School Attendance Boundaries and the Segregation of Public Schools in the US

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Abstract

School segregation is determined by residential sorting, but also by policy choices such as the drawing of attendance boundaries and school siting. This paper develops a new approach to understanding the importance of each of these factors by calculating the distance-minimizing assignment of students to schools and asking whether actual assignments differ systematically by race. Using detailed census data with attendance boundary maps for nearly 1,600 school districts, I find that attendance boundaries create 5 percent more integration than a distance-minimizing baseline, and school siting plays almost no role. Residential segregation alone explains more than 100 percent of school segregation in the U.S. Some local governments act to mitigate school segregation, although their impact is small compared to residential choice.

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1 Introduction

Title II of the Equal Educational Opportunities Act of 1974 makes it unlawful for local school districts to set public school assignments in ways that exacerbate school segregation, unless they follow an arrangement in which students attend the nearest school to their home (EEOA 1974). Yet, most segregation research in economics focuses on household sorting behavior, rather than on the decision of local districts who may choose administrative policy to accomplish competing social objectives. Today, there is reignited interest in redirecting institutional determinants of racial inequality in US cities. For example, the President's budget request for 2021 proposed to make $100 million available for local school district efforts to pursue greater racial integration in schools (Belsha and Darville 2021).

This paper answers the question: How much segregation should we expect to see in a school district given its neighborhood composition? How much do we actually see? Even in today's era of expanding school choice, public school assignment systems are comprised at least partially, if not completely, of *school attendance boundaries* – maps that assign students to schools based on their residential address. I introduce a counterfactual arrangement of school boundaries based on minimizing distance between schools and residences, comparing segregation in this counterfactual to districts' actual boundaries, to evaluate whether school assignment policies mitigate or exacerbate existing residential segregation patterns. I also implement simulations of minimum distance boundaries based on random school locations, to examine the role of school siting in driving segregation. In doing so, I provide a correctly-scaled metric of neighborhood segregation to compare to school segregation, solving a persistent issue in the comparative literature (Lee, Reardon, Firebaugh, Farrell, Matthews and O'Sullivan 2008).

Using census block data on residential demographics, I apply this decomposition framework to a sample of school attendance boundary maps for nearly 1,600 large US school districts, accounting for 52% of national enrollment. My results indicate that residential segregation explains 104% of school assignment segregation for the average district. While the attendance boundaries of most school districts closely replicate residential patterns, some have maps that mitigate the impact of residential segregation on schools.[1] School boundaries account for a 5% reduction in mean segregation levels for Black and Hispanic students. Only about 1% of segregation can be attributed to school siting. An analysis at the level of metropolitan areas shows that these findings are robust to geographic scale, with the additional result that stratification across school district jurisdictional lines explains about 70% of the variance in the residential component of metropolitan school segregation.

The paper presents two validation exercises for this empirical approach. First, I show that the decomposition behaves as one would expect in a famous instance of school redistricting in Charlotte, North Carolina. In 2002, Charlotte ended its decades-long desegregation busing system, reverting to a "neighborhood schools" assignment system, a policy change that has been studied extensively to understand the effect of school segregation (Kane, Staiger and

[1] Few school districts show aggregate assignment patterns that appear to violate the federal EEOA provision. However, my method cannot rule out that individual schools, or pairs of adjacent schools don't violate the provision of the EEOA. For a related discussion see (Monarrez and Schonholzer 2021).

Riegg 2005, Jackson 2009, Deming 2011, Billings, Deming and Rockoff 2014a). I show that, between 2000 and 2010, annual variation in the portion of Charlotte's segregation attributable to school assignments shows a clear jump just after the implementation of redistricting reform, from a negative value (desegregation), to zero (perfect replication of residential patterns). Second, I show that districts with racially desegregated school boundaries tend to have lower levels of actual segregation across their schools' enrollment, with a pass-through rate of about 86%. There is also evidence consistent with desegregated boundaries leading to smaller district-level racial gaps in education inputs, such as exposure to experienced teachers as well as to the Gifted and Talented (GT) school program. These results suggest that attendance boundaries are an important determinant of the equitability of public school systems.

Next, I conduct an examination of drivers of heterogeneity in school boundary segregation. Compared to others, districts under an active desegregation court order have boundaries that are significantly more integrated; unlike districts with rescinded court orders, whose boundaries tend to replicate neighborhood segregation. This is in line with previous literature on the importance of judicial oversight (Lutz 2011, Reardon, Grewal, Kalogrides and Greenberg 2012). Relatedly, desegregated boundaries are correlated with excess commuting for minority households, consistent with the notion that people of color often bear the transportation cost of district integration plans (Pride and Woodward 1995, Johnson 2019). In addition, using survey and election data, I show that local variation in racist attitudes is associated with more segregated school boundary systems. My estimates suggest mild levels of boundary integration in racially tolerant districts, but zero in more intolerant districts. These findings are important, as they provide quantitative basis for the claim that racial animus is still a significant obstacle to efforts to mend inequitable policy at a local government level. To check for robustness, I show that these results are not sensitive to my measurement choices, to the use of different control variables in regression specifications, and to functional form specification.

This paper expands the frontier on the economics literature on public school assignment systems. The strand of the literature on desegregation nearly exclusively focuses on court-ordered policies in a much earlier era (Welch and Light 1987, Orfield and Eaton 1997, Clotfelter 2004, Reber 2005, Rivkin and Welch 2006, Cascio, Gordon, Lewis and Reber 2008, Reardon and Owens 2014). There is much less work on districts' unsupervised choice of student assignment systems (Saporito and Riper 2016, Sohoni and Saporito 2009, Siegel-Hawley 2013). The closest paper to mine is Richards (2014), who implements a similar empirical approach leveraging a different data source.[2] My work also relates to the mechanism design literature on centralized school lottery systems (Abdulkadiroglu, Pathak and Roth 2009, Pathak 2011, Ellison and Pathak 2016). The recent growth in this literature demonstrates that student assignment is an important area of policy and an active topic of both empirical and theoretical research. Since centralized choice systems almost always incorporate priorities for students living within school boundaries (Dur, Kominers, Pathak and Sonmez 2013), this paper is complementary to this strand of the literature.

[2] Richards (2014) reports that school boundaries tend to be segregative using the School Attendance Boundary Information System, an early pilot for the US Department of Education's School Attendance Boundary Survey (the dataset used in this study).

This paper also contributes to the political economy literature on diversity and governance (Alesina, Baqir and Hoxby 2004, Alesina and Zhuravskaya 2011). There is relatively little work in this literature on school boards, though this hyperlocal level is where much of the action occurs. One challenge is that it can be difficult to measure policy choices at this level, which this paper partially addresses by attempting to measure local government behavior. Macartney and Singleton (2018) estimate the effect of the partisan composition of school boards, finding that higher democratic school board shares lead to lower segregation. They provide suggestive evidence that the mechanism at play is linked to changes in school boundaries. My measurement of districts' actual policies is consistent with their findings, and strengthens the notion that school boundaries can be levers used to decrease inequality.

The rest of the paper proceeds as follows. Section 2 describes the historical background of school segregation and local education governance, as well as institutional details of school attendance boundary policy. Section 3 develops the measurement framework and provides validation. Section 4 describes the distribution of school boundaries. Section 5 provides an analysis of heterogeneity. Section 6 concludes.

2 Background

Between the 1960s and 1980s, numerous school districts were placed under court desegregation orders and school segregation decreased dramatically across the nation (Clotfelter 2004). While a small number of desegregation orders remain active today, most districts that were once under court oversight have been released from it (Reardon et al. 2012). School segregation persists today, and most school districts have freedom to choose whether or not to encourage school integration. Local desegregation efforts therefore depend on the views of local school boards and communities, as well as the feasibility and cost of desegregation, given existing residential segregation patterns. In 2007, the U.S. Supreme Court considered that the manipulation of attendance boundaries and the selection of school sites may be an effective, constitutional way of achieving integration: "School boards may pursue the goal of bringing together students of diverse backgrounds and races through other means, including strategic site selection of new schools, and drawing attendance zones with general recognition of the demographics of neighborhoods ..." (Parents Involved in Cmty. Sch. v. Seattle Sch. Dist. No. 1, 551 U.S. 701, 720, 2007)

School districts have administrative authority to set attendance boundaries, and there is little federal or state government regulation. Unlike congressional districts, attendance boundaries are not required to have equal population or to follow contiguity. Many school districts draw discontiguous attendance boundaries for which spatially separate neighborhoods are given the same school assignment.[3] Most frequently, attendance boundaries are represented as a map that partitions the district's jurisdiction into multiple zones, although in some places they are

[3]Discontiguous attendance boundaries have historically been associated with desegregation busing (the so-called "pair and cluster" strategy), but they are also relatively common in districts that have never been under court supervision. In Panel B of Table A1 in the online appendix, I show that about 12% of school boundaries in the 2013-14 SABS were discontiguous.

published as listings linking street and school names. The vast majority of public schools in the U.S. operate with attendance boundary plans, although the degree to which boundaries bind can vary. For example, it is common for districts implementing centralized school choice algorithms to use boundaries to ration seats at oversubscribed schools. In these cases, boundaries determine a set of default student-school matches that may or may not be overridden by parental preferences.

Most school districts make changes to their attendance boundaries every few years. School boundary redistricting is typically brought about by demographic change, school capacity imbalances or new school construction (Lafortune and Schonholzer 2020). School board objectives during the redistricting process vary greatly across localities, but a common theme is a discussion of commuting distance, school capacity constraints, racial equity and correlated issues (Siegel-Hawley 2013, Samuels 2019). Moreover, school redistricting can be politically burdensome, leading to path dependence in policy and petrification of school boundaries. Community input meetings on proposed boundary changes are often heated and politically costly for school board members (Samuels 2011, Schlenker 2017).

3 Data and Measurement

I construct a dataset of school boundary segregation using the NCES 2013-14 School Attendance Boundary Survey (SABS), a nationally representative survey of attendance boundary maps (U.S. Department of Education 2014b). This survey was the US Department of Education's first attempt to collect and harmonize the attendance maps of all public school districts in the country, with 90% of surveyed districts reporting. Each observation in the data corresponds to a school's attendance boundary polygon measured in longitude-latitude space. Using GIS methods, I link attendance boundaries to census block level population counts by race and ethnicity from the 2000 and 2010 Decennial Census (Manson, Schroeder, Riper, Kugler and Ruggles 2019a).[4] In addition, I make use block-group level data on poverty rates and median household income, using the 2010-14 American Community Survey (ACS) estimates (Manson, Schroeder, Riper, Kugler and Ruggles 2019b).[5] For metropolitan areas, I leverage data on 2010 census definitions of Core-Based Statistical Areas, and school district jurisdictions from the NCES Education Demographic and Geographic Estimates for 2013 (U.S. Census Bureau 2010, U.S. Department of Education 2013).

[4]Data from 2000 census is used in the Charlotte analysis in section 3.2, the rest of the paper uses 2010 census data. Census block data are linked using the centroid of each block (the mean longitude and latitude of the block polygon) and assessing whether centroids are located within an attendance boundary polygon. Because blocks tend to be much smaller than attendance zones, this procedure generates an accurate representation of the residential area encompassed by the zone. Figure 1 of the online appendix exemplifies the result of this merge by plotting choropleth maps of the attendance boundaries of eight school districts, highlighting the racial composition of local residents.

[5]Block level statistics on income are not made available by the US Census Bureau. Block-groups are a geographic aggregation considerably larger than census blocks, leading to imperfect overlap with school boundaries. Due to both the survey nature of the ACS and the coarser geographic scale of block-group data, median income and poverty rates (based on 185% of the federal poverty line) for individual attendance zones are measured less accurately than racial breakdowns.

I supplement the school boundary and census data using records of school geographic locations, enrollment breakdowns by race, and other school and district level characteristics from the National Center for Education Statistics (NCES) Common Core of Data (U.S. Department of Education 2014a). I obtain data on student achievement gaps from Stanford's Education Data Archive (SEDA) (Reardon, Ho, Shear, Fahle, Kalogrides and DiSalvo 2016). Data on teacher experience and the GT program is from the Department of Education's 2011-12 Civil Right's Data Collection (U.S. Department of Education 2012). School district level data on the status of court desegregation orders is made publicly available by Reardon et al. (2012). Additionally, I use school district level data from the General Social Survey (GSS) between 1998-2016 to measure local attitudes toward race (Smith, Davern, Freese and Morgan 2016). Finally, I use the National Neighborhood Data Archive (NaNDA) to measure county level election outcomes for the 2004 and 2008 presidential election (University of Michigan 2020).

The analysis sample focuses on school districts facing considerable leeway when drawing school boundaries, by restricting to those administering at least 5 elementary schools.[6] The final analysis sample contains 1,578 school districts, accounting for 9.8 million public school students, about 52% of the elementary school population in 2013. Importantly, the sample captures about 6.4 million minority (Black or Hispanic) students, representing 82% of the population. In Table A1 of the online appendix, I describe the representativeness of my sample, which consists mostly of large urban school districts, with the South region of the country over-represented relative to the Northeast, where districts tend to be smaller. Extrapolation of this study's findings to smaller districts administering only a handful of schools per grade level should thus be avoided.[7]

3.1 Illustrative example

What explains segregation in public school assignments? As an example, Figure 1 shows three maps of Springfield School District No. 186 in Illinois. Census blocks in Springfield are racially segregated in a manner reminiscent of an archetypical American city: near downtown, blocks are predominantly inhabited by minorities, while residents in the suburban outskirts tend to be almost exclusively non-minority (Cutler, Glaeser and Vigdor 1999). Even so, panel 1 shows that Springfield's school attendance boundaries have a low level of segregation – almost all the zones capture a population that is between 0 to 40 percent Black or Hispanic. It is also clear from panel 1 that the school attendance boundary map of Springfield is complex: it features small polygons near the city center that assign residences to schools other than the nearest school. Springfield has been under a desegregation order since 1976, and their school assignment mechanism reflects the school board's attempt at redressing vestiges of historically racist institutions (Levin 1978).

[6] I focus on elementary school boundaries because they are more numerous than middle or high school boundaries, generating a richer context for the district's school boundary drawing problem. Additionally, elementary schools are often feeder schools, such that the boundaries of middle and high schools are approximate unions of elementary school zones. In this sense, elementary school boundaries generate the most consequential student assignments across all K-12 grade levels. For reference, appendix Tables A2 and A3 present summary estimates for middle and high schools.

[7] In the school year 2013-14, 13,092 districts reported non-zero enrollment to the NCES, 8,360 of which administer a single school per grade level.These school districts have no flexibility when setting their student assignment policy, so they are not included in the analysis.

Panel 2 of Figure 1 plots a set of hypothetical boundaries that minimize distance between census blocks and schools, known as the *Voronoi* mapping (Erwig 2000). Minimum distance boundaries consist of as many zones as there are schools, with schools located approximately in the center. This hypothetical assignment is a "neighborhood schools" rule in a strict mathematical sense – blocks are matched to the nearest school, defined using the Euclidean metric ("distance as the crow flies").[8] Generically, minimum distance boundaries replicate patterns of residential segregation, although this interpretation is sensitive to the location of schools. Notably, Springfield's actual attendance boundaries are considerably less segregated than minimum distance boundaries. The latter has two schools near downtown that are between 60 to 80% minority, and many schools in the suburban outskirts in the city get assignment that are only between 0 and 20% minority.

A concern with minimum distance boundaries is that they depend on the location of schools, which are themselves the product of school district decisions. The historical literature reveals that districts have used school siting as a lever both to perpetuate segregation and to encourage integration (Rothstein 2017). To assess the extent to which the segregation of school assignments is driven by school locations, I compute simulated boundaries that are independent of school locations by construction and thus provide a correctly-scaled metric of the extent to which school assignment segregation is explained by neighborhood segregation alone. The simulations are based on a simple algorithm that randomizes school locations and assigns blocks to these hypothetical school sites using the minimum distance criterion. Panel 3 of Figure 1 shows one realization of simulated boundaries for Springfield. For this simulation, there are four zones toward the center of the district that are 40 to 80% minority, surrounded by numerous suburban zones that are 0 to 20% minority. These patterns suggest that, to a modest degree, Springfield's school sites encourage segregation - Voronoi zones based on actual school locations are more segregated than zones based on random school locations. To ensure this interpretation is not a function of sampling error, I compute these simulated boundaries 1,000 times and report the mean level of segregation from these simulations.[9]

The maps in Figure 1 establish a measurement framework providing two findings about Springfield's school assignments: (i) Attendance boundaries are desegregated relative to minimum distance (Voronoi) boundaries; and (ii) minimum distance boundaries are somewhat less segregated than simulated boundaries using random school sites, suggesting that schools are sited in a way that also encourages segregation, albeit only slightly so. To formalize this intuition quantitatively, I take each of these maps and compute a segregation index summarizing the unevenness of the distribution of school assignment demographics. I use the variance ratio index of segregation, which measures average differences in demographics faced by minority and

[8] In the appendix, I provide robustness checks on the potential discrepancy between Euclidean and actual commuting distance, as well as the role of school capacity. Figure A2 in the online appendix shows that Voronoi zones defined by applying Dijkstra's algorithm to the U.S. road network to define a road-based minimum distance metric are very similar to the Euclidean Voronoi zones used throughout the paper.

[9] I sample N random school sites without replacement using the set of all census block centroids in the school district as the set of possible school sites (where N is the total number of schools in the district). This ensures the simulated school locations obey the census geography of the district. The probability that a block is sampled as a school site is weighted by the square root of population, approximating the fact that school sites tend to be located in parts of the district that are more densely populated.

non-minority students (Massey and Denton 1988). It is defined as:

$$Seg_j = E[q_{sj}|M=1] - E[q_{sj}|M=0] = \frac{E[q_{sj}|M=1] - Q_j}{1 - Q_j} \tag{1}$$

where q_{sj} is the fraction of students in school s in school district j that are underrepresented minorities (M). The index measures the average difference in the demographics of school peers between minority and non-minority students, telling us how predictive a student's racial background is of the racial background of their peers. The second equality shows that the index also coincides with an adjusted isolation index, which measures the fraction of minority student peers that are themselves minorities. The adjustment depends on Q_j, the district-wide minority share of the population, scaling isolation relative to the range of variation between a perfect segregation and a perfect integration benchmark.[10]

Using this segregation index, I operationalize a decomposition of the segregation of school assignments as follows:

$$\begin{aligned} A_j &= R_j + (V_j - R_j) + (A_j - V_j) \\ &\equiv R_j + L_j + B_j \end{aligned} \tag{2}$$

where A_j is the segregation of school assignments, V_j is the segregation of minimum distance boundaries, and R_j is the segregation of simulated boundaries with random school locations. There are three components of the decomposition. The first term is driven purely by residential segregation in simulated boundaries R_j, and is measured at the correct scale to compare directly to school segregation.[11] The second term, $L_j \equiv (V_j - R_j)$, is the difference in segregation between minimum distance and simulated assignments, isolating the role that school siting has in determining segregation. The third term $B_j \equiv (A_j - V_j)$ is the difference in segregation between school attendance boundaries and minimum distance boundaries, capturing the extent to which the district's school boundary lines drive segregation.

For the case of Springfield, the decomposition breakdown is as follows: $R_j = 0.169$; $L_j = 0.01$; and $B_j = -0.156$. As is evident from the patterns in Figure 1, Springfield is a segregated city with a residential racial exposure gap of 16.9 percentage points (p.p.). The school sites in Springfield modestly exacerbate this issue, incentivizing greater segregation than one would expect from residential patterns alone, but only by 1 p.p. Nevertheless, Springfield's school attendance boundaries compensate almost completely for both residential segregation and inequitable school siting, by 15.6 p.p. Because the district has aggressively gerrymandered boundaries to achieve integration, its school assignments have very low levels of stratification ($A_j = 0.023$).

[10] In a perfectly integrated setting, all schools would have a composition equal to Q_j. On the other hand, under perfect segregation minority students are only exposed to themselves, so the isolation index would equal one. The variance ratio therefore measures excess isolation relative to the difference between the perfect segregation and perfect integration benchmarks.

[11] Segregation indices are not scale invariant – smaller geographies have more scope for segregation than larger geographies. The minimum distance and simulated boundaries developed here overcome scaling issues for comparing school and residential segregation using census geography (Lee et al. 2008).

3.2 Validation – school redistricting in Charlotte, NC

An initial way of providing validation for this measurement framework is to apply it to a well-known instance of school redistricting related to school desegregation. Perhaps the most famous example of this type of policy change took place in Charlotte-Mecklenburg Schools (CMS), North Carolina. In 1971, CMS was plaintiff in a pivotal Supreme Court decision which held that busing was an appropriate remedy for school segregation.[12] In compliance, CMS enacted a desegregated school boundary map which involved assigning downtown residences to schools in the suburbs. CMS's desegregation plan was successful and quite influential, remaining in place for almost three decades until a series of lawsuits were brought to challenge it (Johnson 2019). In 1999, a federal court decision ordered the district to cease using race as a factor in school assignments. CMS complied and implemented a neighborhood schools plan in 2002.[13] Research on its impacts has established that this policy change led to increased levels of school segregation and worser educational outcomes for students (Billings et al. 2014a).

Figure 2 documents changes in the segregation decomposition that were brought about by school redistricting in CMS, using longitudinal data on their elementary school attendance boundaries over the period 2000-2010 (Billings, Deming and Rockoff 2014b). The top panel shows that school redistricting brought about a dramatic jump in the boundary component of segregation, going from -0.18 in 2000 to approximately zero starting in 2002 and on to 2010. Since we know that in 2002 CMS implemented drastic redistricting that ended the era of desegregation busing, this provides key validation for the proposed decomposition framework. In contrast, the residential segregation component is stable near 0.38 over this period, and the component attributable to school siting is constantly near zero, implying that meaningful changes in the segregation of school assignments were driven entirely by changes to school boundaries.[14] The plot also shows the trend in mean excess commute to school, defined as the difference between actual and minimum-distance boundaries in the population-weighted mean (Euclidean) distance between census blocks and schools. The trend shows that school redistricting in Charlotte was also accompanied by a dramatic drop in commuting costs. During the busing years distance travelled to school per student was 1.53 km, dropping to 0.34 km per student after the enactment of the 2002 neighborhood schools plan, a reduction of 77.8%.

The bottom panel of Figure 2 shows a school level scatter plot summarizing the demographics of CMS attendance boundaries in 2000 and 2010. The horizontal axis measures the minority share of 'neighborhoods' – as defined by schools' minimum distance boundaries – while the vertical axis measures the minority share in the district's actual school assignments. The OLS slope of this scatter can be interpreted as a pass-through rate: when the slope is near one, neighborhood composition is mapped perfectly onto school assignment composition; but when it is zero there is no pass-through from neighborhoods to schools, equivalent to perfect integration in school assignments. It is clear that 2000 boundaries created an attenuated mapping between

[12]Swann v. Charlotte-Mecklenburg Bd. of Educ., 402 U.S. 1 (1971)

[13]Charlotte also implemented a centralized school lottery mechanism in 2002. School boundaries still factor in this school choice system, since schools give priority to students residing "in-boundary".

[14]Because these computations are based on 2000 census block data, the residential component can only vary due to changes in the number of schools in the district over time and sampling error.

neighborhood and school segregation. In contrast, 2010 boundaries almost perfectly replicate residential segregation in school assignments. This pass-through approach to measuring the role of school boundaries is a useful alternative to the one based on a segregation index (equation 2), enabling robustness checks for the descriptive analysis below.

4 The Distribution of School Boundary Segregation

I apply this decomposition framework to characterize the cross-district distribution of segregation of school boundaries. Figure 3 shows a school district level scatterplot of the segregation of minimum distance (Voronoi) boundaries against the segregation of simulated boundaries, weighted by district population. There is a near one-to-one relationship between segregation of Voronoi boundaries based on actual school sites and the mean level of segregation recovered in my random school site simulations. An OLS fit of this relationship has a slope coefficient of 0.98 and a R^2 of 0.98 as well. This implies that in the vast majority of cases, schools are not sited in a manner that exacerbates or ameliorates the impact of residential segregation on school stratification patterns.

Figure 4 presents a similar scatter of segregation in districts' actual 2013-14 boundaries against that of the minimum distance counterfactual. While the forty-five-degree line is still a strong predictor of segregation of school assignments, there is a substantial mass of districts whose attendance zones are considerably less segregated than one would expect from distance-minimizing zones. This is a key result: the attendance boundaries of most school districts in the country replicate the segregation of (Voronoi) neighborhoods, but a sizable minority of school districts desegregate their assignment policy relative to neighborhoods. Most districts with desegregated boundaries tend to be small districts that are considerably less residentially segregated than the largest cities in the country.

Nevertheless, there are other dimensions of stratification that are important. Therefore, Table 1 presents a summary of the decomposition statistics, focusing on four definitions: (1) the segregation of underrepresented minorities (URM) from other groups; (2) segregation between the Black and White populations; (3) segregation between Hispanic and White populations; and (4) segregation of those living below 185% of the poverty, the income threshold determining eligibility for the free or reduced price lunch (FRL) program.[15] Additionally, Figure A3 in the online appendix presents district scatter plots of FRL segregation, which look similar to those in Figure 3.

The estimates indicate that on average residential patterns tend to over-explain segregation of school assignments, and that school boundaries have a role to play in mitigating segregation. The mean decomposition in column 1 shows that average minority segregation in school assign-

[15] Because a number of states have switched their apportionment of subsidized school meals to "community eligibility" (providing free or reduced price lunch to all students in schools whose enrollment has a high share of student living in poverty) the FRL segregation statistics should be interpreted with caution (Owens, Reardon and Jencks 2016). There are thus two shortcomings for the decomposition of FRL segregation: (1) the data we have on residential poverty rates is geographically coarser and more prone to measurement error, and (2) the FRL enrollment counts in the school data may overstate true poverty rates in certain parts of the country.

ments is 0.13, where 103.7% is due to neighborhood segregation patterns, 1.1% is attributable to the location of school sites, and -4.8% is due to school attendance boundaries. This pattern holds when examining Hispanic-White segregation, as well as for economic (FRL) segregation. For Black-White segregation, the school site component is more important, accounting for about 3.5% of stratification patterns. Across definitions, the contribution of boundaries to segregation ranges between -5.7% and -1.3%, while school siting contributes only between 0.9% and 2.91%. Thus, a broad takeaway of Table 1 is that school boundaries tend diminish segregation slightly, while school locations marginally exacerbate it.

In addition, Table 1 summarizes the distribution using an alternative measure of the extent to which neighborhood segregation maps onto school assignments.[16] Following the logic of the bottom panel in Figure 2, for each district I compute the OLS slope of a regression of school attendance zone minority share on the minority share of (Voronoi) neighborhoods.[17] On average, this pass-through rate is 0.90, such that for every 1% increase in the share minority of neighborhoods one expects a 0.9% increase in the minority share of school assignments. This finding is in line with the results above: neighborhood segregation patterns explain almost all school assignment segregation, but there is also a substantial role for school attendance boundaries.

In online appendix tables A2 and A3 I present a parallel decomposition analysis for middle and high schools, suggesting a similar set of takeaways. For example, residential segregation over-explains segregation in middle (high) school assignments by about 9.7% (6.6%), while boundaries account for a 11.5% (10.2%) reduction in segregation, and school sites drive segregation up to 1.8% (3.6%). Furthermore, the pattern of school sites exacerbating Black-White segregation more than for other groups is also replicated at higher grade levels. About 3% (6.8%) of Black-White segregation in middle (high) schools is attributable to school siting, but this figure ranges between 0.8-1.8% (1.1%-3.6%) when defining segregation as URM, Hispanic-White, or FRL segregation.

The analysis has thus far leveraged data on school boundary maps, school sites and census blocks. The bottom of Table 1 shows that segregation in school enrollments has a higher mean and total variance than one would expect from school boundaries alone. This suggests that sorting taking place in schools' actual enrollment demographics can operate above and beyond school assignments (likely due to school choice and outside options like charter and private schools). Then, is segregation in school assignments robustly predictive of segregation in actual school enrollments? In Table A4 of the online appendix I study the correlation between enrollment and assignment segregation, showing that the two are tightly linked, with a pass-through rate from attendance boundaries to enrollment of 86% for URM segregation.[18]

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[16]This is the measurement approach that other research has taken, see Saporito and Sohoni (2009). Chang (2018) uses this study's dataset.

[17]Because some districts have much fewer schools than others, I use Empirical Bayes shrinkage toward zero to adjust the OLS slope estimates. I use the total variance in the estimated betas and their robust standard errors to construct a signal to noise ratio for the shrinkage procedure. This reduces about 60% of the observed variance in the coefficient estimates.

[18]The explanatory variables in Table A4 correspond to each of the decomposition terms in equation 2. Each of them is positively and significantly correlated with enrollment segregation. A 10 percentage point (p.p.) increase

4.1 Racial Gaps in School Quality

Is segregation in school assignments linked to racial differences in achievement and school quality? To answer this question, Table 2 examines the correlation between the segregation of school boundaries and district level racial inequality in selected school characteristics. I define district level racial gaps as: $E[Y_{sj}|M=1] - E[Y_{sj}|M=0]$, where Y_{sj} is a characteristic of school s administered by district j; and M is a student level indicator of being an underrepresented minority. I examine three informative characteristics: mean student achievement in standardized exams, exposure to inexperienced teachers (defined as being in their first or second year of teaching), and exposure to the Gifted and Talented (GT) program.[19]

Columns 1 and 2 show that higher residential segregation is robustly associated with larger achievement gaps, regardless of the inclusion of additional controls.[20] However, the coefficients on the school boundary and school siting components are statistically indistinguishable from zero. Although neighborhood and school segregation are highly correlated, the achievement gap is more closely linked to neighborhood than to school segregation patterns, echoing existing work on the causal impact of segregation on the achievement gap (Card and Rothstein 2007).

In contrast, columns 3 and 4 look at differential exposure to relatively inexperienced teachers, a proxy for inequality in school staffing. Residential segregation is associated with greater racial inequality across this dimension as well. However, the school boundary and school siting components have coefficients that are twice the magnitude. A 10 p.p. increase in boundary segregation is linked to about a 1 p.p. increase in minority students' relative exposure to inexperienced teachers, but a similar increase in residential segregation correlates with only a 0.4 p.p. increase in this gap. Similarly, columns 5 and 6 focus on the gap in exposure to the GT program, which has a mean of -0.038. The estimates show negative coefficients across the board, with larger magnitudes for the boundary and siting components.

These findings suggest that aspects of public school quality controlled by local governments show significantly lower levels of racial inequality when school boundaries (and school sites) are integrated. Variation in boundary and siting policies at the district level can independently explain a significant portion of existing racial inequality in public education, above and beyond the role of residential segregation. This evidence is consistent with earlier research on the impact of school assignment policy on teacher sorting patterns (Jackson 2009) and with studies analyzing the GT program's student selection process and its implications for inequality (Card and Giuliano 2015, Card and Giuliano 2016). Nevertheless, the evidence is unclear on whether school boundary desegregation could lead to lower achievement gaps.

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in boundary segregation is associated with a 9 p.p. increase in enrollment segregation for URM students, 7.5 p.p. increase in Black-White segregation, and 15.8 increase in FRL segregation.

[19] Exposure is measured at the school level, assuming all students within a school interact with its resources. This ignores aspects related to within-school segregation, instead focusing on between-school differences.

[20] The achievement gap is defined as the mean between math and reading achievement gaps in grade 4 through 8, as reported by SEDA (version 1).

4.2 Metropolitan Level Segregation

While school attendance boundary policy is under the administrative authority of school districts, the literature documents the key importance of local political fragmentation and between-district stratification for segregation at the level of metropolitan areas (Clotfelter 2004, Boustan 2012). Therefore, I now turn to an analysis of the metropolitan segregation of schools. I do so using a modified decomposition framework that separates the contribution of school attendance boundaries from that of school district jurisdictional boundaries. Because the SABS survey does not provide exhaustive coverage, I restrict the analysis sample to metropolitan areas with at least 50% of the population matched to an attendance boundary, and drop any that have missing SABS data for the urban core school district.[21]

Research on segregation between school districts has focused on the decomposition proposed by Clotfelter (1999), which splits total metropolitan school segregation into between- and within-district components. It is operationalized by first assuming that schools in a district perfectly reflect the district's overall demographics. Metropolitan segregation under this counterfactual provides a measure of between-district segregation.The within-district component is the difference in total segregation and the between-district component. In Table 3, I summarize metropolitan segregation of school boundaries for 257 metropolitan areas in the sample, providing the Clotfelter decomposition below. Metropolitan segregation is about twice as large as the within-district segregation levels reported in Table 1, in line with the notion that segregation is more severe at this larger scale. The between-district component of segregation is large , explaining approximately 50% of average URM segregation levels. Moreover, variation in between and within segregation explain about 30 to 40% of the variance of metropolitan segregation. The two terms are positively correlated; their covariance explains between 25 to 35% of the variance. Between-district segregation is a key driver of metropolitan stratification across definitions: URM, Black-White, Hispanic-White, and FRL segregation.

The bottom panel of Table 3 shows my boundary decomposition, suggesting that both within- and between-district segregation are largely artifacts of residential segregation at the metropolitan level. Following the approach taken for districts, I compute the residential component of metropolitan segregation by performing 1,000 simulations of minimum distance boundaries based on random school locations and taking the average level segregation of the simulated maps. The residential component tends to just explain or slightly over-explain total levels of school boundary segregation in metropolitan areas. As such, the residential component is approximately equal to the sum of the within- and between-district segregation components in the Clotfelter decomposition, suggesting that both are almost completely accounted for by residential patterns. In Figure 5, I show that an OLS fit of residential segregation as a function of a quadratic in between-district segregation has a R^2 of 0.70, indicating that sorting across school district jurisdictional lines explains about 70% of the variance of the residential component of metropolitan school segregation.

Given these findings, if we drew distance-minimizing boundaries at the metro level, ignoring

[21] Metropolitan areas that get dropped due to this sample restriction include: Boston, MA, Detroit, MI, Cleveland OH, Providence RI, Hartford CT, and Fort-Worth TX.

district lines, would this lead to more or less segregation than the existing district and school boundaries? The boundary decomposition in Table 3 shows that once one accounts for residential segregation, district boundaries themselves explain only a small share of the variance in segregation across metro areas. The district boundary term tests whether there would be meaningful integration gains of moving from a distance-minimizing set of attendance zones that respect district jurisdictional lines, to one that minimizes distance but ignores district boundaries. On average this term is positive, but very small, accounting for at most 1% of mean segregation levels, and explaining less than 1% of total variation across districts. This is not surprising given that residential segregation drives the bulk of segregation between districts, and the district boundary component is limited to marginal "inefficiencies" in integration near district boundary lines.

The rest of the metropolitan segregation decomposition statistics are similar to that of school districts. For instance, while residential segregation is by far the largest component of Black-White segregation, a reduction of about 6% is attributable to desegregated attendance boundaries. In turn, the school site component is positive, suggesting that on average about 3% of segregation in school assignments is attributed to the manner in which schools are sited. A decomposition of the variance suggests similar takeaways, with two additional findings: (1) a negative covariance between the residential and school boundary component leads to a 16.5% compression in the distribution; and (2) the residential, site and district components covary positively, driving variation up slightly. This suggests that, were it not for the presence of desegregated boundaries in some highly residentially segregated metropolitan areas, total variation in metropolitan school segregation would be higher. Nonetheless, given the qualitative similarity of findings at the district and metropolitan scale, the rest of my analysis focuses on the former, which enables an in-depth analysis into school boundary heterogeneity.

5 Heterogeneity in School Boundary Segregation

5.1 Desegregation orders

Do school attendance boundaries vary across districts currently or formerly under a court-mandated desegregation order? Table 4 presents summary statistics for a split sample of districts: (1) those that have never been under a desegregation order, (2) those that are currently under one, and (3) those that have been released from court supervision. Comparing column 1 to columns 2 and 3, districts that have been under a court order (about 75% of them in the South) tend to be twice as large in population; they have a higher Black share and lower Hispanic share of the population; they have lower median household income, and larger racial gaps in income and in student achievement. The bottom panels of Table 4 show that districts that have been under court order are on average much more segregated than those that have not. Further, districts with an active order (column 2) are on average more segregated than those with rescinded ones (column 3). For example, mean Black-White segregation of school assignments is 25.9 in districts with an active order, 21.7 in those with rescinded one, and 3.9 in all others.

Total segregation in districts with active court orders is highest due to their high levels of residential segregation. Average Black-White residential segregation is 26.6 in these districts, compared to 20.5 in rescinded order districts. However, active order districts tend to have boundaries that are relatively more integrated, accounting for a mean reduction in segregation of about -1.6 (6%). In Table A5 of the appendix, I show that active court orders are significantly linked to desegregated boundaries, which is robust to the inclusion of a range of control variables in a multivariate model. In contrast, among districts with rescinded orders I cannot reject the hypothesis that boundaries are as desegregated as those that never faced court supervision, once controls are included.[22] Desegregated attendance boundaries are a tool used by districts known to be actively pursuing greater levels of integration. The resegregation of schools following the end of desegregation orders (Lutz 2011, Reardon et al. 2012), can explain why rescinded order districts have boundaries that replicate neighborhood segregation.

5.2 Excess commuting

Panels 1 and 2 in Figure 6 examine the distribution of excess distance to schools, confirming that the commuting burden of desegregated boundaries is disproportionately borne by minority households.[23] The figure shows binned scatter plots of boundary segregation against mean excess distance borne by Black (panel 1) and White households (panel 2). They visualize residualized variation after controlling for a rich set of covariates, including state fixed effects, log population, the population minority share, indicators for the status of desegregation orders, the level of residential segregation, and the level of segregation in minimum distance boundaries. The inclusion of the latter two controls is crucial for interpreting the reported coefficients as partial "effects" on the school boundary component of segregation, given equation (2). Estimates suggest that a one kilometer increase in Black excess commute is linked to a 3 percentage point increase school boundary desegregation. For Whites, the estimated slope is 1.9 percentage points.

Table 5 disentangles these correlated effects by including both minority and White excess commute in a linear model of boundary segregation. Minority excess commute (columns 1 and 5) has more explanatory power than White excess commute (columns 2 and 6), given the difference the models' R^2. Including both measures in the model (columns 3, 4, 7 and 8) shows that White excess commute has a net positive partial effect on school boundary segregation, once minority commuting is held constant. In contrast, excess minority commuting is linked with more integrated boundaries across models, which is robust to the addition of additional covariates and to the definition of "minority".

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[22]The bottom rows in Table 4 show that this pattern does not hold for Hispanic-White separation, in line with the court desegregation era's primary focus on Black-White segregation. Nonetheless, Table A5 shows that this result holds for FRL segregation.

[23]Excess commuting distance is defined as the difference in mean block-school distance between districts' actual boundaries and minimum distance boundaries. Race-specific commuting distance uses weights equal to the group's total population in a census block.

5.3 Racial animus

Another candidate driver of school boundary heterogeneity is between-district variation in local populations' predominant attitudes toward racial diversity. To examine this channel, I implement two racial animus metrics used previously in the literature. First, I estimate a survey-based index of white racial intolerance at the district level using NORC's General Social Survey (GSS), following the procedure of Card, Mas, and Rothstein (2008). The GSS intolerance index captures district-specific variation in the likelihood that White survey respondents express racially intolerant views, after adjusting for various factors.[24] Panel 3 in Figure 6 presents a binned scatter plot showing that school boundaries are considerably less likely to be desegregated in high animus localities. After partialing out controls, I estimate a linear slope of about a 1.1 percentage point increase in the school boundary component of segregation per standard deviation increase in the GSS intolerance index. The plot suggests mild levels of integration in more tolerant districts, and zero (i.e. replication of residential segregation) in more intolerant ones.

While the GSS intolerance index is well tailored for this setting, it is only observed for a subsample of districts and it pools over a relatively long time period, limiting its usefulness. Therefore, I also analyze the correlation between school boundary segregation and an alternative measure of animus with sufficient geographic granularity, the county level Kerry to Obama vote swing. While generally Obama won a much higher share popular vote than did Kerry, in some counties the 2008 democratic share declined relative to the previous presidential election, and there is evidence that part of this decline was linked to racial animus against the country's first Black presidential candidate (Stephens-Davidowitz 2014).[25]

To test this, I link county level data on 2004 and 2008 presidential election outcomes. I define the Kerry-to-Obama vote swing as $DemShare_{2004} - DemShare_{2008}$, such that positive values denote lower county vote shares for Obama than Kerry, and possibly more racism relative to other places. Panel 4 of Figure 6 shows that districts located in counties that "red-shifted" against Obama tend to have significantly more segregated school boundaries than others. My estimates suggest that a 10 percentage point increase in the Kerry-to-Obama swing is associated with a statistically significant increase in the school boundary component of segregation of about 0.7 percentage points. These results provide further basis for the claim that localities with

[24] I pool waves 1998-2016 of the GSS, matched to respondents' census tract of residence, and restricting the sample to White respondents. The GSS includes seven questions on racial intolerance, see online appendix section A.2 for a detailed description of them. For each question, I compute an indicator for an intolerant response and estimate a linear probability model including school district fixed effects and controlling for respondent gender, age, education, a socioeconomic status index, and survey year indicators. I extract the estimated school district effects from these models, shrink them toward zero using Empirical Bayes (to account for variation in sample size across districts), and standardize each to have mean zero and standard deviation one. I drop districts that are matched to a single survey observation. There is on average 22 survey observations per district in the sample. The final GSS racial intolerance index is the simple average of these standardized school district effects, observed for a subsample of 378 districts. The models in Figure 3 include a control for a missing GSS index observation.

[25] Stephens-Davidowitz (2014) proposes a racial animus measure based on geographic variation in Google online search activity using racially-charged language. Unfortunately, Google Trends geographic data is measured at the "designated market area" level, which tend to be somewhat larger than metropolitan areas and roughly the size of northeastern states. These geographies are not sufficiently granular to study variation between school districts.

greater racism are less likely to pursue desegregation. This finding is important, as it provides a quantitative basis for the influence of racism on the equitability of local public good provision.

5.4 Geography and demographics

Variation in school boundaries is also driven by mechanical factors linked to the cost dimension of desegregation efforts. Panel 5 of Figure 6 summarizes the association between district log population and the boundary component of segregation. The two are positively and significantly correlated, indicating that more populous districts are less likely to have desegregated boundaries. Besides total population, another constraint to desegregation is the geography of the district's jurisdiction. School district jurisdictions are often irregularly shaped, creating an irregular jurisdictional patchwork within metropolitan areas and making it difficult integrate boundaries. To test this, I borrow a measure of non-convexity (or "bizarreness") of district shapes from the congressional gerrymandering literature, for which positive values correspond to more irregular shapes. (Chambers and Miller 2010).[26] Panel 6 in Figure 6 shows that there is a positive relationship between district bizarreness and boundary segregation. Net of controls, districts that face less cumbersome options for desegregation are more likely to pursue it, suggesting that demand for integrated boundaries exists. This result provides suggestive evidence that recent federal initiatives to unlock funding to support district integration plans could be effective (Gaudiano 2019).

5.5 Robustness checks

In the online appendix, I provide a battery of robustness checks for the heterogeneity results above. First, I show that the results are robust to inclusion of various sets of covariates, and to racial versus economic segregation (Table A5). Second, I establish that there are no meaningful links between school siting and the drivers of heterogeneity in school boundaries, suggesting that these correlations are specific to boundary policy (Table A6). Third, I show that the results are robust to the functional form specification of control variables (Table A7). Fourth, Table A8 shows that the results are robust to the use of other segregation indices (like the dissimilarity index), and to using the measure of school boundary segregation based on the OLS slope between neighborhood and assignment demographic compositions, shown in Figure 2, and summarized for the sample in Table 1. Finally, I establish that the results are broadly insensitive to splitting the sample based on (probable) recent school boundary changes due to recently newly opened schools (Table A9). Altogether, these tests demonstrate that the results are robust to a range of statistical tests and to changes in key assumptions and definitions.

[26] The formula for the bizarreness index is $b_j \equiv 1 - \frac{Area(S_j)}{Area(Convexhull(S_j))}$, where S_j the polygon that defines the district j's geographic jurisdiction. I then scale this index to have mean zero and standard deviation one in the analysis sample.

6 Conclusion

The racial integration of U.S. public schools has been a controversial policy topic for over half a century. The federal government has largely retreated from its efforts to influence the hand of local jurisdictions to alleviate racial imbalances in public education. Today, decisions affecting school integration are largely left to local policymakers. Understanding how these officials make choices that affect racial inequality in their jurisdictions is of key importance in this debate.

This paper developed and implemented empirical tools to interpret and evaluate local school attendance boundary maps. I examined what school boundaries may reveal about the status of school integration efforts. My findings indicate that on average residential segregation explains more than 100% of existing levels of school boundary segregation. On net, school boundaries tend to slightly improve integration in the average district. School siting, on the other hand, has almost no role. This result is important, as there is growing interest in combating institutional determinants of inequality, and on the best approaches to redirect vestiges from the era of racist policy. This study furthers our understanding of these mechanisms.

An important topic for future research is to closely examine the impact that changes to school boundary maps have on neighborhoods and housing markets. Qualitative evidence suggests that districts considering school redistricting fear unintended consequences, both politically and in the local real estate market. However, there is a dearth of evidence on the impacts of school redistricting in representative contexts. Existing work shows that equilibrium sorting across boundaries is significant, and that sorting dynamics are heterogeneous over place. Understanding these mechanisms is primordial for the design of effective policy for furthering equity in local public good provision.

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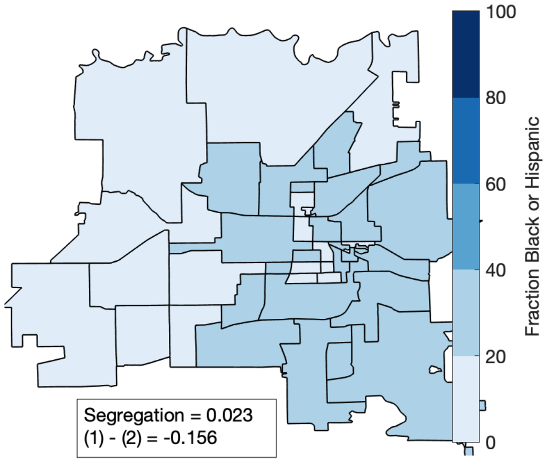
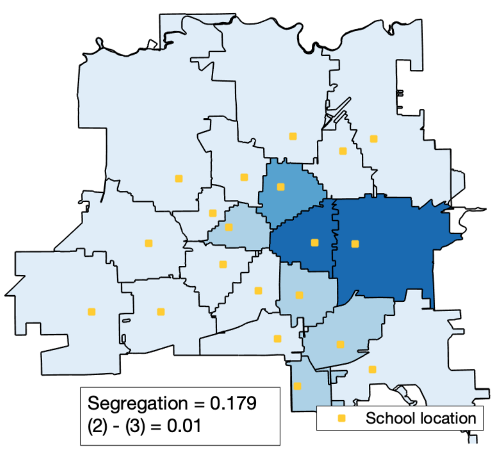
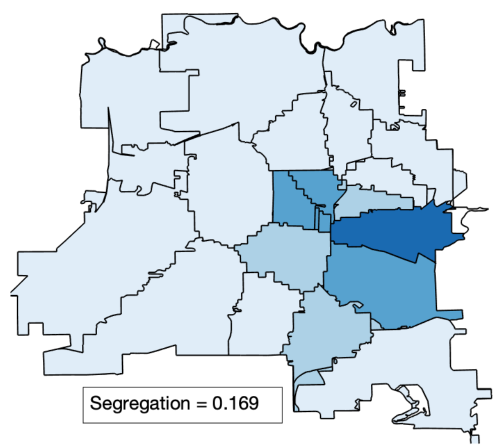
Figure 1: Decomposition of segregation of public school attendance boundaries



(1) Actual 2013-14 school attendance boundaries



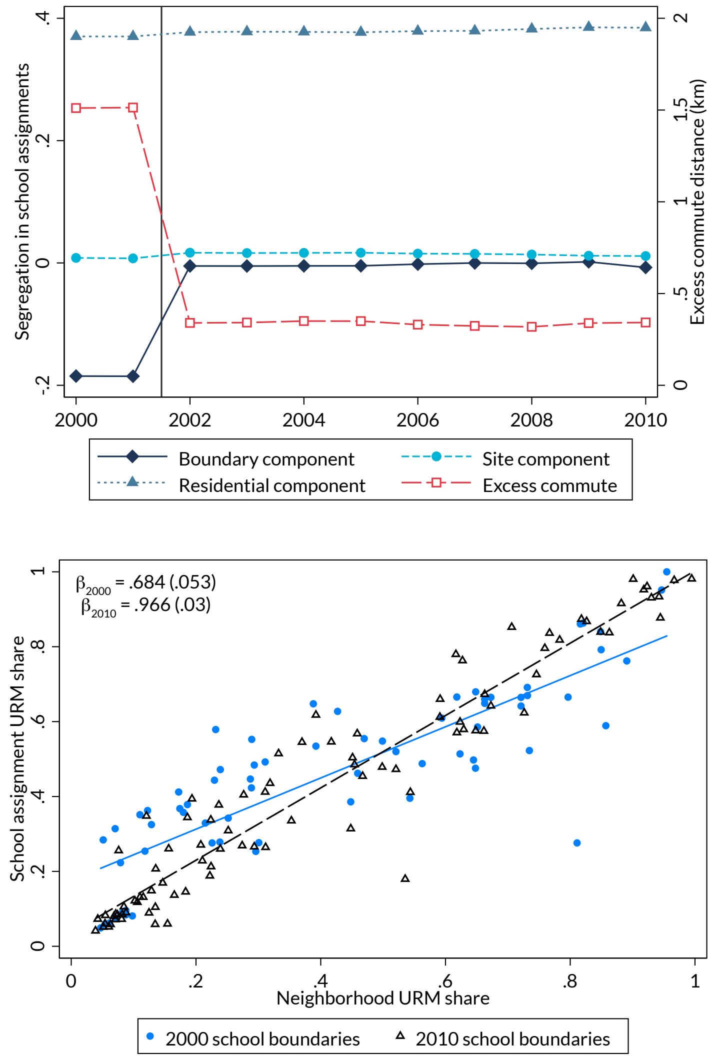
(2) Minimum distance boundaries
(specific to school siting)



(3) Simulated boundaries
(random school sites)

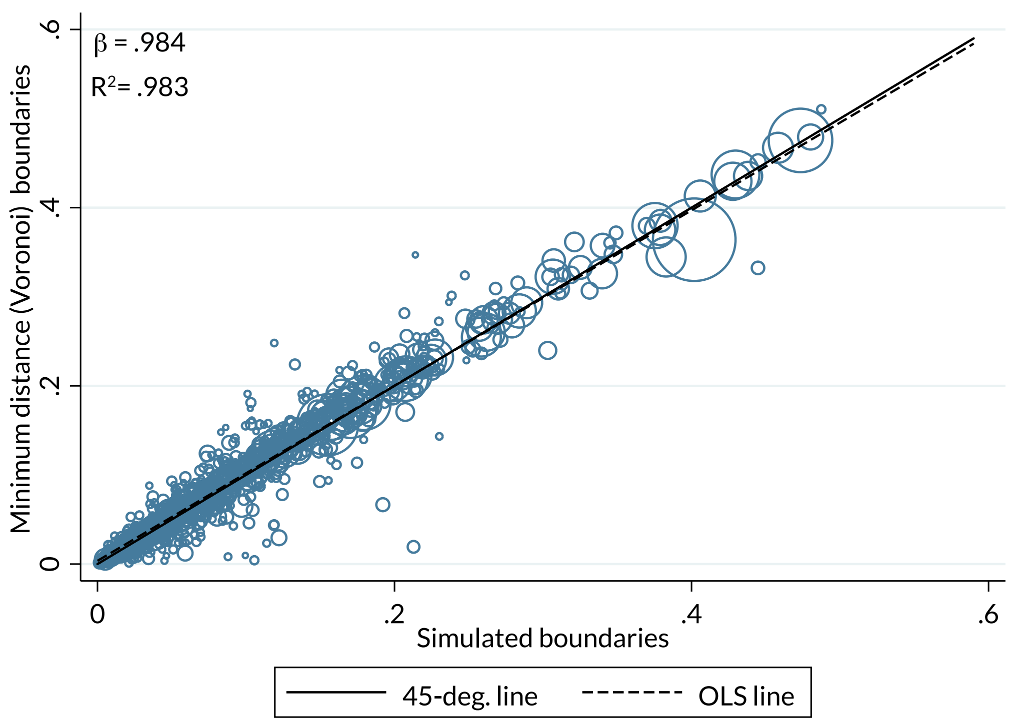
Note: Heat maps of the 2010 census share of minority (Black or Hispanic) residents in three elementary school attendance boundary maps for Springfield SD No. 186 in Illinois. Each of the maps reports the level of minority segregation using the variance ratio index. Panel 1 shows the district's actual attendance boundaries for the 2013-14 school year. Panel 2 shows hypothetical boundaries based on distance minimization from blocks' centroids to school site locations. Minimum distance boundaries are a Voronoi mapping of the district's blocks to its elementary schools, based on euclidean distance (see online appendix for discussion of other distance metrics). Panel 3 shows a Voronoi mapping of Springfield based on random school locations. Random school locations are defined by sampling N blocks in the district to take the role of school sites, where N is the number of elementary schools in the district, and with sampling weights equal to the square root of total block population. Panel 1 also shows the difference in segregation between panels 1 and 2, measuring the contribution of boundaries. Panel 2 presents the difference in segregation between panels 2 and 3, measuring the contribution of school siting. Panel 3 captures neighborhood segregation independent of boundaries or sites.

Figure 2: Decomposition of the effect of Charlotte NC school redistricting on school assignment segregation.



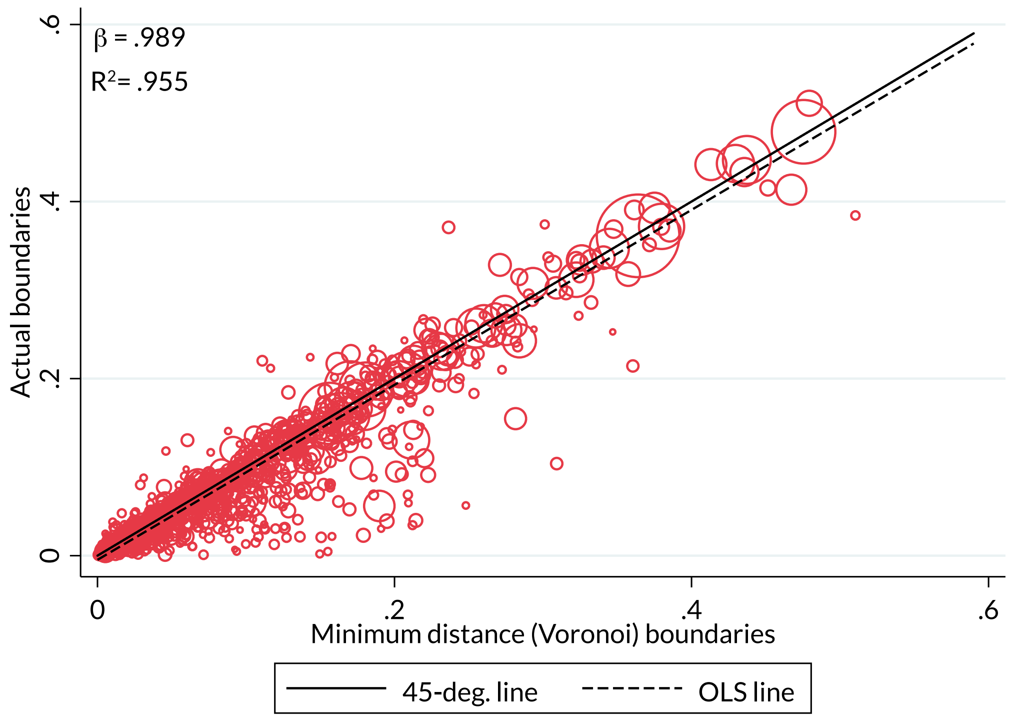
Note: Estimates are based on 2000 census block data. Top panel reports levels of each component of segregation in Charlotte-Mecklenburg Schools (NC) attendance boundaries for each school year in 2000-2010. The boundary component is the difference in segregation between actual boundaries and minimum distance (Voronoi) boundaries based on school site locations. The site component is the difference in segregation between the Voronoi boundaries and the residential component. The residential component is defined as the mean level of segregation from 1,000 simulations of minimum distance boundaries based on a set of random school locations. Excess commute is defined as the difference between actual and Voronoi boundaries in mean euclidean distance from census blocks to assigned school sites. The bottom panel shows a scatter of actual school assignment composition against Voronoi composition. Blue circles correspond to SY 2000-01 and black triangles for SY 2010-11. In 2001 CMS had a desegregation plan in place. In 2002, CMS implemented a neighborhood schools plan. OLS slope coefficients and robust standard errors reported on top left.

Figure 3: Segregation of minorities in minimum-distance versus simulated attendance boundaries.



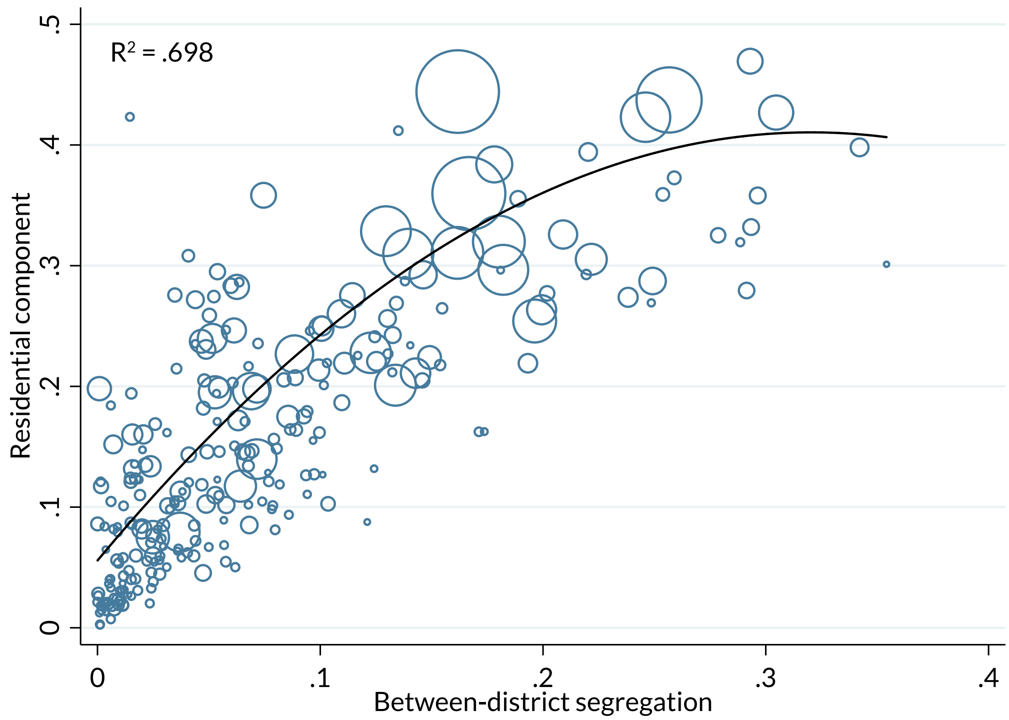
Note: Figure shows a population-weighted scatter plot at the district level (N = 1,578). The vertical axis measures minority (Black or Hispanic) segregation from minimum-distance (Voronoi) boundaries based on actual school locations. The horizontal axis corresponds to the mean level of segregation from 1,000 simulations of Voronoi boundaries based on random school locations. Plot shows the forty-five degree line (solid) and population-weighted OLS line (dashed) for reference. OLS slope coefficient and model R^2 reported top left.

Figure 4: Segregation of minorities in actual versus minimum-distance attendance boundaries.



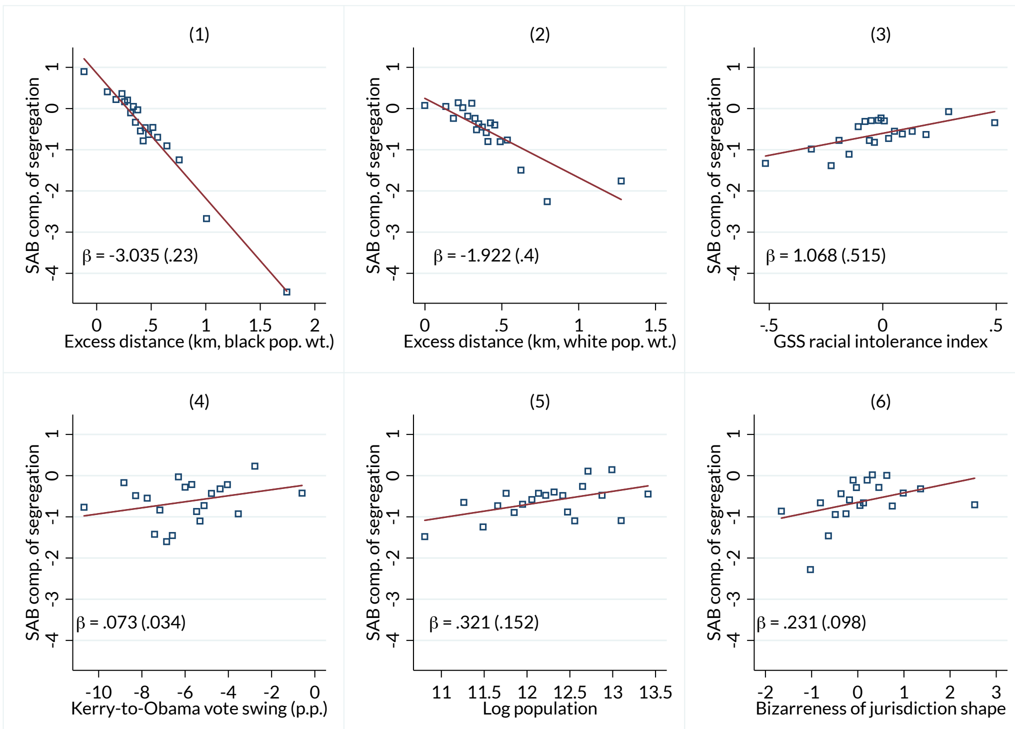
Note: Figure shows a population-weighted scatter plot at the district level (N = 1,578). The vertical axis measures minority (Black or Hispanic) segregation in actual school boundaries from school year 2013-14. The horizontal axis corresponds to the segregation of minimum-distance (Voronoi) boundaries based on actual school locations. Plot shows the forty-five degree line (solid) and population-weighted OLS line (dashed) for reference. OLS slope coefficient and model R^2 reported top left.

Figure 5: Between-district and residential segregation in metropolitan areas



Note: Figure shows a population-weighted, metropolitan area level scatter plot of the residential component of metropolitan URM segregation in school assignments against between-district segregation. The residential component is defined as in equation 2, by taking the average segregation from 1,000 simulations of school boundaries that minimize distance to a random set of N school locations, with N equal to the metro's number of elementary schools. The between district component of segregation in the Clotfelter decomposition is computed by assuming schools' minority share equals that of the district as a whole. OLS quadratic fit is shown, with R-squared reported in the top left.

Figure 6: Correlates of school boundaries' contribution to segregation in school assignments



Note: SAB = School attendance boundary. Figure shows binned scatter plots of the correlation of district characteristics with the boundary component of URM (Black or Hispanic) segregation in school assignments. Plots consist of bins across 25 quantiles of the distribution of the horizontal axis variable and means of the vertical axis variable after partialing out controls. The OLS slope coefficient and robust standard error is reported on the top left. Controls include: state fixed effects, the level of segregation in minimum distance and in simulated boundaries, and the URM share of population, the status of desegregation orders, bizarreness of the districts' jurisdiction shape, log population, the GSS racial intolerance index, an indicator of missingness in the GSS index, the Kerry-to-Obama vote swing, the share of enrollment at charter and private schools, log median income, the URM-white gap in log median income, and the share of the population with a bachelor's degree.

Table 1: Decomposition of district segregation of school assignments

	URM	Black-White	Hispanic-White	FRL
	(1)	(2)	(3)	(4)
Segregation of school assignments				
Mean	12.97	11.52	8.36	7.17
	(12.18)	(15.21)	(9.87)	(4.37)
Mean decomposition (%)				
Residential (R)	103.72	102.79	100.38	102.13
	(93.55)	(129.19)	(118.18)	(59.47)
Attendance boundaries (B)	-4.84	-5.70	-1.27	-3.45
	(19.86)	(22.55)	(16.68)	(20.06)
School siting (L)	1.12	2.91	0.89	1.32
	(12.32)	(12.04)	(13.86)	(14.19)
OLS slope between assignment and neighborhood composition	0.90	0.83	0.92	0.91
	(0.15)	(0.24)	(0.14)	(0.13)
Segregation of school enrollments				
Mean	16.81	14.20	13.42	18.04
	(13.02)	(17.09)	(12.55)	(12.80)
Total Obs.	1,578	1,578	1,578	1,578

Note: Table shows average segregation in elementary school attendance boundaries across four definitions. Observations are at the school district level and weighted by population. Column 1 shows estimates for underrepresented minorities (URM), Black or Hispanic, based on full count 2010 census block data. Columns 2 and 3 correspond to Black-White and Hispanic-White segregation, ignoring other groups. Column 4 shows segregation on the basis of poverty, based on the share of the population eligible for the free or reduced price lunch (FRL) program. Poverty segregation estimates are coarser, as they are based on larger geographies that overlap imperfectly with school zones (block groups) and are based on 5-year (2010-14) estimates from the American Community Survey. The decomposition terms are defined as in equation 2 in the text. The residential component (R) is the mean level of segregation from 1,000 simulations of Voronoi boundaries with random school locations; the boundary component (B) is the difference in segregation between actual and minimum distance boundaries based on real school sites; the siting component (L) is the difference in segregation between minimum distance boundaries and the residential component. Assignment-neighborhood OLS is the estimated slope between the minority population share of schools' actual geographic assignment and the minority share in schools' Voronoi neighborhood (based on real school sites). I apply Empirical Bayes shrinkage to slope estimates given that some districts have as few as five schools. Segregation in enrollment is defined using K-4 enrollment breakdowns.

Table 2: School assignment segregation and racial gaps in school quality

	Achievement		Teacher Inexperience		GT Program	
	(1) (sd)	(2) (sd)	(3) (%)	(4) (%)	(5) (%)	(6) (%)
Residental Segegation	-0.820***	-0.936***	0.010	0.038**	-0.276***	-0.262***
	(0.110)	(0.143)	(0.015)	(0.017)	(0.075)	(0.096)
School Boundaries	0.184	-0.016	0.093	0.105**	-0.777***	-0.713***
	(0.419)	(0.289)	(0.062)	(0.049)	(0.171)	(0.165)
School Sites	-0.574	-0.732**	0.179***	0.128***	-1.538***	-1.409***
	(0.433)	(0.365)	(0.058)	(0.046)	(0.445)	(0.401)
Covariates		✓		✓		✓
Mean	-.575		.005		-.038	
SD	.22		.018		.09	
R^2	0.19	0.43	0.03	0.19	0.13	0.30
N	1,498	1,497	1,578	1,577	1,578	1,577

Note: Robust standard errors reported in parenthesis. In all specifications, the dependent variable is a district level racial gap, defined as $\bar{Y}_j^{nm} - \bar{Y}_j^{m}$, where $\bar{Y}_j^{r}$ is the district average of the outcome for students in racial group $r = nm, m$ (non-minorities and minorities) according to the definition of segregation. In columns 1 and 2, the outcome is the URM-white mean achievement gap between math and reading. In columns 3 and 4 the outcome is the gap in exposure to teachers in their 1st or 2nd year of teaching. In columns 5 and 6 the outcome is the gap in exposure to the Gifted and Talented (GT) program. Covariates include: state fixed effects, log population, and log median household income. Differences total observations across models are due to missing values in the outcome variables.

Table 3: Decomposition of school assignment segregation in metropolitan areas

	(1) URM	(2) Black-White	(3) Hispanic-White	(4) FRL
Mean segregation (pop. weighted)	0.26	0.23	0.16	0.12
Total variance (pop. weighted)	0.01	0.03	0.01	0.00
Clotfelter Decomposition				
Mean (%)				
Between-district	49.35	39.56	44.57	42.91
Within-district	50.65	60.44	55.43	57.09
Variance (%)				
Var(Between)	42.64	27.19	32.79	85.92
Var(Within)	33.05	41.18	30.74	44.27
2Cov(Between,Within)	24.70	32.02	36.86	-29.80
Boundary Decomposition				
Mean (%)				
Residential (R)	100.41	102.57	98.51	96.97
School boundaries (B)	-3.52	-6.38	-1.35	-3.44
District boundaries (D)	1.00	1.25	0.52	1.02
School sites (L)	2.10	2.56	2.31	5.46
Variance (%)				
Var(R)	100.75	102.21	97.61	102.09
Var(B)	3.63	6.24	0.57	10.94
Var(L)	1.31	1.46	0.70	5.43
Var(D)	0.36	0.26	0.08	0.78
2Cov(R,B)	-9.88	-16.75	-2.47	-13.27
2Cov(R,L)	2.84	5.46	3.84	-5.63
2Cov(B,L)	-0.66	-1.16	-0.05	-1.11
2Cov(D,R)	1.95	2.61	0.21	1.58
2Cov(D,B)	-0.04	0.04	-0.10	-0.42
2Cov(D,L)	0.13	0.01	-0.02	-0.01
Total Obs.	257	257	257	257

Note: Table shows the mean and variance of metropolitan level segregation in school assignments across four definitions. Column 1 shows baseline estimates for the segregation of underrepresented minorities (URM), Black or Hispanic. Column 2 and 3 show Black-White and Hispanic-White segregation, ignoring other groups. Column 4 shows segregation based on the share of the population living below 185% of the federal poverty line, the eligibility threshold for the free or reduced price lunch (FRL) program. Between-district component of segregation is computed by assuming schools' minority share equals that of the district as a whole. The within-district component is the difference in total segregation and the between-district component. See notes in Table 1 for the definition of the residential, school boundary, and school site components of segregation. The district boundary component (D) is the difference in segregation between minimum distance boundaries that respect district lines (minimizing within district jurisdictions) and that of boundaries that minimize distance ignoring district jurisdictional lines.

Table 4: Summary of district characteristics by status of court desegregation order

	Never Ordered		Active Order		Rescinded Order	
	(1) Mean	SD	(2) Mean	SD	(3) Mean	SD
District Characteristics						
Population (1000's)	167.63	(186.51)	1611.69	(1758.77)	760.69	(657.21)
% Black	0.09	(0.11)	0.22	(0.14)	0.23	(0.16)
% Hispanic	0.20	(0.21)	0.25	(0.20)	0.19	(0.17)
% White	0.62	(0.23)	0.46	(0.20)	0.51	(0.19)
% FRL	0.30	(0.12)	0.40	(0.08)	0.35	(0.09)
Excess distance to assg. (km)	0.41	(0.32)	0.38	(0.40)	0.45	(0.30)
Black pop. weight	0.43	(0.41)	0.51	(0.56)	0.51	(0.45)
White pop. weight	0.39	(0.31)	0.36	(0.36)	0.45	(0.29)
Achievement gap	-0.60	(0.22)	-0.70	(0.18)	-0.74	(0.23)
Median income (1000's USD)	61.48	(20.40)	46.80	(10.06)	52.66	(16.15)
South	0.33	(0.47)	0.43	(0.50)	0.79	(0.41)
Midwest	0.19	(0.39)	0.20	(0.40)	0.10	(0.30)
Northeast	0.09	(0.29)	0.10	(0.30)	0.00	(0.03)
School assignment segregation						
URM	7.25	(7.47)	24.94	(16.00)	20.14	(10.76)
Residential	7.53	(7.25)	26.57	(15.63)	20.54	(10.33)
School sites	0.16	(1.37)	-0.34	(2.42)	0.32	(1.55)
School boundaries	-0.44	(2.15)	-1.30	(3.28)	-0.73	(2.99)
Black-White	3.92	(6.61)	25.94	(21.88)	21.74	(14.46)
Residential	4.12	(6.49)	26.62	(20.73)	22.16	(13.70)
School sites	0.10	(1.12)	0.88	(1.73)	0.60	(1.62)
School boundaries	-0.31	(1.74)	-1.57	(3.39)	-1.02	(3.49)
Hispanic-White	5.29	(6.04)	19.40	(16.28)	10.11	(8.79)
Residential	5.38	(5.88)	19.72	(16.81)	9.88	(8.55)
School sites	0.10	(1.08)	-0.39	(1.87)	0.24	(0.81)
School boundaries	-0.19	(1.43)	0.07	(1.24)	-0.01	(1.37)
FRL	5.77	(4.02)	9.43	(3.92)	9.25	(4.06)
Residential	5.88	(3.90)	10.10	(4.08)	9.27	(3.70)
School sites	0.17	(1.08)	-0.18	(1.19)	0.05	(0.72)
School boundaries	-0.28	(1.47)	-0.50	(1.45)	-0.06	(1.35)
Total Obs.	1,294		107		177	

Note: Table shows population-weighted means and standard deviations of district level characteristics and segregation, for 3 subsamples: (1) districts that never had a desegregation order; (2) districts that are currently under a court desegregation order; and (3) districts that had a court order but it has since been rescinded and is no longer active. Excess distance to assigned school is computed using group-weighted mean distance from census blocks' centroids to assigned schools. See notes in Table 1 and equation 2 for a description of the segregation decomposition.

Table 5: Race-specific excess distance to school and school boundary desegregation

Panel A	URM"				Black-White			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Minority excess distance	-2.99***		-4.55***	-4.55***	-2.85***		-3.92***	-3.88***
	(0.24)		(0.45)	(0.45)	(0.23)		(0.39)	(0.38)
Non-minority excess distance		-1.90***	2.68***	2.69***		-1.82***	2.15***	2.20***
		(0.39)	(0.54)	(0.54)		(0.43)	(0.48)	(0.47)
Base covariates	✓	✓	✓	✓	✓	✓	✓	✓
Region FE	✓	✓	✓		✓	✓	✓	
Extra covariates				✓				✓
State FE				✓				✓
R^2	0.38	0.23	0.42	0.47	0.43	0.27	0.46	0.51
N	1,578	1,578	1,578	1,577	1,578	1,578	1,578	1,577
Panel B	Hispanic-White"				FRL			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Minority excess distance	-1.09***		-1.85***	-1.88***	-1.80***		-2.75***	-2.64***
	(0.16)		(0.32)	(0.32)	(0.18)		(0.30)	(0.31)
Non-minority excess distance		-0.62***	1.19***	1.18***		-1.68***	1.34***	1.19***
		(0.15)	(0.31)	(0.31)		(0.25)	(0.35)	(0.35)
Base covariates	✓	✓	✓	✓	✓	✓	✓	✓
Region FE	✓	✓	✓		✓	✓	✓	
Extra covariates				✓				✓
State FE				✓				✓
R^2	0.19	0.13	0.21	0.26	0.35	0.26	0.37	0.42
N	1,578	1,578	1,578	1,577	1,578	1,578	1,578	1,577

Note: Robust standard errors reported in parenthesis. Dependent variable in all models is school boundary desegregation, defined for the racial and socioeconomic groupings denoted. Base omitted controls are the level of segregation in minimum distance and in simulated boundaries, log population and the district share minority. Omitted extra covariates are log median household income, the share of the population with a bachelor's degree, indicators for the status of desegregation orders, and the share of enrollment at charter and private schools.