversity of the district as a whole. Because the weighted average diversity of the schools can never be greater than the diversity of the district as a whole (although individual schools may be more diverse than the district), H necessarily ranges between 0, when no segregation exists, and 1, when there is complete segregation (Theil 1972). Regardless of the racial composition of the student population, integration is maximized (that is, $H = 0$) when each school contains the same racial proportions as the total student population. Thus segregation is independent of the population's diversity.[5]

An important characteristic of Theil's index is that the particular mathematical form of H allows it to be decomposed elegantly in two distinct ways: into between- and within-group components, and into between- and within-district (or other organizational unit) components. The general form of any decomposition of H is given by

$$H = \sum_{p \in P} \left(\frac{T_p}{T}\right)\left(\frac{E_p}{E}\right) H_p , \tag{3}$$

where p indexes the components of decomposition P. A proof of this general decomposition is given in the appendix.[6] In the following sections we discuss the specifics and the interpretation of this decomposition as it applies to the analysis of multiracial metropolitan school segregation.

Between-Group Decomposition of *H*

The form of H defined in Eq. (2) describes the total, or mutual, segregation among n racial groups. We may want to know, however (as we do here), the extent to which the mutual segregation among n groups can be attributed to segregation within and between particular combinations of those n groups. Here, for example, we are interested in examining what proportion of the total multiracial segregation in metropolitan areas is attributable to segregation between white students and students from other groups, and what proportion is attributable to segregation among black, Hispanic, and Asian students. This requires partitioning H into two components: One measures the contribution of segregation between white and other groups, and the other measures the contribution of segregation among groups other than white. From Eq. (3) we obtain the following decomposition (see appendix):

$$H_{W\backslash B\backslash H\backslash A} = \left(\frac{E_{W\backslash BHA}}{E_{W\backslash B\backslash H\backslash A}}\right) H_{W\backslash BHA} + Q_{BHA}\left(\frac{E_{B\backslash H\backslash A}}{E_{W\backslash B\backslash H\backslash A}}\right) H_{B\backslash H\backslash A} . \tag{4}$$

In this expression, $H_{W\backslash B\backslash H\backslash A}$ and $E_{W\backslash B\backslash H\backslash A}$ are the multiple group segregation (H) and entropy (E) calculated among white, black, Hispanic, and Asian students; $H_{B\backslash H\backslash A}$ and $E_{B\backslash H\backslash A}$ are the multiple group segregation and entropy calculated among black, Hispanic, and Asian students; $H_{W\backslash BHA}$ and $E_{W\backslash BHA}$ are the pairwise segregation and entropy between whites and the combined black, Hispanic, and Asian student population; and Q_{BHA} is the nonwhite proportion of the student population.

Eq. (4) can be viewed as decomposing the total multiracial segregation into a weighted sum of the segregation between white students and black, Hispanic, and Asian students combined—$H_{W\backslash BHA}$—and segregation among black, Hispanic, and Asian students—$H_{B\backslash H\backslash A}$—where the weight terms depend on the relative magnitude of the between- and within-group entropy terms and on the black, Hispanic, and Asian enrollment share. This means that the two right-hand terms in Eq. (3) are *components* of the multiracial segregation; they are not the actual values of H calculated between white and other students, nor among students other than white, though they incorporate those terms.

For a more tractable interpretation of Eq. (4), however, one can view the first term on the right-hand side as the portion of the total multiracial segregation among white, black, Hispanic, and Asian students that is attributable to segregation between white students and students from other groups. This is the share of the total segregation that could be reduced by changing only the relative white/minority racial balance in schools. The second term on the right-hand side of Eq. (3) is, similarly, the portion of the total multiracial segregation among white, black, Hispanic, and Asian students that is attributable to segregation among black, Hispanic, and Asian students. This is the portion of the total segregation that could be reduced by transferring black, Hispanic, and Asian students among schools while leaving their collective relationship to white students unchanged. Therefore this particular decomposition of H allows us to calculate what proportion of multiracial segregation is due to segregation between white and minority students and what proportion of it is due to segregation among minority students.

Geographic Decomposition of *H*

Racial segregation among schools means that schools differ in their racial compositions. Yet schools may differ because school districts within the same metropolitan area have different racial compositions, or because schools within the same district have different compositions, or both. Segregation attributable to the differing racial compositions of districts (between-district segregation) is generally the result of forces affecting racial groups' differential access to housing markets and the school districts that accompany them, whereas segregation attributable to differing racial compositions of schools within districts (within-district segregation) may be the result of both residential patterns and school assignment practices within individual school districts.

In describing segregation in metropolitan areas, we wish to know to what extent the observed segregation is attributable to both between- and within-district patterns

5. The entropy index H, as well as several other multigroup segregation indices, is calculated by a program (-seg-) that runs under the STATA 6 statistical software program; -seg- can be downloaded free from http://ideas.uqam.ca/ideas/data/bocbocode.html.

6. Additional discussion of the decomposition of H can be found in Miller and Quigley (1990), Theil (1972), and Theil and Finezza (1971).

because each implies a very different set of policy concerns and potential remedies. Insofar as school segregation results from between-district residential forces rather than within-district assignment practices, no within-district policies will affect it. Conversely, insofar as within-district segregation is the dominant pattern, changes in school assignment practices within districts have the potential to have large effects.

Unlike the more commonly used dissimilarity index (Taeuber and Taeuber 1965) and the Gini index, H can be decomposed unambiguously into between- and within-district components, a property that allows the type of analysis described above.[7] In a system made up of k districts, H can be written as the sum of a between-district component and a within-district component that is simply a weighted average of the k within-district segregation levels:

$$H = H_D + \sum_{d=1}^{k} \frac{T_d E_d}{TE} H_d \,, \tag{5}$$

where H is the entropy index calculated over all schools in a system; H_D is the entropy index calculated between districts; H_d is the entropy index calculated within district d; and E_d, E, T_d, and T are respectively the diversities and the total enrollments of district d and the total student population. The within-district component here is a weighted average of the within-district values of H, where districts are weighted by both their relative sizes (T_d/T) and their relative diversities (E_d/E). Segregation in districts with large and diverse student populations contributes more to the within-district segregation component than does comparable segregation in small and/or homogeneous districts.[8]

As Table 1 illustrates, an important trend in U.S. metropolitan areas is the growth of the suburbs, and particularly the rapid growth of minority groups in the suburbs and the decline in white enrollments in cities. These demographic trends may have important effects on metropolitan-area segregation because city-suburban population shifts generally entail a shift in the relative racial composition of districts.

To specifically investigate the effect of city-suburban population shifts on metropolitan-area segregation, we can use a version of the decomposition in Eq. (5) to partition total metropolitan-area segregation into components representing city and suburban components of segregation as well as components representing between- and within-district segregation. In a metropolitan area with districts classified as either suburban or city, we can write the total metropolitan segregation H first as

$$H = H_{C\times S} + \frac{T_C E_C}{TE} H_C + \frac{T_S E_S}{TE} H_S \,, \tag{6}$$

where $H_{C\times S}$ is the segregation between city and suburban districts, and where T_C, E_C, and H_C and T_S, E_S, and H_S are respectively the total enrollment, entropy, and segregation of the city and the suburbs.

The first component on the right-hand side of Eq. (6) is the component of metropolitan-area segregation attributable to segregation between the central city and the suburbs. The second and third components respectively are the portions attributable to segregation within the central city and within the suburbs. The between-city-and-suburb component is the part of the total segregation that can be reduced only by changes in the relative compositions of the central city and the suburbs as a whole. The within-city component is the part that can be reduced through changes in the relative composition of schools within central cities; the within-suburban component, similarly, is the part that can be reduced through changes in the relative composition of schools within suburban areas.

Both the central-city and the suburban components can be regarded as composed of both between- and within-district components (although many metropolitan areas contain only a single central-city district, so the between-city district component in these cases is zero). If we apply the decomposition in Eq. (5) to the H_C and H_S terms in Eq. (6), we obtain a five-part decomposition of the total metropolitan segregation:

$$H = H_{C\times S} + \frac{T_C E_C}{TE} H_{CD} + \sum_{d\in C} \frac{T_d E_d}{TE} H_d + \frac{T_S E_S}{TE} H_{SD} + \sum_{d\in S} \frac{T_d E_d}{TE} H_d \,, \tag{7}$$

7. Rivkin (1994) argues that the Gini index can be decomposed in this way, but his approach is flawed because he erroneously assumes that the "overlap" term in the decomposition of G can be assigned unambiguously to the within-district component. In fact, the Gini index is not decomposable; it is possible to show that there are cases in which reducing within-district segregation can cause an increase in total segregation.

8. An anonymous reviewer pointed out that segregation levels are sensitive to the size of the organizational unit over which they are calculated, which may affect the segregation levels we report. This is an issue in residential segregation research in particular, because census tracts and blocks are relatively arbitrary in size and do not necessarily correspond to meaningful social contexts. It is less of an issue, however, in school segregation research, because the school, regardless of size, is a meaningful unit of analysis. Moreover, because the average enrollment of schools in our sample changed little between 1989 and 1995 (from 524 to 548 students), our description of trends in segregation levels should be relatively unaffected by changes in school size.

A related issue is the effect of variations in district size on the relative proportions of between- and within-district segregation: In metropolitan areas made up of fewer, larger districts, a greater share of their total segregation, on average, will be attributable to within-district segregation. Again, however, in our sample the average number of districts within each metropolitan area changed little from 1989 to 1995 (from 23.9 to 23.3). Moreover, we are not interested here in comparing levels of between-district segregation across metropolitan areas, but rather in partitioning total segregation into within- and between-district components, because each level of segregation is caused, to a certain extent, by a different process: Between-district segregation is due to between-district residential patterns, whereas within-district segregation is due to district-level school assignment policies. Thus any changes we observe in the relative proportions of between- and within-district segregation levels—even if they are due in part to changes in the relative size and number of districts—are meaningful for our analyses, because they indicate how strongly segregation might be affected either by housing or by school assignment policies.

where H_{CD} and H_{SD} are the between-district values of H in the city and the suburbs respectively, and T_d, E_d, and H_d are respectively the total enrollment, entropy, and segregation of district d. In this expression of H, the first term on the right-hand side is the component of metropolitan-area segregation attributable to segregation between the central city and the suburbs. The second and third components respectively are the portions attributable to segregation between and within districts within the central city. Similarly, the fourth and fifth terms are the portions attributable to segregation between and within districts in the suburbs.

A useful property of this decomposition is that the first, second, and fourth terms sum to equal H_D, the total metropolitan between-district segregation in Eq. (5), while the third and fifth terms sum to equal the within-district component of total metropolitan segregation in Eq. (5). So this decomposition allows us to disaggregate total metropolitan segregation completely into between- and within-district and between- and within-city-and-suburb components. Because of this property, it is perfectly suited to answer questions about the metropolitan structure of school segregation.

Simultaneous Between-Group and Geographic Decomposition of *H*

Above we described two different ways in which the entropy index of segregation can be decomposed. The first focuses on components of between- and within-group segregation, allowing us to distinguish the effects of segregation between white students and students from groups other than white from the effects of segregation among the nonwhite groups. The second way focuses on components of between- and within-district and between- and within-city-and-suburb segregation, allowing us to describe the geographic and organizational structure of metropolitan-area segregation.

The two decompositions of H described above need not be conducted separately, however. It is possible to partition total multiracial segregation simultaneously into both hierarchical and between-group components, producing a two-way decomposition of H into (in this case) 10 components: the two group components each decomposed into five geographic components. This two-way decomposition will have the general form given in Eq. (3) above. In particular, each component of segregation depends on three factors: the ratio of the component's enrollment to the total metropolitan enrollment (T_p/T); the ratio of the component's racial diversity (entropy) to the total metropolitan racial diversity (E_p/E); and the level of segregation within the component (H_p). For example, the portion of the total metropolitan multiracial segregation due to segregation among black, Hispanic, and Asian students between suburban districts would be the product of (1) the ratio of the combined black, Hispanic, and Asian suburban enrollment to total MSA enrollment; (2) the ratio of the diversity (entropy) among suburban black, Hispanic, and Asian students to total MSA racial diversity; and (3) the level of suburban between-district segregation among black, Hispanic, and Asian students.

Patterns and Trends in Multiracial Metropolitan School Segregation

Having shown that H can be used as a comprehensive measure of multiracial metropolitan-area segregation, we now use H to examine patterns and trends in metropolitan school segregation among white, black, Hispanic, and Asian students. We address several questions: (1) How segregated are U.S. metropolitan areas, on average, as measured by H? What are the trends in segregation? (2) How is segregation distributed in metropolitan areas, both geographically and between white students and those from other groups? What components account for the largest part of H? (3) What are the trends in H and its components? Are the components of metropolitan segregation each changing in similar or in different ways?

DATA

Data for these analyses were drawn from the Agency and School Universe components of the Common Core of Data (CCD) for the school years beginning in fall 1989 and 1995 (National Center for Education Statistics 1996). The CCD is a data set compiled by the National Center for Educational Statistics (NCES) that contains data from all public schools and school districts in the United States. NCES has collected CCD data every school year since 1987–1988, although many states did not report racial enrollment data in the first few years of data collection. By 1989–1990, however, all states except Georgia, Idaho, Maine, Montana, Missouri, South Dakota, Virginia, and Wyoming were reporting racial enrollment data, and that is the first year in which the CCD contains substantially complete enrollment data for most metropolitan areas. Thus we use 1989 as the base year for this study. The most recent CCD data available at this writing came from the 1995–1996 school year, giving us a six-year period in which to examine trends.

Our analyses here depend on consistent definitions of metropolitan-area boundaries over time. Because the census definitions of these boundaries change over time, even in the six years covered by this study, we use the metropolitan statistical area (MSA) boundaries as defined by the Census Bureau in 1993 to delimit the metropolitan areas for each year (Slater and Hall 1994).[9] As a result, we can make consistent comparisons over time without worrying that changes in MSA boundary definitions might confound the results.

The census defined 323 MSAs in 1993 (Slater and Hall 1994). Some of these MSAs are excluded from the analyses reported here because of incomplete racial enrollment data in either 1989 or 1995. In our analyses we include data from only those MSAs in which at least 90% of the schools reported racial enrollment data in both 1989 and 1995. Information on racial enrollment was missing most commonly because it was not reported at the state level. (Eight states did not report race data in 1989; only one state, Idaho, did

9. We use the term *MSA* throughout this paper to include both metropolitan statistical areas (MSAs) and primary metropolitan statistical areas (PMSAs).

not report race data in any year.) Therefore, we dropped MSAs that were entirely or partially in each of those states for the years in which data were missing. In addition, obvious reporting errors were present in school-level data for two MSAs (Fort Collins, CO and Greensboro, NC); we dropped those MSAs from all analyses. Of the 323 MSAs, the data were at least 90% complete for 253 in both 1989 and 1995.

We are interested here in decomposing metropolitan segregation into city and suburban components; therefore we further restricted the analyses to include only MSAs that contained identifiable city and suburban school districts. An additional 36 MSAs were excluded by this criterion; most were small MSAs in the South and the West, made up of single countywide school districts. The final sample, on which our analyses are based, contains 217 MSAs.

Because of the excluded MSAs, our findings should not be considered representative of all the metropolitan areas in the United States. In particular, because many small and southern MSAs are excluded for lack of identifiable central-city districts, the sample does not represent such MSAs. Nonetheless, the sample includes over three-quarters of the MSAs with populations greater than 500,000; thus it can be considered reasonably representative of such MSAs.

Our analyses include decompositions of segregation in city and suburban components; therefore we identify each school district in the MSAs as either a city district or a suburban district. For this step we relied on the CCD metro status code variable, by which districts are coded as serving central cities, suburbs, or nonmetropolitan areas. The CCD uses census definitions of central cities that allow for more than one central city per metropolitan area. Therefore many MSAs contain more than a single city district: 115 of the 217 MSAs consist of a single census-defined central-city district, 67 contain two or three such districts, and 35 include more than three. By separating the central-city component of segregation into between- and within-district components, however, we avoid confounding the between-district segregation in these MSAs with levels of within-district segregation.

FINDINGS

General Patterns and Trends in Multiracial Metropolitan Segregation, 1989–1995

Before turning to the decomposition of metropolitan multiracial segregation, we examine trends in metropolitan segregation. Table 2 shows the trends in three measures of metropolitan segregation: segregation among white, black, Hispanic, and Asian students; segregation between white students and black, Hispanic, and Asian students combined; and segregation among black, Hispanic, and Asian students. In 1989 all three of these measures were very similar, with values ranging from 0.235 to 0.242.[10] Table 2 also indicates the substantial variation in the values of H across MSAs: The three segregation measures have standard deviations of 0.10 to 0.13 and range from minima of 0.02–0.04 to maxima of 0.55–0.67.

TABLE 2. TRENDS IN AVERAGE MULTIRACIAL METROPOLITAN SEGREGATION MEASURES, 1989–1995

	Multiracial	White/ Minority	Black/ Hispanic/Asian
1989[a]	0.2348	0.2366	0.2415
	(0.1187)	(0.1308)	(0.1037)
1995[a]	0.2367	0.2457	0.2133
	(0.1181)	(0.1306)	(0.0997)
Change[b]	+0.0019	+0.0091***	–0.0282***
	(0.0015)	(0.0018)	(0.0025)
% change	+0.8	+3.8	–11.7

Source: Authors' tabulation of 1989–1995 Common Core of Data.

[a]Standard deviations are shown in parentheses.

[b]Standard errors are shown in parentheses.

$***p < .001$ (two-tailed t-test)

By 1995, however, the average values of the three measures had diverged considerably. From 1989 to 1995 the average segregation between white students and those from other groups *increased* by 3.8% ($p < .001$), and the average segregation among black, Hispanic, and Asian students *decreased* by 11.7% ($p < .001$). The average total multiracial segregation changed very little, however, increasing by only 0.8% ($p = .215$) between 1989 and 1995.[11] This indicates that although total metropolitan-area multiracial school segregation changed little from 1989 to 1995, this stability masks two distinct trends: Groups other than white are becoming less segregated from each other, while segregation between white students and black, Hispanic, and Asian students in metropolitan areas is on the rise.

The Composition of Metropolitan Multiracial School Segregation, 1995

In the previous section we described trends in the average levels of segregation between whites and groups other than whites, and among groups other than whites. The effects of the combination of these trends in segregation levels and the changing demographics of metropolitan areas can be examined by using the decomposition properties of H described earlier. Using this procedure, we can assess the extent to which average levels of metropolitan multiracial segregation are due to both geographic and between- and within-group segregation patterns.

Table 3 shows the complete two-way decomposition of average multiracial metropolitan-area school segregation for

10. These are moderate values of H. Recall that an H of 0.24 means that the levels of diversity in schools are, on average, 24% lower than the level of diversity of the total metropolitan-area enrollment. For comparison with the metric of a more familiar index, the average values of the generalized dissimilarity index (Reardon 1998) among the 217 MSAs are 0.486 for the multiracial segregation, 0.479 for the white/minority segregation, and 0.472 for the segregation among black, Hispanic, and Asian students. Corresponding values of the generalized Gini index (Reardon 1998) among the 217 MSAs are 0.621, 0.612, and 0.614.

11. The p values reported here are the results of two-tailed t-tests of the null hypotheses that the average change in H equals zero.

TABLE 3. TWO-WAY DECOMPOSITION OF AVERAGE MULTIRACIAL METROPOLITAN SCHOOL SEGREGATION (*H*), 1995

	Metro	Central City			Between City and Suburb	Suburbs		
	Total (1)	Total City (2)	Between-District (3)	Within-District (4)	Total (5)	Total Suburb (6)	Between-District (7)	Within-District (8)
Multiracial *H*								
Component	0.2367	0.0777	0.0196	0.0581	0.0967	0.0623	0.044	0.0183
% share	100.0	32.8	8.3	24.5	40.9	26.3	18.6	7.7
White/Minority *H*								
Component	0.1899	0.0559	0.0154	0.0405	0.0874	0.0466	0.0336	0.013
% share	80.2	23.6	6.5	17.1	36.9	19.7	14.2	5.5
Black/Hispanic/Asian *H*								
Component	0.0468	0.0219	0.0043	0.0176	0.0093	0.0156	0.0104	0.0053
% share	19.8	9.3	1.8	7.4	3.9	6.6	4.4	2.2

Source: Authors' tabulations of 1989–1995 NCES Common Core of Data.

Note: $n = 217$ MSAs with both city and suburban school data for 1989 and 1995.

1995. Columns 2, 5, and 6, which indicate the city, between-city-and-suburb, and suburban components of the total metro segregation, sum to column 1. Column 2, in turn, is the sum of columns 3 and 4, which respectively are the components of segregation attributable to segregation between and within central-city districts. Similarly, columns 7 and 8 sum to column 6. In addition, the second and third rows, which indicate the components due to white/minority segregation and black/Hispanic/Asian segregation, sum to the first row.

Here it is useful to remember that the components of *H* indicate the portions of *H* attributable to segregation at different geographic levels and between different racial groups. Each component of segregation represents the amount by which total metropolitan multiracial segregation would be reduced if segregation in that component were eliminated. Thus, for example, the second row of column 4 in Table 3 indicates that eliminating all segregation between white students and students from other groups within central-city school districts would reduce the average total multiracial metropolitan segregation by 0.0405 (a change from 0.2367 to 0.1962), a decline of 17.1%.

Column 1 shows that, in 1995, on average, 80.2% of the multiracial segregation in the 217 MSAs in our sample was due to segregation between whites and members of other groups. This means that even if we eliminated all segregation among black, Hispanic, and Asian students, the total segregation of metropolitan areas would be reduced by only 20% on average. This is the case largely because these groups make up a relatively small part (29% on average, in 1995) of metropolitan public school enrollments.

The top row of Table 3 indicates that an average of 67.7% of the total MSA multiracial segregation is due to segregation between districts (this is obtained by summing columns 3, 5, and 7). The bulk of this between-district segregation (40.9% of the total) is due to segregation between city and suburban districts, but a substantial portion (18.6% of the total) is due to segregation among suburban districts. Segregation between city districts is an important factor in some metropolitan areas with multiple cities and with multiple districts within a city, but on average it constitutes only a relatively small portion of total metropolitan segregation because this component is zero in single-city metropolitan areas. The between-district share of metropolitan-area segregation is important because it is due predominantly to residential segregation patterns, and so cannot be addressed by changes in within-district school assignment procedures.

Although between-district residential segregation is the dominant factor in school segregation at the metropolitan level, this is not necessarily true within central cities; there, on average, the within-district component of multiracial segregation is larger than the between-district component. Overall, segregation within city districts accounts on average for one-quarter (24.5%) of the total metropolitan-area segregation (column 4).

Within-district segregation in suburban districts, however, plays a much less significant role in metropolitan segregation, accounting on average for only 7.7% of total metropolitan segregation. Many suburban districts are very small; when a district contains only a handful of elementary schools and a single high school, as is the case in many suburban districts, there is little room for within-district segregation. Instead the bulk of segregation in the suburbs is due to segregation between districts, which accounts for 71% of total suburban segregation. Therefore any efforts to desegregate students among schools within suburban districts would have little effect on total metropolitan segregation.

The second and third rows of Table 3 indicate the components of total multiracial metropolitan segregation due re-

TABLE 4. TWO-WAY DECOMPOSITION OF TRENDS IN AVERAGE MULTIRACIAL METROPOLITAN SCHOOL SEGREGATION (*H*), 1989–1995

	Metro	Central City			Between City and Suburb	Suburbs		
	Total (1)	Total City (2)	Between-District (3)	Within-District (4)	Total (5)	Total Suburb (6)	Between-District (7)	Within-District (8)
Multiracial *H*								
Component change	+0.0019	–0.0052***	–0.0003	–0.0049***	+0.0043***	+0.0027***	+0.0020***	+0.0008
% share change	0.0	–2.5	–0.2	–2.3	+1.5	+1.0	+0.7	+0.3
% change	0.8	–6.3	–1.5	–7.8	+4.7	+4.5	+4.8	+4.6
White/Minority *H*								
Component change	+0.0021	–0.0046***	–0.0004	–0.0042***	+0.0046***	+0.0021***	+0.0015**	+0.0006
% share change	+0.3	–2.1	–0.2	–1.9	+1.7	+0.7	+0.5	+0.2
% change	+1.1	–7.6	–2.5	–9.4	+5.6	+4.7	+4.7	+4.8
Black/Hispanic/Asian *H*								
Component change	–0.0002	–0.0006	+0.0001	–0.0007*	–0.0002	+0.0006*	+0.0005**	+0.0001
% share change	–0.3	–0.3	+0.1	–0.4	–0.2	+0.2	+0.2	+0.1
% change	–0.4	–2.7	+2.4	–3.8	–2.1	+4.0	+5.1	+1.9

Source: Authors' tabulations of 1989–1995 NCES Common Core of Data.

Note: $n = 217$ MSAs with both city and suburban school data for 1989 and 1995.

*$p < .05$; **$p < .01$; ***$p < .001$ (two-tailed t-test of null hypothesis that average change equals zero)

spectively to white/minority segregation and to segregation among black, Hispanic, and Asian students. In particular, 17.1% of total segregation is due to segregation between white students and students from other groups within central-city districts. Despite decades of desegregation policy targeted at reducing exactly this component, it still plays a significant role in the average level of total metropolitan segregation: It accounts for more than one-sixth of total metropolitan-area school segregation and more than one-fifth (21%) of the total metropolitan white/minority segregation. Similarly, the third row of Table 3 indicates that segregation among black, Hispanic, and Asian students within central-city districts accounts for three-eighths (38%) of all metropolitan segregation among these three groups. These patterns suggest that within-district desegregation strategies in central-city districts may still have an important role to play in reducing metropolitan-area segregation.

Yet despite the continuing importance of urban within-district school segregation, the largest single contributor to total metropolitan segregation is segregation of white students from members of other groups between city and suburban districts. In 1995 this accounted for an average of 36.9% of all total multiracial metropolitan segregation.

The Decomposition of Trends in Multiracial Metropolitan School Segregation, 1989–1995

Table 4 shows the change in each component of multiracial metropolitan segregation between 1989 and 1995. The cells here add just as they do in Table 3; thus we can read it analogously. For example, column 1 shows that the average +0.0019 change in multiracial MSA segregation was due to the combination of a 0.0021 increase in the white/minority component of segregation and a 0.0002 decrease in the black/Hispanic/Asian component of segregation. Two-tailed t-tests showed that neither of these average changes differed significantly from zero.[12]

Column 1 of Table 4 shows no significant change, from 1989 to 1995, in average multiracial metropolitan segregation levels nor in the contribution to these levels by white/minority and black/Hispanic/Asian segregation. The top row of Table 4, however, shows important changes in the geographic distribution of metropolitan segregation during this period. The contribution to metropolitan segregation due to segregation in central cities declined by an average of 0.0052 (a 6.3% decline), of which 0.0049 was due to decreases in within-district segregation (a 7.8% decline in the within-district component). The average declines in central-city within-district components of segregation, however,

12. We conceptualize the changes in *H* and its components as random variables. Although the *values* of *H* and its components among the 217 MSAs in our sample are far from normally distributed, histograms of the *changes* in *H* and its components between 1989 and 1995 show that the changes, in all cases, are distributed approximately normally. Given this, we use two-tailed t-tests in each cell of Table 4 to test the null hypothesis that the average change is equal to zero.

TABLE 5. PERCENTAGE CHANGES IN SEGREGATION LEVEL, RELATIVE ENROLLMENT, RELATIVE ENTROPY, AND METROPOLITAN MULTIRACIAL SEGREGATION COMPONENT, FOR TWO-WAY DECOMPOSITION OF MULTIRACIAL METROPOLITAN SCHOOL SEGREGATION (H), 1989–1995

	Metro (1)	Central City (2)	Between City and Suburb (5)	Suburbs (6)
Multiracial H				
Average percentage change in segregation level (H)	+0.8	–1.6	+4.7***	–1.2
Average percentage change in share of total enrollment (T_p/T)	—	–2.3***	—	+2.0***
Average percentage change in relative entropy (E_p/E)	—	–1.8***	—	+1.7**
Average percentage change in component of total metro H	0.8	–6.3***	+4.7***	+4.5***
White/Minority H				
Average percentage change in segregation level (H)	+3.8***	+1.7%	+7.8***	+1.7
Average percentage change in share of total enrollment (T_p/T)	—	–2.3***	—	+2.0***
Average percentage change in relative entropy (E_p/E)	–2.8***	–5.9***	–2.8***	–0.8
Average percentage change in component of total metro H	+1.1	–7.6***	+5.6***	+4.7***
Black/Hispanic/Asian H				
Average percentage change in segregation level (H)	–11.6***	–12.4***	–11.3***	–12.0***
Average percentage change in share of total enrollment (T_p/T)	+12.4***	+9.5***	+12.4***	+18.4***
Average percentage change in relative entropy (E_p/E)	–15.4***	–15.1***	–15.4***	–14.3***
Average percentage change in component of total metro H	–0.4	–2.7	–2.1	+4.0*

Source: Authors' tabulations of 1989–1995 NCES Common Core of Data.

Note: $n = 217$ MSAs with both city and suburban school data for 1989 and 1995.

*$p < .05$; **$p < .01$; ***$p < .001$ (two-tailed t-tests)

were offset by average increases in the suburban and the between-city-and-suburban components. The contribution due to segregation in the suburbs increased by 0.0027 (a 4.5% increase), of which 0.0020 was due to increases in the component due to segregation between suburban districts. The contribution due to segregation between city and suburban districts increased by 0.0043 (a 4.7% increase). Each of these changes is statistically significant ($p < .001$ in each case).

Overall these findings describe a trend of increasingly important patterns of between-district segregation (the combined between-district components increased by 3.9% on average, from 0.1543 to 0.1603), offset by the declining importance of within-district segregation (the combined within-district components decreased by 5.1% on average, from 0.805 to 0.764). Another way to view this trend is to note that between-district segregation accounted for 65.7% of total metropolitan segregation in 1989, and for 67.7% in 1995. Thus, although overall metropolitan school segregation was essentially unchanged from 1989 to 1995, a slightly greater share of the segregation was due to residential patterns in 1995 than in 1989.

The second and third rows of Table 4 show that the changes in the geographic distribution of segregation are governed by changes in the distribution of segregation between white students and students from groups other than white. In particular, the contribution to total segregation made by central-city within-district segregation between white and nonwhite students declined by 9.4% between 1989 to 1995, decreasing from 19.0% to 17.1% of the total. At the same time, the contribution of white/minority segregation in the suburbs and between the cities and the suburbs increased substantially.

Changes in the geographic components of segregation among black, Hispanic, and Asian students between 1989 and 1995 are small and mostly insignificant, though we found a small increase in the share of segregation among these students between suburban districts and a small decrease in the share within city districts. Neither of these components, however, contributes much on average to overall segregation, so these changes are relatively insignificant.

Causes of Changes in the Components of Metropolitan Multiracial Segregation

Table 4 shows that the absence of an aggregate trend in multiracial metropolitan-area segregation belies a more complex series of changes occurring in metropolitan areas. Between-district segregation between white students and all other students is becoming an increasingly dominant portion of metropolitan-area segregation: It accounted for 55.6% of all metropolitan multiracial segregation in 1989 and for 57.6% of all segregation in 1995.

The trends in the segregation components shown in Table 4, however, do not explain the underlying causes of these changes. Recall from the discussion of Eq. (3) that each component of the overall multiracial metropolitan segregation is the product of three terms:

$$H = \sum_{p \in P} \left(\frac{T_p}{T} \right) \left(\frac{E_p}{E} \right) H_p . \quad (3)$$

Thus a change in a given component's average contribution to total segregation may result from a combination of changes in each of these three factors. Viewing each component of total segregation as a product of three factors helps in understanding the relationship between trends in segregation levels and trends in the composition of total segregation. It can help us understand, for example, why Table 2 can show an 11.7% decline in average levels of segregation among black, Hispanic, and Asian students—changes in $H_{B\backslash H\backslash A}$—while Table 4 shows that the corresponding *component* of segregation—defined earlier as $Q_{BHA}(E_{B\backslash H\backslash A}/E_{W\backslash B\backslash H\backslash A})H_{B\backslash H\backslash A}$—remains essentially unchanged.

Table 5 shows percentage changes, between 1989 and 1995, in the average values of each of the three factors that form the component of H, as well as the average value of the components (their product) of total metropolitan segregation.[13] Column 1 of Table 5 shows that the average 3.8% increase in the level of segregation between white students and those from groups other than white in the metropolitan areas is largely offset by a decrease in the relative entropy term. This means that even though white/minority segregation was increasing from 1989 to 1995, there was a decline in the average level of white/minority diversity relative to total multiracial metropolitan-area diversity ($E_{W\backslash BHA}/E_{W\backslash B\backslash H\backslash A}$). As a net result of these trends, the contribution of white/minority segregation to total segregation increased only slightly. Similarly, average segregation levels among black, Hispanic, and Asian students decreased sharply (–11.6%); and the average diversity among these three groups increased less slowly than the average diversity of metropolitan areas, but black, Hispanic, and Asian students combined to make up a much larger share of the enrollments than previously. As a result, there was no substantial change in the overall contribution, to total segregation, of segregation among these groups.

The top panel of Table 5 describes the causes of the changes in the geographic components of metropolitan segregation. The decline in the contribution of central-city segregation to total segregation is due to decreases in all three factors: Average central-city segregation levels declined, average central-city enrollments declined as a portion of total metropolitan enrollments, and the diversity of central cities increased, on average, less rapidly than that of metropolitan areas.

The story is quite different, however, when we examine change in segregation between cities and suburbs and among suburbs. The growth in the component of segregation between cities and suburbs was due entirely to an increase (+4.7%) in the average level of segregation between cities and suburbs. (Because the cities and the suburbs encompass all students in the metropolitan area, the relative enrollment and diversity factors do not change.) Also, growth in the contribution of suburban-school segregation to total segregation was not due to increases in the average level of segregation in the suburbs. Rather, this increase occurred entirely because both suburban enrollment and suburban diversity increased, on average, faster than their overall metropolitan counterparts. Suburban multiracial segregation levels actually declined slightly, on average, although this decline again masks two divergent trends: Suburban levels of segregation between white students and those from other groups increased slightly (+1.7%), while segregation levels among black, Hispanic, and Asian students declined sharply (–12.0%).

Many of the trends illustrated in Table 5 are linked to the continuing suburbanization of metropolitan areas. Although minority suburban enrollments have grown more rapidly than white suburban enrollments, minority enrollments in central cities have continued to grow rapidly as well, while white central-city enrollments have decreased, on average, as a percentage of total city enrollments. These trends result in a sharp increase in the average level of white/minority segregation between cities and suburbs; they also account for some of the growth in the average suburban share of total segregation. As more of the population, white as well as minority, comes to live in the suburbs, the suburbs account for a larger share of total metropolitan segregation.

Suburbanization in itself, however, does not explain all of the increase in the share of segregation due to segregation between districts. Increases in between-district segregation are probably caused, at least in part, by persistent inequality in access to housing markets, particularly suburban housing markets. Reardon and Yun (1999) have shown that increases in white/minority suburban-school segregation are greatest in suburban areas with rapid minority growth, and that the bulk of the change in segregation is due to increases in between-district segregation in the suburbs. Moreover, the fact that average segregation levels among black, Hispanic, and Asian students in the suburbs are declining rapidly while segregation between white students and those from other groups in the suburbs is increasing suggests that minority suburbanization during the period 1989–1995 tended to concentrate all minority groups in a small number of suburban schools and districts.

CONCLUSION

Several key findings stand out from our results. First, we noted that, on average, 80% of multiracial public-school segregation in the 217 metropolitan areas is due to segregation between whites and members of other groups; 20% is due to segregation among the other groups. This implies that we can make a greater overall impact on multiracial segregation by addressing the segregation between white and minority students. In particular, an average of 23% of the total multiracial segregation is due to white/minority segregation within school districts. Thus almost one-quarter of existing metro-

13. Because the average of a product does not, in general, equal the product of the averages, the average changes in the three factors do not multiply to equal the average change in the component. Nonetheless, the figures in Table 5 indicate the relative directions and magnitudes of change in the three factors; this information is sufficient for our purposes.

politan-area school segregation could be eliminated by traditional within-district desegregation remedies that focus on integrating white and minority students. Many desegregation remedies of this type are being dismantled, or already have been dismantled; yet because within-district segregation between white and nonwhite students remains such a substantial component of metropolitan-area school segregation, the retreat from active desegregation efforts may be premature.

Having said that, we also point out that traditional within-district segregation remedies can affect only one-third of the total segregation in metropolitan areas. If we eliminated all within-district segregation in every district in each metropolitan area, we would reduce the total segregation of metropolitan areas, on average, by only 32%. The remaining two-thirds of segregation is due to between-district segregation resulting largely from residential patterns. These patterns must be addressed through policies aimed at promoting equal access to housing markets, particularly in the suburbs, where between-district residential segregation is increasing most rapidly. In fact, one of the most troubling findings of this paper is that the fastest-growing components of metropolitan segregation are the between-district components. Between-district desegregation remedies have been all but blocked by the Supreme Court's *Milliken I* decision (*Milliken, Governor of Michigan, et al. v. Bradley et al.* 1974), and housing desegregation efforts are largely untried; therefore residential segregation remains a major barrier to metropolitan school desegregation. This is well known, of course, but our study documents the magnitude of between-district segregation and shows that in fact it is increasing, even as within-district segregation is decreasing.

The descriptive statistics reported here are averages over 217 metropolitan areas; as such, they mask a great deal of variation among metropolitan areas in the composition, geography, and changes in school segregation. It would be useful to follow these aggregate descriptive data with careful analysis of the relationships between changes in the various components of segregation and the structural characteristics of metropolitan areas and metropolitan-area school systems.

Reardon and Yun (1999) have shown that much of this variation in the levels of white/minority suburban segregation is related to the size, region, and racial composition of metropolitan areas. They also show that levels of segregation are related to levels of fragmentation among suburban school districts: Levels of segregation tend to be higher in metropolitan areas made up of many small school districts than in areas with fewer and larger districts.

The work by Reardon and Yun is limited to suburban areas, however, and uses indices of segregation that compare only two races at a time. It would be useful to examine in greater detail the relationships among metropolitan-area characteristics and the composition, geography, and trends in multiracial metropolitan-area school segregation. If we can identify the conditions that lead to declining segregation, particularly to declining between-district segregation, such work would be most useful in designing policies to reduce school segregation and create more equal access to all schools.

In this paper we have demonstrated the use of a set of methodological tools based on Theil's entropy index of segregation (H), and we have shown how these tools can be used to provide a detailed description of multiracial segregation in a metropolitan context. The decomposition of H thus makes possible a nuanced analysis of school segregation, allowing us to disentangle the competing factors that shape trends in metropolitan-area school segregation: changes in segregation levels both between and among groups and between and within districts, trends of suburbanization, and differential growth rates of different racial groups.

Without this type of analysis, the subtleties described here would have been lost in the story of aggregate trends. Using this decomposition, we have shown that the apparent stability in average levels of metropolitan-area multiracial segregation masks several divergent trends: increases across metropolitan areas in segregation between white students and students from groups other than white; decreasing segregation among black, Hispanic, and Asian students; and a shift of enrollment share (particularly white enrollment share) from central cities to suburbs. The net result of these trends is that between-district white/minority school segregation, particularly segregation between city and suburban districts and among suburban districts, is the largest and fastest-growing component of total multiracial metropolitan school segregation.

APPENDIX: DECOMPOSITION OF *H*

All of the decompositions of H shown in Eqs. (4)–(7) can be proved by simple, if somewhat tedious, algebraic manipulation. A more elegant and more general proof, however, is given here. This proof relies on the relationship between H and G^2, the likelihood-ratio chi-squared statistic, a decomposable measure of association.

Consider a two-way classification table showing racial enrollments by school, where N_{ri} is the number of students of race r in school i. Denote the percentage of students in school i of race r as $Q_{ri} = N_{ri}/N_{.i}$, and the percentage of students of race r in the system as $Q_r = N_{r.}/N_{..}$. One way of considering segregation is as a measure of the strength of association between two categorical variables: race and school. The absence of an association means that students of a given race are no more likely to attend one school than another; that is, that $Q_{ri} = Q_r$ for all r and i.

	School						
Race	S_1	S_2	.	.	.	S_k	Total
R_1	N_{11}	N_{12}	.	.	.	N_{1k}	$N_{1.}$
R_2	N_{21}	N_{22}	.	.	.	N_{2k}	$N_{2.}$
.	.	.	.			.	.
.	.	.		.		.	.
.	.	.			.	.	.
R_n	N_{n1}	.	.	.	.	N_{nk}	$N_{n.}$
Total	$N_{.1}$	$N_{.2}$	.	.	.	$N_{.k}$	$N_{..}$

One measure of association in a two-way classification table is the likelihood-ratio chi-squared statistic G^2, defined as follows (Agresti 1990):

$$G^2 = 2\sum_{r=1}^{n}\sum_{i=1}^{k} N_{ri} \ln\left(\frac{N_{ri} \times N_{..}}{N_{r.} \times N_{.i}}\right).$$

We can rewrite G^2 as

$$G^2 = 2N_{..}\left[\sum_{r=1}^{n}\frac{N_{r.}}{N_{..}}\ln\left(\frac{N_{..}}{N_{r.}}\right) - \sum_{i=1}^{k}\frac{N_{.i}}{N_{..}}\left(\sum_{r=1}^{n}\frac{N_{ri}}{N_{.i}}\ln\left(\frac{N_{.i}}{N_{ri}}\right)\right)\right].$$

Noting, however, that $N_{..} = T$, the total enrollment of all schools, and that $N_{.i} = t_i$, the enrollment of school i, we obtain

$$G^2 = 2T\left[\sum_{r=1}^{n} Q_r \ln\left(\frac{1}{Q_r}\right) - \sum_{i=1}^{k}\frac{t_i}{T}\left(\sum_{r=1}^{n} Q_{ri}\ln\left(\frac{1}{Q_{ri}}\right)\right)\right].$$

Now, using the definitions of entropy and segregation from Eqs. (1) and (2), we obtain

$$\begin{aligned} G^2 &= 2T\left[E - \sum_{i=1}^{k}\frac{t_i}{T}(E_i)\right] \\ &= 2T\sum_{i=1}^{k}\frac{t_i}{T}(E - E_i) \\ &= 2TEH. \end{aligned}$$

Thus H is related to the likelihood-ratio chi-squared statistic in a simple manner. G^2, however, is a decomposable measure of association, which means that the association between the two variables can be partitioned into associations among and between subtables of the two-way classification table shown above. Thus, if we have a partition P of the table, we know that

$$G^2 = \sum_{p \in P} G_p^2,$$

where G_p^2 is the likelihood-ratio chi-squared statistic for subtable p of the partition P. From this we obtain Eq. (3):

$$\begin{aligned} H &= \frac{G^2}{2TE} \\ &= \frac{\sum_{p\in P} G_p^2}{2TE} \\ &= \frac{\sum_{p\in P} 2T_pE_pH_p}{2TE} \\ &= \sum_{p\in P}\left(\frac{T_p}{T}\right)\left(\frac{E_p}{E}\right)H_p. \end{aligned} \tag{3}$$

This result demonstrates that H can be decomposed into a sum of components, where each component is the product of a term indicating the portion of the total number of persons that are in the relevant subtable, a term indicating the entropy of the subtable population relative to the population as a whole, and a term indicating the segregation level within the subtable.

Two simple decompositions are the decomposition into between- and within-district components and into between- and within-groups components. These correspond respectively to partitioning the association table above into subtables by breaking it between columns and by breaking it between rows. Each is shown below.

Special Case: Decomposition of *H* Into Between- and Among-Groups Components

In the case of the decomposition into between- and within-group components shown in Eq. (4), we consider the table partitioned into two subtables. One contains only two rows: white student counts and combined black, Hispanic, and Asian student counts; the other contains three rows: black, Hispanic, and Asian. Together these constitute a full partition of the race-by-school association table. From Eq. (3), we have the following (where groups separated by a backslash symbol are considered separate groups in the calculation of entropy and segregation, and groups not separated by a backslash are combined before the calculation of entropy and/or segregation):

$$\begin{aligned} H_{W\backslash B\backslash H\backslash A} &= \left(\frac{T_{W\backslash BHA}}{T_{W\backslash B\backslash H\backslash A}}\right)\left(\frac{E_{W\backslash BHA}}{E_{W\backslash B\backslash H\backslash A}}\right)H_{W\backslash BHA} \\ &\quad + \left(\frac{T_{B\backslash H\backslash A}}{T_{W\backslash B\backslash H\backslash A}}\right)\left(\frac{E_{B\backslash H\backslash A}}{E_{W\backslash B\backslash H\backslash A}}\right)H_{B\backslash H\backslash A}. \end{aligned}$$

But $\left(\frac{T_{W\backslash BHA}}{T_{W\backslash B\backslash H\backslash A}}\right) = 1$ and $\left(\frac{T_{B\backslash H\backslash A}}{T_{W\backslash B\backslash H\backslash A}}\right) = Q_{BHA}$, so we obtain Eq. (4):

$$H_{W\backslash B\backslash H\backslash A} = \left(\frac{E_{W\backslash BHA}}{E_{W\backslash B\backslash H\backslash A}}\right)H_{W\backslash BHA} + Q_{BHA}\left(\frac{E_{B\backslash H\backslash A}}{E_{W\backslash B\backslash H\backslash A}}\right)H_{B\backslash H\backslash A}. \tag{4}$$

Special Case: Decomposition of *H* Into Between- and Within-District Components

In the case of the decomposition into between- and within-district components, a partition P has $k + 1$ elements if there are k districts (k within-district components and one between-district component). The k within-district components each have the form

$$\left(\frac{T_d}{T}\right)\left(\frac{E_d}{E}\right)H_d,$$

where d indexes districts. The between-district component is simply H_D—the level of segregation between all districts—because the between-district subtable has the same total enrollment ($T_D/T = 1$) and the same entropy ($E_D/E = 1$ because the row totals are unchanged by aggregating columns). Thus we obtain Eq. (5):

$$H = H_D + \sum_{d=1}^{k}\frac{T_dE_d}{TE}H_d. \tag{5}$$

Eqs. (6) and (7) are derived similarly.

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