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The Geography of Racial/Ethnic Test Score Gaps

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ABSTRACT

We estimate racial/ethnic achievement gaps in several hundred metropolitan areas and several thousand school districts in the United States using the results of roughly 200 million standardized math and reading tests administered to public school students from 2009-2013. We show that achievement gaps vary substantially, ranging from nearly 0 in some places to larger than 1.2 standard deviations in others. Economic, demographic, segregation and schooling characteristics explain roughly three-quarters of the geographic variation in these gaps. The strongest correlates of achievement gaps are local racial/ethnic differences in parental income, local average parental education levels, and patterns of racial/ethnic segregation, consistent with a theoretical model in which family socioeconomic factors affect educational opportunity partly though residential and school segregation patterns.

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The Geography of Racial/Ethnic Test Score Gaps

Abstract

We estimate racial/ethnic achievement gaps in several hundred metropolitan areas and several thousand school districts in the United States using the results of roughly 200 million standardized math and reading tests administered to public school students from 2009-2013. We show that achievement gaps vary substantially, ranging from nearly 0 in some places to larger than 1.2 standard deviations in others. Economic, demographic, segregation and schooling characteristics explain roughly three-quarters of the geographic variation in these gaps. The strongest correlates of achievement gaps are local racial/ethnic differences in parental income, local average parental education levels, and patterns of racial/ethnic segregation, consistent with a theoretical model in which family socioeconomic factors affect educational opportunity partly though residential and school segregation patterns.

The Geography of Racial/Ethnic Test Score Gaps

Introduction

Racial and ethnic disparities in children's academic performance are a stubborn feature of the US educational landscape. Though these achievement gaps are substantially smaller than they were 40 years ago, they remain quite large, on the order of two-thirds to three-quarters of a standard deviation (Neal 2006; Reardon, Robinson-Cimpian and Weathers 2015). They are large when children enter kindergarten and remain large through high school (Fryer and Levitt 2004; Hemphill, Vanneman and Rahman 2011; Phillips, Crouse and Ralph 1998; Reardon and Galindo 2009; Vanneman et al. 2009).

The size and trends of these gaps vary among states (Hemphill, Vanneman and Rahman 2011; Reardon 2015; Vanneman et al. 2009), though in no state are they near zero. National- and state-level patterns, however, may mask considerable variation in academic achievement patterns at smaller geographic scales. Metropolitan statistical areas (MSAs) and counties, for example, vary widely in demographic composition, patterns of racial socioeconomic inequality and racial segregation, and in the structure of their schooling systems. The roughly 14,000 school districts in the U.S. likewise differ substantially in their demographics, patterns of inequality and segregation, and educational resources. They also each have autonomy over some—but not all—important features of the schooling system, including their curricula, their student and teacher assignment policies, and how resources are distributed among and within schools. These demographic and institutional factors may lead to significant variation in the size of achievement gaps among both metropolitan areas and school districts.

In this paper, we provide a detailed descriptive analysis of the patterns of white-black and white-Hispanic academic achievement gaps across US metropolitan areas and school districts. We use new data to estimate achievement gaps in almost every metropolitan area and school district in the US with a significant population of black or Hispanic students. The precision and detail of these estimates—which are based on

the results of roughly 200 million standardized math and reading tests administered to elementary and middle school students from 2009-2013—far surpasses that of any previously available data. Using these estimates, we first describe the geographic patterns of racial/ethnic achievement gaps among metropolitan areas and school districts in the US. We then examine the extent to which these gaps are correlated—in both bivariate and multivariate models—with socioeconomic characteristics of the white, black, and Hispanic populations, with patterns of residential and school segregation, and with local features of the educational system.

The data indicate that racial/ethnic achievement gaps average roughly 0.5 to 0.7 standard deviations among school districts and metropolitan areas. There is substantial geographic variation in the magnitude of achievement gaps, ranging from nearly 0 in some places to larger than 1.2 standard deviations in others. A vector of economic, demographic, segregation and policy variables explains between 64 and 82 percent of the geographic variation in these gaps. The strongest correlates of achievement gaps are racial/ethnic differences in parental education, racial/ethnic segregation, the overall level of parental education. After adjusting for variation among places in racial socioeconomic inequality and segregation, many school districts and metropolitan areas have larger or smaller achievement gaps than predicted, suggesting that other forces are at work as well.

The purpose of this paper is not to estimate the causal effect of any one particular feature of children's environments or of schools on achievement gaps, but rather to ask a set of descriptive questions whose answers may help to build intuition and generate hypotheses regarding the causes of the observed achievement gaps. Think of this as a necessary, but not sufficient, analysis for understanding the causes of academic achievement gaps—providing a detailed description of the "stylized facts" regarding racial/ethnic achievement gaps.

Background and Theoretical Framework

One of the central sets of questions in the sociology of education for the last 50 years—since the publication of the Coleman Report (Coleman, et al., 1966)—concerns the primary causes of racial and ethnic achievement gaps and disparities in educational outcomes more generally. To what extent are these disparities the result of racial/ethnic differences in socioeconomic family background and circumstances, and to what extent are they the result of racial/ethnic differences in school quality? Put differently, to what extent should racial/ethnic disparities in educational outcomes be attributed to institutional features of the US educational system—features that may be malleable through changes in organizational, institutional, and policy features of schooling—and to what extent should they be attributed to factors outside the school system's control, such as racial/ethnic disparities in socioeconomic family and neighborhood conditions?

Framed this way—as if inequalities inside the school system are distinct from inequalities outside of schools—the question implies a false dichotomy. Differences in socioeconomic conditions are not fully separable from disparities in educational conditions. Socioeconomic inequality may lead to inequality between and within schools, as communities with greater resources are able to better fund their local schools (in taxes and other ways). Parents in such communities may also use their greater social capital to secure better educational opportunities (better teachers, smaller classrooms, for example) for their children than less advantaged children within the same schools. Moreover, school systems react to social inequalities in ways that may reduce or exacerbate these inequalities. In most states, for example, when federal, state and local revenues are added up, per pupil expenditures are greater, on average, in districts enrolling large proportions of low-income students than in districts enrolling few poor students. This may attenuate differences in out-of-school opportunities (Aud et al. 2010; National Center for Education Statistics 2012). Conversely, school systems may also reinforce social inequalities by segregating children from low-income families into less demanding academic programs and/or into high poverty schools or by providing fewer resources to the classrooms and schools that enroll low-income students.

[Figure 1 here]

Figure 1 illustrates—in highly stylized form—a subset of the complex relationships between schooling and non-schooling factors that might affect achievement gaps. On the left of the figure are two primary categories of distal influences on achievement gaps. First are racial family socioeconomic disparities (i.e., racial differences in family income, parental education, and other forms of social and economic resources). These disparities are quite large in the U.S. For example, the median incomes of black and Hispanic families are 38% and 36% lower, respectively, than that of white, non-Hispanic families;[1] median black and Hispanic household wealth are less than 10% as large as median white wealth (Sullivan et al. 2015; Wolff 2014); and only 22% of black adults and 15% of Hispanic adults hold a bachelor's degree, compared to 36% of white adults.[2] Second are education policies and structures (such as school finance policies, student assignment policies, and the like); we discuss these at more length below. Both of these factors may lead to academic achievement gaps through multiple pathways.

On the center right of the figure are four categories of potential proximal sources of academic achievement gaps: racial differences in children's home environments; racial differences in children's neighborhood contexts (distinct from home and school environments); between-school racial differences in schooling experiences and opportunities; and within-school racial differences in schooling experiences and opportunities. Each of these might encompass many potential mechanisms.

First, racial differences in children's home environments include differences in opportunities for learning at home—differences in the amount of time parents have to read to their children; in children's access to computers, libraries, and museums; in parental investments in tutoring and other educational activities; in parental human and social capital; and differences in parental stress and depression. All of these experiences are affected by family socioeconomic status; high-income and highly-educated parents have, on

[1] http://www2.census.gov/library/publications/2011/compendia/statab/131ed/tables/12s0697.pdf; retrieved January 7, 2017.
[2] See Table 3 at http://www.census.gov/hhes/socdemo/education/data/cps/2014/tables.html; retrieved September 3, 2015.

average, more resources to foster and support their children's academic skills outside of school (Bassok et al. 2016; Bradley et al. 2001; Chin and Phillips 2004; Lareau 2003; Phillips 2011). To the extent that these affect students' academic achievement, it follows that racial differences in socioeconomic status would then lead to racial differences in academic achievement, net of other factors. Recent studies indicate this is the case; income affects children's academic achievement (Dahl and Lochner 2012; Duncan, Morris and Rodrigues 2011), though the exact pathways through which these effects operate are not clear. Moreover, racial differences in family socioeconomic conditions explain a large portion of racial achievement gaps present when children enter kindergarten (Fryer and Levitt 2004; Fryer and Levitt 2006; Reardon and Galindo 2009; Rothstein and Wozny 2013). There is less clarity about whether racial achievement gaps grow in ways unrelated to socioeconomic background differences as children progress through school.

Second, racial differences in family economic circumstances affect residential segregation patterns (though housing discrimination and racial preferences shape segregation patterns as well; for a review, see Lareau and Goyette 2014). This means that black and Hispanic children live, on average, in poorer neighborhoods than white children. In fact, black and Hispanic children live in much poorer neighborhoods, relative to white children, than would be expected based on their family income (Logan 2011; Pattillo 2013; Reardon, Fox and Townsend 2015; Sharkey 2014). Poorer neighborhoods typically have higher violent crime rates (Sampson, Raudenbush and Earls 1997) and weaker non-school social institutions (such as availability of high-quality child care and pre-school programs; safe parks and playgrounds; and constructive after-school activities, such as clubs and sports teams (Small 2006). These and other factors have long been hypothesized to affect schooling outcomes (Jencks and Mayer 1990; Leventhal and Brooks-Gunn 2000; Sampson 1998), and new evidence from the MTO experiment and other studies confirms that neighborhood conditions affect educational attainment (Burdick-Will et al. 2011; Chetty, Hendren and Katz 2015; Sampson, Sharkey and Raudenbush 2008; Sharkey 2010; Wodtke, Harding and Elwert 2011). This implies that residential segregation patterns may lead to disparities in educational outcomes (see, for example, Ananat

2009; Card and Rothstein 2007; Cutler and Glaeser 1997).

While the top two boxes at the right of Figure 1 describe potential out-of-school influences on racial achievement gaps, the bottom two describe potential school-related influences. These are divided into within- and between-school factors. The key to both is that achievement gaps may be caused, in part, by racial differences in school experiences and opportunities. These differences in experiences and opportunities may result from students attending different schools (between-school segregation) or they may occur even among students attending the same school. Between-school segregation is a necessary (though not sufficient) condition for between-school differences in educational experiences and opportunities to contribute to achievement gaps; if black, Hispanic, and white students are equally represented in each school, then each group will experience the same average level of (and the same variation in) school quality. In the presence of segregation, however, if school racial composition is correlated with school resources (which affect the ability to attract and retain skilled teachers; teacher/student ratios; the quality of instructional materials, equipment, and facilities; the availability of support staff; and less tangible factors like school climate), then black and Hispanic students will, on average, experience fewer opportunities for learning than their white peers. Although the effects of school segregation are difficult to estimate, the best available research suggests that school segregation tends to widen racial educational disparities in achievement and educational attainment, as well as adult income (Ashenfelter, Collins and Yoon 2005; Card and Rothstein 2007; Guryan 2004; Johnson 2011; Reardon 2016).

Historically, fewer resources were available to school districts serving large proportions of black, Hispanic, and poor children compared to those serving predominantly white and middle-class students; however, this pattern has been eliminated or reversed in many states. As a result of state school financing reforms enacted by state legislatures or ordered by courts, per-pupil revenues are now modestly *positively* correlated with districts' enrollment rates of poor and minority students within most states (Cornman 2015). This means that in most states—conventional wisdom notwithstanding—poor and minority students are

enrolled in districts with higher per-pupil spending than white and middle-class students, although there are notable exceptions. Cost-adjustments can affect this inference, as high poverty school districts have greater costs than low poverty districts (Bifulco 2005). Given recent evidence indicating that school spending positively affects student achievement and graduation rates (Jackson, Johnson and Persico 2016; Lafortune, Rothstein and Schanzenbach 2016), this suggests that school policies affecting the distribution of resources among school districts may have important effects on achievement gaps.

Despite the fact that in some states school districts serving predominantly poor students spend more per pupil than those serving higher-income students, low-income and non-white students are, on average, more likely to have inexperienced teachers and greater teacher turnover (Clotfelter, Ladd and Vigdor 2005; Lankford, Loeb and Wycoff 2002; Scafidi, Sjoquist and Stinebrickner 2007), some of which may be due to the fact that high poverty districts must pay teachers more to attract them (Clotfelter et al. 2008). Higher salaries are thought to be necessary because teachers value working conditions that tend to be correlated with the demographic composition of schools such as safety, proximity of the school to their place or residence, leadership stability, availability of support staff (Boyd et al. 2011; Boyd et al. 2005a; Boyd et al. 2005b).

The reason that the influence of out-of-school family socioeconomic disparities cannot be cleanly distinguished from the role of schooling policies and practices in producing achievement gaps is that school segregation is shaped by both factors (as well as by other forces, including housing policy, housing discrimination and preferences, and private school enrollment patterns). Moreover, the extent to which school segregation is linked to between-school racial disparities is dependent on educational policies and practices. If education policy were successful at achieving the "separate but equal" standard articulated in *Plessy v. Ferguson*, school segregation would not be linked to between-school differences in the quality of educational experiences. While there is no evidence that this has ever been, or is likely to be, achieved, education policy may nonetheless moderate the relationship between segregation and unequal school

quality. Policies that provide extra resources to schools serving large proportions of poor and minority students, for example, may weaken the link between school racial and socioeconomic composition and school quality. The effect of such policies is signified by the dashed line in Figure 1.

The processes sketched in Figure 1 suggest that the factors that produce academic achievement disparities cannot be neatly separated into inequalities in family socioeconomic background and inequalities in schooling experiences. Rather there are three sets of forces at work—1) differences in children's home and neighborhood environments that are due to family socioeconomic resources; 2) differences in children's schooling experiences that are due to education policy and practice rather than family socioeconomic differences; and 3) differences in children's schooling experiences that are jointly produced by racial disparities in family resources—which lead to school segregation—and by educational policies and practices which more or less tightly link school segregation to patterns of unequal school quality.

Figure 1 highlights how differences between racial/ethnic groups along a variety of dimensions contribute to achievement gaps. However, these are not necessarily the only factors at play. For example, within-school racial differences in experiences and opportunities to learn may also play a role. Within any school, teachers' skills vary, as do the curricula, instructional practices, and peer composition of different classrooms. If these differences are patterned by student race—because of tracking, differences in teacher expectations, differences in parents' effectiveness at advocating for their children, or other reasons—then these within-school racial differences in educational opportunities and experiences may lead to achievement disparities.

In addition, although Figure 1 highlights racial disparities in socioeconomic, neighborhood, and school conditions as contributors to racial achievement gaps, achievement gaps may also co-vary with average socioeconomic conditions. Some existing scholarship notes that the white-black achievement gap is often large even in relatively affluent, racially diverse communities (Lewis and Diamond 2015; Ogbu 2003), and suggests that this may be due to processes within schools that provide more opportunities to white

students than minority students, even in contexts of relative affluence. It is not clear, however, whether the achievement gaps in such communities are larger or smaller than in poorer communities with similar levels of racial socioeconomic disparity and segregation. For example, racial socioeconomic disparities and patterns of segregation may affect educational opportunities less in contexts of relative advantage than do comparable disparities in disadvantaged communities. Resource and context differences may be more salient when there are few resources to go around. On the other hand, given the sometimes-competitive focus on academic success in affluent communities, racial socioeconomic disparities may be particularly salient, as economic and social capital may matter more in such contexts. Hanushek and Rivkin (2009), for example, show that school segregation appears most harmful to high-achieving minority students, possibly because differences in access to the best schools particularly limits high-achieving students' educational opportunities. This is consistent with a substantial body of ethnographic and social psychological work that illustrates how subtle structural and exclusionary processes may limit minority students' opportunities and advantage white students, even in (or perhaps particularly in) schools enrolling largely middle- and high-income white and minority students (Carter 2012; Lewis and Diamond 2015; Ogbu 2003).

Finally, it is worth noting that Figure 1 describes a set of uni-directional relationships between family and educational effects on achievement gaps. Racial family socioeconomic disparities and education policies affect achievement gaps, in this stylized model, but not vice-versa. However, over a longer time period, there are certainly processes that work in the other direction as well. Racial achievement gaps in one generation shape racial disparities in the next generation's parental educational attainment and family income (Carneiro, Heckman and Masterov 2003; Neal and Johnson 1996) and public policy reactions (such as school desegregation or changes in school funding policies) to persistent racial achievement disparities may shape children's schooling environments. A full model of the dynamic associations among socioeconomic inequality, schooling conditions, and achievement gaps would take these feedback processes into account, but that is beyond the scope of our analyses here.

The Geographic Scale of Achievement Gaps

The conceptual model illustrated in Figure 1 suggests that racial achievement gaps are dependent partly on local racial socioeconomic conditions and disparities, segregation patterns, and school policies, practices, and conditions. To the extent that these factors vary geographically, our model predicts corresponding variation in achievement gaps. To date, however, we have little systematic evidence regarding the geographic variation in these gaps.

The best evidence on racial/ethnic achievement gaps in the US comes from the National Assessment of Educational Progress (NAEP), a set of reading and math assessments that have been administered to large, national representative samples of students since 1971. Since 1990, NAEP assessments have also been administered to state-representative samples of students. The NAEP assessments indicate that the white-black achievement reading and math gaps were both over 1 standard deviation in the 1970s; by 2012, those gaps had shrunk to roughly 0.60 and 0.80 standard deviations, respectively. The white-Hispanic gaps in reading and math have historically been slightly smaller than white-black gaps, but have followed a similar trend over the last 4 decades, and now are roughly 0.50 and 0.60 standard deviations in reading and math, respectively (National Center for Education Statistics 2013; Reardon 2015; Reardon, Robinson-Cimpian and Weathers 2015).

At the state level, most states' white-black achievement gaps in the last decade are between 0.75 and 1.10 standard deviations, though in states with small black populations, the gaps are generally smaller, in some cases less than 0.50 standard deviations. State white-Hispanic gaps generally range from 0.50 to 1.0 standard deviations in this same time period. On average, state achievement gaps have narrowed slightly in the last two decades, though this varies among states (Hemphill, Vanneman and Rahman 2011; Reardon 2015; Vanneman et al. 2009). Reardon (2015) shows that state-level achievement gaps are correlated with state racial socioeconomic disparities: achievement gaps are largest, on average, in states with large racial

differences in family income, poverty rates, educational attainment, and unemployment rates.

Evidence about the national and state-level patterns and trends of achievement gaps are useful as descriptors of overall patterns of inequality in educational outcomes in the U.S. Nonetheless, they reveal little about local patterns of racial inequality and are, by themselves, relatively uninformative regarding the processes that produce and sustain achievement gaps. Large national and state-level achievement gaps do not necessarily imply that gaps are large in most school districts. If most black and Hispanic students are in school districts where all students—white students included—perform poorly on standardized tests, and most white students are in school districts where all students—including black and Hispanic students—perform well, then most students would encounter little racial achievement inequality in their own district, even while state and national achievement gaps are large.

Such patterns would suggest that the forces producing achievement gaps do not operate primarily *within* schools and districts, but *between* school districts. The primary candidates for between-district mechanisms are residential segregation and inequality among school districts in resources and quality. Conversely, if gaps are large within individual school districts, between-district forces cannot fully account for achievement gaps; instead, within-district racial socioeconomic inequality, between-school segregation, and the unequal distribution of resources and opportunities to learn within schools are the likely suspects.

Given the potential importance of variation in local conditions in shaping achievement gaps, our goal in this paper is to provide detailed descriptions of 1) the size and variation in racial/ethnic achievement gaps among both school districts and metropolitan areas; and 2) the associations of these gaps with a set of measures of family socioeconomic conditions, segregation patterns, and school policies and characteristics. We focus on both school districts and metropolitan areas for complementary reasons.

School districts are a key organizational unit of the U.S. public school system. They have a large—though not complete—degree of autonomy over curricula, instruction, student assignment, teacher hiring, and the distribution of resources among schools. Thus, there is reason to think that school districts may vary

substantially in practices that affect between- and within-school disparities in educational opportunities. Districts are also organizational units with clear geographic boundaries and relatively well-known "brands" (based on easily observable features, such as average test scores and student body composition), which means that families with sufficient resources can choose to live in the most desirable districts. This leads to relatively high levels of socioeconomic variation among school districts (Owens 2016; Owens, Reardon and Jencks 2016). Finally, districts vary enormously in size; in large districts, there is far more possibility of between-school segregation and between-school differences in school quality and opportunities. These factors suggest that the conditions that lead to achievement gaps may differ markedly among school districts.

A focus on school districts may obscure patterns of inequality evident at larger geographic scales, however. Because housing prices differ markedly among school districts, socioeconomic and racial differences among districts may be larger than those within districts. For example, roughly two-thirds of all school segregation is due to between-district patterns of segregation (Reardon, Yun and Eitle 2000; Stroub and Richards 2013). Racial socioeconomic disparities are likewise smaller within school districts than in the population at large. We examine achievement gaps within metropolitan areas in order to account for these between-district sorting processes. Although metropolitan areas are not part of the formal organizational structure of the public schooling system, they encompass much of the relevant ecosystem for studying residential and school segregation, in part because most of the residential segregation relevant to inequality occurs within metropolitan areas, not between them (Cutler and Glaeser 1997). As a result, a great deal of social science research treats metropolitan areas as a key geographic unit for studying the patterns and consequences of segregation (see, for example, Card and Rothstein 2007; Logan, Oakley and Stowell 2008; Owens 2015; Reardon, Yun and Eitle 2000). We follow this tradition in including metropolitan area achievement gaps in our analyses.

Estimating School District and Metropolitan Area Racial Achievement Gaps

Our analysis relies on the construction of reliable and comparable measures of racial achievement gaps at the school district and metropolitan area levels. To construct these measures, we use a newly available source of data, containing aggregated data on the scores of over 200 million tests taken by roughly 40 million 3rd-8th grade students in U.S. public schools from 2009 to 2013. Because the test scores available are reported in ordered proficiency categories rather than continuous scale scores, we use methods for estimating between-group differences from coarsened data (Ho and Reardon 2012; Reardon and Ho 2015). As these data and methods have not been used before to construct and compare racial achievement gaps, the data and methods are described below in detail.

Note that the analyses here focus explicitly on local achievement *gaps*—within-district or -MSA differences in academic performance between white students and black or Hispanic students. As a result, the analyses do not indicate to what extent variation in achievement gaps across the U.S. is due to variation in the academic performance of particular ethnic groups.

Achievement Data Source and Geographic Coverage

We use data from the federal ED*Facts* data collection system which were provided to us by the National Center for Education Statistics under a restricted data use license. The data include, for each public school in the United States, counts of students scoring in each of several academic proficiency levels (often labeled something like "Below Basic," "Basic," "Proficient," and "Advanced"). These counts are disaggregated by race (we use counts of non-Hispanic white, non-Hispanic Black, and Hispanic students in this paper), grade (grades 3-8), test subject (math and ELA), and year (school years 2008-09 through 2012-13). We aggregate the school-level counts to the district level. We combine the proficiency counts of charter schools with those of the public school district in which they are formally chartered or, if not chartered by a district, in the district in which they are physically located. Thus, a "school district" is conceptualized as a geographic

catchment area that includes students in all local charter schools as well as in traditional public schools. Virtual schools—online schools that do not enroll students from any well-defined geographic area—are dropped from the sample.

For metropolitan areas, we aggregate data from all public schools and charter schools within a given metropolitan area. Because districts in different states use different achievement tests, proficiency categories in different states are not comparable, so we cannot construct aggregated data for metropolitan areas that cross state boundaries. Instead, for the 45 (out of 384) metropolitan areas that cross state lines, we include only the portion of the metropolitan area that is in the state containing the largest number of the metropolitan area's student population.[3]

There are 384 metropolitan areas and roughly 12,200 school districts serving grades 3-8 in the United States. The Ed*Facts* data span 6 grades, 2 subjects, and 5 years, making a total of roughly 732,000 possible district-grade-subject-year combinations and 23,000 possible metropolitan area-grade-subject-year combinations. In each of these cells, we compute both the white-black and white-Hispanic achievement gap. We exclude cells with fewer than 20 white and/or 20 black students because achievement gaps in such cells cannot be estimated with sufficient precision to be useful. After excluding cells with too few students, we estimate white-black achievement gaps in at least one grade-year for 2,878 and 2,854 districts in ELA and math, respectively, and for 378 metropolitan areas. White-Hispanic achievement gaps are available in at least one grade-year for 3,632 and 3,642 districts, and 377 metropolitan areas, in ELA and math respectively. The number of districts that have at least one achievement gap estimate in either subject is 2,899 (for white-black gaps) or 3,689 (for white-Hispanic gaps); For metropolitan areas, the corresponding numbers are 378 and 377, respectively. Table 1 includes additional information on achievement gap availability.[4]

[3] Appendix Table A1 shows results from bivariate correlations between a subset of explanatory variables (described in data section below) and white-black or white-Hispanic achievement gaps. These correlations are estimated for three different samples of metropolitan statistical areas. As shown, regardless of the MSA sample included, the sign, significance and magnitude of the correlation coefficients is largely unchanged.

[4] The complete data set of estimated achievement gaps is available from the authors.

[Table 1 here]

Given the 5 years, 6 grades, and 2 subjects for which achievement data are available, up to 60 gaps can be estimated for a district or metropolitan area. On average, in the districts and metropolitan areas in our sample (those for which at least one gap is available), the mean number of estimated gaps available is 54 (for white-black and -Hispanic gaps in metropolitan areas) and 44 and 40 (for white-black and -Hispanic gaps in districts). The reason that some districts and metropolitan areas do not have the expected 60 estimated gaps is almost entirely due to the fact that some districts have fewer than 20 minority or white students in some grade-year-subject cells but not others. Because district enrollments are smaller than metropolitan area enrollments, cell sizes fall below the 20-student threshold more commonly in districts than in metropolitan areas. In addition, we cannot compute achievement gaps in several states in particular years or grades because of insufficient data in the Ed*Facts* system or because states did not use a common test across all districts.[5] In total, at the district level, there are 125,380 estimated white-black achievement gaps (in ELA or math) and 146,494 white-Hispanic achievement gaps; at the MSA level, there are 21,507 white-black and 20,520 white-Hispanic achievement gap estimates.

Although the analytic sample includes estimated achievement gaps from less than a quarter of all public school districts in the US, the excluded districts enroll relatively few minority students. Most black (93%) and Hispanic (92-93%) public school students in grades 3-8 in the US are enrolled in districts included in the analytic sample. That so many minority students are enrolled in such a small subset of school districts simply reflects the spatial concentration of minority students in the United States. The metropolitan area analytic sample includes 96% of black and 98% of Hispanic public school students in grades 3-8 that attend public schools in metropolitan areas; the remaining black and Hispanic students are in the excluded portions

[5] We cannot compute achievement gaps in Florida, Colorado, and Wyoming in several years because those states did not report sufficient data to the ED*Facts* system in all years (i.e., in some years they reported test scores in only two proficiency categories, too few to compute V). We also do not compute achievement gaps for California and Virginia in 7th and 8th grade math in all school years or for Nebraska in all grades in ELA in the 2008-09 school year and in all grades in math in the 2008-09 and 2009-10 school years because districts administered different tests to students during these subjects, grades, and years.

of one of the 45 metropolitan areas that cross state lines.

Achievement Gap Measure

Every state uses different standardized tests; within a state, these tests vary across subjects, grades, and often across years. Moreover, the ED*Facts* data do not include group-specific means and standard deviations, but instead include counts of students in a set of ordered proficiency categories whose definitions vary across states, grades, subjects, and sometimes years. Because these definitions vary, simple racial differences in proficiency rates do not provide measures of achievement gaps that are comparable across states, subjects, grades, or years (Ho 2008; Ho and Reardon 2012). Nonetheless, counts of students scoring in different proficiency categories can be used to estimate achievement gaps interpretable as effect sizes (Ho and Reardon 2012; Reardon and Ho 2015), as described below.

The most conventional measure of achievement gaps is the standardized mean difference in test scores between two groups, defined as

$$d = \frac{\mu_a - \mu_b}{\sigma_p},$$

(1)

where μ_a and μ_b are the mean test scores in groups a and b, respectively, and σ_p is the pooled standard deviation of test scores (the square root of the average of the test score variances in groups a and b):

$$\sigma_p = \sqrt{\frac{\sigma_a^2 + \sigma_b^2}{2}}.$$

(2)

This measure, sometimes called Cohen's d (Hedges and Olkin 1985), is a measure of the relative difference in the test score distributions of two groups. It is relative in the sense that it measures gaps as the ratio of the difference in means to the average spread of the two distributions. It can be thought of, loosely, as a measure of the extent to which the distribution of scores in group a is higher than the distribution in

group b.

Two factors complicate the use of d given the data and objectives of our analysis. First, computing d requires estimates of the mean and standard deviation of each district's test score distributions, by race; these statistics are not generally publicly available except from a few state websites in select years. Second, d is sensitive to the scale in which test scores are reported. Although d would be unchanged by any linear transformation of test scores (such a transformation would multiply both the difference in means and the pooled standard deviation by the same factor, leaving their ratio unchanged), it will be altered by a non-linear transformation of scores. Unless the metric in which achievement is measured is inherently meaningful, then, d is sensitive to arbitrary scaling decisions. In order to compare test score gaps across states, grades, subjects, and years in which different tests are used, it is necessary to use a gap measure that is not sensitive to differences in how test scores are scaled.

An alternate measure of the relative difference in distributions, one that is immune to scale transformations of the test score metric, is based on the probability that a randomly chosen observation from distribution a has a higher value than a randomly chosen observation from distribution b. Like d, this measure, denoted $P_{(a>b)}$, can be loosely thought of as a measure of the non-overlap of distributions a and b, or as a measure of the extent to which distribution a contains higher values than distribution b. The value of $P_{(a>b)}$ may range from 0 to 1, with values greater than 0.5 indicating that distribution a is higher than b, and vice versa. Applying a probit transformation to $P_{(a>b)}$ produces the V-statistic (Ho 2009; Ho and Haertel 2006; Ho and Reardon 2012):

$$V = \sqrt{2}\Phi^{-1}\left(P_{(a>b)}\right) \tag{3}$$

The V-statistic has three useful properties for our purposes. First, it is readily interpretable as an effect size. Essentially, Equation (3) converts $P_{(a>b)}$ to an effect size by computing the standardized difference between two normal distributions that would yield the observed value of $P_{(a>b)}$. As a result, if the

test score distributions of groups a and b are both normal (regardless of whether they have equal variance), then V will be equal to Cohen's d (Ho and Reardon 2012). Thus, V can be thought of as measuring gaps in a familiar "effect size" metric.

Second, V is invariant to monotonic transformations of test scales: if a test metric is transformed by any non-linear monotonic transformation, Cohen's d will be changed, but V will not. Thus, V can be understood as the value of Cohen's d if the test score metric were transformed into a metric in which both groups' scores were normally distributed. This transformation-invariance property of V is particularly useful when comparing gaps measured using different tests. In order to compare gaps across tests using Cohen's d, we would have to assume that each test measures academic achievement in an interval-scaled metric (so that a score on any test can be written as a linear transformation of a score on any other test). To compare gaps using V, however, we need only to assume that each test measures achievement in a way that orders two groups the same way (so that the overlap between two groups' distributions would be the same in either test), a much more defensible assumption.[6]

A final advantage of the V-statistic is that it can be estimated very reliably either from student-level continuous test score data or from coarsened data indicating the number of students of each group in each of several (at least three) proficiency categories (Ho and Reardon 2012; Reardon and Ho 2015). That is, it is not necessary to know the means and standard deviations of each group's test score distribution; all that is needed are the counts of black, Hispanic, and white students who score "Far Below Basic," "Below Basic," "Basic," "Proficiency," and "Advanced," for example. This is the form of the achievement data available from ED*Facts*. Because V is estimable with such little ordinal information, it is possible to easily estimate

[6] In a set of validation exercises shown in Appendix A2 (with results in Table A2), state-level achievement gaps estimated from state accountability tests (which differ among states) are compared to achievement gaps estimated for those same states, grades, and years from the National Assessment of Educational Progress (NAEP), which is identical across states, within a grade, year, and subject. The correlation between the gap estimates from the two data sources is above 0.90 in most cases (ranging between 0.85 and 0.97 depending on year, grade and subject), indicating that different state tests order students similarly enough that the V-statistic can be used to compare achievement gaps across a wide range of state and NAEP tests.

achievement gaps based on state accountability tests in each district/metropolitan area-year-grade-subject for which subgroup-specific proficiency category counts are available.

We estimate V-gaps and their standard errors using the maximum likelihood (ML) algorithm described by Ho and Reardon (2012) and Reardon and Ho (2015) for each district/metropolitan area-grade-subject-year cell in which there are at least 20 white students and 20 black or Hispanic students tested. Ho and Reardon (2012) demonstrate that the ML estimator is unbiased under the assumption of respective normality, and is very nearly unbiased even under large departures from respective normality. Finally, in order to correct estimated achievement gaps and standard errors for measurement error, we disattenuate each of the estimated gaps and their standard errors by dividing both by the square root of the reliability of the test used.[7] The reliabilities of most state tests are about 0.90 (Reardon and Ho 2015), so the disattenuated gaps are generally about 5% larger than the unadjusted estimates.

Finally, for both white-black and white-Hispanic gaps, there are up to 30 estimated math and ELA achievement gap estimates (for each of six grades and 5 school years) in each geographic unit (school district or metropolitan area). These (up to) 60 gap estimates are pooled in order to construct a single estimate of the average achievement gap in each unit (one for the white-black gap, and one for the white-Hispanic gap). Pooling the estimates across grades, years, and subjects increases precision substantially, and discards very little information, since gaps vary little within geographic units.[8] The analyses described below are based on these pooled estimates.

Data on Local Contextual Characteristics

We examine the association of racial achievement gaps with five sets of covariates that describe characteristics of school districts and metropolitan areas: 1) average socioeconomic conditions, 2)

[7] Reliabilities were collected from state department of education websites.

[8] As shown in Appendix A3 (with results shown in Table A3), there is little variation in achievement gaps within school districts or metropolitan areas (i.e., among years, grades and subjects within a geographic unit): 93 to 96 percent of the variation in achievement gaps is between geographic units.

racial/ethnic composition, 3) racial socioeconomic disparities, 4) patterns of residential and school segregation, and 5) school system characteristics. Average socioeconomic conditions and racial composition describe school districts' demographic composition. The other three covariate sets correspond to three key elements of the conceptual framework laid out in Figure 1: racial socioeconomic disparities, residential and school segregation patterns, and school policies, practices, and conditions.

The covariates come primarily from three data sources. First is the American Community Survey (ACS) profile tables for years 2006-2010, available for download from the Education Demographic and Geographic Estimates (EDGE) web portal.[9] Second is the Common Core of Data (CCD) universe surveys and finance files for years 2009-2013.[10] Third is the Office for Civil Rights (OCR) Civil Rights Data Collection (CRDC) for school year 2011-2012.[11]

The EDGE data come from a special school district-level tabulation of the ACS, an annual, nationwide survey designed to provide communities with reliable and timely demographic, social, economic, and housing data. The data include tabulations of demographic and socioeconomic characteristics of families who live in each school district in the U.S. and who have children enrolled in public school. Thus, it provides detailed data on the family characteristics of children enrolled in each school district, corresponding to the available achievement data. We use estimates from the 2006-2010 pooled file, which combines different samples of respondents over 5 survey years.[12]

The CCD Public Elementary/Secondary School Universe is an annual survey of all public elementary and secondary schools in the United States. The data include basic descriptive information on schools and school districts, including staff and enrollment counts. The CCD Local Education Agency (School District)

[9] The ACS EDGE data tables are available for download at http://nces.ed.gov/programs/edge/demographicACS.aspx.
[10] CCD universe surveys and finance files are available for download at https://nces.ed.gov/ccd/ccddata.asp.
[11] The CRDC data are available for download at https://www2.ed.gov/about/offices/list/ocr/data.html.
[12] Annual estimates are available only for school districts with 65,000 or more persons; the 5-year pooled estimates are available for all school districts, regardless of size. We use the 2006-2010 ACS tables because the available more recent tables do not include the specific tabulations describing parents who have children enrolled in public schools. For a useful description of the respective strengths and weaknesses of the different surveys, see http://www.census.gov/programs-surveys/acs/guidance/estimates.html.

Finance Survey (F-33) Data contains district level expenditures data by year for all districts in the United States. We compute the measures discussed below using CCD data from 2009-2013 (to overlap with the years of our achievement data) and then take the mean across years to construct a single value for each district.

The CRDC data includes information on teacher experience and absenteeism for the universe of public school districts in the United States. We use CRDC data from the 2011-2012 school year because earlier waves of the CRDC did not collect data from all districts and because the subsequent CRDC wave (2013-2014) falls outside the time frame of the ED*Facts* data.[13] Below we briefly discuss the measures we use; more information on how each variable is constructed is available in Appendix A4.

Measures of School District Characteristics

Several indicators of school district and metropolitan areas' average socioeconomic characteristics are computed. These include median family income, the proportion of families in which a parent has a bachelor's degree, the proportion of parents in managerial occupations, poverty rates, unemployment rates, SNAP receipt rates, single parent household rates, residential mobility rates, the difference in family income between the 90th and 10th percentiles of the income distribution, average household size, free-lunch eligibility rates, median rent, rental rates, and median house value. We also construct measures of the white-black and white-Hispanic disparities of each of these characteristics, except for a few cases where the measures are not available by race (specifically, free-lunch eligibility rates, median rent, and median house value). We construct these socioeconomic measures from the EDGE data (except for free-lunch eligibility rates, which are constructed from CCD data).

The measures of racial/ethnic composition include the proportion of students in public schools who

[13] For a useful description of the OCR CRDC data, see http://www2.ed.gov/about/offices/list/ocr/docs/crdc-2011-12-factsheet.html.

are black and Hispanic, as well as a set of measures of measures of the national origin, foreign-born status, and English fluency of Hispanics. Racial composition variables are computed using the CCD; Hispanic origin and fluency variables are constructed from the EDGE data.

We compute three types of measures of segregation: measures of racial segregation, measures of income segregation, and measures of racial differences in exposure to poverty. The last is of particular interest, given evidence that the racial difference in average school poverty rates is the measure of segregation most highly correlated with racial achievement gaps (Reardon 2016). For each of these, we compute measures of both school segregation (computed based on school enrollment data from CCD), and residential segregation (computed from EDGE data). The residential segregation measures are available for metropolitan areas, but not school districts, because census tracts are not cleanly nested in school district boundaries. We also include indicators of the white-minority private school enrollment rate difference (constructed from EDGE data) and of the proportion of local school districts that were ever, or are still, under a court order to desegregate (for districts these are binary measures). The data on school district court order history is from Reardon et al (2012).

The final set of covariates describe characteristics of the school system in school districts and metropolitan areas. These include per-pupil expenditures, student-teacher ratios, the proportion of teachers who are novice teachers, and rates of teacher absenteeism. These data are constructed from the CCD and CRDC data. We also compute measures of racial/ethnic disparities in student exposure to these characteristics, when possible. To do so we compute the weighted average value of each measure (e.g., pupil/teacher ratio) within a district (or metropolitan area), using the number of white, black or Hispanic students in the school (or district) as the weight. This yields, for example, the pupil/teacher ratio at the average black (or Hispanic or white) student's school in each district. After computing the measure for each racial or ethnic group, we compute between-group disparities in each measure within each geographic unit.

We also include the percent of the student population that is enrolled in charter schools and

racial/ethnic disparities in charter school enrollment rates. These may be related to achievement gaps given evidence that some—though not all—charter schools have been shown to be effective at raising minority students' achievement (Bifulco and Bulkley 2015; Center for Research on Education Outcomes (CREDO) 2015; Gleason et al. 2010). Charter school enrollment data are taken from the CCD. We include measures of the oversight/accountability strength of a state's charter school policies as a crude proxy for a state's quality of charter schools (The Center for Education Reform 2014; Ziebarth 2014). Finally, we include several measures of school accountability, including measures of whether a state's proficiency standards are high or low (as defined by Wong, Cook and Steiner 2015) and the proportion of minority students who are in schools where there were enough members of their subgroup to require reporting under the No Child Left Behind policy. We compute this measure based on CCD enrollment data and information on states' policies on subgroup-specific reporting requirements. Sufficient minority enrollment is an important variable is an indicator for whether schools in districts or metropolitan areas are likely to face race-specific accountability pressure, under the assumption that if counts are too small for test reporting, the school will not be held accountable for those students' performance (Reardon et al. 2013).

The full set of variables, their respective data sources, and detailed description of how the variables are constructed are available in Appendix A4. In the interest of parsimony, Table 2 reports means and standard deviations for only a subset of them. This subset was chosen to include those variables from each of the five categories of variables that are most predictive of achievement gaps. This same subset of variables is included in each of the subsequent tables; tables including estimates for the full set of variables are available in the Appendix (Tables A5 - A7).

Because data come from different sources and because of minimum group size requirements for reporting (e.g., income is not reported for districts or tracts with small populations), our analytic sample is restricted to those districts and metropolitan areas for which there are no missing data for any of the covariates. For the metropolitan area analyses, the analytic samples for white-black and white-Hispanic gaps

include 361 and 371 metropolitan areas (96 and 98 percent of metropolitan areas for which gap estimates are available), respectively. For the district analyses, the analytic samples include 2,476 and 3,241 districts (85 and 88 percent of the districts for which white-black and white-Hispanic gap estimates are available), respectively.

[Table 2 here]

The top row of Table 2 reports the average white-black and white-Hispanic achievement gaps for metropolitan areas and school districts. The white-black and white-Hispanic achievement gaps vary considerably in magnitude across the U.S. Across school districts, the average white-black and white-Hispanic gaps are 0.66 and 0.52 standard deviations, respectively, with standard deviations of 0.22 and 0.23, respectively. The means (0.75 and 0.56) and their standard deviations (0.20 and 0.21, respectively) are similar at the metropolitan level. Given the large number of test scores on which the gap estimates are based, they are generally estimated very precisely. Indeed, the reliability of the estimated school district gaps is 0.84-0.9; for metropolitan area estimates, the reliability is 0.96.[14]

One pattern evident in Table 2 is that there is considerable variation among school districts in many of the socioeconomic and demographic characteristics. For the most part, there is less variation among metropolitan areas. This is evident in a comparison of the standard deviations of the socioeconomic characteristics among school districts and among metropolitan areas. One consequence of this sorting is that between-race differences in socioeconomic status are smaller in districts, on average, than in metropolitan areas. For example, white-minority parental income and parental education gaps are, on average, 1.1 to 1.4 times larger in metropolitan areas than in districts (except, notably, that white-Hispanic parent education gaps are larger in school districts than in MSAs); between school racial segregation and minority free lunch rate differences are both over 3.5 times higher. These patterns reflect the fact that districts tend to be more

[14] Reliabilities are estimated from the model described in Appendix A3 and shown in Appendix Table A3. Reliabilities for subject-specific estimates are slightly higher, ranging between 0.85 to 0.97.

socioeconomically and racially homogeneous, on average, than metropolitan areas. A version of Table 2 including the full set of covariates can be found in Appendix Table A5.

Models and Methods

A Descriptive Model of Achievement Gaps

The analyses here proceed in three stages: 1) a description of the magnitudes and spatial variation in white-black and white-Hispanic achievement gaps; 2) an examination of the bivariate associations between achievement gaps and a set of district/metropolitan area covariates; 3) a set of descriptive multivariate regression models that provide estimates of the partial associations of specific covariates with achievement gaps. Both the bivariate and multivariate models have the form

$$\hat{G}_u = \alpha + (\mathbf{X}_u - \overline{\mathbf{X}})\mathbf{B} + \mathbf{\Delta}_u\mathbf{\Gamma} + \lambda_s + e_u + v_u; \quad e_u \sim N[0, \tau]; \quad v_u \sim N[0, \hat{\omega}_u^2], \tag{1}$$

where $\hat{G}_u$ is the estimated white-black or white-Hispanic achievement gap in a district or metropolitan area u; $\mathbf{X}_u$ is a vector of district or metropolitan area covariates (including average socioeconomic conditions, racial/ethnic composition, and measures of educational policies and practices); and $\mathbf{\Delta}_u$ is a vector of covariates describing racial/ethnic *differences* in context or experience (including racial disparities in family resources and measures of residential and school segregation). $\mathbf{X_u}$ and $\mathbf{\Delta_u}$ can be distinguished in that $\mathbf{\Delta_u}$ has a natural interpretation at zero—there is no racial inequality or segregation in the unit—whereas $\mathbf{X_u}$ corresponds to the average value of the variable in the unit. We center $\mathbf{X}_u$ at the sample mean, but leave $\mathbf{\Delta}_u$ uncentered. This is done so that the intercept α can be interpreted as the average achievement gap in a district with average values of $\mathbf{X}$ and in which white and black/Hispanic students experience equal values of the contextual factors contained in $\mathbf{\Delta}$.

We include state fixed effects, denoted λ_s, in the district models but not the metropolitan area models. The residual error term e_u is assumed to have constant variance τ; the error term v_u is the sampling

error in $\hat{G}_u$ (that is, $v_u = \hat{G}_u - G_u$) and is assumed to have known error variance ω_u^2 (where ω_u is the estimated standard error of $\hat{G}_u$). The two error terms are assumed independent of one another. Because e_u may not be independent of $\mathbf{X}_u$ and $\mathbf{\Delta}_u$, however, we cannot interpret the estimated coefficient vectors $\widehat{\mathbf{B}}$ and $\widehat{\mathbf{\Gamma}}$ in causal terms.

Models with the error structure of Model (1) are sometimes referred to as meta-analytic regression models or precision-weighted random effects models. Such models are appropriate when the outcome variable for each observation represents an estimated value (with known error variance) of a parameter from a different site, and where the true values of that parameter are assumed to vary among sites. We fit these models using Stata's –`metareg`– command (Harbord and Higgins 2008).

Results

Spatial Variation of Achievement Gaps

Figures 2 and 3 illustrate the geographic patterns of achievement gaps across the U.S. Rather than show achievement gaps within each school district, the two figures show achievement gaps within each commuting zone in the U.S. [15] The maps show that white-black gaps are generally largest in coastal areas around major cities, in parts of the South, and in the Rust Belt, though they vary considerably within these regions as well. White-Hispanic gaps are generally largest in the West and along the East Coast from Philadelphia to Boston.

[Figures 2 and 3 here]

Although the maps do not display district-level achievement gaps (because many districts are too

[15] Commuting zones are aggregations of counties that are similar to metropolitan areas, but that cover the entire U.S. Because our method of computing achievement gaps requires all students in a geographic unit to take the same test (so they must be in the same state), when commuting zones cross state boundaries, we split them into separate components in Figures 2 and 3. We show the gaps here at the commuting zone level, rather than the school district level, because commuting zones cover the entire U.S. at a geographic scale that is visible in a national map. Many school districts are too small to be resolvable in a national map, and many districts—particularly in the middle of the country—do not have sufficient numbers of minority students to estimate an achievement gap.

small to be visible in such a map), the extent to which district-level achievement gaps vary within and between states can be estimated by comparing the residual variance (τ) from versions of Model (1) with and without state fixed effects (including no covariates in the model). These analyses (not shown here) indicate that only 11-13% of the variance in district-level achievement gaps is due to between-state variation. That is, within a given state, achievement gaps typically vary almost as much as they do nationwide. This shows that analyses of state-level achievement gaps (see, for example, Hemphill, Vanneman and Rahman 2011; Vanneman et al. 2009) miss almost all of the geographic variation in achievement gap patterns.

One thing that is not clear in Figures 2 and 3 is the extent to which achievement gaps vary across the U.S. because of variation in white students' academic performance or because of black and Hispanic students' performance. For example, the white-black and white-Hispanic achievement gaps are relatively small in West Virginia and Appalachia; is this due to lower than average performance of white students in Appalachia or higher than average performance of minority students? Given the high poverty rates (among whites as well as black and Hispanic populations) in Appalachia, one might guess that this is due to below average performance of white students, but the map (and the available method of computing achievement gaps) do not provide evidence of this. Thus, the data illustrated in these maps is informative about relative performance, but not of absolute performance.

Districts and Metropolitan Areas with the Smallest and Largest Achievement Gaps

Figures 4 and 5 list the 20 school districts with the largest and smallest estimated achievement gaps, while Figures 6 and 7 list the 20 metropolitan areas with the largest and smallest estimated achievement gaps. School districts and metropolitan areas are ranked based on a "shrunken" Empirical Bayes (EB) estimate of the achievement gap, so that units with few students of a given race and imprecisely estimated gaps do not show up as the places with the most extreme gaps simply because of sampling error. These EB estimates are shrunken toward the predicted value of the gap estimated from the version of Model (1)

above that includes the full set of covariates in $\boldsymbol{\Delta}_u$ and $\mathbf{X}_u$ (as well as the state fixed effects λ_s for districts). The inclusion of the covariates and state fixed effects provides more information for the EB estimates when precision is low and has little impact on EB estimates when precision is high.

[Figures 4 and 5 here]

The lists of districts with large white-black achievement gaps includes several large and medium-sized school districts (Atlanta, GA; Washington DC; Orleans Parish, LA; Madison, WI; Charleston, SC; Tuscaloosa, AL; Minneapolis, MN; Oakland, CA), most of which are in the South and are generally highly segregated, with large white-black socioeconomic disparities. But it also includes a number of smaller school districts that are home to prominent universities (Berkeley, CA; Chapel Hill, NC; Evanston, IL; University City, MO; Charlottesville, VA) as well as a set of small, relatively affluent suburban/exurban school districts (Shaker Heights, OH; LaGrange, IL; Huntington Union, NY). The set of districts with the smallest white-black achievement gaps includes a number of districts with relatively small black populations as well as several large, racially diverse, poor school districts (notably Detroit, MI; Clayton County, GA).

Many of the districts with the largest white-black achievement gaps also appear on the list of places with the largest white-Hispanic gaps (Atlanta, GA; Chapel Hill, NC; Evanston, IL; Berkeley, CA; Washington, DC; Minneapolis, MN), suggesting that the local forces producing racial/ethnic inequality are not specific to one race/ethnic group or that the gaps are large because of particularly high performance of white students rather than particularly low performance of black or Hispanic students. Many of the districts with the largest white-Hispanic gaps are in the Bay Area in California (San Rafael; Berkeley; Mountain View; Cabrillo Unified (Half Moon Bay); Menlo Park), where white-Hispanic socioeconomic inequality and segregation are very high. Among the districts with the smallest white-Hispanic achievement gaps, many are in small, relatively low-income school districts in Texas and California.

[Figures 6 and 7 here]

Among metropolitan areas, those with the largest gaps all have relatively large black or Hispanic

populations and large racial/ethnic socioeconomic disparities and relatively high levels of segregation. Ten metropolitan areas are on both the list of places with the 20 largest white-black gaps and the list of those with the 20 largest white-Hispanic gaps (notably, Bridgeport, CT and San Francisco, CA are among the top three on both lists). These metropolitan areas generally have very affluent white populations that are substantially segregated from very poor minority populations.

Correlates of Racial/Ethnic Achievement Gaps

The lists of school districts and metropolitan areas with the largest and smallest achievement gaps suggest a few patterns: achievement gaps are largest in places with large racial/ethnic differences in socioeconomic status, in more segregated places, and in more affluent or socioeconomically advantaged places; they are smallest in smaller, poorer school districts where socioeconomic disparities are relatively small or where there are few minority students. Using data from all school districts and metropolitan areas in the analytic sample, the bivariate analyses reported in Table 3 examine whether these patterns hold more generally.

Table 3 reports the pairwise correlations between achievement gaps and a set of district and MSA characteristics.[16] These characteristics are organized into the five categories described earlier: 1) average socioeconomic conditions, 2) racial/ethnic composition, 3) racial socioeconomic disparities, 4) patterns of residential and school segregation, and 5) school system characteristics. As above, only a subset of the full set of covariates are presented. Those displayed here generally have either the strongest bivariate correlations with achievement gaps or are of particular theoretical interest. A version of Table 3 including the full set of covariates can be found in Appendix Table A6.

[Table 3 here]

[16] Specifically, the correlation coefficient is the precision weighted correlation coefficient whereby the weighting variable is equal to $\frac{1}{\tau + \sigma_u^2}$, where τ is equal to the estimate of the true variance and σ_u^2 is the variance of the gap estimate in district or metropolitan area u. τ is estimated from a random effects meta-analytic regression model.

Table 3 suggests five general patterns. First, achievement gaps are larger in more affluent areas. Districts and metropolitan areas with higher median incomes, higher rates of adults with bachelor's degrees, and lower rates of single parent headed households have larger differences in achievement between white and minority students. The correlation between the proportion of adults with bachelor's degrees and achievement gaps, for example, ranges from .44 to .55. Second, white-black gaps tend to be larger in metropolitan areas with larger black public school enrollments, while white-Hispanic gaps tend to be larger in metropolitan areas with larger Hispanic public school enrollments. Racial/ethnic composition is largely unrelated to achievement gaps at the district level, however. The Hispanic population's English proficiency is negatively associated with the white-Hispanic achievement gap in both metropolitan areas and school districts. In areas where a greater share of the Hispanic population speaks English well, achievement gaps are smaller than those areas with more non-English-proficient Hispanics, a pattern that may result at least in part from the fact that the achievement tests used here are administered in English. Third, areas with larger racial socioeconomic disparities have larger achievement gaps. White-minority differences in family income and white-minority differences in parental education are correlated positively with achievement gaps at between .41 to .62 in each of the samples. This is not surprising given the large body of research describing the relationship between socioeconomic status and academic achievement.

Fourth, districts and metropolitan areas with higher levels of racial and economic segregation have larger achievement gaps, on average, than less segregated places. Although all the measures of segregation we examine are significantly correlated with achievement gaps, the most highly correlated measure is the difference in the extent to which white and minority students have schoolmates who are eligible for free lunch. In metropolitan areas and districts where black and Hispanic students attend schools with higher average poverty rates than white students, achievement gaps are larger, on average, than in places with smaller differences in exposure to school poverty (r=0.66 to 0.70 in MSAs and r=0.35 to 0.38 in districts for white-black and white-Hispanic differences, respectively).

Fifth, although some measures of educational policies and practices are correlated with achievement gaps, these correlations are generally small and inconsistent across groups and geographic units of analysis. The most consistent relationship between schooling characteristics and achievement gaps is the positive association between per pupil instructional expenditures and achievement gaps; in areas with greater spending, even after controlling for between state differences (via the state fixed effects in the district models), achievement gaps tend to be larger than in those with lower spending. Of course, this association is not causal, and does not imply that increasing spending increases achievement gaps. It may be that places with greater spending have greater shares of higher income, non-minority families.

It is worth contrasting the positive and strong association between achievement gaps and average per pupil expenditures against the negative and weak correlation between achievement gaps and racial differences in per pupil expenditures.[17] This negative correlation indicates that achievement gaps are smaller, on average, in metropolitan areas where per pupil expenditures are higher in white students' districts than in minority students' districts. Again, this should not be interpreted causally. The correlations here do not indicate whether spending differences cause differences in achievement gaps or whether differences in achievement induce spending differences (or whether both are driven by some third factor).

Socioeconomic disparities and racial/ethnic achievement gaps

Given the relatively strong correlations between each of the racial/ethnic socioeconomic disparities measures and achievement gaps, we next investigate a) how much variation in achievement gaps can be accounted for by variation in racial socioeconomic disparities; and b) whether achievement gaps are zero, on average, in places with no racial/ethnic socioeconomic disparities. To answer these questions, we first fit Model (1) including only a vector $\boldsymbol{\Delta}_u$ of socioeconomic disparity measures.[18] From this model, we compute

[17] Note that the variable racial differences in per pupil expenditures is only available for MSAs, as district level shares of minority and white expenditures can be aggregated to the metropolitan level.

[18] The variables in Δ_u are white-minority differences in: family income, parental education, occupation type, unemployment rates, poverty rates, SNAP receipt rates, single-parent household rates, homeownership rates, and one-

$\mathbf{\Delta}_u\hat{\mathbf{\Gamma}}$, the predicted contribution of racial socioeconomic disparities to the local academic achievement gap. We also compute the EB estimate of the achievement gap from this model, $\hat{G}_u^*$, and then plot $\hat{G}_u^*$ against $\mathbf{\Delta}_u\hat{\mathbf{\Gamma}}$ (Figures 9-12). Each figure also includes the fitted line $\hat{G}_u = \hat{\alpha} + \mathbf{\Delta}_u\hat{\mathbf{\Gamma}}$. Note that the intercept of this line indicates the estimated average achievement gap in districts or metropolitan areas in which there is no racial/ethnic socioeconomic disparity (i.e., in places where there is socioeconomic racial equality).

Figures 9 and 10 display the association of district-level white-black and white-Hispanic achievement gaps, respectively, to the corresponding socioeconomic disparities. Each point in the figures corresponds to a school district; the size of each point is proportional to the average number of black or Hispanic students in the metropolitan areas. Several patterns are evident in the figures. First, as noted in Table 2, there is considerable variation among school districts in the magnitude of racial/ethnic socioeconomic disparities. For white-black gaps, nearly 11 percent of districts (with 7 percent of the black public school population) have racial/ethnic socioeconomic disparities that are less than or equal to zero. For white-Hispanic gaps, only 3 percent of districts (with less than 1 percent of the Hispanic public school population) have racial/ethnic socioeconomic disparities that are less than or equal to zero. In the vast majority of districts, the disparities are greater than zero, and in some the disparities are large—large enough to correspond to two thirds or more of a standard deviation of the achievement gap (recall that the horizontal axis is scaled in the same units as the achievement gap, since $\mathbf{\Delta}_u\hat{\mathbf{\Gamma}}$ is the magnitude of the contribution of socioeconomic disparities to achievement gaps).

Second, there is a strong association between socioeconomic disparities and achievement gaps: the $R^{2\prime}$s from these models are 0.65 and 0.63 for white-black and white-Hispanic gaps, respectively (implying that the correlation between district-level achievement gaps and an index of racial socioeconomic differences ($\mathbf{\Delta}_u\hat{\mathbf{\Gamma}}$) is roughly 0.81-0.79). In other words, racial socioeconomic disparities are strong predictors

year housing mobility rates. For the analysis described here, the model includes no other variables (including no state fixed effects) so that the constant is interpreted as the average achievement gap when racial/ethnic socioeconomic inequality is zero.

of academic achievement gaps. There nonetheless remains considerable variation in achievement gaps, even conditional on racial socioeconomic disparities. The conditional standard deviation of achievement gaps around the fitted line is roughly 0.17; districts with similar socioeconomic disparities vary in some cases by as much as half a standard deviation in their achievement gaps.

Third, the intercept of the fitted line is 0.5 for the white-black models and 0.25 for the white-Hispanic models. That is, even in the relatively few districts where white and minority students have similar socioeconomic backgrounds, the average district-level achievement gap is well above zero. Thus, racial/ethnic socioeconomic disparities alone do not account for the large racial achievement gaps, despite being highly predictive of the magnitudes of the gaps.

[Figures 9-10 here]

Figures 11 and 12 are similar to the Figures 9 and 10, but illustrate the patterns for metropolitan areas rather than school districts. First note that in only a few MSAs (with less than 0.1 percent of the black population and less than 0.2 percent of the Hispanic population) is there racial/ethnic socioeconomic equality. More generally, however, Figures 11 and 12 show that the associations between metropolitan area achievement gaps and racial/ethnic socioeconomic disparities are very similar to the district-level associations shown in Figure 9 and 10. First, the R^2's from these models are 0.62 and 0.77 (implying that the correlation between MSA achievement gaps and an index of racial socioeconomic differences is roughly 0.79-0.88). Second, while racial/ethnic socioeconomic disparities are strong predictors of academic achievement gaps, there is considerable variation in the magnitude of achievement gaps, even among MSAs with similar degrees of racial socioeconomic inequality. Finally, even when white-black and white-Hispanic socioeconomic disparities are zero, white-black and white-Hispanic achievement gaps are roughly 0.43 and 0.13, respectively.

[Figures 11-12 here]

Multivariate regression model results

In order to describe the partial associations between achievement gaps and each covariate, net of other included district or MSA measures, we present a set of regression models that include the full set of covariates ($\mathbf{X}_u$ and $\mathbf{\Delta}_u$) described above. The coefficients described here should not be interpreted causally. Rather, they simply indicate which covariates are the most robust predictors of achievement gaps.[19]

[Table 4 here]

Several patterns stand out in Table 4. First, among the socioeconomic characteristics, racial differences in parental education as well as overall levels of parental education are the strongest predictors of achievement gaps. Achievement gaps are larger in both school districts and metropolitan areas with high levels of educational attainment and large racial/ethnic gaps in attainment, net of other characteristics. These associations are strong and statistically significant, despite the fact that the models include many other highly-correlated covariates.

Second, among the segregation variables, the strongest and most consistent predictor of achievement gaps is the difference in white and minority students' exposure to low-income schoolmates. This does not mean that other forms of segregation are not correlated with achievement gaps or that they do not cause gaps—indeed, Table 2 shows that both between school racial segregation and differential exposure to poverty are robust bivariate correlates of achievement gaps—rather the correlation between racial segregation and achievement gaps may arise precisely because racial segregation generally leads to large racial disparities in exposure to poor schoolmates (Reardon 2016).

Third, there is no consistent association between achievement gaps and the measures of educational policies and practices, net of the other variables in the model. As with the bivariate correlations, the ratio of white to minority per pupil expenditures has negative coefficients but large standard errors. Similarly, all of these measures have either very small coefficients or imprecise coefficients that sometimes even change

[19] A version of Table 4 including the full set of covariates can be found in Appendix Table A7.

signs across subgroups.

Of the racial/ethnic composition variables we include, both the black and Hispanic shares of the school age population are positively correlated with both white-black and white-Hispanic achievement gaps in both districts and MSAs (though the correlations are generally larger for Hispanic enrollment shares, in most cases the difference in coefficients is not statistically significant). This correlation is equivalent to saying that in districts and MSAs with smaller shares of white students (and larger shares of minority students), racial/ethnic gaps tend to be larger, all else equal.

In sum, in a model that includes many measures of socioeconomic and demographic characteristics, measures of segregation, and characteristics of the education system, the four strongest and most consistent predictors of racial/ethnic achievement gaps are 1) racial/ethnic disparities in parental educational attainment; 2) racial/ethnic differences in exposure to poor schoolmates; 3) overall parental educational attainment levels, and 4) the racial/ethnic composition of students attending public schools in the district or MSA.

Lastly, we estimate the R^2 from models with different sets of covariates. This shows the joint predictive power of the measures we include in each of the 5 sets of covariates. The results are shown in Table 5.

[Table 5 here]

Average socioeconomic conditions, racial disparities in socioeconomic conditions and segregation measures explain a large portion of the variance in achievement gaps on their own—between 40 and 60 percent in most cases. Segregation measures are less predictive of district-level achievement gaps, however, than they are of metropolitan area gaps, largely because segregation is generally both much more pronounced and much more variable at the metropolitan level than it is within individual school districts (see Table 2). Racial composition and educational policies and practices explain less of variance than the other groups of measures. The full models that include all five sets of covariates account for 76-82 percent of the

variance in metropolitan area achievement gaps and 64 percent of the district level achievement gaps.

Discussion

Several key findings emerge from these descriptive analyses. First, there is considerable variation in white-black and white-Hispanic achievement gaps across school districts and metropolitan areas. Yet most of this variation appears to be driven by local, rather than state-level forces: almost 90 percent of the variation in district achievement gaps lies within, rather than between, states. Although average levels of academic performance vary substantially among states, district racial achievement gaps do not differ much, on average, among states, at least not in comparison to how much they differ within states. Local forces dominate state-level processes in shaping patterns of racial/ethnic academic achievement gaps.

Second, of the several thousand school districts we analyze, which enroll over 90% of all black and Hispanic students in the U.S., there are but a handful where the achievement gap is near zero. With the notable exceptions of the Detroit, MI and Clayton County, GA school districts, these tend to be districts that enroll few minority students and where achievement gaps are very imprecisely estimated even in our large data set. And while Detroit and Clayton County do have achievement gaps near zero, this does not appear, at least in the case of Detroit, to be a desirable form of equity: Census data show that both white and black families in Detroit are very poor, on average, and given how low average test scores are in Detroit, the absence of an achievement gap implies that both black and white students are equally low scoring.[20] In other words, there is no school district in the U.S. that serves a moderately large number of black or Hispanic students where achievement is even moderately high and where achievement gaps are near 0.

Third, roughly half the variance in local achievement gaps can be explained by racial/ethnic

[20] Average district NAEP data are available from the Trial Urban District Assessment (TUDA). Generally, subgroup achievement data are available from TUDA but sample sizes for white students in Detroit are too small to meet NAEP reporting guidelines. Average and black achievement data for Detroit are available for years 2009, 2011 and 2013 in ELA and math; data for Detroit and other large urban districts can be downloaded at http://nces.ed.gov/nationsreportcard/naepdata/dataset.aspx.

disparities in socioeconomic status. The bivariate associations between achievement gaps and racial/ethnic differences in family income and parental education are strong, and remain strong in models controlling for other variables. This is not surprising, given the many studies showing the clear association between individual socioeconomic background and test performance documented and that racial/ethnic differences in socioeconomic status explain a substantial proportion of achievement gaps (Fryer and Levitt 2004; Fryer and Levitt 2006; Reardon and Galindo 2009; Rothstein and Wozny 2013). Nonetheless, the evidence here clearly indicates that those same associations appear to account for a significant proportion of geographic variation in achievement gaps as well.

Fourth, although racial/ethnic differences in socioeconomic status explain much of the variation in achievement gaps, socioeconomic disparities are far from determinative. Achievement gaps vary substantially even among places with similar socioeconomic disparities, and remain large even where white and minority students come from relatively similar socioeconomic backgrounds. There are clearly factors other than racial/ethnic socioeconomic disparities at play in generating academic achievement gaps.

Chief among these factors is racial segregation. Our analyses indicate that, net of socioeconomic disparities, general socioeconomic levels, demographic composition, and several (admittedly crude) measures of school quality, segregation is a significant predictor of achievement gaps. In particular, while many of our measures of segregation are correlated with achievement gaps, the one that is a consistently significant predictor in our multivariate models is racial differences in exposure to poverty. Racial achievement gaps are larger, all else equal, in places where black and Hispanic students attend higher poverty schools than their white peers (see Reardon 2016 for a more detailed empirical argument on this point). This suggests that race, *per se*, is not the causal factor linking segregation to worse outcomes for minority students. Rather, racial isolation is correlated with other negative conditions such as exposure to more low-income peers, more crime, fewer positive role models, schools with fewer resources, etc. Because low-income students enter school with below-average academic skills, the curriculum and instructional

practices in high poverty schools may, on average, target lower-level academic skills than in low-poverty schools. These differences in context and opportunities to learn between high- and low-poverty schools may explain why school poverty serves as a proxy for school quality, and why racial differences in school poverty lead to larger racial achievement gaps. More generally, our findings are consistent with evidence that long-term exposure to poverty can have negative effects on cognitive and educational outcomes (Chetty, Hendren and Katz 2015; Sampson, Sharkey and Raudenbush 2008).

Our descriptive analyses reveal one additional puzzling pattern. Achievement gaps are larger, on average, in districts and metropolitan areas with higher levels of parental education, even after we control for many other variables, including racial socioeconomic disparities and segregation. As noted above, one possible explanation for this is the possibility that socioeconomic disparities—and corresponding disparities in social capital, social networks, and access to school district leaders—are more salient in competitive, high resource communities. Another possibility is that social psychological processes that inhibit minority students' performance, such as stereotype threat, are particularly strong in the most affluent places where academic performance is seen as a particularly important marker of intelligence and success and where minority students often comprise only a small share of school district enrollment (Steele 1997). A third possibility is that our socioeconomic measures understate the true racial resource disparities in the most economically advantaged places. Notably, our socioeconomic measures do not include wealth disparities (our only available proxy for wealth is median house value, but that is not available separately by race). If racial wealth disparities are particularly high in more advantaged communities, and if wealth is associated with academic performance after controlling for income (see, for example, Orr 2003; Yeung and Conley 2008), then unmeasured wealth disparities may account for the association we observe between parental education levels and racial achievement gaps.

It is also worth noting that, among all the covariates included in our models, our measures of school characteristics explain the smallest amount of the variance in achievement gaps. Moreover, in some cases,

the bivariate correlations (in Table 3) between racial disparities in school quality and achievement gaps have the opposite of the expected sign. There are several possible explanations for these patterns. First, as has been documented as far back as the Coleman Report (1966), the effect of schools on academic achievement may be relatively small relative to the impact of families. Second, it is possible that our measures of school quality do not capture the important features of school systems that affect racial achievement gaps. While rigorous studies of class size (one of our measures) and school spending indicate that both smaller classes and increased spending lead to higher achievement (Finn and Achilles 1990; Finn and Achilles 1999; Jackson, Johnson and Persico 2016; Lafortune, Rothstein and Schanzenbach 2016; Nye, Hedges and Konstantopoulos 2000), the racial differences in class size and average per pupil spending are not large (average class sizes are 1 to 4 percent larger in black and Hispanic students' schools than in white students' schools; average per pupil spending is roughly 3 percent greater in black and Hispanic students' school districts than in white students' districts; see Table 2). Moreover, these differences vary relatively little among metropolitan areas and school districts, so they have little power to explain the variation in racial achievement gaps. Finally, class size, spending, and charter school enrollment patterns are likely correlated with other unobserved characteristics of communities. For example, educational spending may be higher in communities with greater needs; there may be more demand for charter schools among minority students in communities where the local public schools are particularly low quality. Such patterns might give rise to bivariate correlations with the opposite of the expected sign—for example, the negative association between achievement gaps and white/minority per pupil instructional expenditures or the positive association between achievement gaps and minority-white differences in charter school enrollment rates (see Table 3).

Conclusion

We began with a conceptual model that posits that racial academic achievement gaps are shaped by two key distal factors: racial differences in family socioeconomic circumstances and resources, and educational policies and practices. We hypothesized that patterns of residential and school segregation are

key mediators through which both family resource disparities and educational policy affect achievement gaps. But because segregation patterns are jointly shaped by family resource patterns and social and educational policy, the relative contribution of these three factors to achievement gaps are not cleanly identifiable. That is, the old sociological question posed by Coleman and the generation of sociologists of education who followed him—"how much are the disparities in academic achievement due to family background, and how much are they due to inequalities in school environments?"—may not be answerable.

Instead, we set out to answer a different (and simpler) set of questions: "to what extent do racial achievement gaps vary across the U.S., and what are the strongest correlates of these gaps?" The analyses here confirm that family resource differences and segregation patterns are strongly associated with racial achievement gaps in school districts and metropolitan areas. In all of our analyses, racial socioeconomic disparities and segregation patterns are consistently the strongest predictors of racial achievement gaps. This is qualitatively consistent with our conceptual model, in which residential and school segregation play a key role in linking both family background and education policy to achievement gaps. And while school characteristics are correlated with achievement gaps, these correlations largely disappear once we control for segregation patterns and racial socioeconomic disparities. This may be because segregation patterns affect academic achievement through pathways other than those measured by our limited set of school quality variables.

In general, then, our analyses describe a set of distal factors that are strongly predictive of racial achievement gaps, but they do not identify the more proximal mechanisms that produce these gaps. Family resources and segregation patterns are likely linked to achievement gaps through a complex set of processes, including a host of racial differences in the opportunities and experiences of students in their homes, neighborhoods and schools. We would need better measures of such processes, as well as a research design capable of identifying their effects, to adjudicate among competing explanations of the proximal sources of achievement gaps.

The patterns we note should not be taken as describing causal relationships. The forces producing racial/ethnic inequality in educational outcomes are complex, interactive, and self-reinforcing, meaning that correlational analyses like those here may not describe the effects of changing social or educational conditions. Despite their correlational nature, the analyses here are quite revealing. They are the first to examine geographic variation in racial academic achievement gaps for the entire country at a fine geographic scale and to provide a detailed description of the patterns and correlates of achievement gaps. Our hope is that the patterns we describe will stimulate and inform both future sociological research and policies designed to reduce educational inequality.

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Figure 1

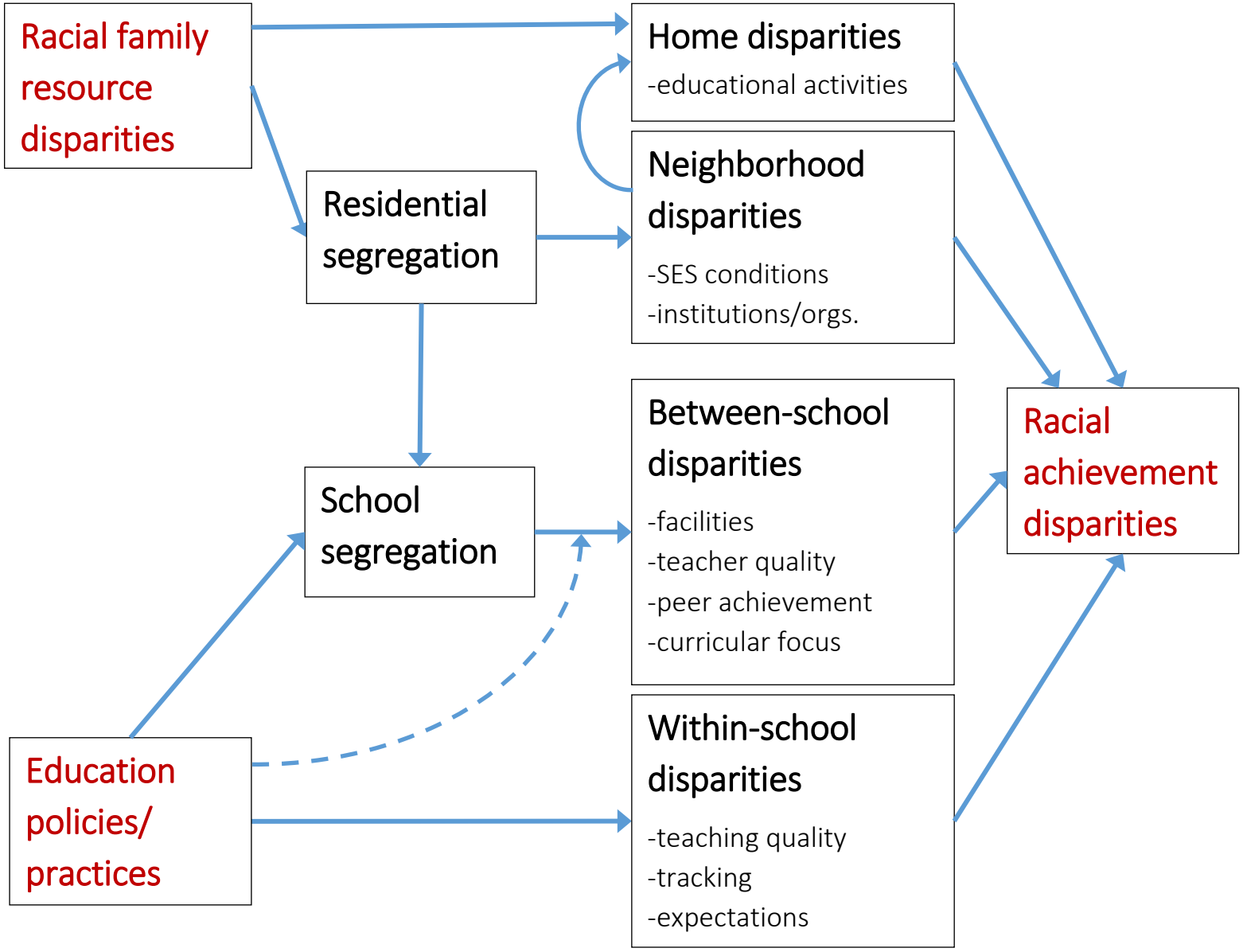
Racial family resource disparities
Residential segregation
School segregation
Education policies/ practices
Home disparities
-educational activities
Neighborhood disparities
-SES conditions
-institutions/orgs.
Between-school disparities
-facilities
-teacher quality
-peer achievement
-curricular focus
Within-school disparities
-teaching quality
-tracking
-expectations
Racial achievement disparities

Figure 2

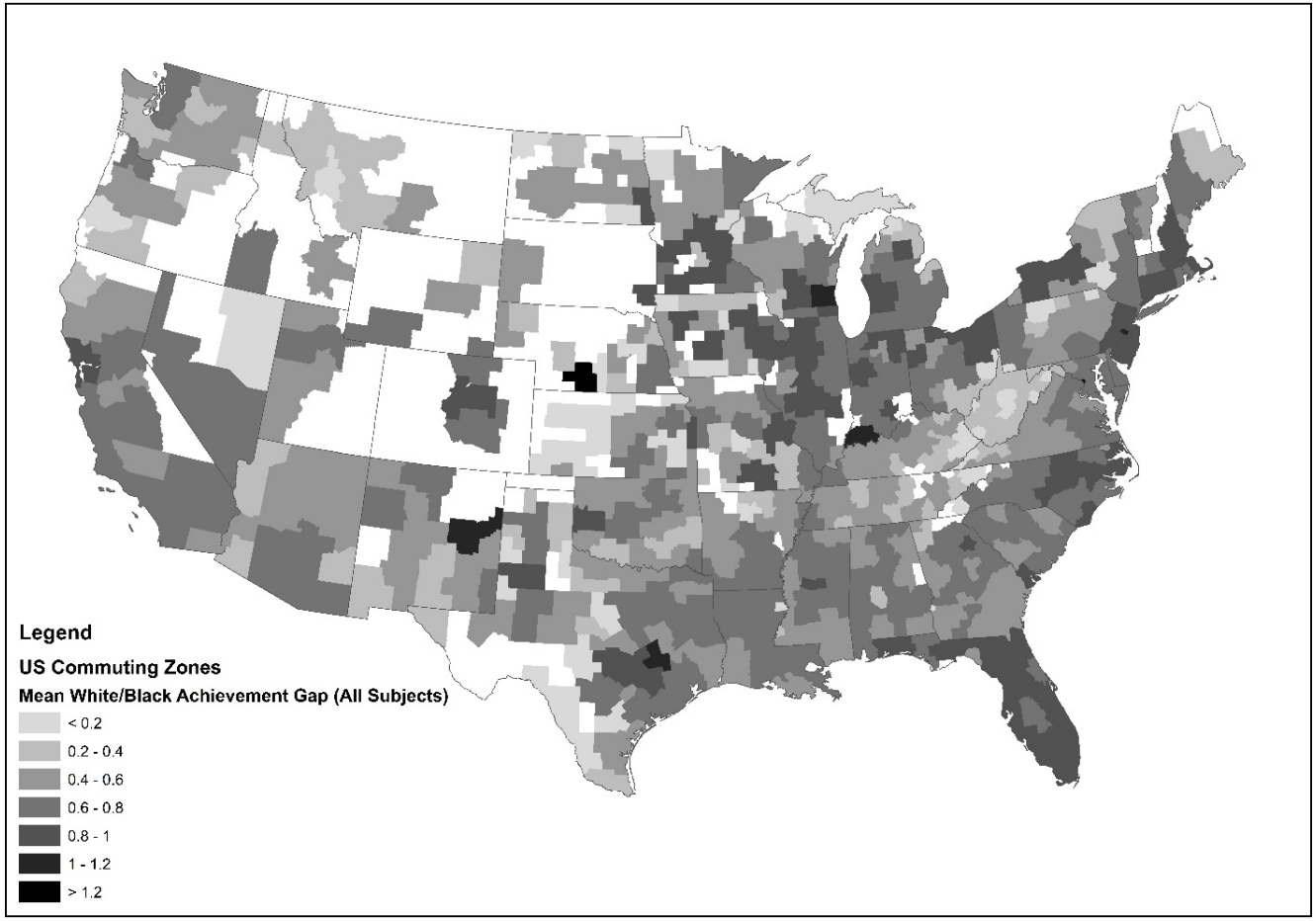
Legend
US Commuting Zones
Mean White/Black Achievement Gap (All Subjects)
< 0.2
0.2 - 0.4
0.4 - 0.6
0.6 - 0.8
0.8 - 1
1 - 1.2
> 1.2

Figure 3

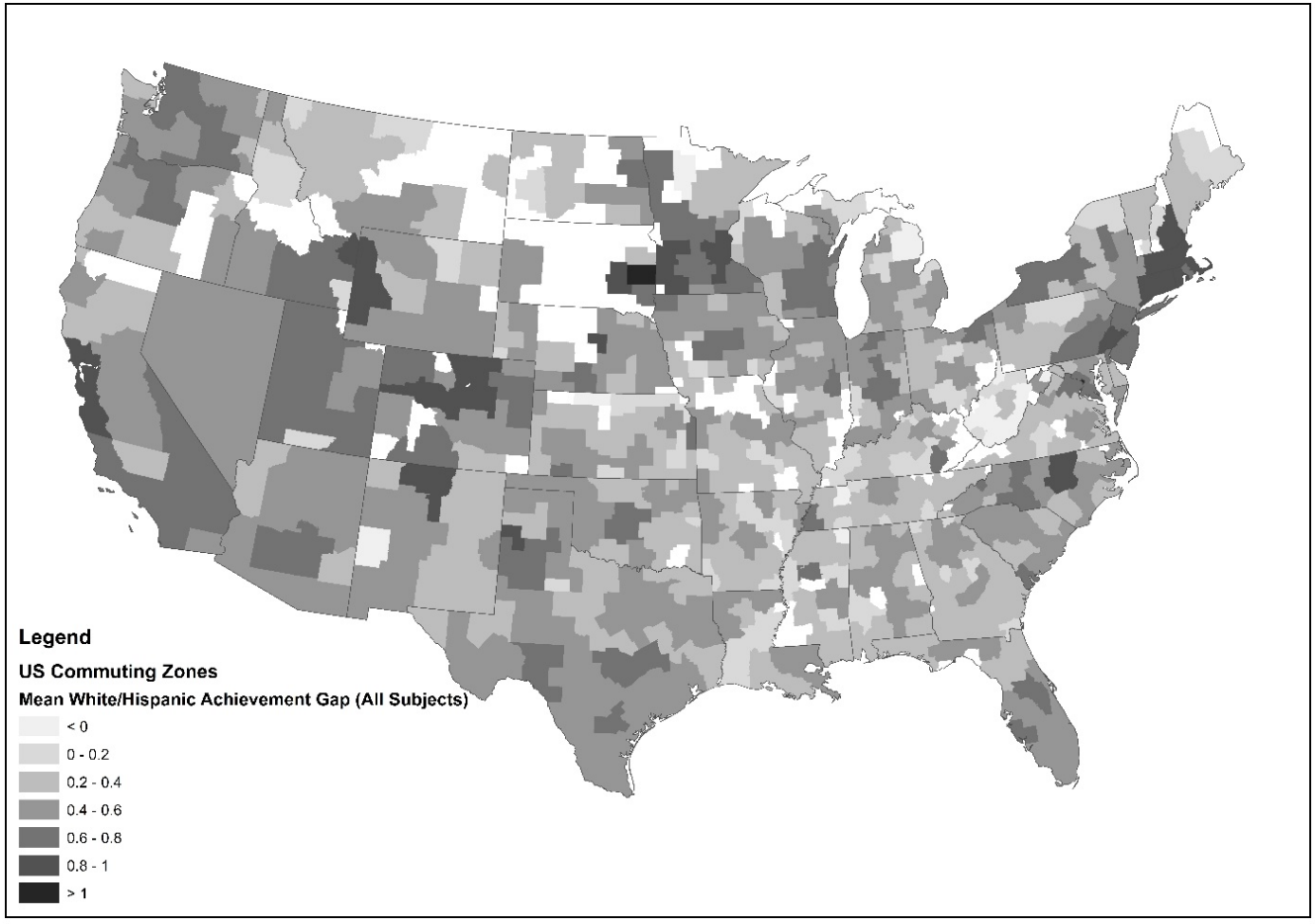
Legend
US Commuting Zones
Mean White/Hispanic Achievement Gap (All Subjects)
< 0
0 - 0.2
0.2 - 0.4
0.4 - 0.6
0.6 - 0.8
0.8 - 1
> 1

Figure 4

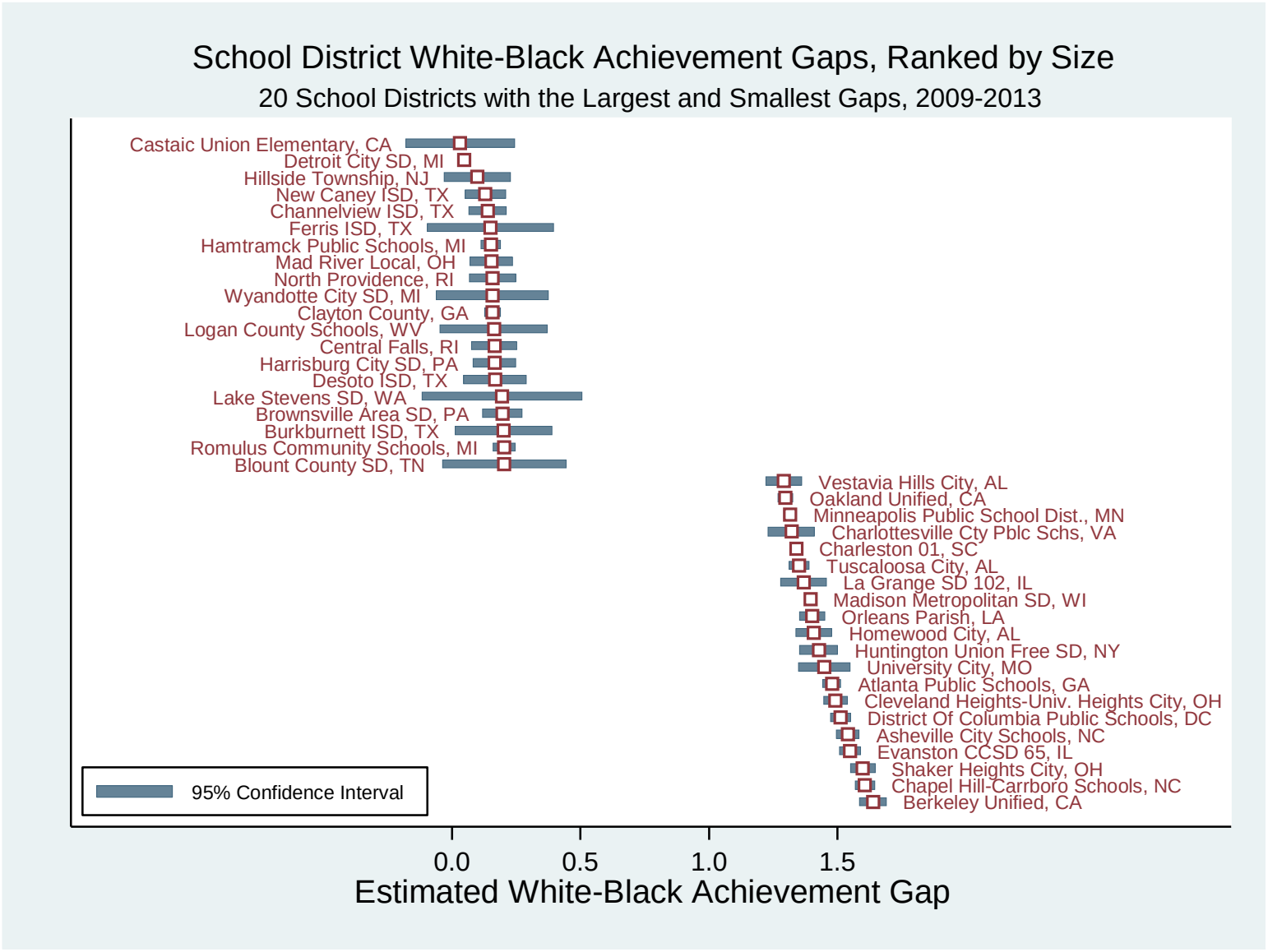
School District White-Black Achievement Gaps, Ranked by Size
20 School Districts with the Largest and Smallest Gaps, 2009-2013
Castaic Union Elementary, CA
Detroit City SD, MI
Hillside Township, NJ
New Caney ISD, TX
Channelview ISD, TX
Ferris ISD, TX
Hamtramck Public Schools, MI
Mad River Local, OH
North Providence, RI
Wyandotte City SD, MI
Clayton County, GA
Logan County Schools, WV
Central Falls, RI
Harrisburg City SD, PA
Desoto ISD, TX
Lake Stevens SD, WA
Brownsville Area SD, PA
Burkburnett ISD, TX
Romulus Community Schools, MI
Blount County SD, TN
Vestavia Hills City, AL
Oakland Unified, CA
Minneapolis Public School Dist., MN
Charlottesville Cty Pblc Schs, VA
Charleston 01, SC
Tuscaloosa City, AL
La Grange SD 102, IL
Madison Metropolitan SD, WI
Orleans Parish, LA
Homewood City, AL
Huntington Union Free SD, NY
University City, MO
Atlanta Public Schools, GA
Cleveland Heights-Univ. Heights City, OH
District Of Columbia Public Schools, DC
Asheville City Schools, NC
Evanston CCSD 65, IL
Shaker Heights City, OH
Chapel Hill-Carrboro Schools, NC
Berkeley Unified, CA
95% Confidence Interval
0.0
0.5
1.0
1.5
Estimated White-Black Achievement Gap

Figure 5

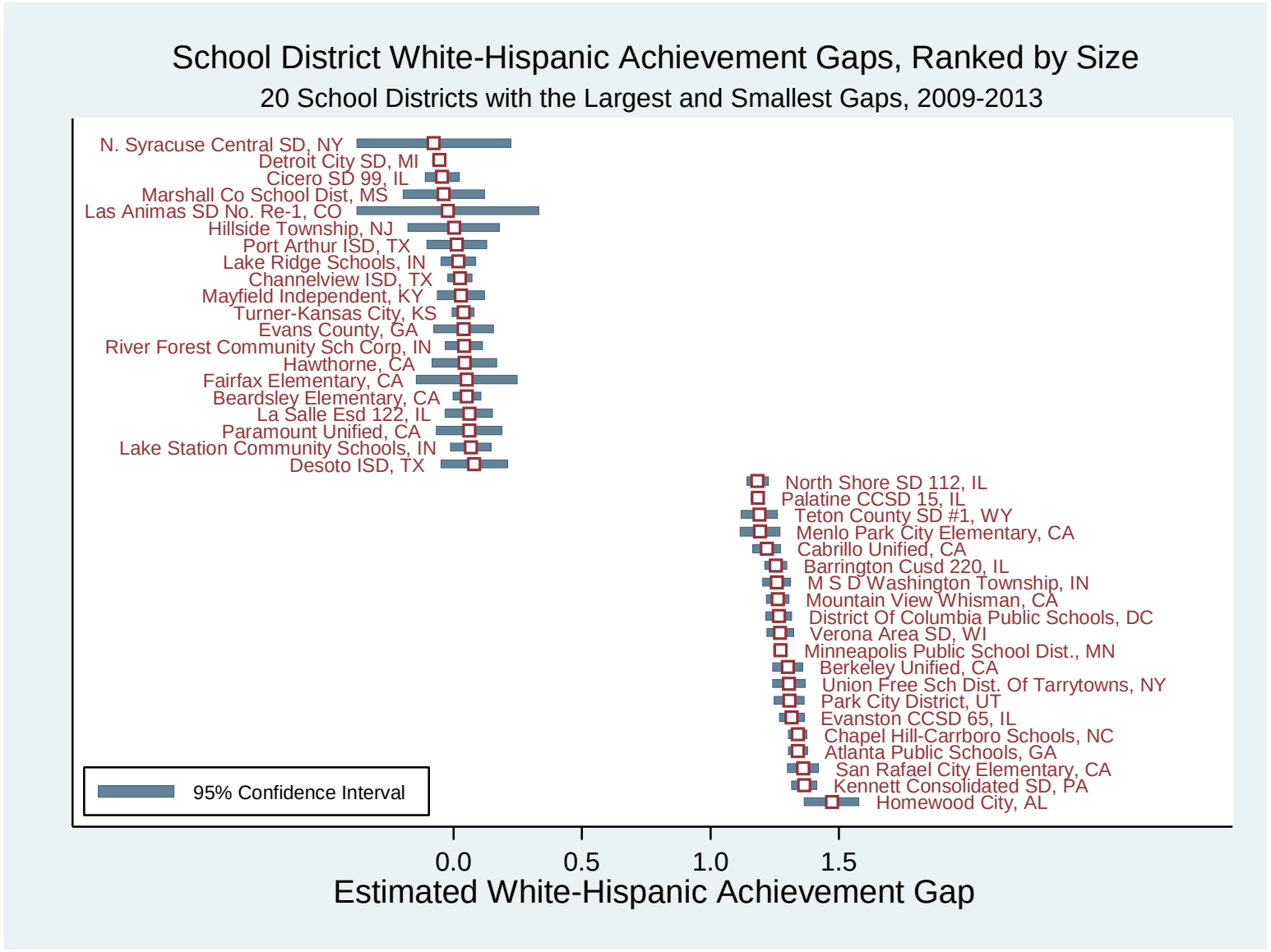
School District White-Hispanic Achievement Gaps, Ranked by Size
20 School Districts with the Largest and Smallest Gaps, 2009-2013
N. Syracuse Central SD, NY
Detroit City SD, MI
Cicero SD 99, IL
Marshall Co School Dist, MS
Las Animas SD No. Re-1, CO
Hillside Township, NJ
Port Arthur ISD, TX
Lake Ridge Schools, IN
Channelview ISD, TX
Mayfield Independent, KY
Turner-Kansas City, KS
Evans County, GA
River Forest Community Sch Corp, IN
Hawthorne, CA
Fairfax Elementary, CA
Beardsley Elementary, CA
La Salle Esd 122, IL
Paramount Unified, CA
Lake Station Community Schools, IN
Desoto ISD, TX
North Shore SD 112, IL
Palatine CCSD 15, IL
Teton County SD #1, WY
Menlo Park City Elementary, CA
Cabrillo Unified, CA
Barrington Cusd 220, IL
M S D Washington Township, IN
Mountain View Whisman, CA
District Of Columbia Public Schools, DC
Verona Area SD, WI
Minneapolis Public School Dist., MN
Berkeley Unified, CA
Union Free Sch Dist. Of Tarrytowns, NY
Park City District, UT
Evanston CCSD 65, IL
Chapel Hill-Carrboro Schools, NC
Atlanta Public Schools, GA
San Rafael City Elementary, CA
Kennett Consolidated SD, PA
Homewood City, AL
95% Confidence Interval
0.0
0.5
1.0
1.5
Estimated White-Hispanic Achievement Gap

Figure 7

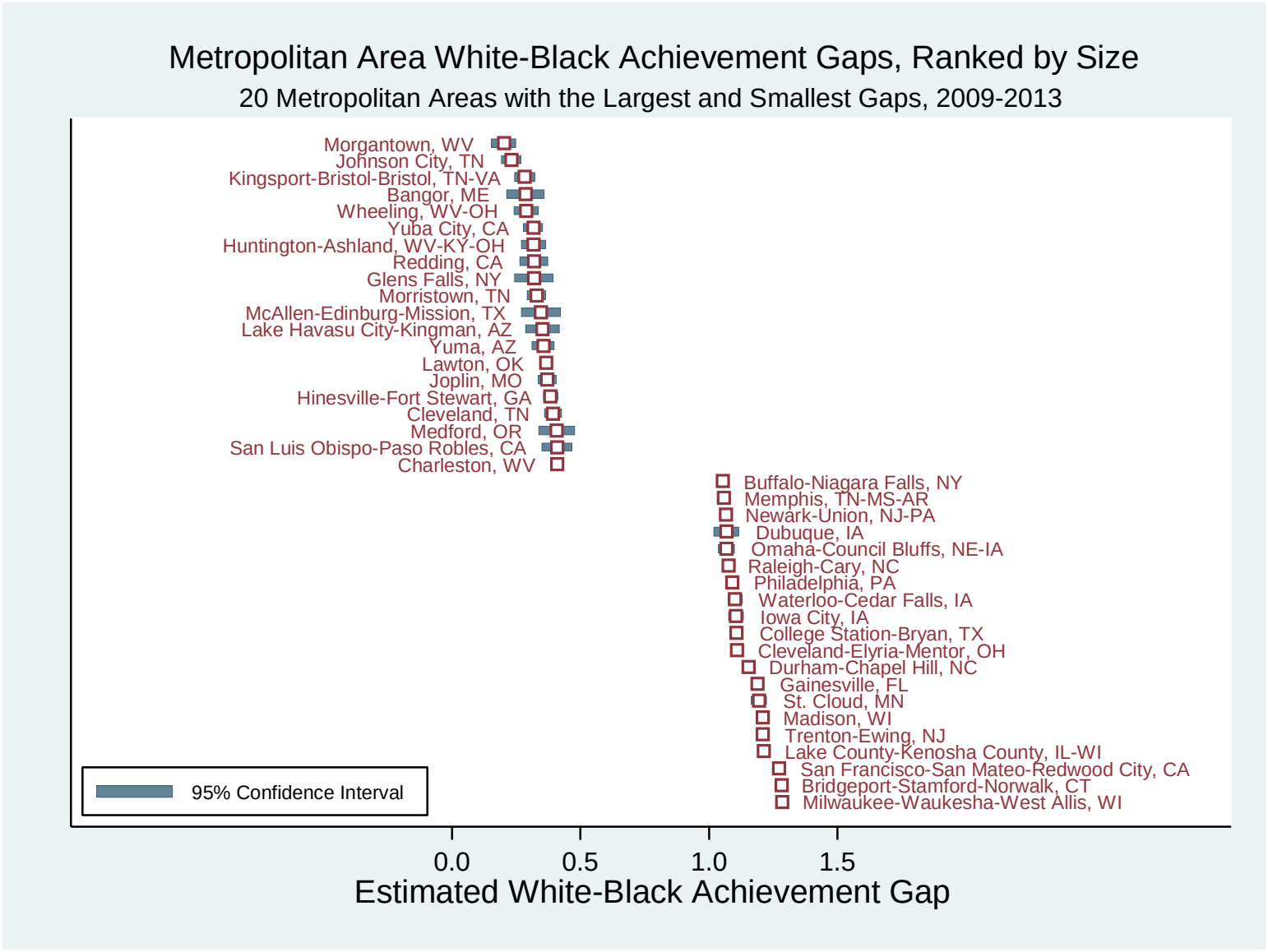
Metropolitan Area White-Black Achievement Gaps, Ranked by Size
20 Metropolitan Areas with the Largest and Smallest Gaps, 2009-2013
Morgantown, WV
Johnson City, TN
Kingsport-Bristol-Bristol, TN-VA
Bangor, ME
Wheeling, WV-OH
Yuba City, CA
Huntington-Ashland, WV-KY-OH
Redding, CA
Glens Falls, NY
Morristown, TN
McAllen-Edinburg-Mission, TX
Lake Havasu City-Kingman, AZ
Yuma, AZ
Lawton, OK
Joplin, MO
Hinesville-Fort Stewart, GA
Cleveland, TN
Medford, OR
San Luis Obispo-Paso Robles, CA
Charleston, WV
Buffalo-Niagara Falls, NY
Memphis, TN-MS-AR
Newark-Union, NJ-PA
Dubuque, IA
Omaha-Council Bluffs, NE-IA
Raleigh-Cary, NC
Philadelphia, PA
Waterloo-Cedar Falls, IA
Iowa City, IA
College Station-Bryan, TX
Cleveland-Elyria-Mentor, OH
Durham-Chapel Hill, NC
Gainesville, FL
St. Cloud, MN
Madison, WI
Trenton-Ewing, NJ
Lake County-Kenosha County, IL-WI
San Francisco-San Mateo-Redwood City, CA
Bridgeport-Stamford-Norwalk, CT
Milwaukee-Waukesha-West Allis, WI
95% Confidence Interval
0.0
0.5
1.0
1.5
Estimated White-Black Achievement Gap

Figure 8

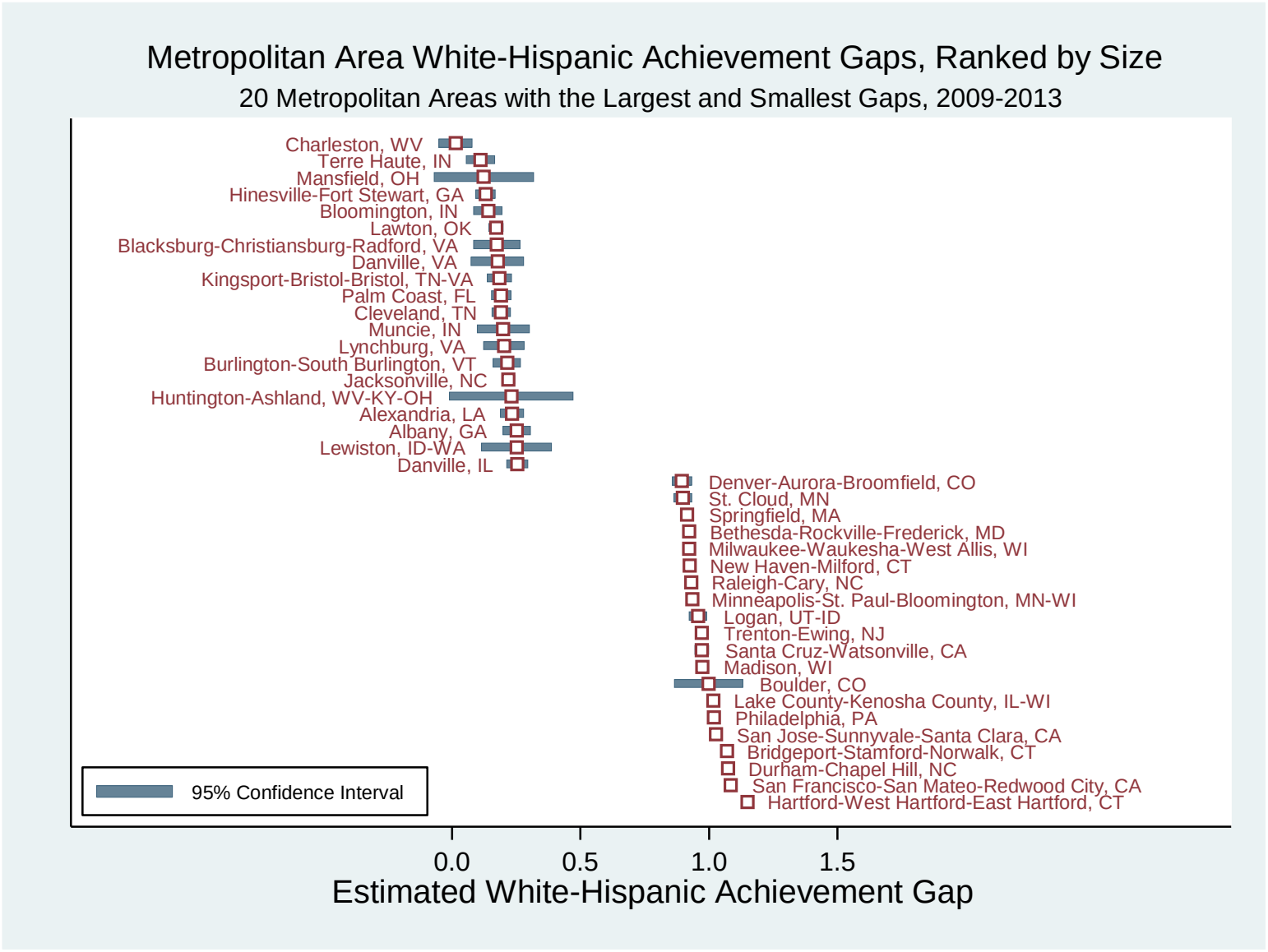
Metropolitan Area White-Hispanic Achievement Gaps, Ranked by Size
20 Metropolitan Areas with the Largest and Smallest Gaps, 2009-2013
Charleston, WV
Terre Haute, IN
Mansfield, OH
Hinesville-Fort Stewart, GA
Bloomington, IN
Lawton, OK
Blacksburg-Christiansburg-Radford, VA
Danville, VA
Kingsport-Bristol-Bristol, TN-VA
Palm Coast, FL
Cleveland, TN
Muncie, IN
Lynchburg, VA
Burlington-South Burlington, VT
Jacksonville, NC
Huntington-Ashland, WV-KY-OH
Alexandria, LA
Albany, GA
Lewiston, ID-WA
Danville, IL
Denver-Aurora-Broomfield, CO
St. Cloud, MN
Springfield, MA
Bethesda-Rockville-Frederick, MD
Milwaukee-Waukesha-West Allis, WI
New Haven-Milford, CT
Raleigh-Cary, NC
Minneapolis-St. Paul-Bloomington, MN-WI
Logan, UT-ID
Trenton-Ewing, NJ
Santa Cruz-Watsonville, CA
Madison, WI
Boulder, CO
Lake County-Kenosha County, IL-WI
Philadelphia, PA
San Jose-Sunnyvale-Santa Clara, CA
Bridgeport-Stamford-Norwalk, CT
Durham-Chapel Hill, NC
San Francisco-San Mateo-Redwood City, CA
Hartford-West Hartford-East Hartford, CT
95% Confidence Interval
0.0
0.5
1.0
1.5
Estimated White-Hispanic Achievement Gap

Figure 9

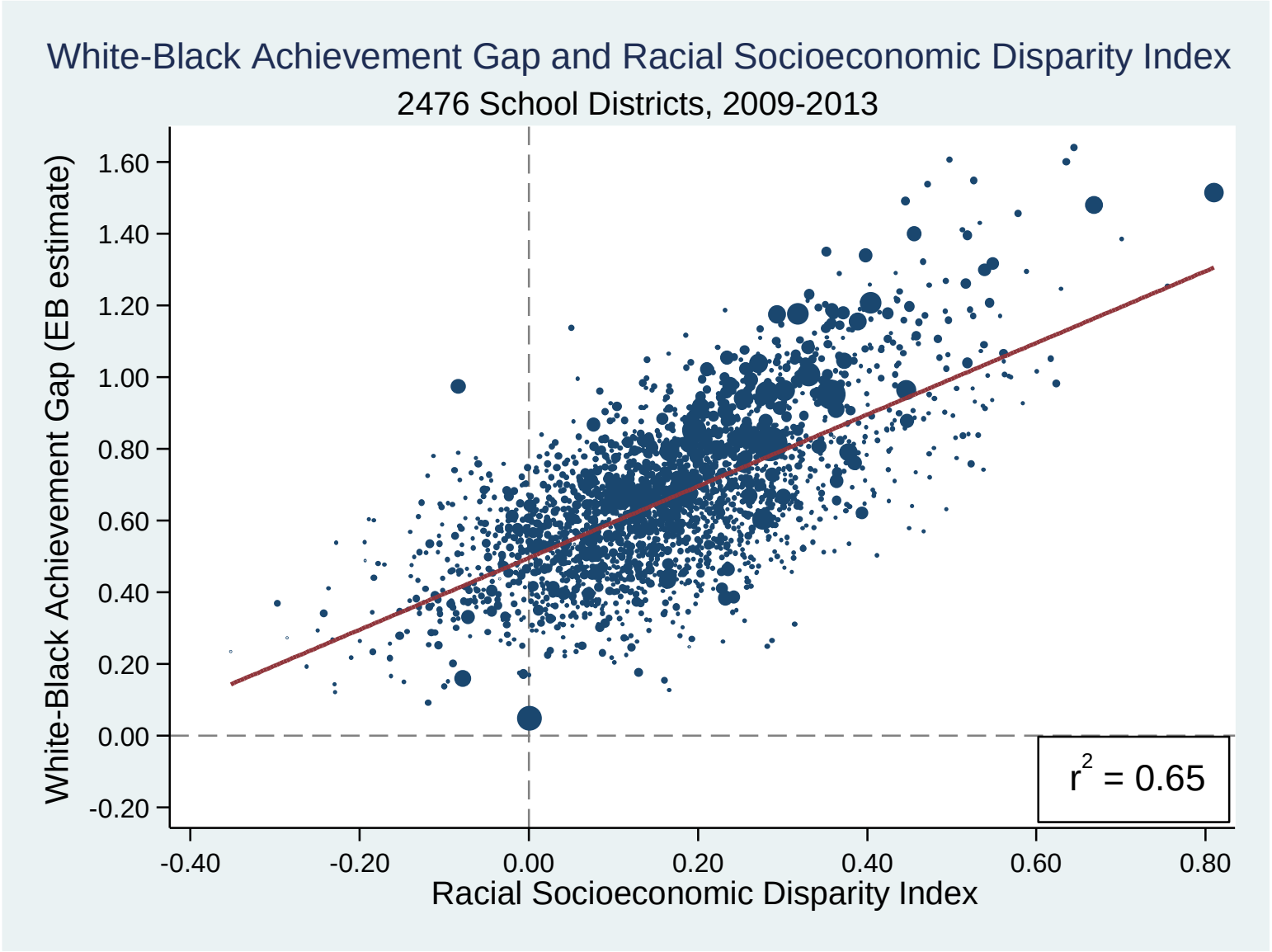
White-Black Achievement Gap and Racial Socioeconomic Disparity Index
2476 School Districts, 2009-2013
White-Black Achievement Gap (EB estimate)
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.20
0.00
0.20
0.40
0.60
0.80
Racial Socioeconomic Disparity Index
r2 = 0.65

Figure 10

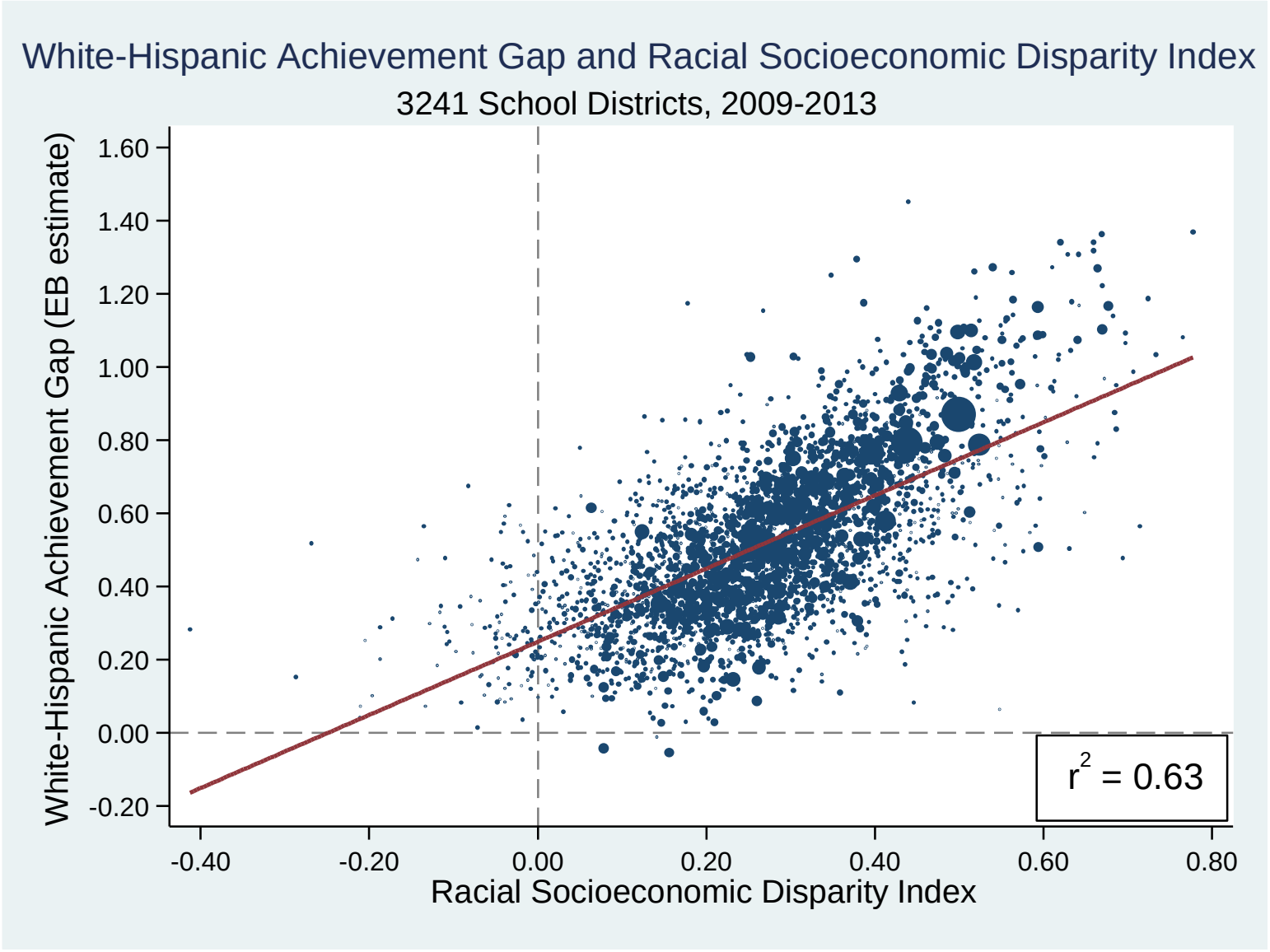
White-Hispanic Achievement Gap and Racial Socioeconomic Disparity Index
3241 School Districts, 2009-2013
White-Hispanic Achievement Gap (EB estimate)
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.20
0.00
0.20
0.40
0.60
0.80
Racial Socioeconomic Disparity Index
r2 = 0.63

Figure 11

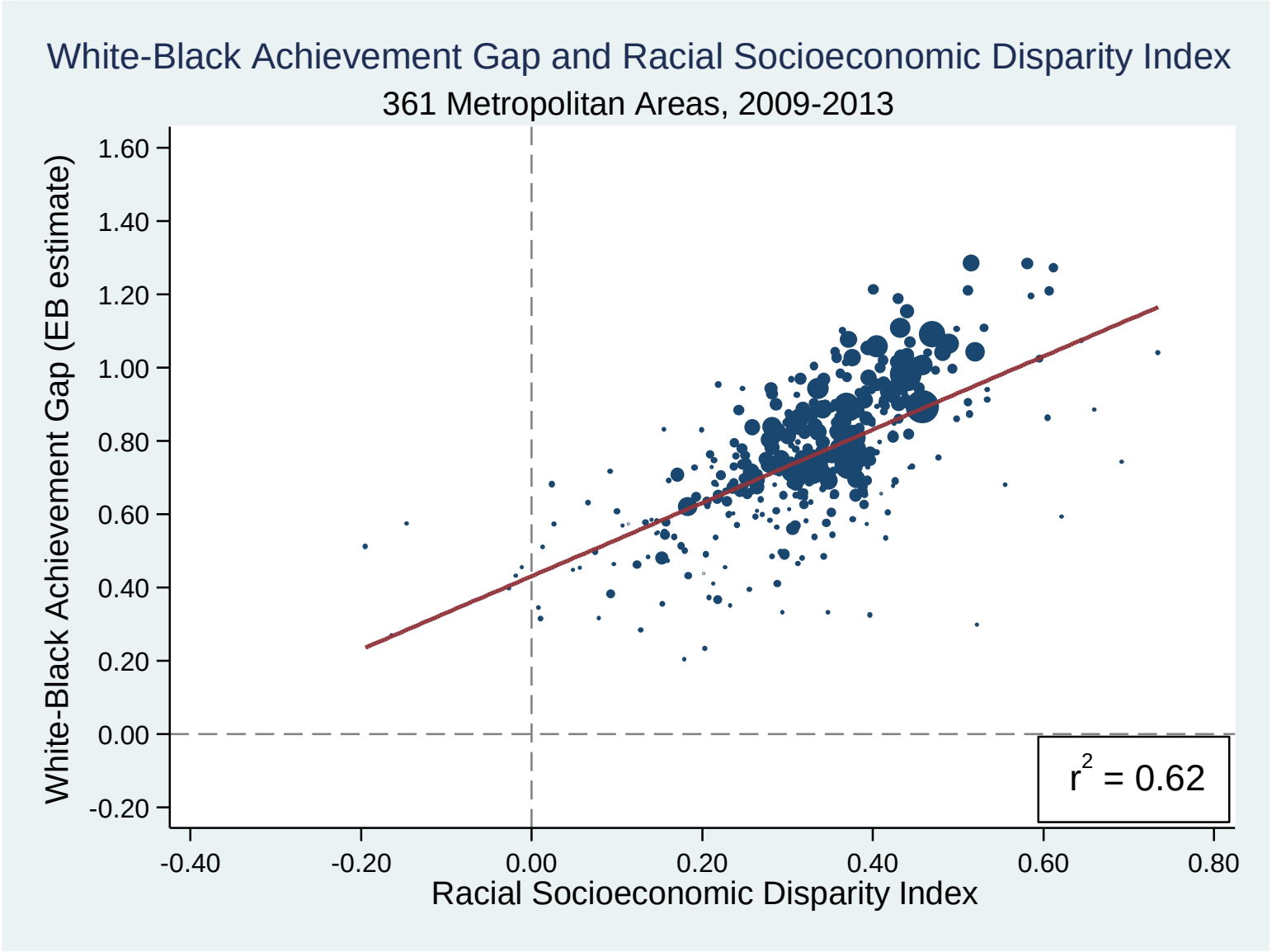
White-Black Achievement Gap and Racial Socioeconomic Disparity Index
361 Metropolitan Areas, 2009-2013
White-Black Achievement Gap (EB estimate)
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.20
0.00
0.20
0.40
0.60
0.80
Racial Socioeconomic Disparity Index
r2 = 0.62

Figure 12

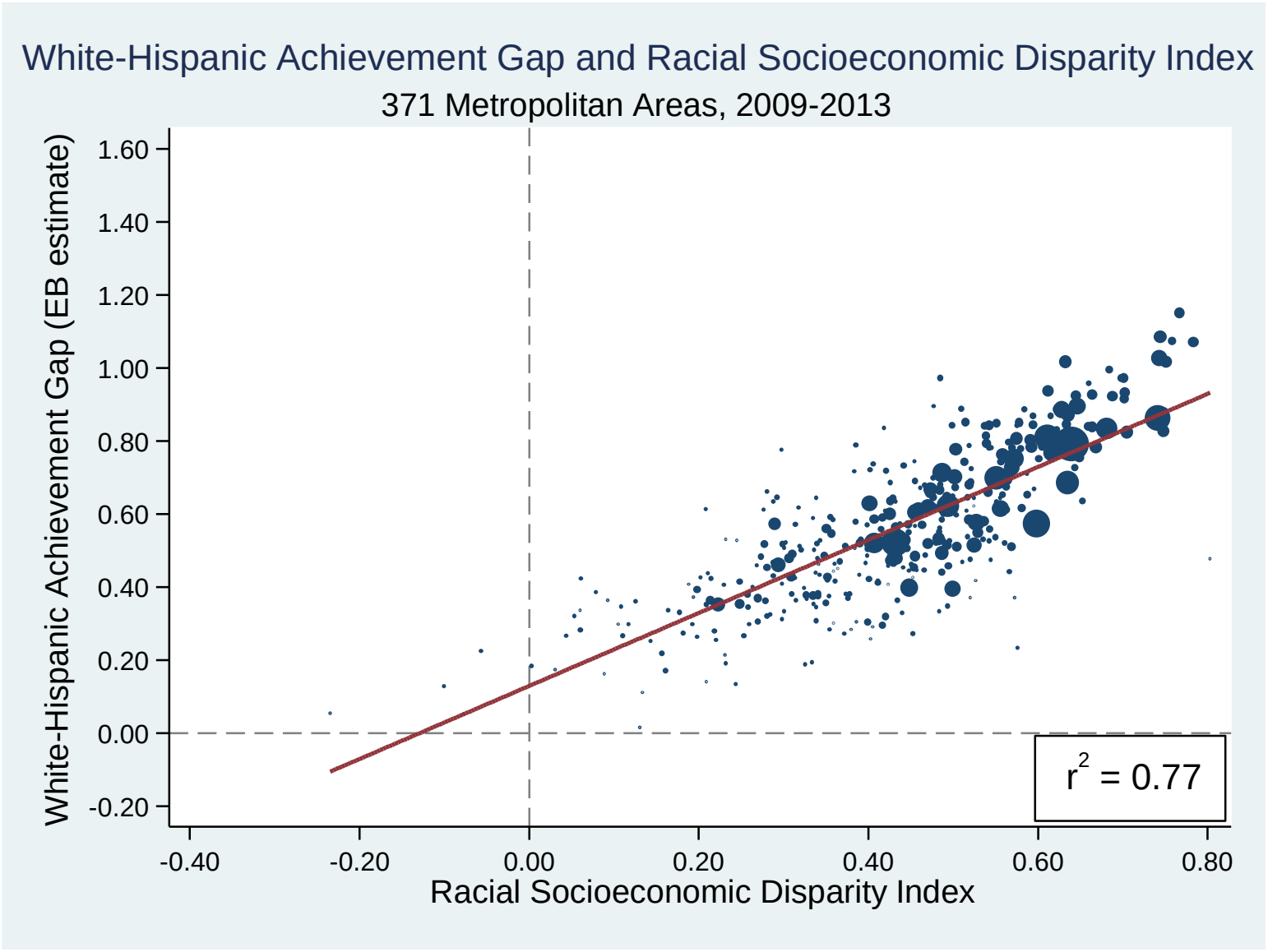
White-Hispanic Achievement Gap and Racial Socioeconomic Disparity Index
371 Metropolitan Areas, 2009-2013
White-Hispanic Achievement Gap (EB estimate)
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.20
0.00
0.20
0.40
0.60
0.80
Racial Socioeconomic Disparity Index
r2 = 0.77

Table 1. Gap Data Coverage by Subject, Group and Unit

	White-Black Gaps			White-Hispanic Gaps		
	ELA	Math	Pooled	ELA	Math	Pooled
Number with 1 or More Gaps in Any Grade or Year						
Metros	378	378	378	377	377	377
Districts	2878	2854	2899	3632	3642	3689
Mean Number of Gaps, Among those with 1 or More Gaps (maximum=30 by subjects, 60 for pooled)						
Metros	27.39	26.57	53.96	27.66	26.82	54.48
Districts	22.24	21.82	43.68	20.74	19.82	40.10
Percent with 20 (40 for pooled) or More Gaps, Among those with 1 or More Gaps						
Metros	0.93	0.92	0.93	0.94	0.93	0.93
Districts	0.71	0.70	0.70	0.64	0.63	0.63
Percent of Minority Students in Metro/District when Metro/District has 1 or More Gaps						
Metros						
2009	0.96	0.96	0.96	0.98	0.98	0.98
2010	0.96	0.96	0.96	0.98	0.98	0.98
2011	0.96	0.96	0.96	0.98	0.98	0.98
2012	0.96	0.96	0.96	0.98	0.98	0.98
2013	0.96	0.96	0.96	0.98	0.98	0.98
Districts						
2009	0.93	0.93	0.93	0.93	0.92	0.93
2010	0.93	0.93	0.93	0.92	0.92	0.93
2011	0.93	0.93	0.93	0.93	0.92	0.93
2012	0.93	0.93	0.93	0.93	0.92	0.93
2013	0.93	0.93	0.93	0.92	0.92	0.93

Table 2. Means and Standard Deviations of Gap Correlates

	White-Black				White-Hispanic			
	Metros		Districts		Metros		Districts	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Achievement Gaps	0.749	0.197	0.659	0.218	0.559	0.208	0.516	0.225
Socioeconomic Composition								
Median Income (in $100,000)	0.579	0.123	0.597	0.246	0.579	0.122	0.644	0.267
Proportion of Adults, Aged 25+ with a Bachelor's Degree or Higher	0.275	0.086	0.270	0.146	0.276	0.087	0.276	0.151
Proportion Receiving Free Lunches in Public Schools	0.414	0.112	0.445	0.201	0.414	0.112	0.406	0.202
Single Parent Household Rate	0.272	0.056	0.288	0.107	0.271	0.056	0.245	0.097
Racial/Ethnic Composition								
Proportion Black in Public Schools	0.157	0.143	0.220	0.199	0.153	0.143	0.114	0.153
Proportion Hispanic in Public Schools	0.174	0.193	0.179	0.201	0.179	0.197	0.265	0.228
Hispanics, Speak English Well or Very Well	0.864	0.074	0.865	0.144	0.862	0.074	0.858	0.114
Racial Socioeconomic Disparities								
White-Minority Income Gap	0.765	0.344	0.649	0.472	0.704	0.295	0.633	0.456
White-Minority Education Gap	0.243	0.222	0.175	0.358	0.674	0.326	0.719	0.413
Minority-White Single Parent Household Rate Difference	0.288	0.144	0.270	0.179	0.070	0.114	0.037	0.161
Segregation								
Between School Racial Segregation	0.257	0.149	0.073	0.095	0.179	0.113	0.051	0.071
Between School Free Lunch, Not Free Lunch Segregation	0.161	0.089	0.056	0.065	0.161	0.089	0.050	0.067
Between Tract Racial Segregation	0.271	0.118			0.165	0.081		
Between Tract Poor-Non-Poor Segregation	0.106	0.039			0.105	0.039		
Minority-White Tract Poverty Rate Difference	0.086	0.049			0.056	0.038		
Minority-White Free Lunch Rate Difference	0.187	0.114	0.050	0.071	0.157	0.108	0.045	0.067
School Characteristics								
Per Pupil Instructional Expenditures in Average Student's School (in $10,000)	0.601	0.155	0.629	0.204	0.595	0.154	0.629	0.225
Average Student-Teacher Ratio	16.47	2.81	16.76	27.24	16.61	2.90	16.66	3.79
Proportion Attending Charter Schools	0.031	0.040	0.025	0.067	0.032	0.046	0.024	0.063
White/Minority Per Pupil Instructional Expenditures Ratio	0.964	0.061			0.975	0.046		
Minority/White Student-Teacher Ratio Ratio	1.039	0.056	1.016	0.034	1.031	0.055	1.012	0.038
Minority-White Charter School Enrollment Rate Difference	0.019	0.053	0.003	0.063	-0.001	0.039	-0.007	0.046
Sample Size	361		2476		371		3241	

Notes: SD = standard deviation

Table 3. Pairwise Correlations Among Average Achievement Gaps in Each Metro/District and Other Factors

	White-Black Gaps		White-Hispanic Gaps	
	Metros	Districts	Metros	Districts
Socioeconomic Composition				
Median Income (in $100,000)	0.312 ***	0.267 ***	0.485 ***	0.200 ***
Proportion of Adults, Aged 25+ with a Bachelor's Degree or Higher	0.455 ***	0.554 ***	0.522 ***	0.437 ***
Proportion Receiving Free Lunches in Public Schools	-0.198 ***	-0.247 ***	-0.307 ***	-0.160 ***
Single Parent Household Rate	0.102	-0.051 *	-0.295 ***	-0.083 ***
Racial/Ethnic Composition				
Proportion Black in Public Schools	0.269 ***	0.007	-0.162 **	-0.004
Proportion Hispanic in Public Schools	-0.132 *	-0.081 ***	0.263 ***	0.046 **
Hispanics, Speak English Well or Very Well	-0.171 **	-0.055 **	-0.351 ***	-0.177 ***
Racial Socioeconomic Disparities				
White-Minority Income Gap	0.551 ***	0.415 ***	0.615 ***	0.413 ***
White-Minority Education Gap	0.411 ***	0.558 ***	0.597 ***	0.423 ***
Minority-White Single Parent Household Rate Difference	0.394 ***	0.252 ***	0.245 ***	0.139 ***
Segregation				
Between School Racial Segregation	0.538 ***	0.194 ***	0.658 ***	0.341 ***
Between School Free Lunch, Not Free Lunch Segregation	0.399 ***	0.261 ***	0.464 ***	0.257 ***
Between Tract Racial Segregation	0.450 ***		0.554 ***	
Between Tract Poor-Non-Poor Segregation	0.522 ***		0.355 ***	
Minority-White Tract Poverty Rate Difference	0.418 ***		0.426 ***	
Minority-White Free Lunch Rate Difference	0.656 ***	0.346 ***	0.699 ***	0.383 ***
School Characteristics				
Per Pupil Instructional Expenditures in Average Student's School (in $10,000)	0.156 **	0.257 ***	0.222 ***	0.256 ***
Average Student-Teacher Ratio	-0.131 *	-0.012	0.101	-0.092 ***
Proportion Attending Charter Schools	0.136 **	0.027	0.197 ***	0.071 ***
White/Minority Per Pupil Instructional Expenditures Ratio	-0.209 ***		-0.055	
Minority/White Student-Teacher Ratio Ratio	0.225 ***	0.201 ***	0.074	0.181 ***
Minority-White Charter School Enrollment Rate Difference	0.353 ***	0.007	-0.005	-0.052 **
Sample Size	361	2476	371	3241

Notes: ***p<=.001; **p<=.01; *p<=.05 The correlations for districts include state fixed effects and are therefore within state correlations. The correlations for metros do not include state fixed effects because there are not sufficient metros within each state to support including the state fixed effects.

Table 4. Full Models, Select Coefficients

	White-Black Gaps		White-Hispanic Gaps	
	Metros	Districts	Metros	Districts
Socioeconomic Composition				
Median Income (in $100,000)	-0.265	-0.099 *	-0.045	-0.132 ***
	(0.198)	(0.046)	(0.172)	(0.033)
Proportion of Adults, Aged 25+ with a Bachelor's Degree or Higher	0.714 ***	0.603 ***	0.569 ***	0.510 ***
	(0.189)	(0.057)	(0.167)	(0.049)
Proportion Receiving Free Lunches in Public Schools	-0.045	-0.239 ***	-0.428 ***	-0.178 ***
	(0.141)	(0.046)	(0.126)	(0.038)
Single Mother Households	0.389	0.074	0.210	-0.101
	(0.369)	(0.073)	(0.347)	(0.063)
Racial/Ethnic Composition				
Proportion Black in Public Schools	0.075	0.084 **	0.220 *	0.027
	(0.114)	(0.032)	(0.109)	(0.031)
Proportion Hispanic in Public Schools	0.189 *	0.117 ***	0.152 *	0.146 ***
	(0.074)	(0.031)	(0.068)	(0.026)
Hispanics, Speak English Well or Very Well	-0.193	-0.033	-0.119	-0.023
	(0.116)	(0.022)	(0.109)	(0.029)
Racial Socioeconomic Disparities				
White-Minority Income Gap	-0.004	0.018	-0.020	0.029 **
	(0.040)	(0.010)	(0.037)	(0.009)
White-Minority Education Gap	0.133 ***	0.169 ***	0.226 ***	0.175 ***
	(0.035)	(0.011)	(0.037)	(0.010)
Minority-White Single Parent Household Rate Difference	-0.003	0.068 **	0.084	0.019
	(0.060)	(0.021)	(0.071)	(0.020)
Segregation				
Between School Racial Segregation	0.396 *	-0.145 **	0.461	0.023
	(0.185)	(0.055)	(0.247)	(0.087)
Between School Free Lunch, Not Free Lunch Segregation	-0.788 ***	-0.342 ***	-0.160	-0.190 **
	(0.227)	(0.079)	(0.189)	(0.065)
Between Tract Racial Segregation	-0.356 **		-0.454 *	
	(0.133)		(0.190)	
Between Tract Poor-Non-Poor Segregation	0.062		-0.063	
	(0.248)		(0.216)	
Minority-White Tract Poverty Rate Difference	0.238		-0.019	
	(0.251)		(0.297)	
Minority-White Free Lunch Rate Difference	0.769 ***	0.904 ***	0.727 ***	0.708 ***
	(0.180)	(0.090)	(0.175)	(0.100)
School Characteristics				
Per Pupil Instructional Expenditures in Average Student's School (in $10,000)	0.166 *	0.033	0.061	0.009
	(0.082)	(0.020)	(0.069)	(0.015)
Average Student-Teacher Ratio	-0.002	0.000	-0.001	-0.003 *
	(0.004)	(0.000)	(0.004)	(0.001)
Proportion Attending Charter Schools	0.179	-0.097	0.065	0.072
	(0.188)	(0.051)	(0.154)	(0.046)
White/Minority Per Pupil Instructional Expenditures Ratio	-0.067		-0.221	
	(0.136)		(0.133)	
Minority/White Student-Teacher Ratio Ratio	0.278 *	0.002	0.094	0.128
	(0.122)	(0.099)	(0.133)	(0.080)
Minority-White Charter School Enrollment Rate Difference	0.075	0.053	-0.009	0.149 *
	(0.151)	(0.051)	(0.183)	(0.064)
Sample Size	361	2476	371	3241

Note: ***p<=.001; **p<=.01; *p<=.05

Table 5. R^2 From Models with Different Covariate Sets:

	Metro-Level		District-Level	
	W-B	W-H	W-B	W-H
Socioeconomic Composition	0.44	0.47	0.43	0.37
Racial/Ethnic Composition	0.12	0.24	0.06	0.07
Racial Socioeconomic Disparities	0.39	0.60	0.42	0.40
Segregation	0.51	0.58	0.17	0.18
School Characteristics	0.35	0.38	0.12	0.16
Racial Socioeconomic Disparities + Socioeconomic Composition	0.60	0.75	0.58	0.58
Racial Socioeconomic Disparities + Socioeconomic Composition +				
--Racial/Ethnic Composition	0.63	0.77	0.59	0.60
--Segregation	0.71	0.80	0.62	0.62
--School Characteristics	0.69	0.77	0.61	0.61
All	0.76	0.82	0.64	0.64
N	361	371	2476	3241

The district models include state fixed effects and therefore the R^2 reflects the proportion of within state variance explained. The models for metros do not include state fixed effects because there are not sufficient metros within each state to support including the state fixed effects.

Appendix A1: Different Samples of Metropolitan Statistical Areas, Bivariate Correlations of Selected Variables

Table A1 reports the pairwise correlations between achievement gaps and a set of metropolitan area characteristics.[21] As described in the body of the text, these characteristics are organized into five categories: 1) average socioeconomic conditions, 2) racial/ethnic composition 3) racial disparities in family resources, 4) patterns of residential and school segregation, and 5) educational policies and practices. As above, only a subset of the full set of covariates are shown here. Correlations are shown for three different samples of metropolitan statistical areas: (1) all MSAs contained within a single state plus the largest MSA sub-section that overlaps with a state (this is the sample used in the paper); (2) only MSAs contained within a single state; (3) all MSAs contained within a single state, as well as all MSA sub-sections. Our preferred sample is sample (1). Sample (2) would remove MSAs like New York-White Plains-Wayne, NY-NJ, which have large shares of the student population in one of the subsections. Sample (3) would include much smaller MSA subsections, such as Washington-Arlington-Alexandria, DC-VA-MD-WV, for which the outlying areas are much more homogeneous and socioeconomically disconnected from the larger MSA subsection.

The bivariate correlations for the different MSA samples show that the overall descriptive patterns described in the text are, for the most part, insensitive to which sample we used. For white-black and white-Hispanic gaps, in no cases do the signs of the correlations change between MSA sample. Statistical significance, in nearly all cases, is commensurate across the three MSA samples. Finally, the magnitudes of the correlations are very similar across the samples.

[Table A1 here]

[21] Specifically, the reported correlation coefficient is the precision-weighted correlation coefficient, where the weighting variable is equal to $\frac{1}{\tau + \sigma_u^2}$, where τ is equal to estimated true variance of the gaps and σ_u^2 is the estimated sampling variance of the gap estimate in district or metropolitan area u. τ is estimated from a random effects meta-analytic regression model.

Appendix A2: Using ED*Facts* Data to Estimate Achievement Gaps, NAEP Comparison

To assess whether state accountability test data from ED*Facts* (which is based on different tests in each state and grade) accurately describes achievement gaps, we compare estimates of the state-level V-statistics computed from ED*Facts* and from the National Assessment of Educational Progress (NAEP). We use two primary data sources to estimate state-level achievement gaps: NAEP[22] and state assessments. We use NAEP 4th and 8th grade math and reading test score data from 2009, 2011 and 2013, and categorical proficiency data (e.g., percentages of students scoring "Below Basic," "Basic," "Proficient," and "Advanced") from state-administered standardized math and reading tests compiled by ED*Facts*. Though ED*Facts* data are available for grades 3-8, we use data for grades 4 and 8 in order to match what is available from NAEP.

Across all grades, years, subjects and data source, the sample includes 1,062 white-black achievement gaps and 1,090 white-Hispanic achievement gaps. From these data, we compute state-level achievement gaps (V) for state assessments and the NAEP for white-black and white-Hispanic gaps in each state-year-grade-subject combination for which we have NAEP and state test data. In the case of Ed Facts, the V-statistic is estimated from coarsened proficiency data (see the section of the text titled *Achievement Gap Measure* for description); for the NAEP, the V-statistic can be calculated from the complete cumulative distribution function using student-level data.

We wish to test the extent to which V-gaps estimated from state assessment data depart from V-gaps estimated from NAEP. To do this, we estimate 24 precision-weighted random coefficients models, in which each model corresponds to a grade (4, 8), year (2009, 2011, 2013), subject (math, ELA), and gap (white-black, white-Hispanic). For each iteration, we include only observations for which we were able to estimate a gap in both the NAEP and ED*Facts*. Depending on the year, grade, subject and gap groups, the

[22] We use "State NAEP" data, based on math and reading assessments administered to representative samples of fourth- and eighth-graders roughly every two years in each of the 50 states. State NAEP sample sizes are roughly 2,500 students, from approximately 100 schools, in each state-grade-subject.

number of overlapping observations ranged between 70 to 98. The model takes the form:

$$\hat{G}_u = [\gamma_{n0} + v_{mu}]N_s + [\gamma_{e0} + v_{eu}]E_s + \epsilon_u$$

$$\epsilon_u \sim N[0, \hat{\omega}_u^2]$$

$$\begin{bmatrix} v_{nu} \\ v_{eu} \end{bmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \tau_{nn} & \tau_{ne} \\ \tau_{ne} & \tau_{ee} \end{pmatrix}\right]$$

(A1)

Here, $\hat{G}_u$ is the estimated achievement gap for state u; its estimated standard error is $\hat{\omega}_u$. The variables N_s and E_s are dummy variables indicating, respectively, whether $\hat{G}_u$ describes a NAEP or ED*Facts* gap. The model is estimated separately for each grade, year and subject. The error terms in the model indicate that estimated gaps may vary in two ways. First, estimated gaps may differ from their true values because of sampling variance; this is indicated by the error term ϵ_u, which is assumed to be normally distributed with a known variance equal to $\hat{\omega}_u^2 = var(\hat{G}_u)$. Second, unit-specific average NAEP and ED*Facts* gaps may deviate from the mean NAEP and ED*Facts* gaps among states (which are denoted by γ_{n0} and γ_{e0}, respectively). We allow these deviations (v_{nu} and v_{eu}) to differ for NAEP and ED*Facts*; they are assumed multivariate normal with a variance matrix $\tau = \begin{pmatrix} \tau_{nn} & \tau_{ne} \\ \tau_{ne} & \tau_{ee} \end{pmatrix}$ that must be estimated.

The parameters of interest are the NAEP and ED*Facts* intercepts, γ_{n0} and γ_{e0}, respectively and the correlations between v_{nu} and v_{eu} ($\rho_{ne} = \frac{\tau_{ne}}{\sqrt{\tau_{nn} \cdot \tau_{ee}}}$). The intercept terms correspond to the precision-weighted average gap according to the NAEP and ED*Facts* in the corresponding grade, year and subject. We also construct NAEP/ED*Facts* average gap ratio ($\hat{\gamma}_{n0}/\hat{\gamma}_{e0}$); ratio values greater than one indicate the estimated NAEP gap is greater than the estimated ED*Facts* gap. The correlation of the NAEP and ED*Facts* state-specific random effects (ρ_{ne}) indicates how consistently states are ranked according to the different measures.

Estimates from the model are shown in Table A2. Table A2 shows the precision-weighted NAEP and ED*Facts* intercepts for years 2009, 2011 and 2013; grades 4 and 8; subjects Math and ELA; and gap-

groups White-Black and White-Hispanic. NAEP gaps are consistently larger than those from Ed Facts, on average, in math (the NAEP/ED*Facts* ratio is greater than one in all cases for math gaps, ranging between 1.11 and 1.27) and are closer, on average, to those from Ed Facts in ELA (the NAEP/ED*Facts* ratio ranges between 0.91 and 1.08). In most cases, the null hypothesis that γ_{n0}= γ_{e0} is rejected (always in math, some of the time in ELA). Despite these differences, correlation coefficients on the NAEP and ED*Facts* random effects are very high, ranging between 0.85 to 0.97. These high correlations indicate that gaps estimated from state tests correspond well to gaps estimated from the NAEP, despite the fact that that states use different tests. Thus, comparing gaps based on different state tests appears largely valid.

[Table A2 here]

Appendix A3: Pooling Achievement Gaps within Districts

To assess whether pooling the up to 60 achievement gap estimates (across grades, years, and subjects) for each district or metropolitan areas is likely to obscure important within-district variation in gaps across grades, year, and subject, we fit the following precision-weighted random effects model, using all available estimated white-black (or white-Hispanic) gaps in the data:

$$\hat{G}_{usgy} = \left[\gamma_{m0} + \gamma_{m1}(g_g - 5.5) + \gamma_{m2}(y_y - 2011) + v_{mu}\right]M_s + \left[\gamma_{e0} + \gamma_{e1}(g_g - 5.5) + \gamma_{e2}(y_y - 2011) + v_{eu}\right]E_s + e_{usgy} + \epsilon_{usgy}$$

$$\epsilon_{usgy} \sim N\left[0, \hat{\omega}^2_{usgy}\right]$$

$$e_{usgy} \sim N[0, \sigma^2]$$

$$\begin{bmatrix} v_{mu} \\ v_{eu} \end{bmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \tau_{mm} & \tau_{me} \\ \tau_{me} & \tau_{ee} \end{pmatrix}\right] \quad \text{(A2)}$$

Here, $\hat{G}_{usgy}$ is the estimated achievement gap for unit u in subject s in grade g and year y; its estimated standard error is $\hat{\omega}_{usgy}$. The variables M_s and E_s are dummy variables indicating, respectively, whether $\hat{G}_{usgy}$ describes a math or ELA gap. Grade (g_g) and year (y_y) are centered around 5.5 and 2011, respectively, so that the math and ELA intercepts (γ_{m0} and γ_{e0}, respectively) describe the average achievement gap at the midpoint of the years (2009 to 2013) and grades (3 to 8) represented in our data. The error terms in the model indicate that estimated gaps may vary in three ways, net of linear subject-specific grade and year trends. First, estimated gaps may differ from their true values because of sampling variance; this is indicated by the error term ϵ_{usgy}, which is assumed to be normally distributed with a known variance equal to $\hat{\omega}^2_{usgy} = var\left(\hat{G}_{usgy}\right)$. Second, gaps may differ from their unit-specific grade-year-subject predicted value because of within-unit variation not captured by the subject-specific grade and year trends; this is indicated by the error term e_{usgy}, which is assumed normally distributed with a constant variance σ^2 that must be estimated. Third, unit-specific average math and ELA gaps may

deviate from the mean math and ELA gaps among units (which are denoted by γ_{m0} and γ_{e0}, respectively). We allow these deviations (v_{mu} and v_{eu}) to differ for math and ELA; they are assumed multivariate normal with a variance matrix $\tau = \begin{pmatrix} \tau_{mm} & \tau_{me} \\ \tau_{me} & \tau_{ee} \end{pmatrix}$ that must be estimated.

The key parameters of interest here are the variance components σ^2 and τ. If σ^2 is small compared to τ_{mm} and τ_{ee} (that is, if the intraclass correlations $\rho_m = \frac{\tau_{mm}}{\tau_{mm}+\sigma^2}$ and $\rho_e = \frac{\tau_{ee}}{\tau_{ee}+\sigma^2}$ are large), then there is little variation within units relative to the variation in gaps among units, implying that we can pool gaps within units and subjects with little loss of information. In addition, if the correlation between v_{mu} and v_{eu}, $\rho_{me} = \frac{\tau_{me}}{\sqrt{\tau_{mm} \cdot \tau_{ee}}}$, is high, then the math and ELA gaps in a unit contain little unique information, implying that we can pool gaps across subject within units as well.

The estimates from this model are shown in Table A3. We fit model (A2) separately for white-black and white-Hispanic gaps and for metropolitan areas and school districts. In the metropolitan area models, the intraclass correlations of achievement gaps are between 0.90 and 0.93; in the district models, they are between 0.86 and 0.90. In each case, then, roughly 90% of the within-subject variation in achievement gaps is between metropolitan areas or districts. The correlations between average math and ELA gaps within geographic units are also quite high, ranging from 0.91 to 0.95. These results indicate that we can pool estimated gaps within geographic units with little loss of information.

Moreover, Table A3 indicates that the pooled estimates are sufficiently precise that we can very reliably distinguish among geographic units. Subject-specific estimated reliabilities (which correspond to model A2 above) range between 0.96-0.97; for district level estimates it is 0.86-0.90.

[Table A3 here]

The results in Table A3 indicate that pooling gap estimates across years, grades, and subjects within geographic units results in very little loss of information (and a considerable increase in precision). Given this evidence, we pool the estimated achievement gaps within each metropolitan area and district

as follows. For each district or metropolitan area u, we fit the model:

$$\hat{G}_{usgy} = \gamma_{u0} + \gamma_{u1}(g_g - 5.5) + \gamma_{u2}(y_y - 2011) + \gamma_{u3}(M_s - 0.5) + e_{usgy} + \epsilon_{usgy}$$

$$\epsilon_{usgy} \sim N[0, \hat{\omega}^2_{usgy}]$$

$$e_{usgy} \sim N[0, \sigma^2]$$

(A3)

We take $\hat{\gamma}_{u0}$ as our pooled estimate. This is a precision-weighted meta-analytic average, controlling for grade, year, and test subject, of the (up to) 60 gap estimates available in each district or metropolitan area. We use these pooled estimates for the remainder of our analysis.

In this pooled model, intra-class correlations are slightly higher than in the subject-specific models, ranging between 0.93 to 0.95 for metropolitan statistical areas and 0.84 and 0.89 for school districts. The reliability of metropolitan-level intercept random effects ranges between 0.961 and 0.964 for white-black and white-Hispanic gaps, respectively; for district level estimates, the reliabilities are a little smaller, ranging between 0.893 and 0.844 for white-black and white-Hispanic gaps, respectively. In Table A3, all results are from Model (A2) unless indicated as "pooled."

Appendix A4: Covariate Description

Here we discuss the various measures that are used to characterize the demographic and socioeconomic composition of districts and metropolitan statistical areas. A full list of variables and their data source is shown in Table A4. All EDGE data are for the ACS rolling survey for years 2006-2010. In order for the demographic enrollment data to correspond to the achievement data, all data from the CCD are taken for years 2008-09 through 2012-13 and averaged across years (and grades when applicable). All CRDC data are for years 2009-2010. For the EDGE data, two tabulations are used. When the data apply to parents (e.g., education level) and not families, households or children, the tabulation is "parents of relevant children—enrolled public." When the data apply to children or households (e.g., family income), the tabulation is "relevant children—enrolled public." Parent tabulations are only used when children tabulations are unavailable.

[Table A4 here]

For "Socioeconomic Composition" variables, we include the following (variable names are included inside brackets following the variable description): (1) median family income (in $100,000) [Median Income (in $100,000)]; (2) proportion of adults with children enrolled in public school, aged 25+ with a Bachelor's degree or higher [Proportion of Adults, Aged 25+ with a Bachelor's Degree or Higher]; (3) proportion of adults with children enrolled in public school employed in a managerial/professional occupation [Proportion Managerial/Professional Occupation]; (4) percent of students eligible for free lunch [Proportion Free Lunch Poverty Rate]; (5) among households with 5-17 year olds , the percent who are in poverty [Poverty Rate, Households with 5-17 Year Olds]; (6) unemployment rate [Unemployment Rate]; (7) percent of households receiving food stamps or SNAP [Proportion of Households Receiving Food Stamps or SNAP]; (8) the 90/10 family income ratio [90/10 Income Ratio]; (9) proportion of households that are single parent [Proportion Single Parent Households]; (10) average number of persons in a household [Average Household Size]; (11) median housing value (in $100,000) [Median Housing

Value (in $100,000)]; (12) percentage of persons that are renting (as opposed to owning) a residence [Rental Rate All]; (13) median rent (in$10,000) [Median Rent (in$10,000)]; and (14) the percent of individuals who lived in the same house one year ago [One-Year Housing Stability Rate].

All of the variables included in the category "Socioeconomic Composition" except free lunch eligibility are taken from the EDGE. For each of these variables that are defined as a percentage, the share is generated as a fraction of the parents, children, or households in the unit that fulfill the criteria of the variable over the total number within the unit. Median family income is taken directly from the EDGE. The 90/10 income ratio is generated from the counts of individuals falling in one of the 16 income categories recorded in the US Census. Free lunch shares are computed as the average number of children in grades 3-8 who qualify for free or reduced price lunch for years 2006-2010 relative to the total number of public enrolled students in grades 3-8.

For "Racial/Ethnic Composition" variables, we include the following (variables names are included in brackets following the variable description): (1) percent of the public school population that is black [Proportion Black in Public Schools]; (2) percent of the public school population that is Hispanic [Proportion Hispanic in Public Schools]; (3) of Hispanic parents of children enrolled in public schools, the proportion that speak only English or speaks English very well [Hispanics, Speak English Well or Very Well]; (4) of Hispanic parents of children enrolled in public schools, the percent that are foreign born [Hispanics, Foreign Born]; (5) of Hispanic parents of children enrolled in public schools, the percent that is of Mexican origin [Proportion of Hispanic Population that is Mexican]; (6) of Hispanic parents of children enrolled in public schools, the percent that is of Puerto Rican origin [Proportion of Hispanic Population that is Puerto Rican]; (7) of Hispanic parents of children enrolled in public schools, the percent that is of Cuban origin [Proportion of Hispanic Population that is Cuban]; (8) of Hispanic parents of children enrolled in public schools, the percent that is of Central American origin [Proportion of Hispanic Population that is Central American]; and (9) of Hispanic parents of children enrolled in public schools,

the percent that is of South American origin [Proportion of Hispanic Population that is South American].

Shares of students that are Hispanic or black are taken directly from the CCD universe surveys for which school-by-grade-by-race counts of students are available. These counts are aggregated to the district level and averaged across grades 3-8 and years 2009-2013. The percent of the Hispanic population that speaks English well is taken from EDGE and uses the cross-tabulation "parents of relevant children." The country of origin variables for the Hispanic population is taken from the EDGE and uses the cross-tabulation "parents of relevant children." These variables represent characteristics of parents and not households or children; it is for this reason that the parent tabulation is preferred.

For variables characterized as "Racial Socioeconomic Differences," we include the following: (1) White-Minority Income Gap; (2) White-Minority Education Gap; (3) White-Minority Managerial/Professional Occupation Rate Difference; (4) Minority-White Unemployment Rate Difference; (5) Minority-White Poverty Rate Difference; (6) Minority-White SNAP Rate Difference; (7) Minority-White Single Parent Household Rate Difference; (8) Minority-White Rental Rate Difference; and (9) White-Minority One-Year Housing Stability Rate Difference.

All of the "Racial Socioeconomic Difference" variables are computed from EDGE data, using either the children or parent tabulations when appropriate. For income and parental education, we compute racial gaps using the same V-statistic that was used to compute racial achievement gaps (Ho and Reardon 2012). The EDGE provides counts of parents that fall into 16 ordered income categories and 4 ordered education categories.[23] These categorical counts are analogous to the counts of students falling into different academic proficiency categories ("Below Basic," "Basic," and "Proficient"). Income and education gaps are interpretable as white-minority standardized mean differences in income and

[23] For family income, the 16 categories are (in $10,000): $< 10, 10-14.9, 15-19.9, 20-24.99, 25-29.99, 30-34.99, 35-39.99, 40-44.99, 45-49.99, 50-59.99, 60-74.99, 75-99.99, 100-124.99, 125-149.99, 150-199, > 200$; for education, the 4 categories are less than high school diploma, high school graduate, GED, or equivalent, some college or associate's degree, and Bachelor's degree or higher.

educational attainment.

The remainder of the "Racial Socioeconomic Differences" variables are constructed as differences in the relevant race-specific values of the socioeconomic characteristic variables. For example, the variable White-Minority Managerial/Professional Occupation Rate Difference is defined as the percent of white parents of children enrolled in public schools employed in managerial or professional occupations minus the percent of minority parents of children enrolled in public schools with the same occupation.

For the "Segregation" variables, we include the following: (1) Between District Racial Segregation; (2) Between School Racial Segregation; (3) Between District Free Lunch-Not Free Lunch Segregation; (4) Between School Free Lunch-Not Free Lunch Segregation; (5) Between Tract Racial Segregation; (6) Between Tract Poor-Non-Poor Segregation; (7) Between-District Income Segregation of Families with Children Enrolled in Public School; (8) School District Fragmentation; (9) Minority-White Tract Poverty Rate Difference; (10) Minority-White Free Lunch Rate Difference; (11) White-Minority Private School Enrollment Rate Difference; (12) Percent of Black/Hispanic Students' Whose District was Ever Under a Desegregation Court Order; and (13) Percent of Black/Hispanic Students' Whose District is Currently Under a Desegregation Court Order.

The "Segregation" variables are computed from two sources. Measures of between school and between district segregation are computed using the Common Core of Data (CCD). Between-tract measures of segregation are computed for metropolitan areas using data from the EDGE. In both cases, we have counts of white, black, Hispanic, Asian and other race students in each unit, as well as the counts of the number of poor and non-poor students. We use this information to compute the information theory segregation index. The information theory index capturing between school segregation is computed as the average deviation of each student's school racial diversity from the district-wide or metropolitan-wide racial diversity. At the metropolitan area level, the information theory index capturing between district and between tract segregation is computed as the average deviation of each student's

district/tract racial diversity from the metropolitan area-wide racial diversity. Differences in minority-white free lunch rates are computed using school-level CCD data. We take the school level free lunch measure and collapse it to the district or metropolitan area level using the number of 3rd-8th grade white/black/Hispanic students as the weight. This gives us the free lunch rate in the average black student's school in the district, for example. With the free lunch rates estimated separately by race we compute the differences by subtracting the white rate from the minority rate. This measure is computed for both districts and metropolitan areas. For metropolitan areas, we are also able to compute racial differences in tract poverty rates using the same method. Information on black/Hispanic students attending schools in districts that were ever or are currently under court order desegregation plans were computed using a complete list of districts ever under court order desegregation plans and, if applicable, years of release from these plans. These data are described in detail in (Reardon et al. 2012). At the district level, these measures are 0-1 indicator variables (district was/is under a court order), while at the metropolitan area level the measures reflect the proportion of blacks/Hispanics in the area that attend schools in districts that were/are under court orders.

For variables characterized as "School Characteristics—School Inputs", we include the following: (1) White/Minority Per Pupil Total Expenditures Ratio; (2) White/Minority Per Pupil Instructional Expenditures Ratio; (3) Minority-White Student-Teacher Ratio Difference; (4) Minority-White Proportion First or Second Year Teachers Difference; (5) Minority-White Proportion Teachers Absent 10+ Days Difference; (6) PP Total Expenditures in Average Student's School (in $10,000); (7) PP Instructional Expenditures in Average Student's School (in $10,000); (8) Pupil-Teacher Ratio-Weighted by Tot Enrl; (9) Percent First or Second Year Teachers in Typical Student's School; and (10) Percent Teachers Absent 10+ Days in Typical Student's School.

All data for "School Characteristics—School Inputs" come from the CCD except for information about teacher absenteeism and experience. These data are taken from the CRDC school-level file. Counts

of novice teachers and teacher absences (teacher absences are coded as counts of teachers with greater than 10 days absent in a school year) are aggregated to the district or MSA and the share is a fraction of the total number of teachers in the district across grades 3 – 8. Because these CRDC data are available at the school-level, we also calculate the average proportion of novice and absent teachers in the schools of white and minority students within each district and MSA. We use the minority-white difference in these average rates in our analyses (the variables Minority-White Percent First or Second Year Teachers Difference and Minority-White Percent of Teachers Absent 10+ Days Difference, respectively). Class size (the variable Pupil-Teacher Ratio-Weighted by Tot Enrl) is taken from the school-level CCD file and is the average student-teacher ratio in the district for grades 3-8; because these data are available at the school-level, we can also calculate white and minority group ratios of class size (the variable Minority/White Student-Teacher Ratio). Expenditures data are taken from the F-33 for instructional and total expenditures (the variables PP Total Expenditures in Average Student's School (in $10,000) and PP Instructional Expenditures in Average Student's School (in $10,000), respectively). These variables are not available by race at the district level but we construct the ratio of White/Minority ratio average district per pupil expenditures by computing the racial-enrollment-weighted averages of district per pupil expenditures, and taking the White/minority ratio of these (the variables White/Minority Per Pupil Total Expenditures Ratio and White/Minority Per Pupil Instructional Expenditures Ratio, respectively).

For variables characterized as “School Characteristics—Charter School Characteristics,” we include the following: (1) Strength of Charter Policies-- Center for Education Reform Measure; (2) Strength of Charter Policies-- National Alliance for Charter Schools Measure; (3) Minority-White Charter School Enrollment Rate Difference; and (4) Percentage of Students in Metro/District Attending Charter Schools.

The variables measuring a state’s strength of charter policy are taken from the Center for Education Reform and the National Alliance of Charter Schools (The Center for Education Reform 2014;

Ziebarth 2014). The variables capture between-state differences in charter school strength at the state level. The Center for Education Reform ranking is based on how many charter schools are allowed in the state, whether charters are allowed autonomy, and how well funded they are compared to traditional public schools. The National Alliance of Charter School ranking is based primarily on student enrollments in charter schools, new charter school openings and closings, and charter practices (such as increasing the length of the school day and academic calendar among charter schools). Charter enrollment rates and enrollment rate differences (the variables Percentage of Students in Metro/District Attending Charter Schools and Minority-White Charter School Enrollment Rate Difference, respectively) are taken from the CCD school universe survey, which provides counts of students by race attending a charter school. These counts of students are aggregated to the district or MSA and a share is constructed from them. For the racial/ethnic differences variable, the share of minority students enrolled in a charter is subtracted from the share of white students enrolled.

For the variables characterized as "School Characteristics—Accountability Standards," we include the following: (1) Low Proficiency Standards; (2) High Proficiency Standards, and (3) Percent Minority in the Unit in Schools with Enough Blacks/Hispanics for NCLB Reporting.

The variables low and high proficiency standards are taken from the catalogue of state-specific accountability standards compiled by Wong, Cook, and Steiner (2015). The percent of the minority population in the district or MSA attending schools with enough blacks or Hispanic for NCLB reporting is based on the minimum subgroup size necessary for NCLB reporting. In schools with fewer black or Hispanic students than the state-determined minimum subgroup size (often 20 or 40 students) in a grade, the school is not held accountable for those subgroups' test scores. In districts or states with large numbers of minority students in such schools, then, there may be less accountability pressure to improve minority students' test scores. The share of minority students among schools within districts or MSAs that have too few students for NCLB reporting determines the variable. The variable will be influenced by the

distribution of minority students among schools, as well as the reporting threshold determined by the state.

For all of the variables above, when we construct variables for metropolitan areas, we aggregate district-level data from the EDGE, CCD, and CRDC to the metropolitan area level and then construct metropolitan area measures. For measures where count data are unavailable (e.g., median income), we take the weighted average of the district variables, using the average enrollment per grade for years 3-8 as the weighting variable.

Tables A5-A7 report the descriptive statistics and bivariate and regression coefficients for the full set of covariates described above.

[Tables A5-A7 here]

Appendix References

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Appendix Table A1: Bivariate Correlations, Select Variables, Using Different Metropolitan Samples

	White-Black Gaps			White-Hispanic Gaps		
	Metros: Largest	Metros: No Overlapping	Metros: All Overlapping	Metros: Largest	Metros: No Overlapping	Metros: All Overlapping
Socioeconomic Composition						
Median Income (in $100,000)	0.312 ***	0.302 ***	0.287 ***	0.485 ***	0.490 ***	0.457 ***
Proportion of Adults, Aged 25+ with a Bachelor's Degree or Higher	0.455 ***	0.445 ***	0.486 ***	0.522 ***	0.500 ***	0.541 ***
Proportion Receiving Free Lunches in Public Schools	-0.198 ***	-0.195 ***	-0.158 **	-0.307 ***	-0.314 ***	-0.288 ***
Single Parent Household Rate	0.102	0.099	0.151 **	-0.295 ***	-0.305 ***	-0.206 ***
Racial/Ethnic Composition						
Proportion Black in Public Schools	0.269 ***	0.260 ***	0.304 ***	-0.162 **	-0.182 **	-0.105 *
Proportion Hispanic in Public Schools	-0.132 *	-0.160 **	-0.079	0.263 ***	0.256 ***	0.268 ***
Hispanics, Speak English Well or Very Well	-0.171 **	-0.141 *	-0.171 ***	-0.351 ***	-0.334 ***	-0.332 ***
Racial Socioeconomic Disparities						
White-Minority Income Gap	0.551 ***	0.574 ***	0.576 ***	0.615 ***	0.632 ***	0.633 ***
White-Minority Education Gap	0.411 ***	0.411 ***	0.440 ***	0.597 ***	0.579 ***	0.603 ***
Minority-White Single Parent Household Rate Difference	0.394 ***	0.417 ***	0.407 ***	0.245 ***	0.252 ***	0.270 ***
Segregation						
Between School Racial Segregation	0.538 ***	0.520 ***	0.557 ***	0.658 ***	0.653 ***	0.654 ***
Between School Free Lunch, Not Free Lunch Segregation	0.399 ***	0.348 ***	0.422 ***	0.464 ***	0.454 ***	0.465 ***
Between Tract Racial Segregation	0.450 ***	0.437 ***	0.481 ***	0.554 ***	0.547 ***	0.542 ***
Between Tract Poor-Non-Poor Segregation	0.522 ***	0.504 ***	0.538 ***	0.355 ***	0.337 ***	0.379 ***
Minority-White Tract Poverty Rate Difference	0.418 ***	0.413 ***	0.445 ***	0.426 ***	0.411 ***	0.423 ***
Minority-White Free Lunch Rate Difference	0.656 ***	0.641 ***	0.679 ***	0.699 ***	0.696 ***	0.700 ***
School Characteristics						
Per Pupil Instructional Expenditures in Average Student's School (in $10,000)	0.156 **	0.161 **	0.175 ***	0.222 ***	0.204 ***	0.233 ***
Average Student-Teacher Ratio	-0.131 *	-0.161 **	-0.130 **	0.101	0.103	0.092
Proportion Attending Charter Schools	0.136 **	0.118 *	0.228 ***	0.197 ***	0.186 ***	0.255 ***
White/Minority Per Pupil Instructional Expenditures Ratio	-0.209 ***	-0.202 ***	-0.211 ***	-0.055	-0.052	-0.072
Minority/White Student-Teacher Ratio Ratio	0.225 ***	0.235 ***	0.245 ***	0.074	0.074	0.116 *
Minority-White Charter School Enrollment Rate Difference	0.353 ***	0.341 ***	0.380 ***	-0.005	-0.010	0.024
Sample Size	361	320	399	371	330	404

***p<=.001; **p<=.01; *p<=.05

Appendix Table A2. Comparing State-Level ED*Facts* Gaps with NAEP Gaps for Overlapping Observations

Gap	Year	Grade	Subject	ED*Facts* Intercept	NAEP Intercept	NAEP/ ED*Facts* Ratio	NAEP-ED*Facts* Correlation	p-value from ttest that NAEP= ED*Facts*	N
White-Black	2009	4	Math	0.75	0.95	1.27	0.87	0.00	94
White-Black	2009	4	ELA	0.72	0.75	1.05	0.89	0.08	92
White-Black	2009	8	Math	0.81	0.92	1.14	0.94	0.00	98
White-Black	2009	8	ELA	0.71	0.76	1.08	0.96	0.00	98
White-Black	2011	4	Math	0.77	0.95	1.22	0.92	0.00	82
White-Black	2011	4	ELA	0.73	0.76	1.04	0.94	0.11	74
White-Black	2011	8	Math	0.81	0.92	1.14	0.87	0.00	94
White-Black	2011	8	ELA	0.74	0.76	1.03	0.91	0.25	90
White-Black	2013	4	Math	0.79	0.94	1.19	0.95	0.00	98
White-Black	2013	4	ELA	0.77	0.76	0.99	0.92	0.60	96
White-Black	2013	8	Math	0.82	0.92	1.11	0.89	0.00	76
White-Black	2013	8	ELA	0.77	0.76	0.99	0.93	0.80	70
White-Hispanic	2009	4	Math	0.59	0.73	1.24	0.87	0.00	96
White-Hispanic	2009	4	ELA	0.65	0.65	1.00	0.96	0.93	92
White-Hispanic	2009	8	Math	0.63	0.71	1.12	0.91	0.00	98
White-Hispanic	2009	8	ELA	0.66	0.60	0.92	0.85	0.02	98
White-Hispanic	2011	4	Math	0.55	0.70	1.27	0.89	0.00	86
White-Hispanic	2011	4	ELA	0.60	0.65	1.07	0.97	0.00	80
White-Hispanic	2011	8	Math	0.58	0.69	1.20	0.97	0.00	94
White-Hispanic	2011	8	ELA	0.61	0.58	0.96	0.93	0.16	92
White-Hispanic	2013	4	Math	0.54	0.65	1.20	0.93	0.00	98
White-Hispanic	2013	4	ELA	0.64	0.62	0.98	0.94	0.37	96
White-Hispanic	2013	8	Math	0.54	0.61	1.12	0.90	0.00	84
White-Hispanic	2013	8	ELA	0.60	0.54	0.91	0.91	0.00	76
Averages									
Math Average	All	All	Math			1.18	0.91		
ELA Average	All	All	ELA			1.00	0.93		
Grade 4 Average	All	4	All			1.13	0.92		
Grade 8 Average	All	8	All			1.06	0.91		
Math Grade 4 Average	All	4	Math			1.23	0.90		
Math Grade 8 Average	All	8	Math			1.14	0.91		
ELA Grade 4 Average	All	4	ELA			1.02	0.94		
ELA Grade 8 Average	All	8	ELA			0.98	0.91		

Appendix Table A3. Comparison of Metro/District Gaps in Math and Reading

	Metropolitan Areas				Districts			
	White-Black		White-Hispanic		White-Black		White-Hispanic	
	Math	Reading	Math	Reading	Math	Reading	Math	Reading
Average Gap	0.765 ***	0.717 ***	0.530 ***	0.586 ***	0.681 ***	0.627 ***	0.483 ***	0.538 ***
	(0.011)	(0.010)	(0.011)	(0.011)	(0.004)	(0.004)	(0.004)	(0.004)
Average Grade Trend	-0.002	0.001	-0.001	-0.003 +	0.000	-0.000	0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Average Year Trend	0.006 ***	0.003 **	0.001	-0.006 ***	-0.005 ***	-0.001 *	-0.005 ***	-0.007 ***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Within-Unit Standard Deviation	0.072	0.062	0.064	0.059	0.088	0.080	0.082	0.077
Between-Unit Standard Deviation	0.211	0.199	0.207	0.219	0.221	0.224	0.224	0.234
Reliability (by subject)	0.961	0.961	0.967	0.972	0.868	0.883	0.854	0.875
Reliability (pooled model)	0.961		0.964		0.893		0.844	
Intraclass Correlation (by subject)	0.895	0.911	0.912	0.933	0.864	0.886	0.883	0.903
Intraclass Correlation (pooled model)	0.931		0.945		0.940		0.955	
p-value: Math Intercept = Reading Intercept	0.000		0.000		0.000		0.000	
Correlation: Math Intercept, Reading Intercept	0.948		0.915		0.950		0.932	
Total Observations	20379		20520		125380		146494	
Metro/District Observations	378		377		2899		3689	

***p<=.001; **p<=.01; *p<=.05; all results are from Model (A2) unless indicated as “pooled.”

Appendix Table A4 : Full List of Covariates Used

Measure	Source
Socioeconomic Composition	
Median Income (in $100,000)	EDGE, 2006-2010
Proportion of Adults, Aged 25+ with a Bachelor's Degree or Higher	EDGE, 2006-2010
Proportion Managerial/Professional Occupation	EDGE, 2006-2010
Proportion Free Lunch	CCD, 2009-2013
Poverty Rate, Households with 5-17 Year Olds	EDGE, 2006-2010
Unemployment Rate	EDGE, 2006-2010
Proportion of Households Receiving Food Stamps or SNAP	EDGE, 2006-2010
90/10 Income Ratio	EDGE, 2006-2010
Proportion Single Parent Households	EDGE, 2006-2010
Average Household Size	EDGE, 2006-2010
Median Housing Value (in $100,000)	EDGE, 2006-2010
Rental Rate All	EDGE, 2006-2010
Median Rent (in$10,000)	EDGE, 2006-2010
One-Year Housing Stability Rate	EDGE, 2006-2010
Racial/Ethnic Composition	
Proportion Black in Public Schools	CCD, 2009-2013
Proportion Hispanic in Public Schools	CCD, 2009-2013
Hispanics, Speak English Well or Very Well	EDGE, 2006-2010
Hispanics, Foreign Born	EDGE, 2006-2010
Proportion of Hispanic Population that is Mexican	EDGE, 2006-2010
Proportion of Hispanic Population that is Puerto Rican	EDGE, 2006-2010
Proportion of Hispanic Population that is Cuban	EDGE, 2006-2010
Proportion of Hispanic Population that is Central American	EDGE, 2006-2010
Proportion of Hispanic Population that is South American	EDGE, 2006-2010
Racial Socioeconomic Differences	
White-Minority Income Gap	EDGE, 2006-2010
White-Minority Education Gap	EDGE, 2006-2010
White-Minority Managerial/Professional Occupation Differencce	EDGE, 2006-2010
Minority-White Unemployment Rate Difference	EDGE, 2006-2010
Minority-White Poverty Rate Difference	EDGE, 2006-2010
Minority-White SNAP Rate Difference	EDGE, 2006-2010
Minority-White Single Parent Household Rate Difference	EDGE, 2006-2010
Minority-White Rental Rate Difference	EDGE, 2006-2010
White-Minority One-Year Housing Stability Rate Difference	EDGE, 2006-2010
Segregation	
Between District Racial Segregation	CCD, 2009-2013
Between School Racial Segregation	CCD, 2009-2013
Between District Free Lunch, Not Free Lunch Segregation	CCD, 2009-2013
Between School Free Lunch, Not Free Lunch Segregation	CCD, 2009-2013
Between Tract Racial Segregation	EDGE, 2006-2010
Between Tract Poor-Non-Poor Segregation	EDGE, 2006-2010
Between-District Income Segregation of Families with Children Enrolled in Public School	EDGE, 2006-2010
School District Fragmentation	CCD, 2009-2013
Minority-White Tract Poverty Rate Difference	EDGE, 2006-2010
Minority-White Free Lunch Rate Difference	CCD, 2009-2013
White-Minority Private School Enrollment Rate Difference	EDGE, 2006-2010
Proportion Black/Hispanic Students' Whose District was Ever Under Court Order	Reardon, et al. (2012)
Proportion Black/Hispanic Students' Whose District is Currently Under Court Order	Reardon, et al. (2012)

School Characteristics:	
---School Inputs	
Per Pupil Instructional Expenditures in Average Student's School (in $10,000)	CCD, 2009-2013
Per Pupil Total Expenditures in Average Student's School (in $10,000)	CCD, 2009-2013
Pupil-Teacher Ratio-Weighted by Tot Enrl	CCD, 2009-2013
Proportion First or Second Year Teachers in Typical Student's School	OCR
Proportion Teachers Absent 10+ Days in Typical Student's School	OCR
White/Minority Per Pupil Instructional Expenditures Ratio	CCD, 2009-2013
White/Minority Per Pupil Total Expenditures Ratio	CCD, 2009-2013
Minority/White Student-Teacher Ratio Ratio	CCD, 2009-2013
Minority-White % First or Second Year Teacher Difference	OCR
Minority-White % Teachers Absent 10+ Days Difference	OCR
---Charter School Characteristics	
Strength of Charter Policies-- Center for Education Reform Measure	Center for Education Reform
Strength of Charter Policies-- National Alliance for Charter Schools Measure	National Alliance for Charter Schools
Minority-White Charter School Enrollment Rate Difference	CCD, 2009-2013
Proportion of Students in Metro/District Attending Charter Schools	CCD, 2009-2013
---Accountability Standards	
Low Proficiency Standards	Wong, Cook and Steiner (2014)
High Proficiency Standards	Wong, Cook and Steiner (2014)
Proportion Minority in the Unit in Schools with Enough Blacks/Hispanics for NCLB Reporting	CCD, 2009-2013

Appendix Table A5. Means and Standard Deviations of Gap Correlates

	White-Black				White-Hispanic			
	Metros		Districts		Metros		Districts	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Achivement Gaps	0.749	0.197	0.659	0.218	0.559	0.208	0.516	0.225
Socioeconomic Composition								
Median Income (in $100,000)	0.579	0.123	0.597	0.246	0.579	0.122	0.644	0.267
Proportion of Adults, Aged 25+ with a Bachelor's Degree or Higher	0.275	0.086	0.270	0.146	0.276	0.087	0.276	0.151
Proportion Managerial/Professional Occupation	0.181	0.049	0.171	0.089	0.181	0.049	0.179	0.092
Proportion Free Lunch	0.414	0.112	0.445	0.201	0.414	0.112	0.406	0.202
Poverty Rate, Households with 5-17 Year Olds	0.164	0.053	0.173	0.100	0.164	0.053	0.152	0.094
Unemployment Rate	0.048	0.012	0.050	0.018	0.048	0.012	0.048	0.018
Proportion of Households Receiving Food Stamps or SNAP	0.174	0.063	0.179	0.112	0.173	0.063	0.150	0.102
90/10 Income Ratio	9.468	1.779	9.311	3.682	9.443	1.773	8.423	3.354
Proportion Single Parent Households	0.272	0.056	0.288	0.107	0.271	0.056	0.245	0.097
Average Household Size	4.019	0.188	4.023	0.247	4.024	0.195	4.113	0.268
Median Housing Value (in $100,000)	1.987	1.144	2.102	1.513	2.007	1.131	2.499	1.819
Rental Rate All	0.319	0.070	0.332	0.138	0.320	0.069	0.315	0.139
Median Rent (in$10,000)	0.090	0.021	0.094	0.030	0.090	0.020	0.100	0.033
One-Year Housing Stability Rate	0.847	0.034	0.851	0.060	0.846	0.034	0.857	0.062
Racial/Ethnic Composition								
Proportion Black in Public Schools	0.157	0.143	0.220	0.199	0.153	0.143	0.114	0.153
Proportion Hispanic in Public Schools	0.174	0.193	0.179	0.201	0.179	0.197	0.265	0.228
Hispanics, Speak English Well or Very Well	0.864	0.074	0.865	0.144	0.862	0.074	0.858	0.114
Hispanics, Foreign Born	0.126	0.078	0.120	0.136	0.126	0.077	0.122	0.114
Proportion of Hispanic Population that is Mexican	0.623	0.272	0.604	0.329	0.635	0.267	0.666	0.315
Proportion of Hispanic Population that is Puerto Rican	0.151	0.182	0.159	0.227	0.142	0.179	0.122	0.197
Proportion of Hispanic Population that is Cuban	0.022	0.039	0.020	0.067	0.021	0.038	0.016	0.045
Proportion of Hispanic Population that is Central American	0.069	0.073	0.072	0.124	0.067	0.073	0.061	0.098
Proportion of Hispanic Population that is South American	0.046	0.053	0.051	0.097	0.045	0.053	0.048	0.091
Racial Socioeconomic Differences								
White-Minority Income Gap	0.765	0.344	0.649	0.472	0.704	0.295	0.633	0.456
White-Minority Education Gap	0.243	0.222	0.175	0.358	0.674	0.326	0.719	0.413
White-Minority Managerial/Professional Occupation Differencce	0.126	0.104	0.100	0.174	0.209	0.125	0.204	0.159
Minority-White Unemployment Rate Difference	0.040	0.035	0.035	0.048	0.020	0.021	0.016	0.042
Minority-White Poverty Rate Difference	0.250	0.125	0.184	0.178	0.185	0.098	0.140	0.163
Minority-White SNAP Rate Difference	0.232	0.126	0.172	0.166	0.128	0.114	0.077	0.146
Minority-White Single Parent Household Rate Difference	0.288	0.144	0.270	0.179	0.070	0.114	0.037	0.161
Minority-White Rental Rate Difference	0.354	0.143	0.277	0.202	0.240	0.139	0.178	0.206
White-Minority One-Year Housing Stability Rate Difference	0.107	0.091	0.080	0.149	0.061	0.076	0.037	0.125

Segregation								
Between District Racial Segregation	0.168	0.145			0.107	0.104		
Between School Racial Segregation	0.257	0.149	0.073	0.095	0.179	0.113	0.051	0.071
Between District Free Lunch, Not Free Lunch Segregation	0.091	0.084			0.090	0.084		
Between School Free Lunch, Not Free Lunch Segregation	0.161	0.089	0.056	0.065	0.161	0.089	0.050	0.067
Between Tract Racial Segregation	0.271	0.118			0.165	0.081		
Between Tract Poor-Non-Poor Segregation	0.106	0.039			0.105	0.039		
Between-District Income Segregation of Families with Children Enrolled in Public School	0.050	0.044			0.049	0.044		
School District Fragmentation	0.668	0.267			0.662	0.268		
Minority-White Tract Poverty Rate Difference	0.086	0.049			0.056	0.038		
Minority-White Free Lunch Rate Difference	0.187	0.114	0.050	0.071	0.157	0.108	0.045	0.067
White-Minority Private School Enrollment Rate Difference	0.056	0.065	0.101	0.121	0.049	0.059	0.077	0.116
Proportion Black/Hispanic Students' Whose District was Ever Under Court Order	0.334	0.404	0.246	0.431	0.291	0.375	0.131	0.338
Proportion Black/Hispanic Students' Whose District is Currently Under Court Order	0.103	0.261	0.100	0.300	0.091	0.238	0.043	0.203
School Characteristics:								
---Average Levels of School Characteristics								
Per Pupil Instructional Expenditures in Average Student's School (in $10,000)	0.601	0.155	0.629	0.204	0.595	0.154	0.629	0.225
Per Pupil Total Expenditures in Average Student's School (in $10,000)	1.168	0.271	1.225	0.367	1.157	0.271	1.230	0.413
Pupil-Teacher Ratio-Weighted by Tot Enrl	16.470	2.814	16.760	27.237	16.614	2.897	16.658	3.793
Proportion of Students in Metro/District Attending Charter Schools	0.031	0.040	0.025	0.067	0.032	0.046	0.024	0.063
Proportion First or Second Year Teachers in Typical Student's School	0.098	0.054	0.092	0.077	0.098	0.053	0.090	0.082
Proportion Teachers Absent 10+ Days in Typical Student's School	0.307	0.107	0.300	0.166	0.305	0.108	0.283	0.170
--Racial Differences of School Characteristics								
White Per Pupil Instructional Expenditures/Minority Per Pupil	0.964	0.061			0.975	0.046		
White Per Pupil Total Expenditures/Minority Per Pupil	0.961	0.078			0.975	0.062		
Minority/White Student-Teacher Ratio Ratio	1.039	0.056	1.016	0.034	1.031	0.055	1.012	0.038
Minority-White Charter School Enrollment Rate Difference	0.019	0.053	0.003	0.063	-0.001	0.039	-0.007	0.046
Minority-White % First or Second Year Teacher Difference	0.019	0.037	0.006	0.022	0.014	0.042	0.002	0.016
Minority-White % Teachers Absent 10+ Days Difference	0.010	0.078	0.001	0.032	0.010	0.059	0.004	0.024
--Accountability Standards								
Strength of Charter Policies-- Center for Education Reform Measure	0.466	0.203	0.471	0.187	0.469	0.201	0.491	0.167
Strength of Charter Policies-- National Alliance for Charter Schools Measure	0.545	0.202	0.560	0.176	0.548	0.199	0.585	0.149
Low Proficiency Standards	0.288	0.454	0.291	0.454	0.286	0.452	0.297	0.457
High Proficiency Standards	0.224	0.418	0.231	0.422	0.226	0.419	0.279	0.448
Proportion Minority in the Unit in Schools with Enough Blacks/Hispanics for NCLB Reporting	0.648	0.351	0.657	0.375	0.498	0.362	0.553	0.407
N	361		2476		371		3241	

Notes: SD = standard deviation

Appendix Table A6: Pairwise Correlations Among Average Achievement Gaps in Each Metro/District and Other Factors

	White-Black Gaps		White-Hispanic Gaps	
	Metros	Districts	Metros	Districts
Socioeconomic Composition	0.312 ***	0.267 ***	0.485 ***	0.200 ***
Median Income (in $100,000)	0.455 ***	0.554 ***	0.522 ***	0.437 ***
Proportion of Adults, Aged 25+ with a Bachelor's Degree or Higher	0.336 ***	0.410 ***	0.455 ***	0.319 ***
Proportion Managerial/Professional Occupation	-0.198 ***	-0.247 ***	-0.307 ***	-0.160 ***
Proportion Free Lunch	-0.227 ***	-0.134 ***	-0.343 ***	-0.125 ***
Poverty Rate, Households with 5-17 Year Olds	0.034	-0.237 ***	-0.069	-0.212 ***
Unemployment Rate	-0.215 ***	-0.185 ***	-0.380 ***	-0.176 ***
Proportion of Households Receiving Food Stamps or SNAP	0.180 ***	0.117 ***	-0.061	0.100 ***
90/10 Income Ratio	0.102	-0.051 *	-0.295 ***	-0.083 ***
Proportion Single Parent Households	-0.095	-0.170 ***	0.327 ***	-0.089 ***
Average Household Size	0.146 **	0.368 ***	0.473 ***	0.363 ***
Median Housing Value (in $100,000)	-0.119 *	-0.006	-0.095	0.022
Rental Rate All	0.201 ***	0.137 ***	0.422 ***	0.120 ***
Median Rent (in$10,000)	0.200 ***	0.074 ***	0.375 ***	0.065 ***
One-Year Housing Stability Rate				
Racial/Ethnic Composition				
Proportion Black in Public Schools	0.269 ***	0.007	-0.162 **	-0.004
Proportion Hispanic in Public Schools	-0.132 *	-0.081 ***	0.263 ***	0.046 **
Hispanics, Speak English Well or Very Well	-0.171 **	-0.055 **	-0.351 ***	-0.177 ***
Hispanics, Foreign Born	0.148 **	0.172 ***	0.164 **	0.214 ***
Proportion of Hispanic Population that is Mexican	-0.124 *	-0.062 **	-0.027	0.021
Proportion of Hispanic Population that is Puerto Rican	0.102	-0.055 **	0.104 *	-0.083 ***
Proportion of Hispanic Population that is Cuban	0.089	0.026	-0.159 **	-0.030
Proportion of Hispanic Population that is Central American	0.132 *	0.078 ***	-0.008	0.082 ***
Proportion of Hispanic Population that is South American	0.191 ***	0.149 ***	-0.032	0.083 ***

Racial Socioeconomic Differences				
White-Minority Income Gap	0.551 ***	0.415 ***	0.615 ***	0.413 ***
White-Minority Education Gap	0.411 ***	0.558 ***	0.597 ***	0.423 ***
White-Minority Managerial/Professional Occupation Differencce	0.391 ***	0.356 ***	0.567 ***	0.427 ***
Minority-White Unemployment Rate Difference	0.287 ***	0.119 ***	0.258 ***	0.012
Minority-White Poverty Rate Difference	0.334 ***	0.192 ***	0.276 ***	0.189 ***
Minority-White SNAP Rate Difference	0.343 ***	0.225 ***	0.242 ***	0.154 ***
Minority-White Single Parent Household Rate Difference	0.394 ***	0.252 ***	0.245 ***	0.139 ***
Minority-White Rental Rate Difference	0.368 ***	0.344 ***	0.300 ***	0.370 ***
White-Minority One-Year Housing Stability Rate Difference	0.146 **	0.106 ***	0.148 **	0.080 ***
Segregation				
Between District Racial Segregation	0.428 ***		0.535 ***	
Between School Racial Segregation	0.538 ***	0.194 ***	0.658 ***	0.341 ***
Between District Free Lunch, Not Free Lunch Segregation	0.358 ***		0.387 ***	
Between School Free Lunch, Not Free Lunch Segregation	0.399 ***	0.261 ***	0.464 ***	0.257 ***
Between Tract Racial Segregation	0.450 ***		0.554 ***	
Between Tract Poor-Non-Poor Segregation	0.522 ***		0.355 ***	
Between-District Income Segregation of Families with Children Enrolled in Public School	0.407 ***		0.363 ***	
School District Fragmentation	0.145 **		0.247 ***	
Minority-White Tract Poverty Rate Difference	0.418 ***		0.426 ***	
Minority-White Free Lunch Rate Difference	0.656 ***	0.346 ***	0.699 ***	0.383 ***
White-Minority Private School Enrollment Rate Difference	0.313 ***	0.140 ***	0.352 ***	0.165 ***
Proportion Black/Hispanic Students' Whose District was Ever Under Court Order	0.269 ***	0.114 ***	-0.064	0.079 ***
Proportion Black/Hispanic Students' Whose District is Currently Under Court Order	0.107 *	0.053 **	-0.025	0.029

School Characteristics:								
---Average Levels of School Characteristics								
Per Pupil Instructional Expenditures in Average Student's School (in $10,000)	0.156	**	0.257	***	0.222	***	0.256	***
Per Pupil Total Expenditures in Average Student's School (in $10,000)	0.222	***	0.221	***	0.266	***	0.203	***
Pupil-Teacher Ratio-Weighted by Tot Enrl	-0.131	*	-0.012		0.101		-0.092	***
Proportion of Students in Metro/District Attending Charter Schools	0.136	**	0.027		0.197	***	0.071	***
Proportion First or Second Year Teachers in Typical Student's School	0.062		-0.043	*	-0.084		-0.013	
Proportion Teachers Absent 10+ Days in Typical Student's School	-0.116	*	-0.018		-0.115	*	-0.024	
--Racial Differences of School Characteristics								
White/Minority Per Pupil Instructional Expenditures Ratio	-0.209	***			-0.055			
White/Minority Per Pupil Total Expenditures Ratio	-0.271	***			-0.109	*		
Minority/White Student-Teacher Ratio Ratio	0.225	***	0.201	***	0.074		0.181	***
Minority-White Charter School Enrollment Rate Difference	0.353	***	0.007		-0.005		-0.052	**
Minority-White % First or Second Year Teacher Difference	0.159	**	0.078	***	0.178	***	0.121	***
Minority-White % Teachers Absent 10+ Days Difference	-0.009		0.038		0.050		0.079	***
--Accountability Standards								
Strength of Charter Policies-- Center for Education Reform Measure	0.101		0.003		0.062		0.020	
Strength of Charter Policies-- National Alliance for Charter Schools Measure	0.077			***	0.081		0.005	
Low Proficiency Standards	0.012		-0.005		0.034		0.001	
High Proficiency Standards	-0.206	***	0.009		0.044		0.013	
Proportion Minority in the Unit in Schools with Enough Blacks/Hispanics for NCLB Reporting	0.466	***	0.092	***	0.515	***	0.163	***
Sample Size	361		2476		371		3241	

***p<=.001; **p<=.01; *p<=.05 The correlations for districts include state fixed effects and are therefore within state correlations. The correlations for metros do not include state fixed effects because there are not sufficient metros within each state to support including the state fixed effects.

Appendix Table A7: Full Models, Select Coefficients

	White-Black Gaps		White-Hispanic Gaps	
	Metros	Districts	Metros	Districts
Socioeconomic Composition				
Median Income (in $100,000)	-0.265	-0.099 *	-0.045	-0.132 ***
	(0.198)	(0.046)	(0.172)	(0.033)
Proportion of Adults, Aged 25+ with a Bachelor's Degree or Higher	0.714 ***	0.603 ***	0.569 ***	0.510 ***
	(0.189)	(0.057)	(0.167)	(0.049)
Proportion Managerial/Professional Occupation	0.190	0.037	0.062	0.219 **
	(0.323)	(0.083)	(0.273)	(0.070)
Proportion Free Lunch	-0.045	-0.239 ***	-0.428 ***	-0.178 ***
	(0.141)	(0.046)	(0.126)	(0.038)
Poverty Rate, Households with 5-17 Year Olds	-1.500 **	-0.106	-0.787	-0.353 ***
	(0.499)	(0.090)	(0.457)	(0.081)
Unemployment Rate	1.822 *	-0.072	0.110	-0.902 ***
	(0.741)	(0.244)	(0.645)	(0.211)
Proportion of Households Receiving Food Stamps or SNAP	-0.287	-0.037	0.470 *	0.113
	(0.234)	(0.074)	(0.216)	(0.065)
90/10 Income Ratio	0.011	0.002	0.005	0.005 ***
	(0.007)	(0.001)	(0.007)	(0.001)
Proportion Single Parent Households	0.389	0.074	0.210	-0.101
	(0.369)	(0.073)	(0.347)	(0.063)
Average Household Size	0.138	0.024	0.101	-0.026
	(0.072)	(0.021)	(0.064)	(0.016)
Median Housing Value (in $100,000)	0.017	0.006	0.038 *	0.014 **
	(0.018)	(0.006)	(0.016)	(0.004)
Rental Rate All	-0.177	-0.098 *	-0.375 *	-0.038
	(0.208)	(0.049)	(0.177)	(0.040)
Median Rent (in $10,000)	-1.736	-1.085 ***	-2.154 *	-0.925 ***
	(0.958)	(0.231)	(0.881)	(0.181)
One-Year Housing Stability Rate	0.070	-0.030	0.319	-0.075
	(0.302)	(0.068)	(0.273)	(0.059)

Racial/Ethnic Composition				
Proportion Black in Public Schools	0.075	0.084 **	0.220 *	0.027
	(0.114)	(0.032)	(0.109)	(0.031)
Proportion Hispanic in Public Schools	0.189 *	0.117 ***	0.152 *	0.146 ***
	(0.074)	(0.031)	(0.068)	(0.026)
Hispanics, Speak English Well or Very Well	-0.193	-0.033	-0.119	-0.023
	(0.116)	(0.022)	(0.109)	(0.029)
Hispanics, Foreign Born	-0.144	0.052 *	0.057	0.071 *
	(0.111)	(0.024)	(0.108)	(0.030)
Proportion of Hispanic Population that is Mexican	0.275 **	0.041	0.066	0.052
	(0.105)	(0.022)	(0.094)	(0.031)
Proportion of Hispanic Population that is Puerto Rican	0.248 *	0.021	0.226 *	0.151 ***
	(0.112)	(0.025)	(0.102)	(0.035)
Proportion of Hispanic Population that is Cuban	0.209	0.035	0.108	-0.079
	(0.218)	(0.050)	(0.198)	(0.077)
Proportion of Hispanic Population that is Central American	0.144	0.041	-0.133	0.045
	(0.138)	(0.031)	(0.125)	(0.043)
Proportion of Hispanic Population that is South American	0.236	0.012	-0.079	0.020
	(0.166)	(0.039)	(0.161)	(0.049)

Racial Socioeconomic Differences				
White-Minority Income Gap	-0.004	0.018	-0.020	0.029 **
	(0.040)	(0.010)	(0.037)	(0.009)
White-Minority Education Gap	0.133 ***	0.169 ***	0.226 ***	0.175 ***
	(0.035)	(0.011)	(0.037)	(0.010)
White-Minority Managerial/Professional Occupation Differencce	0.037	0.072 ***	0.098	0.108 ***
	(0.071)	(0.019)	(0.070)	(0.022)
Minority-White Unemployment Rate Difference	0.511 *	0.084	0.646 *	0.059
	(0.209)	(0.065)	(0.287)	(0.068)
Minority-White Poverty Rate Difference	0.178 *	0.041	0.078	0.009
	(0.078)	(0.023)	(0.082)	(0.022)
Minority-White SNAP Rate Difference	0.181 *	0.037	-0.045	0.030
	(0.081)	(0.025)	(0.071)	(0.022)
Minority-White Single Parent Household Rate Difference	-0.003	0.068 **	0.084	0.019
	(0.060)	(0.021)	(0.071)	(0.020)
Minority-White Rental Rate Difference	0.014	0.076 ***	0.157 **	0.099 ***
	(0.064)	(0.020)	(0.057)	(0.018)
White-Minority One-Year Housing Stability Rate Difference	0.114	0.026	0.032	0.007
	(0.076)	(0.022)	(0.082)	(0.024)

Segregation				
Between District Racial Segregation	-0.460 **		-0.255	
	(0.148)		(0.190)	
Between School Racial Segregation	0.396 *	-0.145 **	0.461	0.023
	(0.185)	(0.055)	(0.247)	(0.087)
Between District Free Lunch, Not Free Lunch Segregation	1.117 ***		0.246	
	(0.294)		(0.261)	
Between School Free Lunch, Not Free Lunch Segregation	-0.788 ***	-0.342 ***	-0.160	-0.190 **
	(0.227)	(0.079)	(0.189)	(0.065)
Between Tract Racial Segregation	-0.356 **		-0.454 *	
	(0.133)		(0.190)	
Between Tract Poor-Non-Poor Segregation	0.062		-0.063	
	(0.248)		(0.216)	
Between-District Income Segregation of Families with Children Enrolled in Public School	-0.429		-0.636	
	(0.398)		(0.360)	
School District Fragmentation	-0.070		-0.006	
	(0.037)		(0.031)	
Minority-White Tract Poverty Rate Difference	0.238		-0.019	
	(0.251)		(0.297)	
Minority-White Free Lunch Rate Difference	0.769 ***	0.904 ***	0.727 ***	0.708 ***
	(0.180)	(0.090)	(0.175)	(0.100)
White-Minority Private School Enrollment Rate Difference	0.063	-0.060 *	-0.013	0.027
	(0.117)	(0.029)	(0.123)	(0.026)
Proportion Black/Hispanic Students' Whose District was Ever Under Court Order	0.020	0.010	-0.054 *	-0.000
	(0.023)	(0.009)	(0.023)	(0.011)
Proportion Black/Hispanic Students' Whose District is Currently Under Court Order	-0.022	0.017	0.055 *	0.013
	(0.025)	(0.011)	(0.026)	(0.015)

School Characteristics:

---Average Levels of School Characteristics

Per Pupil Instructional Expenditures in Average Student's School (in $10,000)	-0.297 *	0.064	-0.138	0.112 **
	(0.144)	(0.048)	(0.125)	(0.042)
Per Pupil Total Expenditures in Average Student's School (in $10,000)	0.166 *	0.033	0.061	0.009
	(0.082)	(0.020)	(0.069)	(0.015)
Pupil-Teacher Ratio-Weighted by Tot Enrl	-0.002	0.000	-0.001	-0.003 *
	(0.004)	(0.000)	(0.004)	(0.001)
Proportion of Students in Metro/District Attending Charter Schools	0.179	-0.097	0.065	0.072
	(0.188)	(0.051)	(0.154)	(0.046)
Proportion First or Second Year Teachers in Typical Student's School	0.238	-0.083	0.069	-0.053
	(0.155)	(0.043)	(0.135)	(0.036)
Proportion Teachers Absent 10+ Days in Typical Student's School	0.058	-0.003	-0.010	-0.000
	(0.062)	(0.017)	(0.056)	(0.016)

--Racial Differences of School Characteristics

White/Minority Per Pupil Instructional Expenditures Ratio	0.147		0.375 *	
	(0.161)		(0.186)	
White/Minority Per Pupil Total Expenditures Ratio	-0.067		-0.221	
	(0.136)		(0.133)	
Minority/White Student-Teacher Ratio Ratio	0.278 *	0.002	0.094	0.128
	(0.122)	(0.099)	(0.133)	(0.080)
Minority-White Charter School Enrollment Rate Difference	0.075	0.053	-0.009	0.149 *
	(0.151)	(0.051)	(0.183)	(0.064)
Minority-White % First or Second Year Teacher Difference	-0.524 **	0.248	-0.197	0.299
	(0.180)	(0.144)	(0.151)	(0.175)
Minority-White % Teachers Absent 10+ Days Difference	-0.018	0.133	0.170	0.096
	(0.075)	(0.099)	(0.092)	(0.113)

--Accountability Standards

Strength of Charter Policies-- Center for Education Reform Measure	-0.027		0.075	
	(0.069)		(0.058)	
Strength of Charter Policies-- National Alliance for Charter Schools Measure	0.055		-0.040	
	(0.064)		(0.057)	
Low Proficiency Standards	-0.008		-0.011	
	(0.017)		(0.015)	
High Proficiency Standards	-0.017		-0.018	
	(0.019)		(0.017)	
Proportion Minority in the Unit in Schools with Enough Blacks/Hispanics for NCLB Reporting	0.152 ***	0.082 ***	0.047	0.057 ***
	(0.033)	(0.012)	(0.029)	(0.010)
Constant	-0.510	0.002	-0.454	0.004
	(0.517)	(0.003)	(0.464)	(0.003)
N	361	2476	371	3241

***p<=.001; **p<=.01; *p<=.05