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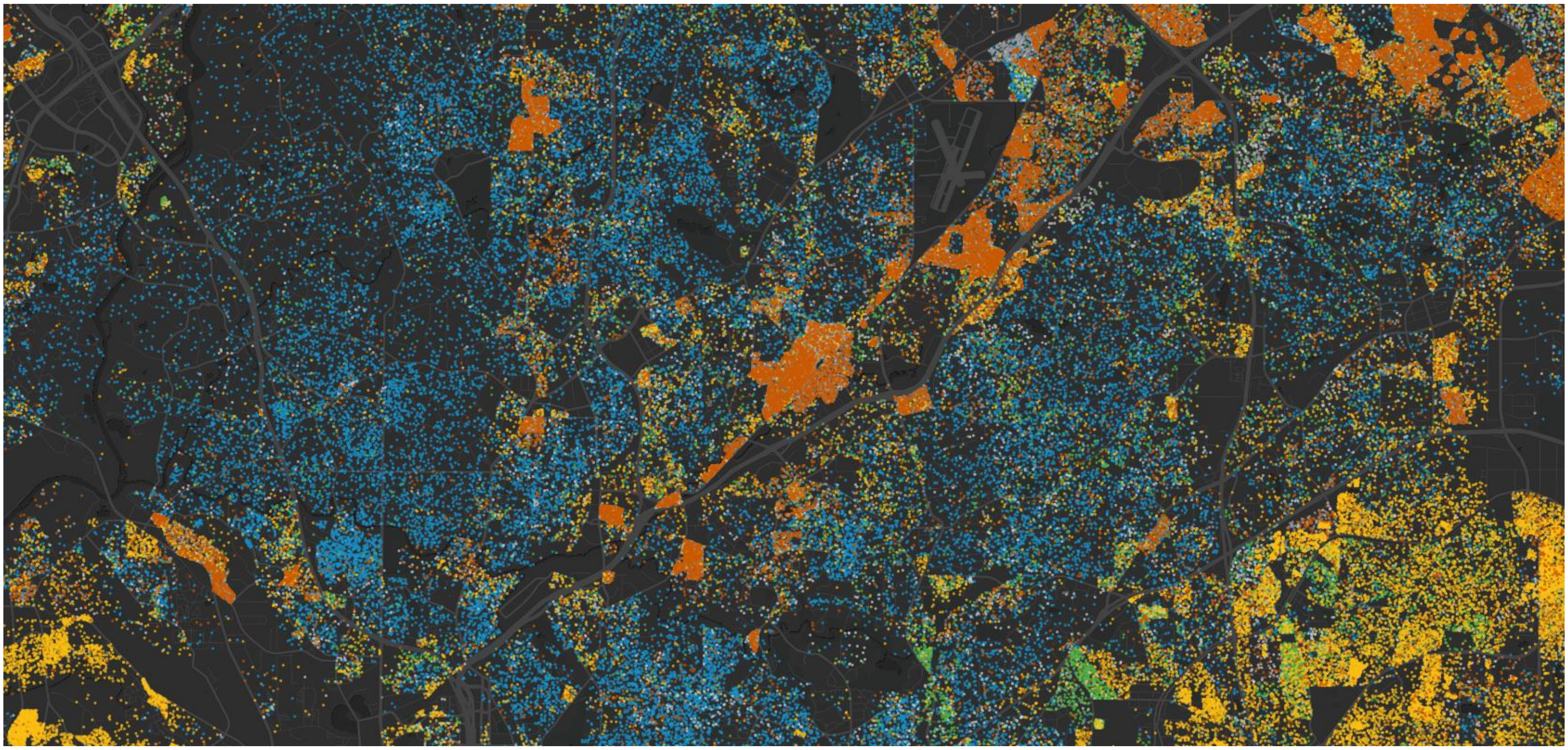

RESEARCH REPORT

Dividing Lines

Racially Unequal School Boundaries in US Public School Systems

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Executive Summary

Segregation on the basis of race or ethnicity is one of the most enduring and pervasive inequities in US public education. School segregation is determined by residential sorting and families' preferences and by local policy choices such as the drawing of school attendance boundaries. This report examines the role of individual school attendance boundary lines in perpetuating racial and ethnic segregation in urban school systems.

The report is divided into three sections. First, we apply spatial regression discontinuity methods to census block and school boundary map data, evaluating the boundary line dividing attendance rights between every pair of neighboring public schools in US metropolitan areas. We find more than 2,000 pairs of neighboring public schools that are vastly different in terms of the racial and ethnic composition of the population living on either side of the boundary. We show that inequality between these schools (many of which are within the same school district) is not only in terms of racial and ethnic demographics but with regard to school staffing, educational program offerings, student discipline rates, and mean student achievement on standardized exams. Unequal school attendance zones do not only perpetuate racial and ethnic segregation, they amplify inequality between students of color and their white peers, all while being almost right next to each other.

Second, we show that many racially unequal school boundaries are linked to the New Deal's Home Owners' Loan Corporation (HOLC) redlining maps, a notorious instance of explicit and consequential racist federal policy. We show that redlining maps often match closely with the school boundary lines we detect as racially unequal. Averaging across our list of unequal school boundaries, the side with more Black or Hispanic residents is more likely to have a HOLC grade that is rated "hazardous" than the side with fewer Black or Hispanic residents, which is more likely to be rated "best" or "desirable." This evidence suggests that many of the racially unequal boundaries in our data are direct vestiges of our cities' historic roots of explicit racism, and not merely an artifact of recent individual household choices.

Finally, we collect data on the 100 largest districts in the country, studying the interaction between school choice policies and school boundaries. Although various forms of school choice policies exist in large urban districts, school boundaries at least partially determine school assignments in all but one of the 100 most-populous districts. Further, our examination of segregation trends for districts that have introduced centralized school lotteries (which allow parents to choose any school in the system) suggests that segregation patterns have not changed considerably following the move to centralized choice.

Persistent school segregation is the legacy of racist housing policy and the product of intentional decisions by the local leaders who determine school attendance zones. Our findings show that small changes to the attendance boundaries of neighboring schools in many cases could make a big difference for school integration. That some districts already use school attendance boundaries to promote integration demonstrates the viability of this strategy. But such changes require political will and a commitment to sharing access to high-quality opportunities. From the view of a policymaker interested in addressing racial inequality in public education, racially unequal school boundaries should be viewed as a highly inefficient preservation of old, problematic policy in need of immediate updating.

Dividing Lines

Segregation on the basis of race or ethnicity is one of the most enduring and pervasive inequities in US public education. Public school segregation has its roots in government-backed racist policies of the early 20th century. The landmark 1954 Supreme Court decision in *Brown v. Board of Education of Topeka* ruled that government-enforced school segregation was unconstitutional, but over the following decades, action at every level of government directly or indirectly ensured that schools stayed segregated. Because of this resistance to integration, the average instructional experience that Black and Hispanic children face in public schools today is vastly different from that of white children. Decades of social science research has established that public school segregation reinforces differences in socioeconomic outcomes, from student test scores and high school graduation rates to income and wealth in adulthood and even life expectancy (Johnson 2019; reardon and Owens 2014; Welch 1987).

In this report, we rigorously characterize the role of school boundaries in perpetuating school segregation. To be comprehensive, we define "school boundaries" broadly as any geographic delineation of access to public education. We study both school attendance boundaries administered by local school districts and the jurisdictional boundaries that divide school districts themselves. Doing so enables us to provide a full taxonomy of the lines that drive school segregation in US metropolitan areas.

This report is centered around a novel geographic information system (GIS) dataset and a spatial measurement methodology to dig into the microgeography of school segregation. The goal of this study is to pinpoint the worst dividing lines in public education access across the country, highlighting the many racial and ethnic borders that perpetuate school segregation in our cities today. Policymakers invested in improving integration in schools can use the tools we develop to tackle vestiges of our country's racist origins still present in school assignment policy today. We hope that elevating these inequities can facilitate further research and discussion toward developing a sustainable solution to racial and ethnic inequality in public education.

What Causes School Segregation?

School segregation has several causes. Many of them are linked, complicating the process of developing policy solutions. Economists have long espoused a simplistic theory of "de facto" segregation to understand the problem and its potential solutions. This theory holds that segregation is largely the result of families' free choices regarding where to live and where to send their children to school (Bayer, Ferreira, and McMillan 2007; Bewley 1981; Tiebout 1956). This theory naturally lends itself to the conclusion that if segregation is the equilibrium outcome of an efficient housing market, there is limited basis for policy to intervene in an effort to desegregate schools (Hoxby 2000).

What is missing from the de facto segregation theory is the government's role in setting the stage for sorting to take place. Segregation is caused not only by individual choices but by government agencies that set the rules for allocating public goods (Rothstein 2017). School segregation is also linked to neighborhood segregation, both exerting influence on each other (Card and Rothstein 2007; Frankenberg 2013). And neighborhoods have their own impact on children's outcomes (Chetty and Hendren 2018; Chetty, Hendren, and Katz 2016). Evidence shows that the government policies that created and perpetuated racial and ethnic segregation have also contributed to today's racial and ethnic wealth gap and persisting housing discrimination (Akbar et al. 2019; Avenancio-Leon and Howard 2020).

From the view of school districts, there is little power to remedy residential segregation, and school segregation needs to be addressed by taking neighborhood disparities as an immutable fixture of an urban area (Clotfelter 2004).

But neighborhood segregation need not be perfectly replicated in public schools, because districts have policy levers to push toward integrated schools. School districts have the administrative authority to set student assignment policy, which determines which children get to attend which public schools in the local system. This means district officials have full discretion for setting "default" public school assignments in the community. Default assignments could be set to promote equity in education access, compensating for structural racism. Districts can also restructure grade levels across schools to bring diverse communities together (Orfield and Frankenberg 2013). Most school systems feature administrative mechanisms by which families can opt out of default school assignments, but student assignment policy is the key lever available to district officials to tilt the scale toward racially and ethnically balanced public school enrollment.

Virtually every school district in the country bases its student assignment rules on school attendance boundary (SAB) systems (or "catchment areas").[1] Although districts vary in how much school choice alters the relevance of SABs, the ubiquity of SABs in particular can be useful. Updated boundaries could change patterns of segregation across the country. Districts would not have to introduce a new integration program or develop a complicated plan. They would not have to do anything except change their boundaries.

Previous research has demonstrated that, on the aggregate, most school districts have SAB maps that replicate patterns of neighborhood segregation in schools (Richards 2014).[2] This represents a lost opportunity. But our work has shown that multiple districts in 2013 had SABs that, on the aggregate, ameliorate the impact of neighborhood segregation on school segregation (Monarrez 2019). Indeed, it is more common to find SAB systems that ameliorate, rather than exacerbate, the impact of neighborhood segregation on school segregation. We also found that the waning number of districts under court-ordered desegregation plans use SABs to encourage integration in their jurisdictions. Evidence supports the notion that attendance boundary policy is a promising lever available to school districts to promote integration in public schools.

Although school districts have broad discretion in setting student assignments, attendance boundary maps are a prominent feature of the organization of most local school systems, and the politics associated with changing SABs are complicated. There are many notable anecdotes of the protracted community debates regarding SAB reform. Parents often show furious opposition to proposed boundary changes.[3] There is ample evidence that some families purchase homes in particular neighborhoods because of the reputation of the school they are linked to, and many families pay a large premium for it (Black 1999; Bayer, Ferreira, and McMillan 2007). It is also clear that in some contexts, high-income (typically white) families have leveraged the SAB system to capture desirable public schools (Siegel-Hawley 2013). In some of the more egregious cases, politically connected families have secured massive public investments from the state and local government for their neighborhood school, while enforcing strict "in-boundary" enrollment rules that leave out historically underserved communities (DeRoche 2020).

Our analysis is foundational to developing a solution to school boundary inequality. We develop tools to combine school boundary and census data in a way that captures the extent to which certain boundary lines are unequal. This allows us to provide some of the first quantitative data describing instances in which lines create racial and ethnic inequality in the school system. We believe that a thorough descriptive analysis of the scope and nature of the problem of inequitable school boundaries can help spur better research and discussion of optimal solutions.

Segregation between School Districts

Attendance boundaries are only the beginning of the story when it comes to the geographic fragmentation of access to public education. Most US cities are composed of several independent local school districts, each with its own elected leaders, instructional practices, and independent funding flows. The lion's share of the historic inequality between public schools is caused by stark differences between school districts, both in terms of total funding for schools and racial and ethnic segregation (Lafortune, Rothstein, and Schanzenbach 2018; Monarrez, Kisida, and Chingos 2020). There is therefore great interest in understanding how redressing between-district disparities could affect aggregate inequality in public education.

The scope for inequality is greater when a city has many school districts. This was made clear during the era of judicial intervention and court-mandated desegregation orders. White families that opposed integration could move to other districts in the same metropolitan area, often in the suburbs. District fragmentation set the stage for decades of "white flight" between school districts in a city (Baum-Snow and Lutz 2011). Across the country, there is large variation in the extent of district fragmentation and in the prevalence of school district secessions (i.e., new district creation). Research shows that patterns of residential segregation vary across cities with varying levels of district fragmentation (Clotfelter 2004; Hoxby 2000) and that new district creation can increase racial and ethnic inequality (Frankenberg, Siegel-Hawley, and Diem 2017).

The Supreme Court helped perpetuate between-district segregation in its 1974 *Milliken v. Bradley* decision, holding that the unconstitutionality of school segregation did not apply to between-district disparities and thus that no remedy was necessary to address segregation between school districts. To the benefit of intolerant white families willing to move to suburban districts to avoid desegregation, this decision left education officials with few tools to address segregation between school districts. This, along with other decisions aimed against desegregation efforts, led to a loss of the school integration gains made during the late 1960s and 1970s (Billings, Deming, and Rockoff 2014; Lutz 2011; reardon et al. 2012).

Any attempt to comprehend the role of geographic boundaries in perpetuating school segregation would thus fall short without an explicit look into school district boundaries. There is research documenting that many adjacent school districts have vastly different socioeconomic compositions.[4] Our work builds and improves on this work by adding an analysis of school attendance boundaries and by focusing our measurement at the microgeographic level. We highlight socioeconomic differences near a boundary, showing that in many cases, it would take only a small boundary change to decrease racial and ethnic inequality (we describe our measurement framework below).

In terms of the tools we have developed to find inequitable boundaries, there is little difference between a divisive SAB line or an inequitable jurisdictional boundary between school districts. We believe it is useful to analyze these together to provide a full portrait of the education borders that perpetuate segregation. But the implications for potential policy solutions are different between the two. SABs are an administrative policy set by school district leaders at their discretion. But the creation of school district jurisdictions is state policy. In some states, communities can vote to secede to form new districts or to dismantle district jurisdictions altogether. Tennessee state law prohibited district secession, but suburbanites lobbied to change that law (Frankenberg, Siegel-Hawley, and Diem 2017). Districts can merge either by bilateral agreement or by mandate of the state education agency. They can also be shut down by state authorities. In some states, all changes to district jurisdictions need to be reviewed by the state legislature, while in others, there is only local control. Taken together, state policies governing changes to jurisdictional boundaries can have a profound impact on districts' ability to splinter into more segregated entities on the one hand or to merge into more integrated ones on the other. As such, acting based on the information we provide will involve different players in each state.

Data

Our analysis is focused on identifying school boundary lines that exacerbate segregation in public schools.

To do so, we use GIS data on school attendance boundary maps from a private data services firm, Precisely. The data include information on more than 65,000 school attendance boundaries, covering all metropolitan areas in the country and including data for most school districts. Prominent real estate and school rating websites such as Zillow, Redfin, and GreatSchools use Precisely's data to show families the link between prospective home addresses and area public schools. The attendance boundary data correspond to the 2019–20 school year. Figure 1 shows an example of the boundary map data for the Atlanta metropolitan area, which is partitioned into 609 elementary school SABs and 36 school districts.

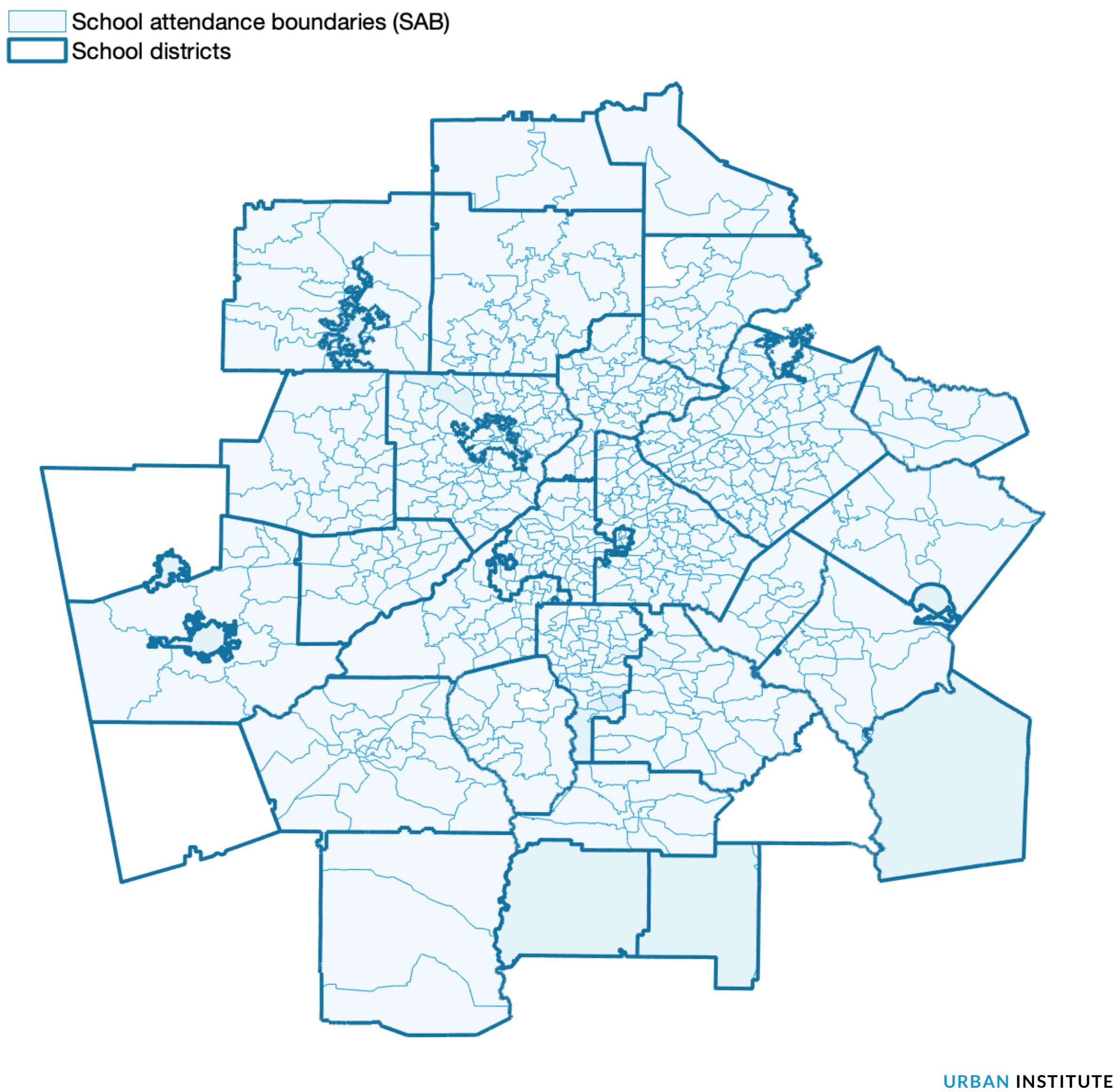
We supplement the school boundary data with information on public school enrollment demographics and school geographic locations from the National Center for Education Statistics Common Core of Data (CCD) for the 2018–19 school year, accessed via the Urban Institute's Education Data Portal. Additionally, we collect information on student test scores at the school level from the Stanford Education Data Archive (SEDA), which provides school-level measures of average student proficiency in mathematics and reading (combined into one composite score per school). Finally, we leverage the Civil Rights Data Collection (CRDC) from the US Department of Education's Office for Civil Rights to obtain information on school staffing, student enrollment in advanced studies programs, discipline action rates, and student attendance. Together, these data enable us to assess the extent to which inequality in attendance boundaries is correlated with inequality in schools' educational environments.

Using GIS tools, we also link the school boundary data to 2010 Decennial Census data on demographics at the most granular geography available, census blocks, allowing us to observe the racial and ethnic breakdowns of the total population residing within any given SAB.[5] We focus the analysis on metropolitan areas and restrict attention to school boundaries encompassing a population of at least 200 people and schools with total enrollment of at least 100 students.[6]

In appendix table A.1, we present summary statistics of schools in our analysis sample, demonstrating the national representativeness of our study. According to the CCD, there were 56,318 active public schools in metropolitan areas in 2018, 47,517 of which are represented in the Precisely school boundary GIS dataset. The patterns in appendix table A.1 show that the subsample of schools with boundary data has average characteristics similar to that of the CCD universe of metropolitan schools.

FIGURE 1

School Attendance Boundaries and School Districts in the Atlanta Metropolitan Area



Sources: National Center for Education Statistics Education Demographic and Geographic Estimates and Precisely data services.
Note: School boundary data are not available for Haralson County, Heard County, and Butts County.

Measurement Framework

The task of identifying individual school boundary lines that support segregated public schools is complicated by the sheer number of SABs and school districts in a given city, and by the difficulty of handling the GIS and census data to assess the demographic characteristics of each SAB. To overcome these challenges, we propose a novel dataset structured at the "neighboring school pair" level. We define neighboring school pairs as schools whose attendance boundaries are adjacent to each other, meaning that they share a boundary line. This means that most schools are a part of more than one pair of neighboring schools (if SABs were ordered like a checkerboard, each zone would have eight neighbors). This definition allows for schools located at the edges of school districts to neighbor each other, such that the line separating their attendance zones is a district boundary. With this definition, there are 143,470 neighboring school pairs (and 47,517 unique schools) in our national dataset of school boundaries.

In plain terms, the goal of our empirical exercise is to identify pairs of neighboring schools with a large white population on one side of the boundary and a large Black or Hispanic population on the other (in close proximity).[7] We take this feature as a "sufficient statistic" or "proxy" approach to defining segregated school pairs. By searching for schools that satisfy these criteria, we can find boundaries where there is a racial or ethnic division between white students and Black and Hispanic students. We choose this definition because these are the types of racial inequities that have been at the center of the school segregation debate for decades.

Furthermore, because neighboring schools are geographically proximate and share a boundary, it is easy to envision a policy reform that would make small, equity-improving changes to the attendance boundary between them. Such a localized change to the SAB map would not cause a large disruption in student commuting patterns, and it would not affect the overall structure of the student assignment system. If done right, such a reform could significantly increase school integration.[8]

It is not our intention to claim that this is the correct way to define racially unequal boundaries. Instead, the purpose of this proxy approach is to come up with a feasible, effective, and transparent way of dealing with massive amounts of school boundary and census data. When evaluating individual instances of school boundaries, it is important to look at the full richness of available demographic data. We hope this measurement approach will enable policymakers and researchers to easily find lines that help maintain school segregation among the tens of thousands of boundary lines that exist in the country.

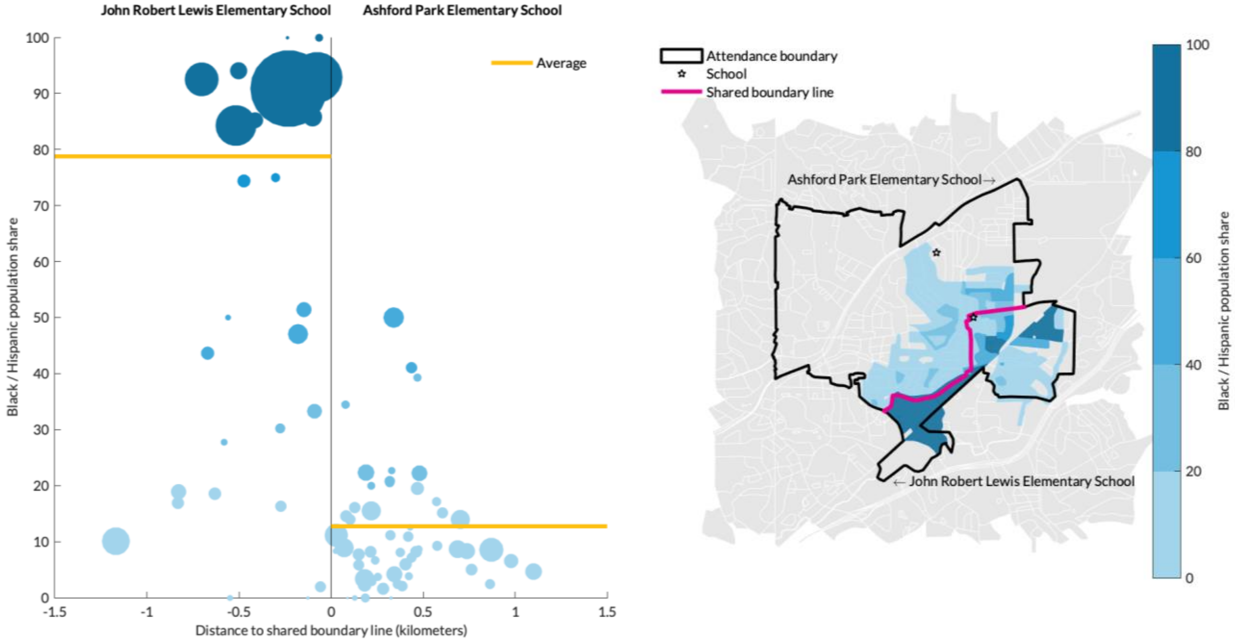
Figure 2 showcases our measurement approach for two schools in the Atlanta suburbs, in the DeKalb County public school district: Ashford Park Elementary and John R. Lewis Elementary. The left panel presents a scatterplot of our proxy of census blocks' demographic composition, the share of residents that are Black or Hispanic, against their distance to the boundary line divvying up the right to attend either of these schools. Observations in the scatterplot are weighted by total population. The right panel presents a map of the Ashford Park and John R. Lewis attendance boundaries against the backdrop of the city. The shared boundary line between the school is shown in pink. The blue census blocks correspond to the dots in the scatterplot, those within 500 meters of the school pair boundary line, with darker colors denoting a higher Black or Hispanic share of the population.

The patterns in figure 2 make it clear that the boundary between Ashford Park and John R. Lewis constitutes a border that reinforces public school segregation in the DeKalb County district and in the Atlanta metropolitan area in general. This is visualized by the yellow lines in the scatterplot, which denote the average racial and ethnic composition of blocks on each side of the boundary. The left side of the plot shows that blocks assigned to John R. Lewis are blocks where 80 percent of the population is Black or Hispanic. In sharp contrast, blocks on the other side of the road, which are assigned to Ashford Park, are blocks where only about 10 percent of the population is Black or Hispanic, and many of these blocks are almost 100 percent white. There are exceptions on both sides (e.g., not all blocks on the John R. Lewis side are more than 80 percent Black or Hispanic, and not all blocks on the Ashford Park side are less than 10 percent Black or Hispanic), but the overall pattern is clear. The boundary between these schools closely delineates an effective racial and ethnic border between the two schools.

If the boundary between the schools ran from north to south, instead of from east to west, the default composition of these schools would be more racially and ethnically balanced. From a perspective of racial equity, this school boundary does not make sense. If policymakers were trying to minimize racial segregation in the district, drawing the boundary from north to south would have led to a better outcome. Instead, they chose to perpetuate racial divisions in this neighborhood by preserving racially identifiable neighboring schools.

FIGURE 2

Measuring Racial and Ethnic Inequality in School Attendance Boundaries



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Sources: US Census Bureau and Precisely.

Notes: Observations are census blocks, and the scatterplot is weighted by total population. The yellow line denotes the average Black or Hispanic share in blocks on each side of the boundary. Grayed-out blocks are those outside these schools' attendance zones or those not within 500 meters of the shared boundary between the schools.

The key contribution of this study is to estimate boundary discontinuities like figure 2 for every neighboring school attendance boundary pair in the country. Doing so provides a large national dataset (*N* = 143,470) of estimated discontinuities in residential racial and ethnic composition near the boundary separating two neighboring public schools. For most school pairs nationally, there is little to no discontinuity in demographics at the boundary, implying that most neighboring schools are similar in terms of their residential composition (appendix figure A.1). This is perhaps not surprising, as many cities and school districts in the country are known to be largely homogenous in demographics, so it makes sense that most neighboring schools do not show large gaps in demographics.

Nevertheless, for a nontrivial share of school pairings in the data, there are massive discontinuities in demographics at the shared boundary line. These examples delineate the location of racial borders in the geography of public school systems. For these cases, such as figure 2, it is almost certainly the case that the boundary exacerbates segregation in the local school system by needlessly separating populations of different racial and ethnic backgrounds across neighboring schools.

To be sure, though, gaps in demographic composition near the boundary are not unequivocally indicative of demographic differences in school enrollments. It could be the case that school boundaries are not fully binding in the local school system and that parents can exercise some degree of choice to attend schools other than the one assigned by their catchment zone. If this was the case, raising red flags about a demographically unequal boundary could be misleading and miss the larger picture. In addition, there may be some degree of measurement error in our boundary dataset for some cases. This could arise in cases in which the boundary GIS data are not a completely accurate representation of the districts' assignment system or because the census block data we leverage for residential demographics do not accurately reflect the current demographics of the student population. Finally, although discontinuities in demographics near the boundary are present, the schools' attendance zones as a whole might not meaningfully differ, implying that the discontinuity approach would constitute a "false positive" identification of an unequal school assignment system.

Defining Racially Unequal Boundaries

To overcome these potential limitations in the boundary discontinuity data, we introduce additional criteria when defining our final indicator of a racially unequal school boundary. Specifically, we define racially unequal boundaries as those fulfilling the following requirements:

1. A *boundary discontinuity* of at least 25 percentage points in the Black or Hispanic residential share of individuals living within 500 meters of the boundary, such as in figure 2.
2. A difference of at least 25 percentage points in the Black or Hispanic share of the *total population* living within the neighboring schools' attendance zones.
3. A difference of at least 25 percentage points in the Black or Hispanic share of the *total enrollment* of the neighboring schools (using 2018–19 school year data from the Common Core of Data).
4. A boundary discontinuity of at least 25 percentage points in the *white* residential share.

Using these absolute criteria, we can be sure that the school pairs identified as racially unequal are highly unequal both in terms of residential demographic patterns at the boundary and in the schools' enrollment. The enrollment criterion ensures that the difference reflected in census data are replicated in the schools' classrooms, ruling out the possibility that school choice policies or other mechanisms may undo the residential gap in boundary demographics for these schools. The final criteria ensure that the differences in the Black or Hispanic share near the boundary also reflect differences in the white population, ensuring that the type of segregation highlighted by our unequal boundary reflects the dimension that policymakers have historically focused on.[9] (See the appendix for a more detailed discussion of our measurement framework.)

By identifying school boundaries that satisfy these criteria, we obtain a list of the most racially unequal dividing school attendance boundary lines in US public education.

Four Examples of Racially Unequal Boundaries across the US

Examples of racially unequal boundaries can be found all over the country.

In figure 3, we show the boundary line dividing two public elementary schools administered by Akron Public Schools in Ohio: Helen Arnold Community Learning Center and Pfeiffer Elementary School. The figure shows a map of the two schools' attendance boundaries, the northern one corresponds to Helen Arnold, and the southern one corresponds to Pfeiffer. Each dot in the map represents one person (according to their residence), with different colors representing a different race or ethnicity, as reported by the census. Visually, it is almost unavoidable to see the pattern outlined by the shared boundary line of the two schools: to the north, 79 percent of residents are Black, and to the south, 76 percent of residents are white. Near the shared boundary, there is a 49 percentage-point gap between the Black or Hispanic share of residents on either side of the boundary. When looking at the schools' enrollment numbers, the absolute gap is about the same size.

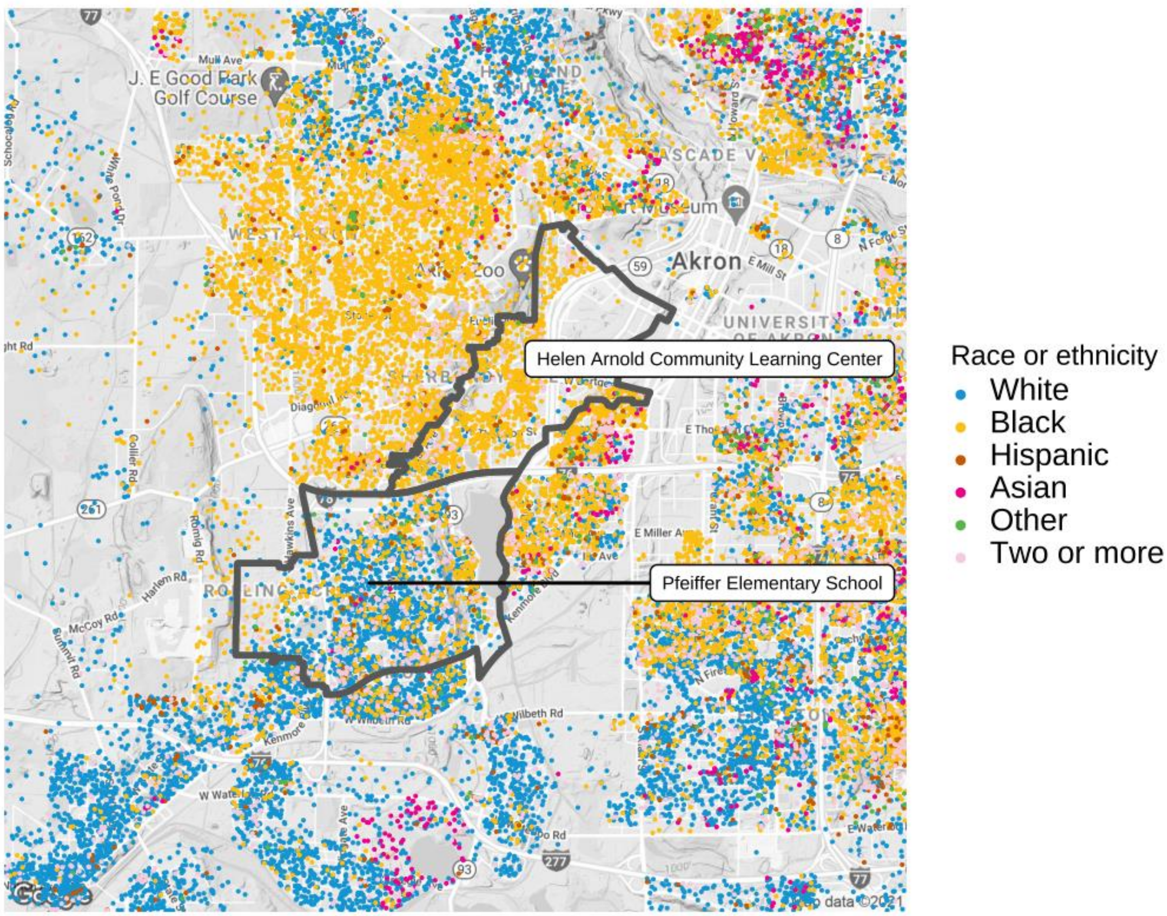
The two schools are about two miles apart, and although there is a highway that coincides with their shared boundary, a Google Maps search reveals that it is a 7-minute car ride (or 18-minute bicycle ride) to travel between the two schools. In fact, the Pfeiffer attendance boundary extends across the same highway (US Interstate 76) in its westernmost area, just not toward its northern perimeter. Given these patterns, it would be difficult to claim that the inequality between the two schools is an artifact of the difficulty of "crossing the highway" that divides them. Many of the residents in the southern portion of the Arnold zone actually live closer to Pfeiffer, but the leadership at Akron Public Schools has decided not to assign them to their nearest school.

The differences between the two schools do not stop at the composition of their student bodies. According to the CRDC, about 12 percent of teachers in Arnold were in their first or second year of teaching from 2011 to 2017, but at Pfeiffer, every single teacher has more experience. Arnold averaged 58 student suspensions per year, while Pfeiffer had only about 30. Although neither of these schools has stellar academic performance, students at Arnold, on average, score 0.70 standard deviations below the state average, while Pfeiffer students scored 0.49 standard deviations below average, a gap of 0.21 standard deviations. Given the history of structural discrimination in Ohio and the country at large, the gaps in student outcomes between the two schools are most likely largely attributable to institutional, not individual, factors.

FIGURE 3

Example of Adjacent Schools with Highly Unequal Attendance Boundaries in Akron, Ohio

Helen Arnold Community Learning Center and Pfeiffer Elementary School



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Sources: US Census Bureau and Precisely.

Notes: One dot corresponds to one person. Demographic data are based on 2010 census block data.

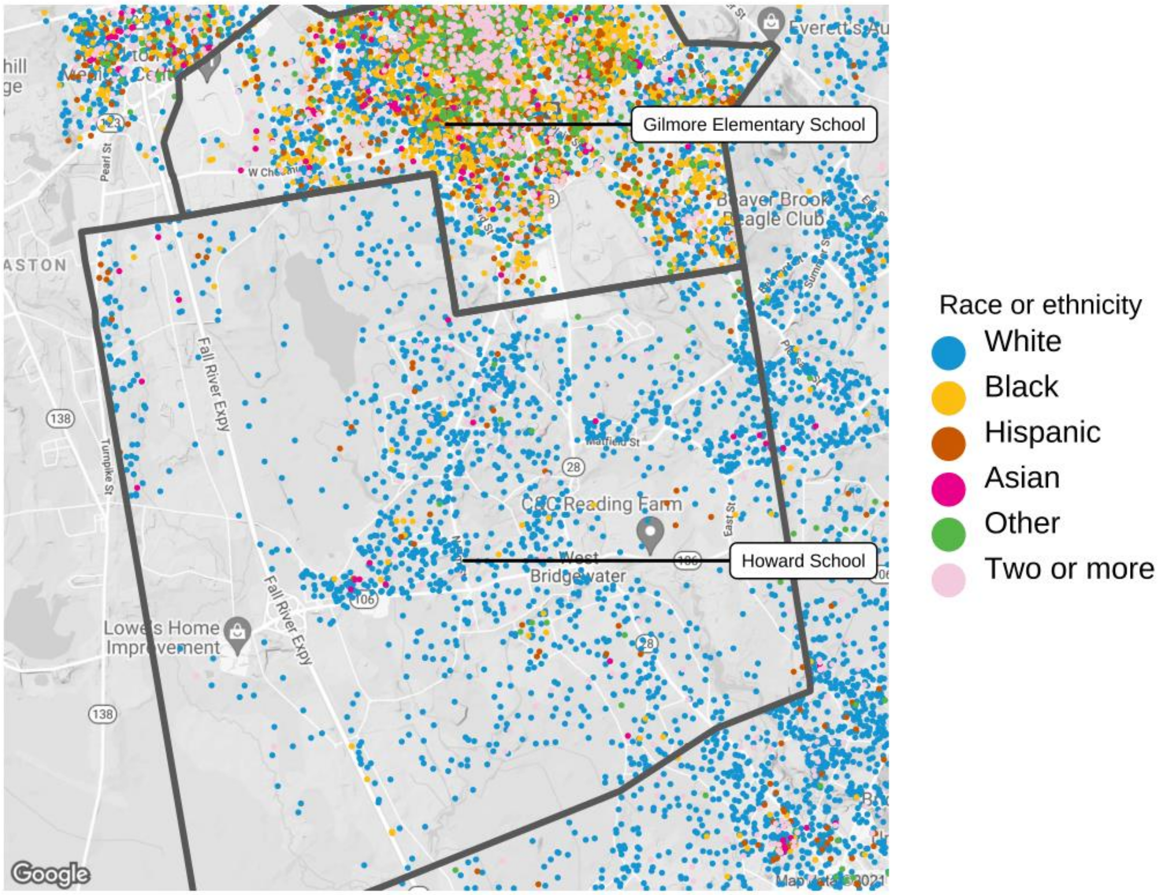
Figure 4 shows an example in the southern suburbs of the Boston metropolitan area: the line dividing the attendance boundaries of Gilmore Elementary School and Howard School. Gilmore is under the jurisdiction of Brockton Public Schools, and Howard is part of West Bridgewater Public Schools. As such, no single local government has the authority to remedy this inequity, as these schools are technically in different towns. But empirically, the result is the same: these are two geographically proximate communities separated by an invisible line that doles out rights to vastly different public schools. In this case, the line is jurisdictional, not administrative. Still, one could imagine a solution that would entail cooperation between these two districts, perhaps with aid of the state or federal government.

The dots in figure 4 make it self-evident that racial and ethnic inequality persists between these two schools largely because Howard School is zoned for an almost exclusively white population (94 percent). In sharp contrast, Gilmore's attendance zone is richly diverse: 28 percent of residents are Black, 10 percent are Hispanic, 2 percent are Asian, 43 percent are white, and 17 percent come from a multiracial or other ethnic background. Just as we saw in the previous example, many students assigned to Howard have residences closer to Gilmore. But for this example, there is no large highway or other landmark that "naturally" divides the two school zones; it is simply a line on a map drawn by local stakeholders. This invisible line coincides with large gaps in student socioeconomic status: 80 percent of students in Gilmore are economically disadvantaged, while only 16 percent in Howard are. Mean student achievement at Gilmore is -0.29 standard deviations below state average, while Howard is 0.56 standard deviations above average (a gap of 0.86 standard deviations).

FIGURE 4

Example of Adjacent Schools with Highly Unequal Attendance Boundaries in Boston, Massachusetts

Gilmore Elementary School and Howard School



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Sources: US Census Bureau and Precisely.

Notes: One dot corresponds to one person. Demographic data are based on 2010 census block data.

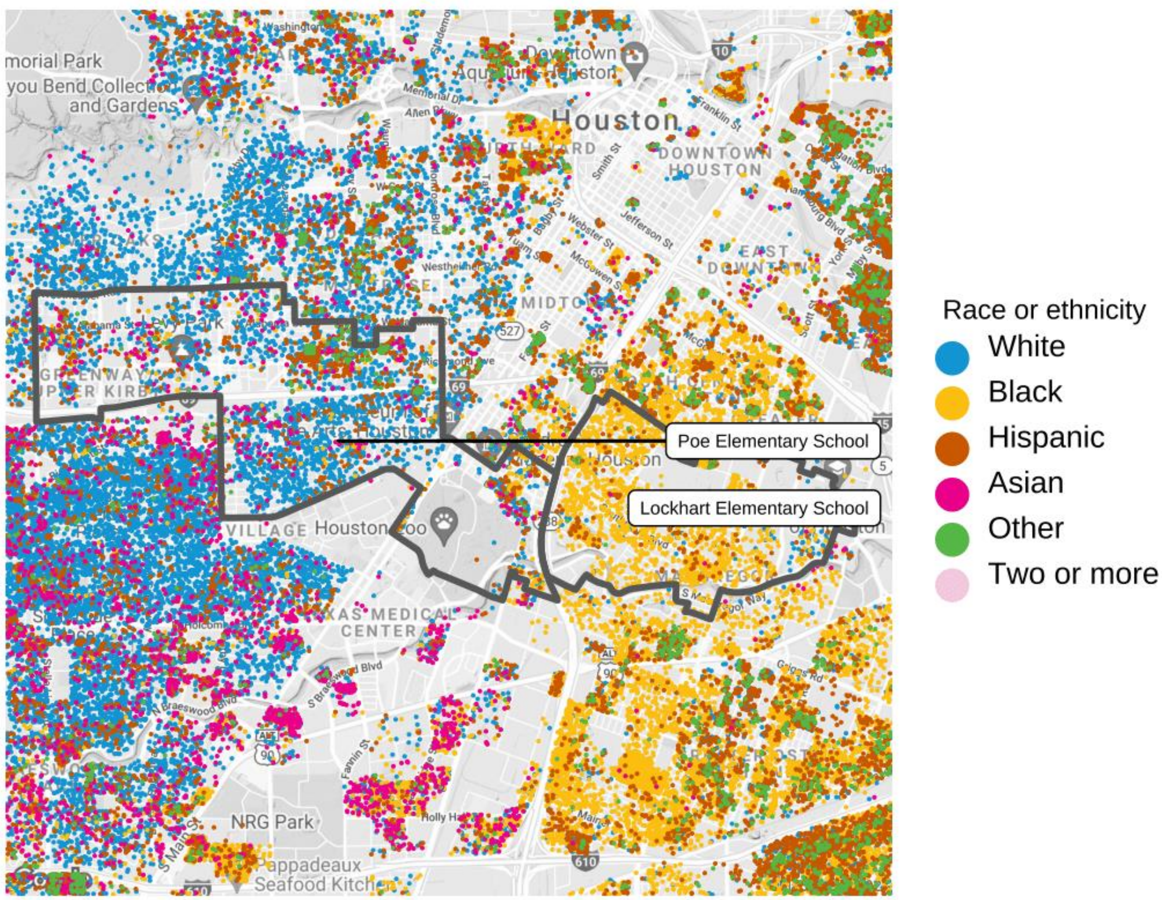
Another example of a school boundary that needlessly separates students can be found in Houston, Texas (figure 5). Poe Elementary School and Lockhart Elementary School, located near downtown, are both under the jurisdiction of Houston Independent School District. The Poe attendance zone is 68 percent white, 14 percent Hispanic, 8 percent Asian, and 6 percent Black. In contrast, the Lockhart attendance zone is 76 percent Black, 11 percent white, 6 percent Hispanic, and 4 percent Asian.

These two schools are somewhat distant. Even though they are less than 2.5 miles apart as the crow flies, the city's road network means that one must drive about 4.5 miles to get from one school to the other. But this potential commuting burden does not appear to dissuade the district from allowing the Poe attendance boundary to stretch eastward almost all the way to the location of Lockhart. Is it a random coincidence that the homes at the easternmost end of the Poe attendance zone, which are closer to Lockhart and next to a golf course, are predominantly inhabited by white residents? Could not the Lockhart attendance zone stretch westward in a similar fashion, which would almost certainly diminish segregation?

FIGURE 5

Example of Adjacent Schools with Highly Unequal Attendance Boundaries in Houston, Texas

Poe Elementary School and Lockhart Elementary School



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Sources: US Census Bureau and Precisely.

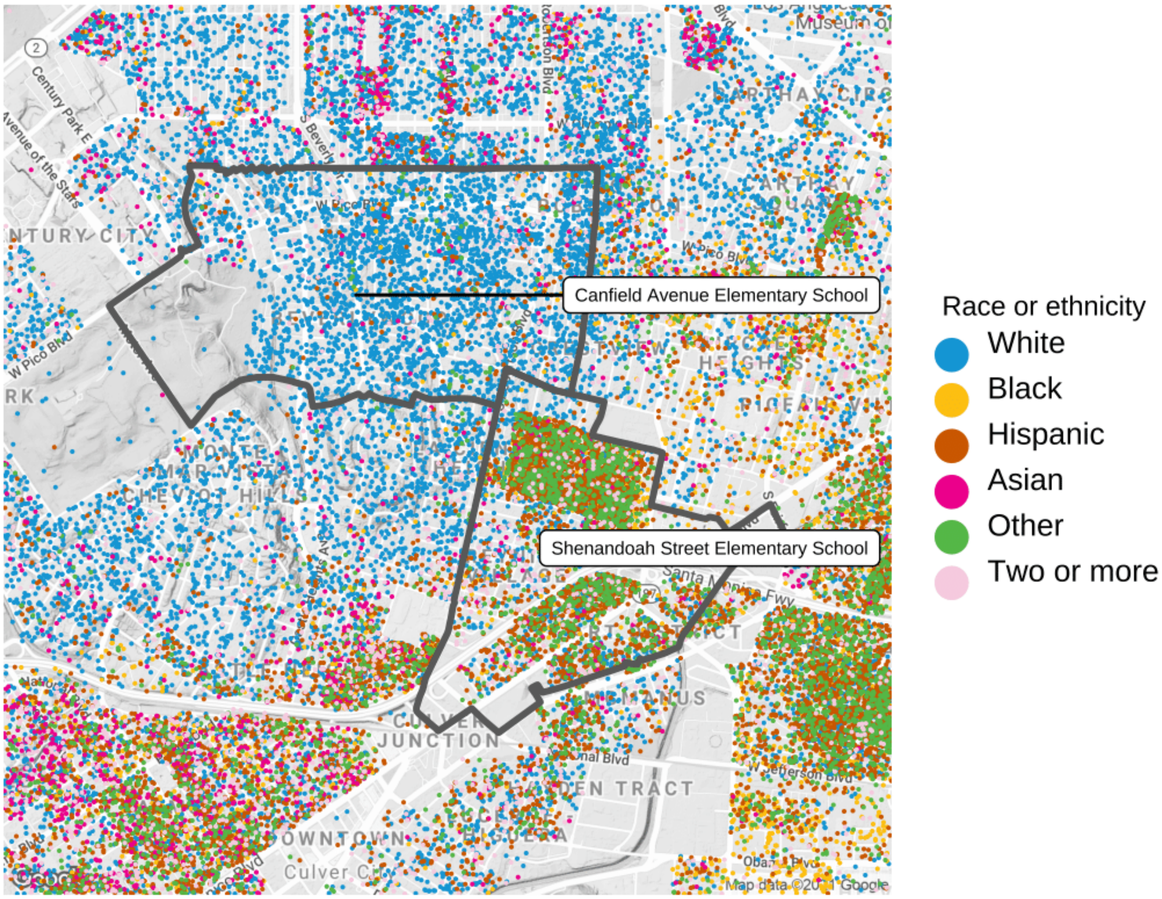
Notes: One dot corresponds to one person. Demographic data are based on 2010 census block data.

A final example of a highly unequal school boundary pair can be found in western Los Angeles, California, near the "Beverlywood" neighborhood. The schools—Canfield Avenue Elementary School and Shenandoah Elementary School—are under the control of Los Angeles Unified School District, one of the country's largest public school systems, boasting more than 450,000 students, 74 percent of whom are Hispanic and 8 percent of whom Black. Although the two schools share only a small segment of their attendance boundary, they are only 1.2 miles apart (a 5-minute car ride or a 25-minute walk). Canfield's school attendance boundary is 83 percent white, while Shenandoah's is 55 percent Hispanic, 14 percent Black, and 6 percent Asian. The vast differences in the schools' catchment area demographics are largely reflected in the school's enrollment patterns. The absolute difference in the Black or Hispanic enrollment share for these schools is a massive 76 percentage points. The gap in economic disadvantage between the schools is 67 percentage points. Further, according to the CRDC, 27 percent of teachers were absent more than 10 days of the school year in Shenandoah, compared with 4 percent at Canfield. Perhaps, then, it is not surprising that mean student achievement at Canfield is 0.28 standard deviations above the state average, while Shenandoah's is -0.56 standard deviations below the state average. Such massive inequities between neighboring schools, both within the same local public school system, are difficult to justify.

FIGURE 6

Example of Adjacent Schools with Highly Unequal Attendance Boundaries in Los Angeles, California

Canfield Avenue Elementary School and Shenandoah Street Elementary School



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Sources: US Census Bureau and Precisely.

Notes: One dot corresponds to one person. Demographic data are based on 2010 census block data.

The Distribution of School Boundary Inequality

The examples above suggest that racially unequal boundaries may be commonplace. Given our definition, we have identified 2,373 boundary lines for 2,799 unique schools nationwide whose attendance boundaries are racially unequal, or about 6 percent of the metropolitan public schools represented in the Precisely school boundary data (N = 47,517).[10]

Our measurement approach guarantees that the neighboring school pairs in this list are highly segregated in terms of race and ethnicity, but how do these geographically proximate, yet highly unequal, schools differ in terms of their conditions and their instructional quality?

Table 1 shows the average characteristics of schools on either side of racially unequal boundaries. Neighboring school pairs are ordered based on their racial and ethnic composition. Side A is the school that has a higher share of Black or Hispanic residents on its side of the shared boundary. Side B is the opposite side, which has a lower share of Black or Hispanic residents. Figure 2 provides a visual representation of this ordering of school pairs.[11]

The first few rows in table 1 show that, as one would expect given our selection criteria, the school pairs in our sample are vastly unequal in terms of their demographics. On average, the school on one side of the boundary (side A) has around 580 students, of whom 46 percent are Hispanic, 41 percent are Black, 8 percent are white, and 3 percent are Asian. In sharp contrast, schools on the other side of the line (side B) tend to have around 620 students, of whom 52 percent are white, 22 percent are Hispanic, 14 percent are Black, and 7 percent are Asian. The third column takes differences in these averages, highlighting the gap in characteristics between the neighboring schools. The fourth and fifth columns report the *t*-statistics and *p* values for a statistical test of the null hypothesis that the characteristics between the two schools are the same.

Additionally, there are marked differences in the share of students that have limited English proficiency and the share of students that are economically disadvantaged, proxied by the share of students receiving free and reduced-price lunch (FRL).[12] The gap in the limited English proficiency share is 14 percentage points, while the FRL gap is 40 percentage points. This pattern indicates that, on average, racialized school boundaries also divide people on the basis of socioeconomic status.

There are large, statistically significant differences in the composition of the student body in schools on either side of racially unequal boundaries. Moving beyond student demographics, table 1 examines differences in staff characteristics at these neighboring schools. There is no significant difference in the total number of teachers at these schools. The difference in the student-teacher ratio, while statistically significant, is not large in magnitude—less than one student per teacher. But differences in teacher characteristics suggest there is also inequality in staff composition. Schools on the more Black or Hispanic side of the boundary are more likely to be staffed with teachers with only one or two years of teaching experience, and students experience more frequent chronic absenteeism from their teachers. Both these gaps are about 4 percentage points in magnitude, on average, but they get wider as neighboring schools grow more unequal.

The four scatterplots in figure 7 show that as inequality in the racial and ethnic composition of neighboring schools grows more intense, so do gaps in staff characteristics. These plots use the entire neighboring-pair dataset, not only our list of racially unequal boundaries. On the horizontal axis, the plots show the difference (gap) in the Black or Hispanic share on each side of the school boundary connecting neighboring schools. The vertical axis measures the difference in staff characteristics across these neighboring schools. The linear model estimate in panel 1 shows that a 25 percentage-point increase in the racial or ethnic gap between neighboring schools is associated with a 2.0 percentage-point increase in the share of teachers that are relatively inexperienced (in their first or second year of teaching). The relationship between gaps in racial and ethnic composition and chronic teacher absenteeism is also significant, amounting to a 0.5 percentage-point increase per 10 percentage-point increase in the racial or ethnic gap between the schools. Appendix table A.2 shows that these correlations are robust to controlling for several factors.

Furthermore, there are significant differences in the likelihood that unequal school pairs have staff dedicated to student services, such as counselors and health workers. And we see gaps in the opposite direction with respect to the presence of security guards as permanent school staff. Table 1 shows statistically significant gaps in access to counselors in our sample of racially unequal school pairs. The finding is confirmed in panel 3 of figure 7, which shows a marked correlation between the racial or ethnic gap in neighboring schools and the gap in the total number of counselors (schools on the more Black or Hispanic side of the boundary have fewer counselors). The estimate suggests that a 25 percentage-point increase in the racial or ethnic gap is associated with a 0.14 full-time equivalent (FTE) increase in the gap in access to counselors for students in these schools (appendix table A.2). Table 1 shows that a similar gap arises with respect to access to school nurses and other health workers.

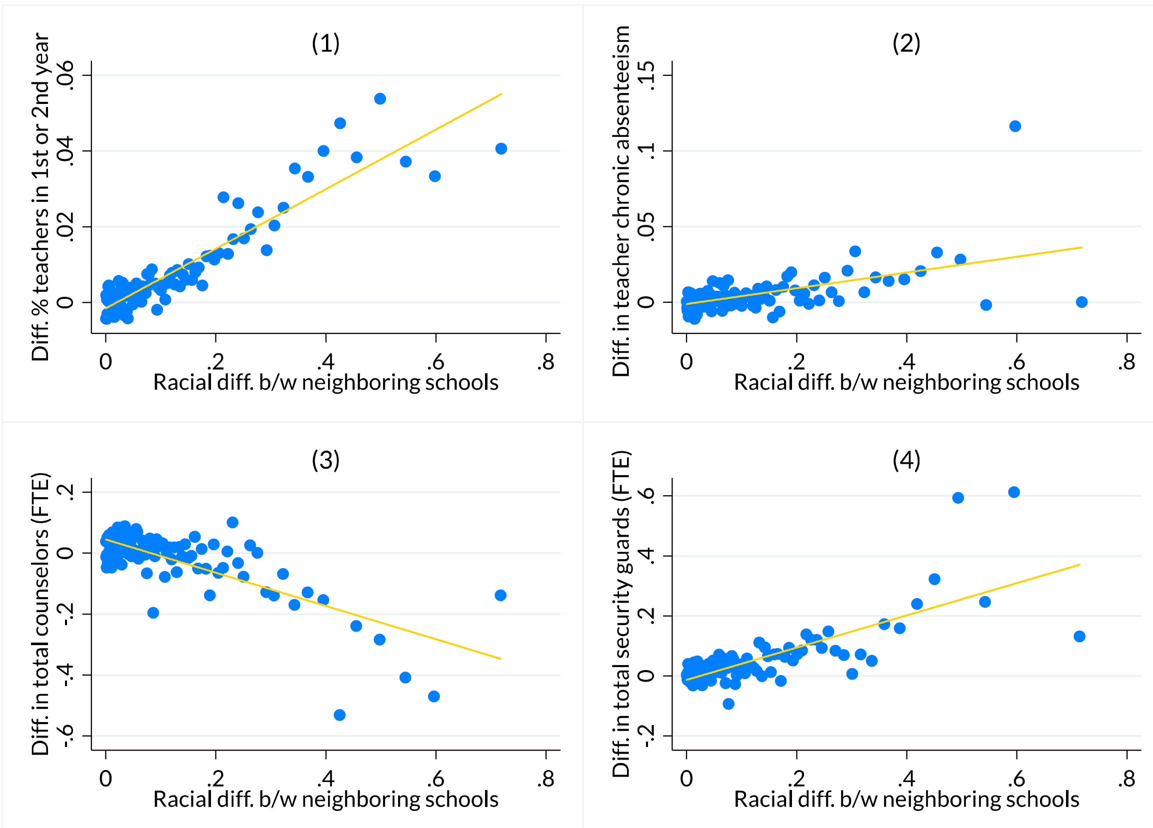
Further demonstrating the inequality between these neighbors, the gap in school staffing goes in the opposite direction when we look at the presence of permanent security guards employed at these schools. For the school on the side with more Black or Hispanic residents, there is an average of 0.55 full-time equivalent security guards; on the other side, this average is 0.25 (table 1). Also, the gap in exposure to security personnel grows as schools grow more racially unequal from each other (figure 7, panel 4). Our estimates suggest that a 25 percentage-point increase in the racial or ethnic gap between neighboring schools is linked to a 0.13 FTE increase in exposure to school security guards. This relationship is almost exactly the opposite of what we saw for access to counselors.

The patterns in table 1 and figure 7 establish that inequality between neighboring school boundaries in our list extends beyond the demographics of the student body. Important features of the staff at these schools (something outside of local families' control) are significantly different between them, most likely affecting the quality of education services.

FIGURE 7

How Differences in the Racial and Ethnic Composition of Adjacent Schools Correlate with Differences in School Staffing

Sample of all neighboring school pairs (N = *143,470)*



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Sources: Authors' analysis of Precisely school attendance boundary data linked to US Census Bureau data on residential demographics, school data from the National Center for Education Statistics Common Core of Data, the Civil Rights Data Collection, and the Stanford Education Data Archive.

Notes: FTE = full-time equivalent. The binned scatterplots show means of the y-axis variable across 100 percentile bins of the x-axis variable. The plots summarize the conditional expectation function of the difference between the characteristics of neighboring school pairs as a function of differences in the racial or ethnic composition of residents on either side of the boundary dividing the school pair. The yellow line denotes the ordinary least squares regression line between the two variables.

We test for between-neighboring-school differences in the availability of advanced education programs. We proxy for this by measuring the share of students participating in the following programs collected by the CRDC: Advanced Placement, International Baccalaureate, and gifted and talented, which we denominate commonly as "advanced tracking programs." Because seats for these programs are typically determined by school district policy, their participation rates can be partly interpreted as a measure of the supply of advanced education in these schools (Card and Giuliano 2016). Notably, only 7 percent of school seats on side A of the boundary are for advanced programs, relative to 13 percent on side B. The 6 percentage-point gap is statistically significant and suggests that racially unequal boundaries are linked to unequal educational offerings in public schools. Further, panel 1 of figure 7 shows a scatterplot indicating that the gap in advanced tracking is also growing with the racial and ethnic inequality between schools.

TABLE 1

Average Characteristics of Schools on Either Side of Racially Unequal School Boundaries

	Side A (greater share of Black and Hispanic residents)	Side B (smaller share of Black and Hispanic residents)	Difference	*t*-statistic	*P* value
Enrollment demographics					
Total enrollment	582.54	617.54	-35.00***	-4.09	0.00
Racial and ethnic composition					
Asian share	0.03	0.07	-0.04***	-25.58	0.00
Black share	0.41	0.14	0.27***	48.06	0.00
Hispanic share	0.46	0.22	0.25***	45.95	0.00
White share	0.08	0.52	-0.44***	-114.71	0.00
Socioeconomic composition					
Limited English proficiency share	0.22	0.08	0.14***	29.47	0.00
Share receiving FRL (CCD)	0.82	0.40	0.43***	81.13	0.00
Economically disadvantaged share (EdFacts)	0.85	0.41	0.44***	77.77	0.00
Staff characteristics					
Total full-time equivalent teachers	38.52	38.94	-0.42	-1.00	0.32
Student-teacher ratio	14.37	15.25	-0.89***	-10.59	0.00
Share of teachers in 1st or 2nd year	0.14	0.10	0.04***	21.72	0.00
Share of teachers absent more than 10 days	0.32	0.28	0.04***	12.20	0.00
Total counselors	1.03	1.17	-0.13***	-5.39	0.00
Total health workers	1.62	1.71	-0.09***	-3.76	0.00
Total security guards	0.55	0.25	0.29***	14.32	0.00
Academic characteristics					
Share of students on advanced tracking	0.07	0.13	-0.05***	-13.95	0.00
Mean achievement (SEDA)	-0.48	0.22	-0.70***	-64.86	0.00
Student discipline					
Suspensions / enrollment	0.14	0.07	0.07***	24.10	0.00
Total expulsions	0.94	0.51	0.43***	8.25	0.00
Share of students chronically absent	0.20	0.11	0.09***	32.81	0.00
Observations	2,373				

Sources: Authors' analysis of Precisely school attendance boundary data linked to school data from the National Center for Education Statistics CCD, the Civil Rights Data Collection, and SEDA.

Notes: CCD = Common Core of Data; FRL = free and reduced-price lunch; SEDA = Stanford Education Data Archive. Observations are at the neighboring school-pair level. The sample is restricted to pairs that are racially unequal, using the definition provided in the text.

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Given that school staff characteristics and educational offerings are significantly different between racially unequal neighboring schools, perhaps it is not surprising that they also differ considerably in the average student performance on state examinations. Table 1 shows that the difference is substantial: students on side A score -0.48 standard deviations below the mean, on average, while students on side B have mean scores 0.22 standard deviations above average, amounting to a large and significant gap in student achievement of 0.70 standard deviations. Panel 2 of figure 8 confirms this finding, demonstrating a precise link between the racial and ethnic difference between neighboring schools and their difference in achievement. The plot suggests that a 25 percentage-point increase in the racial or ethnic gap is associated with a 0.25 standard deviation increase in the achievement gap between these schools, a near one-to-one relationship.

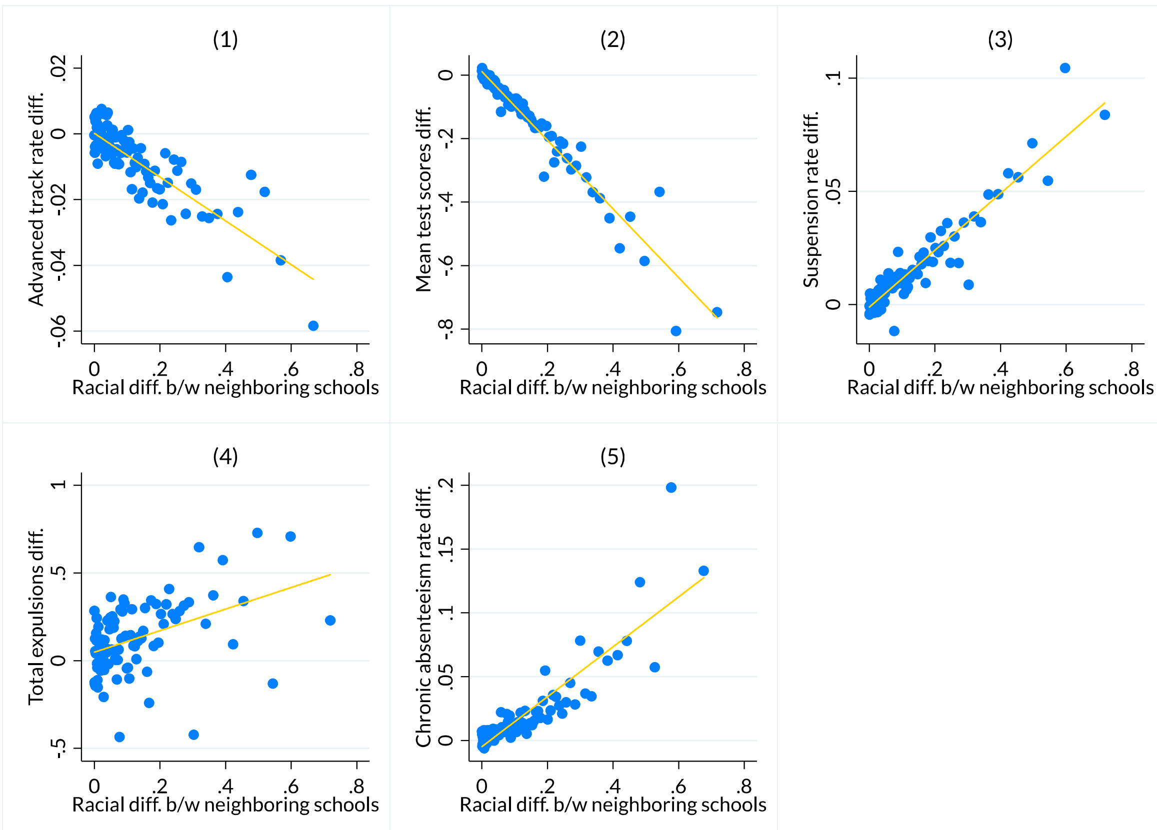
Finally, we examine differences in rates of student disciplinary action and chronic absenteeism between racially unequal schools that share an attendance boundary. We use two metrics of student discipline rates: the suspensions-to-enrollment ratio (a loose interpretation of this ratio can be as a suspension rate, but we cannot control for the fact that the same student can be suspended more than once), and the total number of annual student expulsions. Again, the estimates in table 1 show that there are significant differences in disciplinary action rates between the racially unequal schools represented in our list. Similarly, panels 3 and 4 of figure 8 suggest that these differentials grow larger as neighboring schools grow more racially unequal. A parallel story can be told when looking at rates of student chronic absenteeism: 11 percent of students on side B and 20 percent on side A are chronically absent. Panel 5 of figure 8 shows that a 25 percentage-point increase in the racial or ethnic gap between neighboring schools is linked to a 5 percentage-point increase in the differential in chronic absenteeism between these schools.

The results in this section establish that racial inequality between neighboring public schools is tightly correlated with large and significant differences in school conditions and educational quality. These results are alarming because there are few or no justifiable reasons for maintaining such stark levels of inequality between neighboring public schools.

A skeptical audience could question the implications of these findings by claiming that there is little new information here, since many studies have documented racial inequality in public schools. What such skeptics would be missing is that, by definition, every comparison we make in this analysis is between two schools that share an attendance boundary line and are located near each other. These schools are often in the same neighborhood and are often administered by the same local governing body. Why should two neighboring public schools be so vastly different, not only in terms of their student demographics but in terms of the staff members who work there and the educational programs that are offered? Our informed opinion is that they should not be and that there are plenty of policy remedies at districts' disposal to address this, including a change to these racially divisive boundaries.

FIGURE 8

How Differences in the Racial and Ethnic Composition of Neighboring Schools Correlate with Differences in School Characteristics and Outcomes



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Source: Authors' analysis of Precisely school attendance boundary data linked to US Census Bureau data on residential demographics, school data from the National Center for Education Statistics Common Core of Data, the Civil Rights Data Collection, and the Stanford Education Data Archive.

Notes: The binned scatterplots show means of the y-axis variable across 100 percentile bins of the x-axis variable. The plots summarize the conditional expectation function of the difference between the characteristics of neighboring school pairs as a function of differences in the racial or ethnic composition of residents on either side of the boundary dividing the school pair. The yellow line denotes the ordinary least squares regression line between the two variables.

How Frequently Do Racially Unequal Lines Coincide with District Boundaries?

Given how strikingly different racially unequal neighboring school pairs are, a key policy question for actors seeking to end this inequality is, how often do racially unequal school boundaries coincide with school district jurisdictional boundaries? Table 2 provides a breakdown of our sample by boundary type (district and nondistrict), racial and ethnic inequality, and school grade level. The total number of school boundary pairs in the dataset is 143,470 (i.e., instances of schools with geographically adjacent boundaries), of which 2,375 are racially unequal boundaries. And of these, 1,730 correspond to elementary schools, 447 correspond to middle schools, and 196 correspond to high schools. These patterns make sense because elementary schools and their boundaries are more numerous, affording a greater number of opportunities to divide populations demographically.

Racially unequal attendance boundaries are disproportionately more likely to coincide with a district jurisdictional line. For elementary schools, 956 (55 percent) of boundary lines that we identify as unequal are jurisdictional divisions, while the remaining 774 (45 percent) are completely contained within districts. For middle schools, the share of racially unequal school lines that constitute two different local governments is higher (354 / 447 = 0.79, or 79 percent). Similarly, for high schools, this share is 165 / 196 = 0.84, meaning that 84 percent of unequal high school boundaries correspond to a between-district division.

The patterns in table 2 establish that the problem of racially unequal school boundaries is disproportionately an issue about between-district jurisdictional divisions. Nonetheless, appendix tables A.2 and A.3 show that the differences in school quality documented above are pervasive across both types of unequal boundaries: attendance (administrative) boundaries and district (jurisdictional) boundaries.

On one hand, the finding that district divisions drive the bulk of inequities is in line with research showing that the bulk of metropolitan school segregation is driven by between-district demographic divisions (Clotfelter 1998, 2004; Monarrez, Kisida, and Chingos 2020). On the other hand, it complicates the set of potential policies that could redress the segregation these lines cause. Individual local governments cannot change jurisdictional lines on their own; they need to cooperate with neighboring jurisdictions and hope for the intervention or approval of the state or federal government. Still, this takeaway does not apply to 898 (38 percent) of the racially unequal boundaries in our sample, which are contained within a single school district, implying that the local school board would be well within its means if it decided to get rid of the boundary segment that is driving segregation between two of its neighboring schools.

TABLE 2

Breakdown of School Boundaries by Racial Inequality, Type, and Grade Level

Racially unequal school boundaries are more likely to be district jurisdictional lines

	Elementary Schools		Middle Schools		High Schools	
	Attendance boundary	District boundary	Attendance boundary	District boundary	Attendance boundary	District boundary
Not unequal	55,053	31,179	16,286	18,400	5,874	14,305
Racially unequal	774	956	93	354	31	165

Source: Authors' calculations using US Census Bureau and Precisely data.
Note: See the definition of racially unequal boundaries in the text above.

Because most unequal boundaries are district boundaries, one concern with our findings might be that the bulk of the inequities in school conditions seen in tables 1 and 2 and figures 7 and 8 is merely an artifact of between-district differences, which have been documented in the literature (Clotfelter 2004).[13] This would be worrisome because it would limit our claim that many of the inequities between neighboring schools are caused by district policies that maintain high levels of inequality.

But further investigation in the appendix (tables A.2 and A.3) establishes that such a concern is not a threat to the interpretation of our findings. We rule out the possibility that our key findings are entirely an artifact of school district differences by estimating models of gaps in neighboring school conditions as a function of their differences in racial and ethnic composition. These models are akin to the plots in figures 7 and 8, but they also control for an indicator variable of whether the boundary between neighboring schools is a district boundary. The models also control for other factors, including total population on either side of the boundary and metropolitan area fixed effects. In addition, we present specifications that add an interaction term to capture whether the relationship is statistically different between administrative (SAB) and jurisdictional (district) boundaries. The results show that, across the board, differences in school conditions across racially unequal school boundaries are robust to controlling for the district boundary indicator. In other words, we can confidently state that the inequities documented in this section apply both to neighboring school pairs separated by district boundaries and to those entirely contained within a district, separated only by an administrative attendance boundary line.

Racially Unequal School Boundaries and the 1930s HOLC Redlining Maps

Thus far, the results in this report have established that there are thousands of neighboring schools nationwide that are vastly unequal in terms of the demographics of the communities they serve, their student bodies, and their quality (as measured by staffing, program offerings, and mean student achievement). The classic literature on the economics of public good provision has a simple explanation for this inequality: individual households choose their residence partly based on school boundaries, and white people seem to have a "higher willingness to pay" for "higher-quality" schools, as revealed by their choice to live on the side of the boundary with a better school (Bayer, Ferreira, and McMillan 2007).

Although there is truth to this theory, models based on individual household choice ignore the government's role in perpetuating segregation. The government has set policies to create racial and ethnic segregation that would otherwise not have taken place. Perhaps the most influential exponent of the government's role in perpetuating segregation in US cities is Richard Rothstein (2017). His historical account, captured in the book *The Color of Law*, describes instances in which local, state, and federal governments enforced explicit racism in the provision of housing subsidies and even intervened to reverse integration in areas that were naturally becoming more diverse. An accurate theory of the causes of segregation must incorporate the role of individual choices, that of government policymaking, and the complex and dynamic interaction between the two.

The most well-known of the federal government's New Deal segregationist policies were the Home Owner's Loan Corporation (HOLC) "redlining" maps. Between 1935 and 1940, HOLC agents used data and evaluations organized by local real estate professionals in each city and assigned grades to residential neighborhoods that reflected their "mortgage security" that would then be visualized on color-coded maps. Neighborhoods receiving the highest grade of "A"—colored green on the maps—were deemed minimal risks for banks and other mortgage lenders when they were determining who should receive loans and which areas in the city were safe investments. "B"-graded neighborhoods (blue) were still desirable, while "C"-graded neighborhoods (yellow) were considered declining areas. Those receiving the lowest grade of "D," colored red, were considered "hazardous."[14] A large part of the reasoning for these ratings was explicit racism, as is self-evident in the notes written by the HOLC staff (Rothstein 2017). Neighborhoods with a "D" rating frequently received this grade because "undesirable" populations, such as Jewish, Asian, Hispanic, and Black families, were living there.

Today, there is a reignited interest in understanding how redlining perpetuated urban segregation and the implications this has on the government's responsibility to redress its harms. A burgeoning empirical literature highlights serious inequity in economic outcomes across the neighborhood boundaries generated by redlining maps, using an approach akin to this report's (Aaronson, Hartley, and Mazumder, forthcoming; Lukes and Cleveland 2021).

For our examination of school boundaries, the history of redlining can help us demonstrate that the legacy of racist government practice of the past plays a role in explaining unequal school boundaries today. Redlining maps were developed in the 1930s, while modern school assignment policies were determined more recently, as they need to be updated frequently (in some places, annually). Although the partitions of urban spaces created by redlining likely reflect neighborhood differences dating back to the 1930s, which have likely evolved into seemingly "natural" neighborhood boundaries, today's school boundaries were determined more recently. This suggests that local policymakers have had plenty of opportunities to break the link between school assignment policy and the vestiges of racism in our cities. Our findings in this section suggest that many have chosen not to do so, thus perpetuating the legacy of redlining in our public schools.

Because there is no disagreement that redlining is a vestige of racist government policy, were we to find that school boundary lines and redlining coincide, this would constitute strong evidence that they serve a segregationist purpose. Therefore, a key research question is, how frequently do racially unequal school boundaries coincide with the HOLC redlining maps? We use GIS data on HOLC maps from the University of Richmond's Mapping Inequality project to understand how often redlining lines coincide with racially unequal school attendance boundary lines. This dataset includes information on the HOLC grades of 8,878 residential neighborhoods in about 200 cities.

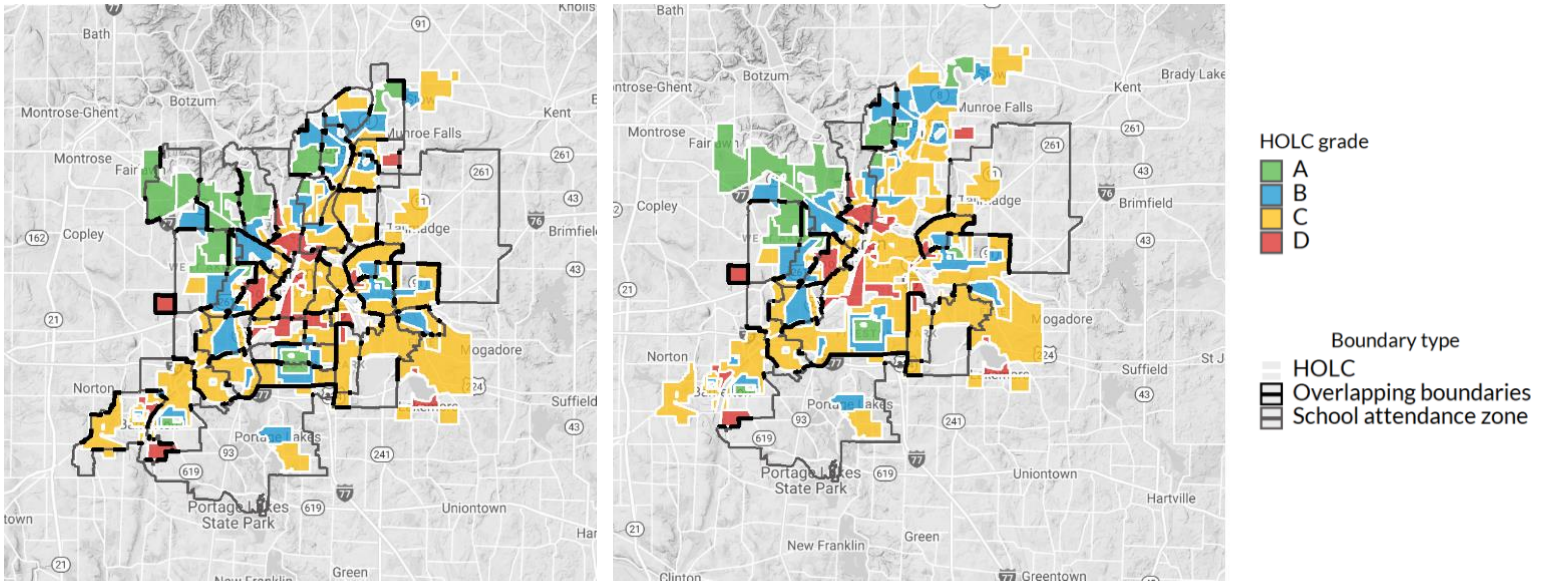
To compare the HOLC data from the 1930s with school attendance boundary data from 2019, we first use GIS tools to determine whether each HOLC neighborhood polygon is located within a school attendance boundary zone. Because cities have developed and changed from how they were from 1930 to 1940, when the HOLC maps were created, we limit and define cities based on their urban development in the 1930s. We use cities entered in the HOLC data as our conceptual anchor point and unit of comparison, such that we can analyze only SAB zones that geographically intersect in cities as defined by HOLC maps in the 1930s. We exclude SAB zones corresponding to areas where urban development took place between 1935 and 2019 and do not intersect with any HOLC polygons.

Consider the example in figure 9, a map of Akron, Ohio. We compare HOLC redlining boundaries in 1935 with SAB zone lines in 2019 by overlaying one map over the other. We do this to determine whether racially unequal boundaries and HOLC maps represent the same geographic partitioning of cities. We use two methods to analyze whether the two maps coincide. The first method focuses on their perimeter by studying the rate at which racially unequal school boundaries line up with the boundaries of HOLC neighborhoods. HOLC polygons are bounded by white lines, while SAB zones are bounded by gray lines. When HOLC boundaries and SAB boundaries line up, the lines in the figure appear bolded and black. More specifically, we define a “line-up” when HOLC lines and SAB lines overlap so that the position of some part of one line appears to be the same as the position of some part of another line.[15]

FIGURE 9

Redlining and Racially Unequal School Boundaries in Akron, Ohio

All attendance boundary zones *Racially unequal attendance boundaries*



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Sources: The University of Richmond's Mapping Inequality project and Precisely.

Notes: HOLC = Home Owners' Loan Corporation. School attendance zones that do not intersect with HOLC neighborhoods are omitted. Perimeter line-up is defined as noted in endnote 13.

In the left panel of figure 9, we visualize the rate at which school boundaries line up with HOLC boundaries, defined as the share of the city's total SAB perimeter that lines up with HOLC boundaries. With this measurement, we strive to capture how often modern SABs coincide with redlining boundaries from the 1930s. In this example, 40.3 percent of Akron's total SAB perimeter overlaps with Akron's HOLC map. This suggests that Akron's entire SAB system somewhat mimics the old, *racist* partition of HOLC. But because the HOLC partition is older, it is possible that neighborhoods have significantly changed and that previously racist boundaries are meaningless. To verify whether this is true, we look at another measure, depicted in the right panel.

In the right panel, we show the rate at which racially unequal boundaries in Akron line up with its HOLC boundaries by measuring the share of the city's SAB perimeter (*including only SABs we have identified as racially inequitable*) that lines up with redlining. This measures how often *racialized* SABs today coincide with redlining boundaries from the 1930s. If a boundary line we suspect to be racially inequitable was also racially inequitable in the 1930s, we interpret this as providing evidence that the racialization of this SAB has historical roots. Whereas the left panel provides a baseline for how heavily Akron's SAB system is based on HOLC partitions in general, the right panel tests how often highly unequal SABs coincide with redlining. If an unequal school boundary lines up with a HOLC boundary, this establishes that the SAB line is likely a vestige of racist institutions.

In this example, 38 percent of Akron's "bad" SAB perimeter overlaps with its HOLC boundaries in the 1930s. Although this is lower than the percentage in the left panel, the ratio between the two rates is 0.94—the "bad" boundary perimeter line-up rate (38 percent) divided by the total perimeter line-up rate (40.3 percent). This suggests that today's unequal school boundaries in Akron align with HOLC boundaries about as often as they do for the entire city. At the very least, this pattern implies that such perimeter line-ups are not accidental. To dig deeper into what perimeter line-ups could mean for Akron, and which boundaries in Akron's SAB system retain the same racist institutions of the past, we examine the data using a different approach.

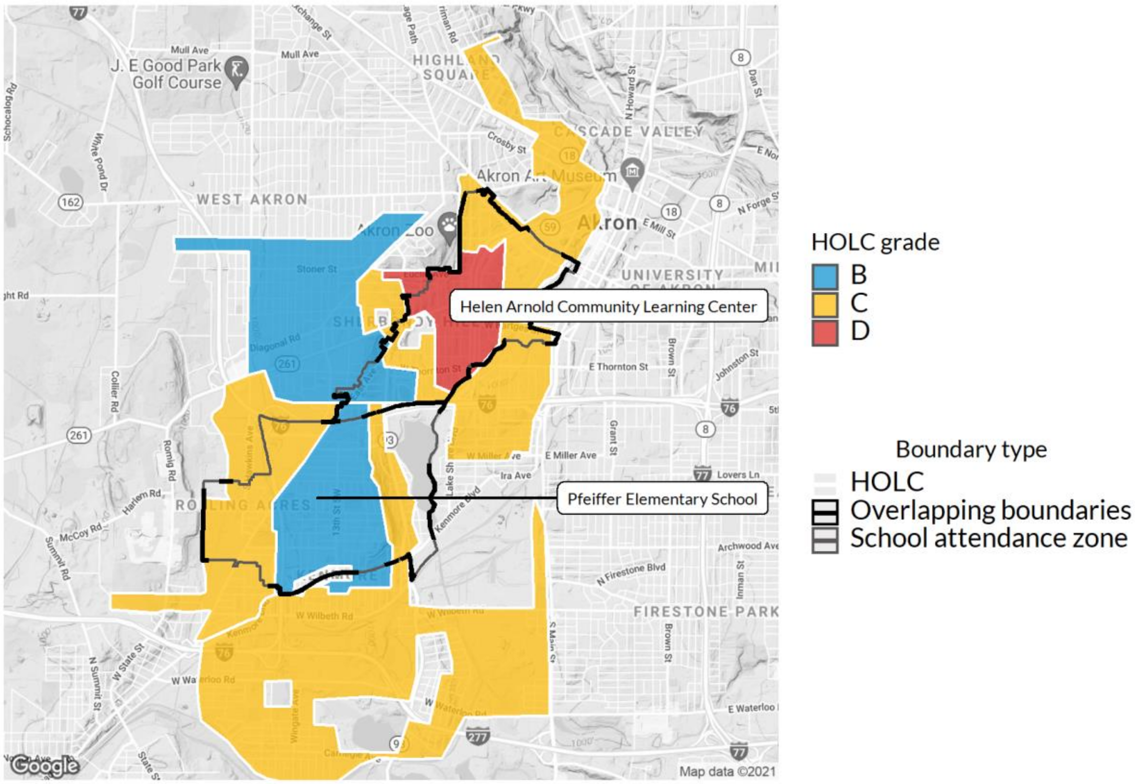
The second way to think about the degree of spatial correlation between unequal school boundaries and the HOLC maps is to consider the share of SAB areas covered by different HOLC grades. This method involves the surface area (as opposed to the perimeter) of these geographies. It allows us to study, for example, how often and what share of a racially unequal school zone overlaps with C-grade and D-grade HOLC neighborhoods in the 1930s.

Consider figure 10, which shows the distribution of HOLC grades across the bolded line for Helen Arnold Community Learning Center and Pfeiffer Elementary School (the example in figure 3). According to the HOLC maps, the Helen Arnold SAB was 79.9 percent C- and D-grade HOLC neighborhoods (an indication of large racial and ethnic minority populations, limited services, and declining government investment) and only 13.0 percent A- and B-grade HOLC neighborhoods, which were mostly white and well serviced. Pfeiffer Elementary School, on the other side of the boundary, was 40.2 percent C- and D-grade HOLC neighborhoods and 43.1 percent A- and B-grade HOLC neighborhoods.

In this example, the unequal school boundary overlaps with the divisions established by redlining. There is a marked division in the types of HOLC grades that primarily populate one side versus the other. Pfeiffer has 30.1 percent more A- and B-grade HOLC neighborhoods and 39.7 percent fewer C- and D-grade HOLC neighborhoods than Helen Arnold, both considerable gaps that align with large modern-day gaps in the SABs' Black and Hispanic populations. From this, we can conclude that the boundary separating these two HOLC polygons has implications for how racist institutions from the 1930s continued to influence school systems today. The same geographically bound racial inequities resonate across time and predispose the SAB system to the biases of redlining. Even if the neighborhood segregation that is the legacy of redlining is part of why these schools are so segregated, policymakers could easily adjust the boundary to redress these inequities, and they have not.

FIGURE 10

Helen Arnold Community Learning Center, Pfeiffer Elementary School, and Redlining



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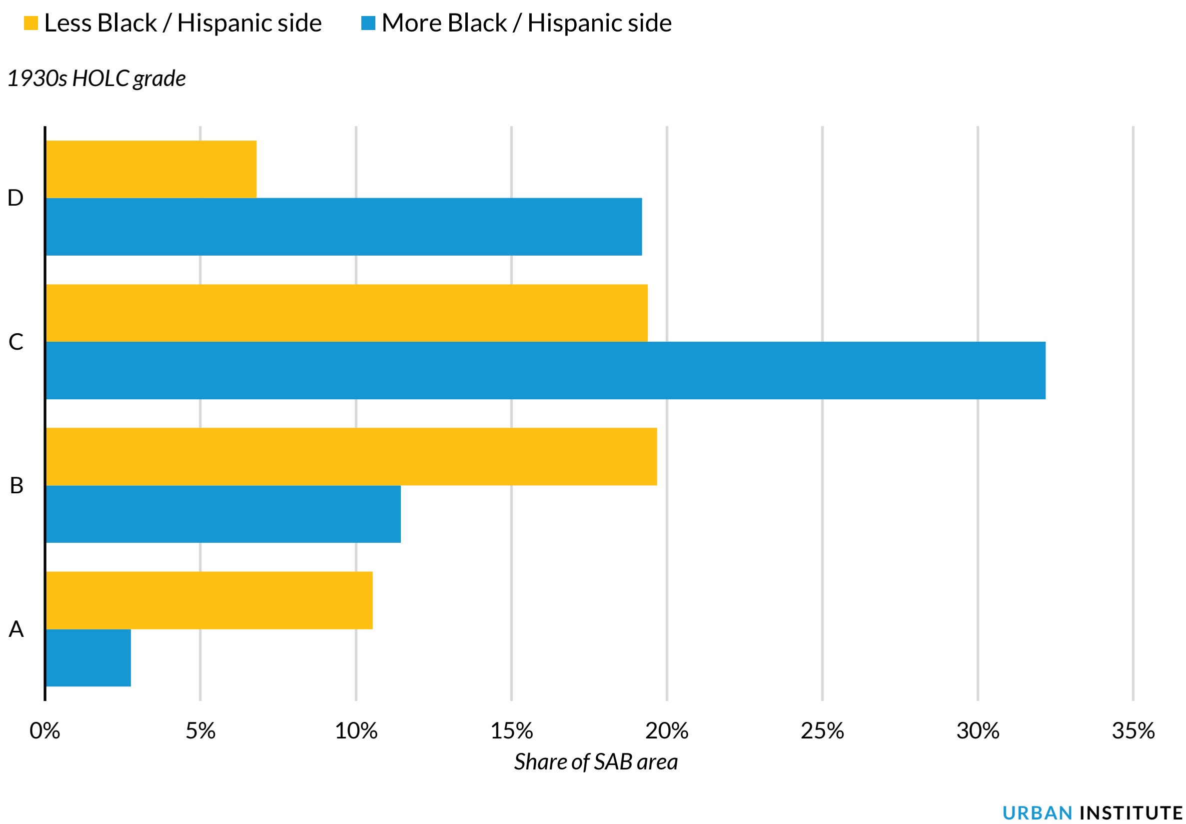
Sources: The University of Richmond's Mapping Inequality project and Precisely.
Note: See endnote 15 for a description of perimeter overlap statistic.

Figure 11 generalizes the area-overlap approach in a national analysis of the geographic link between racially unequal school boundaries and redlining. Looking across neighboring school pairs, it compares the rate at which different HOLC grades overlap with school attendance zones on either side of the boundary—the less Black or Hispanic side and the more Black or Hispanic side. We can see that the more Black or Hispanic side has a considerably higher average share of C- and D-grade HOLC neighborhoods and a lower average share of A- and B-grade HOLC neighborhoods than the less Black or Hispanic side. In particular, the more Black or Hispanic side has an average of 19 percent of its area covered by D-grade neighborhoods, relative to about 7 percent on the less Black or Hispanic side, a 12 percentage-point gap. As such, this figure establishes that racial inequality in school boundaries is spatially correlated with redlined areas. This implies that modern school zones with more Black or Hispanic students are more likely to have historically been labeled as "bad" neighborhoods by the government and were discriminated against in the 1930s, suffering from lower public investment for racist reasons.

Appendix table A.4 confirms this in both a national and city-by-city area overlap analysis, in which we find that for the entire US, school attendance zones with a higher share of Black and Hispanic students have 30 percent more C- and D-grade HOLC zones and 17percent fewer A- and B-grade HOLC zones than those with a lower share of Black and Hispanic students.

FIGURE 11

Average Area Overlap between HOLC Neighborhood Grades and Racially Unequal School Boundaries



Source: Urban Institute analysis of Precisely SAB map data and HOLC data.
Notes: HOLC = Home Owner's Loan Corporation; SAB = school attendance boundary. The figure shows the average share of SAB area that is overlapped by each HOLC map grades. Only a subset of schools in the data have HOLC information. The data are based on a geographic information system analysis of geographic area overlap between HOLC maps and neighboring SABs ordered based on their racial or ethnic composition.

In general, we find that unequal boundary lines nationwide are somewhat correlated with redlining perimeters, but unequal SAB areas are more highly correlated with redlined areas (appendix table A.4). A national perimeter analysis reveals that 30.8 percent of all SABs in all US cities that also existed back in the 1930s line up with HOLC boundaries. If we restrict our attention to unequal school boundaries, this share increases to 34.4 percent. In contrast, only 29.5 percent of SABs that are not categorized as unequal line up with HOLC boundaries. These statistics show that preexisting HOLC structures match more frequently with school boundary structures that are racially unequal (34.4 percent) than with school boundary structures that are not unequal (29.5 percent). In our view, one key takeaway is that it is possible to overcome the legacy of redlined neighborhoods in school assignment systems, but many local and state policymakers nationwide have simply chosen not to do so.

Although it may seem that this perimeter analysis shows a strong correlation between racial divisiveness in the modern SAB system and racial inequality in the neighborhood ranking system of the 1930s, a deeper look at several example cities reveals additional complexity.

Statistics in appendix table A.4 show that SAB zones in St. Petersburg, Florida; Little Rock, Arkansas; and Oakland, California, have strong spatial correlations with redlined neighborhoods in terms of both perimeter and area. St. Petersburg has a perimeter ratio statistic of 2.63, meaning racially unequal boundaries line up with redlining boundaries 2.63 times more often than all SAB boundaries do. This ratio is computed by taking the share of unequal SAB-HOLC boundary line-ups (46 percent) and dividing it by the share of total SAB-HOLC line-ups in St. Petersburg (17 percent). Appendix table A.4 also shows that of SAB zones separated by an unequal boundary, the average SAB zone that is more Black or Hispanic in St. Petersburg is occupied by 25 percentage points fewer A- and B-grade HOLC areas and 25 percentage points more C- and D-grade HOLC areas than the average SAB zone that is less Black or Hispanic. Examples like these showcase cities that have serious racial equity gaps in their school boundary systems, which can be correlated to the racial disparities in the 1930s redlining systems.

Other cities, such as Minneapolis, Minnesota, and Greensboro, North Carolina, show essentially no differences in unequal SAB-HOLC perimeter line-ups and all SAB-HOLC perimeter line-ups (a ratio statistic of 1.04 and 1.00, respectively) but show strong HOLC area correlations. The share of A- and B-grade HOLC areas is 6 and 14 percentage points less in SABs that are more Black or Hispanic for Minneapolis and Greensboro, respectively. The share of C- and D-grade areas is 26 and 61 percentage points greater in SABs that are more Black or Hispanic. These examples demonstrate that although perimeter line-ups do not occur more often for unequal boundaries in some cases, HOLC area analysis reveals that the unequal boundaries that do line up with the redlining system are not superficial; there is still strong spatial correlation between HOLC grades racial and ethnic distributions in SAB zones today. Other cities, still, such as Philadelphia and Pittsburgh, Pennsylvania, have slightly higher ratio statistics (1.22 and 1.30, respectively), but HOLC area analysis finds that more Black or Hispanic areas have lower shares of C- and D-grade HOLC areas and higher shares of A- and B-grade HOLC areas.

Interpretation for these cases is more complex, suggesting that in these cities, the unequal school boundaries do not appear to be connected to the HOLC maps.

School Choice Systems, Boundary Maps, and Segregation

One important aspect of school assignment policy are "school choice" policies. This term applies to a broad range of policies undertaken by local school systems to replace a traditional school boundary assignment system in which residential address determines assignments. School choice policies range from the small (the opening of a magnet or charter school that all district members can choose to enroll in) to the comprehensive (centralized school lotteries, an increasingly popular form of school choice that allows parents to rank schools by preference, after which an algorithm calculates the final match to a school, considering preferences, school capacities, neighborhood priority, and school diversity).

Advocates often wonder whether school choice leads to more integration, perhaps simply because choice uncouples neighborhoods and schools. In theory, things could go either way: school segregation could decrease or increase as school choice is introduced. The empirical evidence on this question is mixed, in part because of the varying definitions of school choice and different research approaches in the literature. Our research on charter schools shows that charter schools, on average, have not led to integration. The advent of charter schools has led to considerably higher levels of school segregation in many school districts, although perhaps not as much as some alarmist media accounts have made it out to be (Monarrez, Kisida, and Chingos 2020). Research on the impact of magnet schools, open enrollment, and school voucher programs has had more mixed findings, which we summarize in a literature review on the topic (Monarrez and Chingos 2020). We are not aware of studies that take stock of the advent of centralized school lotteries and their average impact on school segregation nationally.

In addition, researchers know little about the interaction between school boundaries and school choice policy and how it may affect racial and ethnic sorting and diversity in public schools. To try to make progress along this dimension, our research team collected information on the school assignment systems of the 100 largest US school districts by enrollment. Specifically, we manually collected information on these districts by searching their websites to obtain information on SABs and the following types of school choice policy:

1. **General school choice language.** The district website mentions school choice and how its assignment policies provide some degree of it.

2. **Centralized school lottery.** The district website provides a portal for parents to rank schools by preference. An algorithm aggregates these data to generate final school assignments. These systems can still incorporate school boundaries to provide priority to applicants living "in boundary," and they commonly provide priority to students with siblings enrolled at the school. We report an indicator on centralized lotteries by grade level.
3. **Charter school enrollment share.** The share of students attending a charter school in a district. This provides a measure of the intensity of charter school presence.
4. **School transfer system.** The district website describes a policy for students to transfer out of their default school assignment to another school in the same district that has seats available.
5. **Open enrollment policy.** The district website mentions an open enrollment policy for at least some of its schools, indicating that any district family can enroll in the school *if* the school has seats available. We also collect information on whether the open enrollment policy entails a "first-come-first-serve" feature or whether some families can have priority over others for registration.
6. **Magnet school presence.** There are magnet school programs in the district—that is, schools that have specialized curricula and that any district family can apply for enrollment. We also collect information on whether the magnet school requires an entrance exam and whether the district website provides language alluding to the magnet school having a diversity or integration objective, typically based on where the magnet school is sited.

Table 3 summarizes the findings of our data collection for the 100 largest school districts, which account for almost a quarter of all public school students. The full dataset is available via the Urban Institute's data catalog.[16] We present estimates for the 100 largest, 50 largest, and 20 largest districts. These districts educate an average of 106,035 students, with the 20 largest averaging more than half a million.

Almost every district in this list (98 percent of the top 100 and 100 percent of the top 20) uses SABs to (at least partially) determine their school assignments for elementary school students. Interestingly, these districts are slightly less likely to use SABs for middle or high schools, indicating that school choice programs may be slightly more common at higher school grades. Most of these districts (95 percent of the top 100 and 100 percent of the top 20) make their maps available on their websites, though only a handful provide GIS versions of them, such as the ones we use in the first two sections of this report. Moreover, essentially every district website makes it clear that school registration is contingent on the family's ability to produce a proof of residential address. Some of these simply require proof that one is residing in the school district, while others request proof that one resides within a school's attendance zone. The upper panel of table 3 thus provides clear evidence that virtually every large school district makes at least partial use of SABs and student addresses to conduct their school assignments.

The lower panel in table 3 summarizes the findings of our data collection on school choice policies for the 100 largest districts. Eighty-one percent include language on their websites that alludes to a policy related to school choice. But what this phrasing means varies dramatically across districts. About half the districts in the sample have a centralized school lottery, which is slightly more common at the high school level (53 percent) than at the elementary school level (48 percent). In addition, centralized choice is less common in the 20 largest school systems (40 percent).

Other school choice policies are more broadly defined, though many of them include stipulations that limit parents' ability to choose any school of their liking. Most school districts in our top 100 have school transfer systems (74 percent) and open enrollment policies (53 percent), though few provide free reign to open enrollment by implementing first-come-first-serve policies (8 percent). Moreover, although 83 percent of districts have at least one magnet school, most of these have exam requirements, limiting the degree to which they may have meaningful impacts on diversity and integration. Further, although the National Center for Education Statistics defines magnet schools as programs intended to address segregation, only about 6 percent of districts in our sample (10 percent among the 20 largest) explicitly state that the magnet school has been sited to increase diversity.

In sum, table 3 establishes that, even in the presence of varied school choice programs, school boundaries are virtually ubiquitous in the country's largest school systems. School choice policies are common in these school systems, though their scope and extent vary. Most of the large school districts in our sample mention that diversity is an explicit goal of their assignment system (59 percent), but few outline concrete ways their school boundaries or choice policies further diversity or integration.

TABLE 3

School Attendance Boundaries and School Choice Policy in the 100 Largest School Districts by Enrollment

	Top 100	Top 50	Top 20
Average total enrollment	106,035	155,094	254,124
SABs			
SABs present (elementary school)	0.98	0.98	1.00
SABs present (middle school)	0.96	0.96	1.00
SABs present (high school)	0.95	0.94	0.95
SAB map available on website	0.95	0.94	1.00
Proof of address required for registration	0.99	0.98	1.00
School choice policy			
General school choice language	0.81	0.86	0.85
Centralized lottery (elementary school)	0.48	0.44	0.35
Centralized lottery (middle school)	0.50	0.50	0.40
Centralized lottery (high school)	0.53	0.50	0.40
School transfer system	0.74	0.58	0.70
Open enrollment policy	0.53	0.40	0.35
First-come-first-serve policy	0.08	0.06	0.10
Magnet school presence	0.83	0.86	0.85
Exam required for magnet school	0.34	0.52	0.50
Magnet school sited for diversity	0.06	0.10	0.10
Charter school enrollment share	0.09	0.11	0.12
Assignment system acknowledges integration	0.59	0.52	0.65
Observations	**100**	**50**	**20**

Source: Urban Institute data collection.
Notes: SABs = school attendance boundaries. Observations are at the school district level.

Perhaps the most consequential and fastest-growing form of school choice policies are centralized school lotteries, which have been adopted by dozens of urban districts since 2003, when economists introduced the idea of using matching algorithms and mechanism design for school assignment (Abdulkadiroğlu and Sönmez 2003; Pathak 2011). A key unanswered question is whether centralized lotteries have led to meaningful shifts in school segregation. We aim to provide initial descriptive evidence on this question by leveraging the centralized lottery indicator from our data collection on the 100 largest school districts.

Centralized lotteries can affect school sorting patterns, as they afford families the opportunity to express a ranked list of preferences for any public school in the district. But even in the presence of centralized choice, school boundaries are still present in almost all cases (table 3). The role of boundaries within centralized choice systems is in providing priority to students who apply to a school and live within the school's boundary. As such, if a school's available seats are filled entirely by students living in boundary, this makes out-of-boundary applications superfluous. Nonetheless, some districts allow schools to set a priority for students considered "at risk," which could open access to diverse student bodies, especially if at-risk priorities are ranked higher than boundary priorities. Because of these complex interactions between the design of centralized choice, school boundaries, and neighborhood segregation, we must look at empirical evidence to begin assessing the impact of centralized lotteries on racial equity of urban school districts.

For a first look at whether centralized school lotteries have affected segregation, we provide split-sample summary statistics of the 100 largest districts, separately for those with centralized lottery systems and those without (table 4). The first rows show average population shares by race or ethnicity and by socioeconomic status as proxied by free and reduced-price lunch (FRL) rates. The lower rows show varying measures of segregation: (1) the variance ratio index, which measures how much a student's race, ethnicity, or socioeconomic status predicts the race or ethnicity of her peers (alternatively, this index can be interpreted as a measure of isolation that is adjusted by the group's share of the total population); (2) the dissimilarity index, which measures the relative share of students of a given group that would need to move schools to achieve perfect integration; and (3) the Theil Multigroup Entropy Index, a measure of segregation akin to the dissimilarity index that can account for all racial and ethnic groups simultaneously.[17]

Columns 1 and 4 in table 4 show that in 2018, districts with centralized school lotteries are demographically different and have higher rates of racial, ethnic, and socioeconomic segregation than others. Districts with centralized lotteries have a higher share of Black students (30 percent) than those with traditional-assignment students (17 percent), a difference that is statistically significant (appendix table A.5). Other differences in population shares across the two groups of districts are smaller and not significant. But in terms of racial, ethnic, and socioeconomic segregation, there are marked differences between districts with centralized choice and other districts. The variance ratio for Black students is 0.20 in districts with lotteries, relative to 0.11 in districts with traditional SAB-based systems. Segregation of white students is also higher for white students in choice districts. But we do not detect meaningful differences in segregation for other racial or ethnic groups or in terms of FRL status. These patterns are replicated when examining the dissimilarity index. Finally, when looking at the measure of multigroup segregation, the result is replicated: districts with centralized choice have significantly more uneven rates of diversity than other school systems.

Clearly, correlation is not causation. Average differences in contemporaneous levels of segregation between districts with and without centralized lotteries are insufficient for a claim that centralized lotteries cause higher levels of segregation. It may be the case that districts with centralized choice are more segregated for reasons unrelated to the advent of the centralized lottery system. To test this, table 4 also shows summary statistics for segregation in 2003, the year centralized lotteries were first proposed in theory, well before the adoption of this system in any of the districts in our sample. By comparing changes in segregation between districts with and without lotteries, we can assess how much the patterns documented above may be driven by fixed or preexisting differences between the two groups of districts.

Columns 3 and 6 show the 2018–2003 change in demographics and segregation in districts with and without centralized school lotteries. The Black share of the student population decreased in both groups, albeit only slightly (-0.03 and -0.01, respectively). This has been offset by an increase in the Hispanic share of students, about 0.10 in both cases. Interestingly, the data suggest that, although the white share of students has fallen in districts both with and without school lotteries, the decline has been considerably smaller in choice districts (-0.08) than in districts with traditional SAB assignment (-0.14). Taking the difference in the change in demographics between the two types of districts provides a simple estimator of the causal effects of centralized choice (Card and Krueger 1993). The apparent positive effect of choice on the white share of students, about 0.06, is the only estimate that is significantly different from zero at the conventional 5 percent level of confidence (column 9). This result suggests that centralized choice may have a role in diminishing white flight from public school systems. In contrast, none of the difference-in-differences estimates of the impact of centralized choice on segregation (column 7) are statistically significant (columns 8 and 9), and most are near zero.

Thus, difference-in-differences estimates suggest that centralized lotteries have had a null net effect on racial and ethnic segregation in public schools. Nevertheless, we acknowledge that these are rough estimates, given that lotteries were presumably introduced at various points during this long period, a source of variation that could be leveraged to improve our estimates but that we are ignoring, as we do not have information on when these programs were first implemented.

Altogether, the results in table 4 establish that districts that are more segregated are more likely to have pursued centralized choice systems, relative to less segregated ones. Because the differences in segregation between these two groups existed before the advent of centralized choice, we find it unlikely that these novel assignment systems could have caused meaningful changes in segregation. Nevertheless, we should reiterate that these findings constitute merely a preliminary look at the impact of these policies on racial and ethnic stratification. We hope future research will pursue a better research design to provide a more definitive answer to this important policy question, perhaps by exploiting variation in the timing of the introduction of choice in all districts that have adopted such policies, not only those among the 100 largest. In particular, our initial finding that centralized school choice may reduce white flight should be explored further, as it may have important implications for the long-term stability and success of large urban public school systems.

TABLE 4

Centralized School Choice and School Segregation in the 100 Largest School Districts by Enrollment

	Centralized Lottery			No Centralized Lottery					
	2018	2003	Diff.	2018	2003	Diff.	Diff.-Diff.	*t*-statistic	*p* value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Population share									
Black	0.30	0.33	-0.03	0.17	0.18	-0.01	-0.016	0.74	0.46
Hispanic	0.30	0.20	0.10	0.35	0.24	0.11	-0.010	0.95	0.34
White	0.28	0.37	-0.08	0.34	0.48	-0.14	0.055	-2.08	0.04
Asian	0.07	0.06	0.01	0.08	0.07	0.01	-0.001	0.10	0.92
FRL	0.54	0.47	0.07	0.49	0.36	0.13	-0.064	1.74	0.09
Variance ratio index									
Black	0.20	0.23	-0.02	0.11	0.13	-0.02	-0.004	0.41	0.68
Hispanic	0.17	0.16	0.01	0.14	0.13	0.00	0.003	-0.25	0.80
White	0.18	0.21	-0.02	0.14	0.17	-0.03	0.004	-0.38	0.71
Asian	0.08	0.05	0.03	0.06	0.03	0.03	0.002	-0.17	0.86
FRL	0.21	0.22	-0.01	0.23	0.21	0.02	-0.026	1.07	0.29
Dissimilarity index									
Black	0.41	0.43	-0.02	0.34	0.35	-0.02	0.001	-0.05	0.96
Hispanic	0.37	0.40	-0.04	0.33	0.36	-0.03	-0.012	1.12	0.27
White	0.44	0.44	-0.01	0.36	0.37	-0.02	0.011	-0.89	0.38
Asian	0.41	0.37	0.04	0.36	0.29	0.06	-0.025	1.93	0.06
FRL	0.41	0.41	0.00	0.43	0.41	0.01	-0.008	0.35	0.73
Theil Multigroup Entropy Index									
	0.18	0.21	-0.03	0.13	0.15	-0.02	-0.010	1.36	0.18
Observations	**49**			**51**					

Source: National Center for Education Statistics Common Core of Data.

Notes: FRL = free and reduced-price lunch. Observations are at the school district level.

Discussion

The story of two vastly unequal schools with adjacent attendance boundaries is repeated thousands of times in the country. To an outside observer, it may appear baffling that even after decades of Supreme Court decisions and local efforts to end the racial and ethnic segregation of schools, our local governments are still willing to sustain stark racial and ethnic borders in the administrative service maps they use for student assignment. To a seasoned advocate for racial equity in the US, this may be all too familiar, perhaps even obvious. We believe that a large part of the problem is that these inequities happen at a microgeographic level, making them easy to hide. Therefore, it is necessary to employ quantitative tools to elevate the thousands of invisible lines that create racial and ethnic borders in our cities. States could do this, especially ones that have racial-imbalance laws that require district reports on public school demographics and racial and ethnic enrollment balance (e.g., Connecticut's Sec. 10-226e-1).

A key result from our analysis is that racially unequal school boundary lines often coincide with the HOLC redlining maps, perhaps the most well-known of the federal policies implemented to create racial and ethnic inequality in wealth and to perpetuate segregation during the 1930s and 1940s. Racially unequal boundaries that line up with racist redlining maps are a clear indictment of the school assignment system, as this clearly establishes that they are a vestige of racist policies of an earlier era. Coincidences between racially unequal boundaries and redlining show that the choices of individual families to live on either side of the line cannot be the only driver of inequality. These results demonstrate that government institutions had a role in creating racial and ethnic divisions in our urban school systems. It is the government's responsibility to redress racially unequal school boundaries when they are a vestige. Because school assignment systems need to be updated regularly, policymakers have had numerous opportunities to amend the school boundaries to redress these harms, but many of them have simply chosen not to do so.

For many of these unequal boundaries, it would take a simple redrawing of the line to remedy much of the inequality between the schools. Redrawing the line separating adjacent schools would not lead to much of a change in households' commuting patterns, and it would not disrupt the rest of the school system, but it could significantly decrease segregation between the two schools. In turn, redressing a multiplicity of these unequal boundaries in a given city could help dismantle segregation in the entire public school system.

Politics are a significant factor impeding local action on racially unequal school boundary systems. High-income groups have been known to leverage their political influence to ensure that school boundaries remain inequitable (DeRoche 2020). It is obviously not a coincidence that high-quality public schools often serve areas populated exclusively by affluent white residents. School districts and states have the power to break down these barriers, but the specter of unintended consequences always hovers over discussions of equitable student assignment reform. The fear is that a brusque readjustment of housing values would follow a school redistricting reform, resulting in a wholesale exodus of affluent families, also known as “white flight.” In some cases, these fears are substantiated by past experience, but in many others, it is less clear what the full consequences of reform would be, and the uncertainty can result in limited buy-in from the community and district leadership.

A generalized claim that severe market readjustment would completely undo the benefits of school redistricting reform drives much of the anxiety over school boundary reform. But the evidence of real estate depreciation and white exodus for localized school redistricting in recent decades is scant (Monarrez 2019; Monarrez and Schönholzer 2021). Instead, anxiety over reform is typically based on a dim view of the history of court-ordered desegregation and shock at the documented instances of white flight following the implementation of integration plans more than 40 years ago (Lutz 2011). Social and economic dynamics are much different today. There is a greater impetus for racial and ethnic equity and redressing the harms of structural racism. Our analysis of centralized school choice policies shows that white flight effects as a reaction to changes in the school assignment system are likely less common today than they once were. Once school boundaries change, they are typically accepted by the community, so with enough support, some districts could see sustainable improvements to integration via school boundary reform. This is a key area in which we believe more rigorous research could quell the anxiety associated with a policy agenda aimed at redressing the legacy of structural racism in public education.

Appendix

The following describes the procedure we use to build our novel dataset measuring disparities between adjacent school attendance boundary pairs.

We begin by loading and linking GIS data on school boundaries (SABs and school districts) from Precisely and National Center for Education Statistics Education Demographic and Geographic Estimates. Next, we link these data to US Census Bureau TIGER/Line shapefiles of 2010 census blocks (in urban areas, these delineate city blocks) using standard centroid GIS matching procedures (these procedures test whether the average coordinates of a census block lie within the polygon that makes up the school boundary). This merge allows us to assign census blocks to school boundaries that we can then aggregate up to obtain SAB area demographics. This method is flawed because about a quarter of unique census blocks overlap with multiple school attendance boundaries. But among these, 68 percent are more than 90 percent overlapping with their best match, and 56 percent are more than 96 percent overlapping. We opt for the centroid matching procedure rather than a procedure based on percentage area overlap because it allows for most blocks to be cleanly sorted into a single school boundary and avoids duplicating or losing data from blocks spread over multiple boundaries. We collect racial and ethnic composition data both for the entire population and for the population of children ages 5 to 9. Because the 2010 Census data are 10 years old, we employ census block estimates of the residential composition of the employed population from LODES in 2017 to assess whether our analysis is sensitive to recent changes in neighborhood demographics.

A complication with the SAB data is that, unlike school district jurisdictions, SABs can overlap, meaning that a given block may be assigned to more than one school serving the same grades. This precludes our ability to simply structure the data as a long crosswalk between census block IDs and assigned school IDs. We build a nested data structure that can handle this complexity by allowing block observations to be repeated across overlapping SABs. As such, it is possible, though uncommon, that a block could be assigned to a predominantly Black school and a predominantly white school simultaneously.

There are also complications with census data measured at the block level. Because blocks tend to be small geographic units of observation, privacy protection considerations sometimes need to be enforced before the Census Bureau makes the data publicly available. For example, if only one person lives in a given census block, reporting that person's race or ethnicity would violate privacy protections. The Census Bureau solves this problem by introducing random noise into the data. For the example provided, the Census Bureau protects privacy by randomly swapping the identity of the person living in the block, meaning that the person's reported race or ethnicity in the data could be wrong. This noise problem is a smaller issue when population sizes are larger. Hence, when estimating the boundary discontinuities, we focus on the total block population (as opposed to the school-age population), which minimizes any inaccuracies driven by random noise at this fine-grained geographic level of observation.[18]

Once we have the link between the SAB map data and census blocks, the next step in our data building procedure is to generate the school-pair structure needed for the regression discontinuity samples we use to identify unequal boundaries. To do this, we create small buffers around all SABs and intersect these to tell whether SABs are adjacent to each other. Once we find a pair of adjacent SABs, we link blocks located around a one-kilometer buffer of the shared boundary using intersection (as opposed to centroid) matching. This creates the regression discontinuity sample of blocks near the attendance boundary, grabbing blocks approximately 500 meters on each side. Next, we compute the perpendicular distance between the regression discontinuity sample of block centroids and the attendance boundary. Finally, we arbitrarily assign one side of the boundary to have negative distance to the boundary, generating the running variable for our regression discontinuity models, as shown, for example, in figure 2.

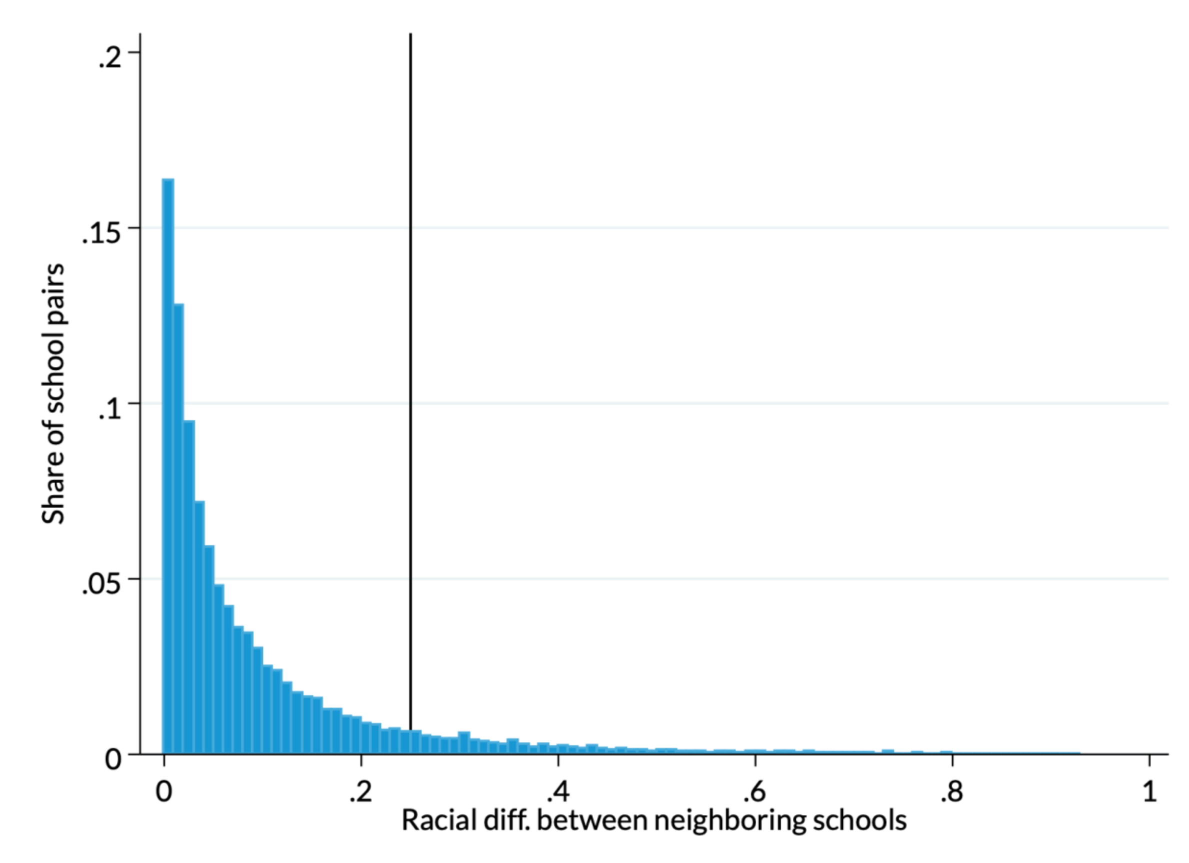
Given this data structure, we define the regression discontinuity estimate of the "jump" between the demographics as one crosses the boundary as the absolute value of the ordinary least squares coefficient from a regression of the Black or Hispanic share of the block population on an indicator for which side of the boundary the block lies in. These models are fit using only the regression discontinuity sample of blocks near the boundary and use population weights. Therefore, the regression discontinuity coefficient is approximately given by $|A - B|$, where A is the Black or Hispanic share of the population living within 500 meters on the A side of the boundary and B is the same value for the other (B) side of the boundary. Thus, the regression discontinuity coefficient provides an estimate of the jump on demographic composition around a school boundary. This framework allows us to generate a statistic summarizing racial and ethnic inequity across every adjacent school boundary pair in the country. This is critical for getting a handle of the extent of the issue and for assessing how egregious some of these cases might be relative to all other boundaries in the country. It may not come as a surprise that many of the regression discontinuity estimates are close to zero, which makes the cases in which they are not zero all the more stark.

In practice, these regression discontinuity estimates can be noisy, especially for school boundaries with low population density or lopsided cases in which there are a lot of people living on one side but not the other. It may also be the case that there is an unobserved policy that may help balance enrollments between unequal boundaries, meaning that it would be unfair to highlight such a boundary as highly inequitable. To ensure that our list of the most unequal boundaries does not suffer from such shortcomings, we define the unequal boundary index used to make our figures and tables as the product of four terms: (1) the absolute value of the estimated boundary discontinuity, (2) the absolute difference in the Black or Hispanic share of the population in the entire SAB area, (3) the absolute difference in the Black or Hispanic share of total enrollment, and (4) the total population residing near the boundary.

The key advantage of this index is that it will be approximately "zeroed out" if any of the values of the first three terms is near zero. In other words, the unequal boundary index will be positive and relatively large only if all three of the following are the case: (1) there is a jump in demographics at the boundary, (2) the SABs as a whole are really different in composition, and (3) the enrollments in the associated schools reflect large differences in racial and ethnic composition. Finally, the index weighs observations by total population, giving boundaries affecting more people more importance.

FIGURE A.1

School Attendance Boundaries and School Districts in the Atlanta Metropolitan Area



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Sources: US Census Bureau and Precisely.

Notes: Racial difference between neighboring schools is the absolute gap in the residential share of Black or Hispanic residents on either side of the schools' shared attendance boundary line. The vertical line denotes the 25 percentage-point threshold used to define a racially unequal boundary.

TABLE A.1

Summary Statistics of Schools in the Analysis Sample

Increasingly restrictive samples demonstrating national representativeness of analysis

	CCD Universe		School-Pair Dataset		Racially Unequal Pairs	
	Mean	SD	Mean	SD	Mean	SD
Enrollment demographics						
Total enrollment	635.68	(456.10)	697.65	(481.56)	629.58	(406.91)
Racial and ethnic composition						
Asian share	0.05	(0.10)	0.05	(0.10)	0.05	(0.07)
Black share	0.15	(0.22)	0.16	(0.22)	0.28	(0.29)
Hispanic share	0.26	(0.27)	0.28	(0.28)	0.33	(0.29)
White share	0.48	(0.32)	0.46	(0.31)	0.29	(0.26)
Socioeconomic composition						
Limited English proficiency share	0.12	(0.16)	0.13	(0.16)	0.16	(0.19)
Share receiving FRL (CCD)	0.51	(0.28)	0.52	(0.28)	0.63	(0.28)
Economically disadvantaged share (EdFacts)	0.53	(0.29)	0.54	(0.29)	0.65	(0.29)
School characteristics						
Mean achievement (SEDA)	0.01	(0.44)	0.00	(0.45)	-0.16	(0.49)
Share of students on advanced tracking	0.11	(0.26)	0.11	(0.12)	0.10	(0.12)
Suspensions / enrollment ratio	0.10	(0.59)	0.10	(0.12)	0.11	(0.13)
Total expulsions	1.17	(3.05)	1.28	(3.21)	0.93	(2.65)
Share of students chronically absent	0.14	(0.62)	0.14	(0.10)	0.15	(0.12)
Staff characteristics						
Total full-time equivalent teachers	38.08	(20.90)	40.71	(21.08)	39.80	(19.33)
Share of teachers in 1st or 2nd year	0.11	(0.08)	0.11	(0.07)	0.12	(0.08)
Share of teachers absent more than 10 days	0.29	(0.14)	0.29	(0.13)	0.30	(0.13)
Total counselors	1.27	(1.30)	1.38	(1.37)	1.19	(1.27)
Total health workers	1.29	(1.01)	1.29	(1.01)	1.51	(1.11)
Total security guards	0.27	(0.76)	0.28	(0.78)	0.39	(0.89)
School attendance boundary areas by 1930s HOLC rating (%)						
A	0.05	(0.13)	0.05	(0.13)	0.06	(0.15)
B	0.13	(0.19)	0.12	(0.19)	0.13	(0.20)
C	0.25	(0.26)	0.25	(0.26)	0.25	(0.25)
D	0.14	(0.24)	0.14	(0.24)	0.13	(0.21)
Observations	**56,318**		**47,517**		**2,799**	

Sources: National Center for Education Statistics CCD, Civil Rights Data Collection, SEDA, and the University of Richmond's Mapping Inequality project.

Notes: CCD = Common Core of Data; FRL = free and reduced-price lunch; HOLC = Home Owners' Loan Corporation; SD = standard deviation; SEDA = Stanford Education Data Archive. Observations are at the school level.

TABLE A.2

How Differences in the Racial or Ethnic Composition of Neighboring Schools Correlate with Differences in Staffing

	Total Counselors			Total Security Guards		
	(1)	(2)	(3)	(4)	(5)	(6)
|Ma - Mb|	-0.546***	-0.118***	0.295***	0.537***	0.425***	0.238***
	(0.025)	(0.023)	(0.025)	(0.020)	(0.020)	(0.020)
1(district boundary) x |Ma - Mb|			-0.701***			0.320***
			(0.042)			(0.036)
Outcome mean	-0.02			0.05		
Outcome standard deviation	1.13			0.76		
Covariates		X	X		X	X
Metropolitan area fixed effects		X	X		X	X
R^2	0.0048	0.3650	0.3666	0.0100	0.0997	0.1004
N	136,226	136,226	136,226	136,456	136,456	136,456

	Share of Teachers in First or Second Year			Teacher Chronic Absenteeism Rate		
	(1)	(2)	(3)	(4)	(5)	(6)
|Ma - Mb|	0.079***	0.071***	0.075***	0.052***	0.027***	0.027***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)
1(district boundary) x |Ma - Mb|			-0.005			-0.001
			(0.004)			(0.006)
Outcome mean	0.01			0.01		
Outcome standard deviation	0.08			0.14		
Covariates		X	X		X	X
Metropolitan area fixed effects		X	X		X	X
R^2	0.0211	0.0397	0.0398	0.0029	0.0356	0.0356
N	140,066	140,066	140,066	139,669	139,669	139,669

Sources: Precisely SAB data matched to school data from the National Center for Education Statistics Common Core of Data, the Civil Rights Data Collection, and the Stanford Education Data Archive.

Notes: SAB = school attendance boundary; SD = standard deviation. Observations are at the neighboring school pair level. |Ma - Mb| is the racial or ethnic differential between neighboring schools, which is defined as the absolute difference in the Black or Hispanic share of residents across the neighboring schools' SABs. We denote an indicator for whether the boundary dividing the school pair is a district boundary using 1(district boundary), such that |Ma - Mb| x 1(district boundary) is the interaction between the two variables. Robust standard errors are reported in parentheses in all models. Differences in sample size across models are caused by differential missingness in the various outcome variables. Covariates include indicators for whether the boundary is a highway or a residential roadway, log population on either side of the boundary, number of census blocks on either side, and indicators for the school grade level (elementary, middle, or high school).

*** $p < 0.01$.

TABLE A.3

How Differences in the Racial and Ethnic Composition of Neighboring Schools Correlate with Differences in Student Outcomes

	Suspension Rate			Total Expulsions			Free Lunch Rate		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
|Ma - Mb|	0.126***	0.103***	0.107***	0.615***	0.893***	0.953***	0.607***	0.593***	0.510***
	(0.003)	(0.003)	(0.005)	(0.068)	(0.077)	(0.101)	(0.006)	(0.006)	(0.008)
1(district boundary) x |Ma - Mb|			-0.006			-0.102			0.148***
			(0.007)			(0.147)			(0.012)
Outcome mean	0.01			0.12			0.07		
Outcome standard deviation	0.12			3.36			0.22		
Covariates		X	X		X	X		X	X
Metropolitan area fixed effects		X	X		X	X		X	X
R^2	0.0236	0.0970	0.0970	0.0007	0.0665	0.0665	0.1497	0.2282	0.2300
N	136,025	136,025	136,025	136,770	136,770	136,770	118,471	118,471	118,471

	Advanced Track Rate			Chronic Absenteeism Rate			Mean Test Scores		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
|Ma - Mb|	-0.067***	-0.084***	-0.084***	0.196***	0.125***	0.100***	-1.082***	-0.971***	-0.860***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(0.012)	(0.012)	(0.015)
1(district boundary) x |Ma - Mb|			-0.001			0.044***			-0.203***
			(0.007)			(0.006)			(0.022)
Outcome mean	-0.01			0.02			-0.12		
Outcome standard deviation	0.12			0.12			0.41		
Covariates		X	X		X	X		X	X
Metropolitan area fixed effects		X	X		X	X		X	X
R^2	0.0056	0.0470	0.0470	0.0537	0.1958	0.1964	0.1409	0.2412	0.2422
N	109,556	109,556	109,556	134,442	134,442	134,442	108,501	108,501	108,501

Sources: Precisely SAB data matched to school data from the National Center for Education Statistics Common Core of Data, the Civil Rights Data Collection, and the Stanford Education Data Archive.

Notes: SAB = school attendance boundary; SD = standard deviation. Observations are at the neighboring school pair level. |Ma - Mb| is the racial or ethnic differential between neighboring schools, which is defined as the absolute difference in the Black or Hispanic share of residents across the neighboring schools' SABs. We denote an indicator for whether the boundary dividing the school pair is a district boundary using 1(district boundary), such that |Ma - Mb| x 1(district boundary) is the interaction between the two variables. Robust standard errors are reported in parentheses in all models. Differences in sample size across models are caused by differential missingness in the various outcome variables. Covariates include indicators for whether the boundary is a highway or a residential roadway, log population on either side of the boundary, number of census blocks on either side, and indicators for the school grade level (elementary, middle, or high school).

*** $p < 0.01$.

TABLE A.4

Redlining Perimeter and Area Match Analysis of Sample US Cities

City	Total perimeter line-up rate of SABs and HOLC map (1)	Perimeter line-up rate of racially unequal SABs and HOLC map (2)	Perimeter line-up rate ratio (2) / (1) (3)	Area overlap rate difference in A and B HOLC grades between less and more Black/Hispanic side of SAB (4)	Area overlap rate difference in C and D HOLC grades between less and more Black/Hispanic side of SAB (5)
Miami, FL	0.15	0.42	2.76	-0.03	0.12
St. Petersburg, FL	0.17	0.46	2.63	-0.25	0.25
Charleston, WV	0.17	0.35	2.03	N/A	N/A
Little Rock, AR	0.18	0.32	1.76	-0.28	0.22
Oakland, CA	0.45	0.79	1.75	-0.13	0.26
Buffalo, NY	0.24	0.39	1.62	-0.58	0.32
Birmingham, AL	0.20	0.32	1.62	-0.54	0.12
Syracuse, NY	0.30	0.47	1.56	0.00	0.30
Columbia, SC	0.17	0.27	1.55	-0.08	0.57
Staten Island, NY	0.41	0.62	1.53	-0.06	0.22
Greater Kansas City, MO	0.32	0.49	1.52	-0.33	0.16
San Diego, CA	0.31	0.47	1.52	-0.54	0.60
Rochester, NY	0.19	0.28	1.51	0.04	0.52
Hartford, CT	0.42	0.63	1.50	-0.27	0.33
Albany, NY	0.08	0.12	1.47	0.03	0.28
Kenosha, WI	0.24	0.35	1.45	N/A	N/A
Oklahoma City, OK	0.29	0.41	1.44	N/A	N/A
Holyoke Chicopee, MA	0.33	0.47	1.40	-0.05	-0.41
Cleveland, OH	0.41	0.57	1.39	-0.77	0.49
Hudson Co., NJ	0.56	0.77	1.38	-0.06	0.22
Wichita, KS	0.39	0.53	1.37	-0.18	0.36
Columbus, GA	0.27	0.36	1.31	-0.01	0.42
Pittsburgh, PA	0.24	0.31	1.30	0.14	0.07
Toledo, OH	0.35	0.45	1.28	-0.05	0.18
Pontiac, MI	0.16	0.20	1.27	-0.06	0.16
El Paso, TX	0.40	0.50	1.26	N/A	N/A
Memphis, TN	0.26	0.33	1.25	-0.53	0.69
Dallas, TX	0.31	0.38	1.24	-0.35	0.36
Peoria, IL	0.23	0.28	1.24	-0.16	0.57
Chattanooga, TN	0.18	0.23	1.22	-0.14	0.29

City	Total perimeter line-up rate of SABs and HOLC map (1)	Perimeter line-up rate of racially unequal SABs and HOLC map (2)	Perimeter line-up rate ratio (2) / (1) (3)	Area overlap rate difference in A and B HOLC grades between less and more Black/Hispanic side of SAB (4)	Area overlap rate difference in C and D HOLC grades between less and more Black/Hispanic side of SAB (5)
Philadelphia, PA	0.40	0.48	1.22	0.13	0.07
Knoxville, TN	0.18	0.22	1.21	-0.01	-0.01
Roanoke, VA	0.28	0.34	1.21	-0.06	-0.36
Manhattan, NY	0.48	0.57	1.19	-0.06	0.22
Los Angeles, CA	0.36	0.43	1.19	-0.23	0.22
Bronx, NY	0.58	0.68	1.18	-0.06	0.22
Bergen Co., NJ	0.41	0.48	1.17	-0.06	0.22
Erie, PA	0.35	0.41	1.17	-0.06	0.19
Lexington, KY	0.23	0.27	1.17	-0.16	0.43
Chicago, IL	0.45	0.53	1.17	-0.18	0.22
Hamilton, OH	0.22	0.25	1.16	-0.03	0.43
New Britain, CT	0.41	0.48	1.16	-0.27	0.33
Detroit, MI	0.39	0.45	1.15	-0.06	0.16
Nashville, TN	0.16	0.18	1.14	-0.50	0.28
Newport News, VA	0.13	0.15	1.12	-0.06	0.21
Winston-Salem, NC	0.15	0.17	1.12	-0.14	0.61
Essex Co., NJ	0.84	0.94	1.12	-0.06	0.22
Columbus, OH	0.36	0.40	1.10	-0.44	0.20
Grand Rapids, MI	0.29	0.32	1.09	0.22	0.04
Union Co., NJ	0.52	0.56	1.08	-0.06	0.22
Camden, NJ	0.40	0.43	1.08	0.13	0.07
Richmond, VA	0.43	0.46	1.06	-0.28	0.01
San Jose, CA	0.42	0.45	1.06	-0.27	0.43
Charlotte, NC	0.32	0.34	1.05	-0.30	0.67
Lima, OH	0.15	0.16	1.04	0.00	0.67
Minneapolis, MN	0.47	0.49	1.04	-0.06	0.26
Lower Westchester Co., NY	0.68	0.70	1.04	-0.06	0.22
Youngstown, OH	0.31	0.33	1.03	-0.09	0.27
East St. Louis, IL	0.25	0.25	1.03	-0.11	0.11
Aurora, IL	0.32	0.33	1.02	-0.18	0.22
Atlanta, GA	0.25	0.25	1.02	-0.06	0.10
Milwaukee Co., WI	0.35	0.36	1.01	-0.03	0.29

City	Total perimeter line-up rate of SABs and HOLC map (1)	Perimeter line-up rate of racially unequal SABs and HOLC map (2)	Perimeter line-up rate ratio (2) / (1) (3)	Area overlap rate difference in A and B HOLC grades between less and more Black/Hispanic side of SAB (4)	Area overlap rate difference in C and D HOLC grades between less and more Black/Hispanic side of SAB (5)
Greensboro, NC	0.30	0.30	1.00	-0.14	0.61
USA	0.30	0.34	1.13	-0.17	0.30

Source: Urban Institute analysis of Precisely and HOLC data.

Notes: HOLC = Home Owner's Loan Corporation; SAB = school attendance boundary. See the main text for a detailed description of reported statistics.

TABLE A.5

Differences in Segregation, by Centralized Lottery Presence

100 largest school districts, 2018–19 school year

	No Centralized Lottery		Centralized Lottery				
	Mean	SD	Mean	SD	Difference	*t*-statistic	*p* value
Population share							
Black	0.17	(0.14)	0.30	(0.21)	-0.14	-3.80	0.00
Hispanic	0.35	(0.21)	0.30	(0.20)	0.05	1.26	0.21
White	0.34	(0.20)	0.28	(0.19)	0.06	1.57	0.12
Asian	0.08	(0.08)	0.07	(0.07)	0.01	0.92	0.36
Other	0.06	(0.06)	0.05	(0.03)	0.01	1.30	0.20
FRL	0.49	(0.21)	0.53	(0.27)	-0.04	-0.90	0.37
Variance ratio index							
Black	0.12	(0.12)	0.21	(0.18)	-0.09	-3.20	0.00
Hispanic	0.14	(0.08)	0.17	(0.14)	-0.03	-1.32	0.19
White	0.15	(0.07)	0.19	(0.09)	-0.04	-2.46	0.02
Asian	0.06	(0.05)	0.09	(0.09)	-0.02	-1.61	0.11
Other	0.01	(0.02)	0.01	(0.01)	0.00	0.45	0.65
FRL	0.23	(0.11)	0.24	(0.16)	0.00	-0.17	0.86
Dissimilarity index							
Black	0.34	(0.12)	0.42	(0.16)	-0.08	-2.64	0.01
Hispanic	0.34	(0.09)	0.37	(0.15)	-0.03	-1.35	0.18
White	0.36	(0.11)	0.44	(0.15)	-0.08	-2.98	0.00
Asian	0.36	(0.11)	0.42	(0.14)	-0.06	-2.28	0.02
Other	0.19	(0.09)	0.22	(0.10)	-0.03	-1.39	0.17
FRL	0.42	(0.11)	0.42	(0.17)	0.00	0.11	0.91
Theil Multigroup Entropy Index							
	0.13	(0.07)	0.19	(0.12)	-0.05	-2.75	0.01
Observations	51		49				

Sources: Urban Institute data collection and National Center for Education Statistics Common Core of Data.

Notes: FRL = free and reduced-price lunch; SD = standard deviation. Observations are at the school district level.

Notes

1 Even in school systems that have implemented school choice mechanisms, student residential addresses and attendance boundaries still play an important role in determining the order in which students are admitted into oversubscribed schools.

2 Alvin Chang, "We Can Draw School Zones to Make Classrooms Less Segregated. This Is How Well Your District Does," *Vox*, last updated August 27, 2018, https://www.vox.com/2018/1/8/16822374/school-segregation-gerrymander-map.

3 Nikole Hannah-Jones, "Choosing a School for My Daughter in a Segregated City," *New York Times Magazine*, June 12, 2016, 34, https://www.nytimes.com/2016/06/12/magazine/choosing-a-school-for-my-daughter-in-a-segregated-city.html.

4 "Fault Lines: America's Most Segregating School District Borders," EdBuild, accessed August 26, 2021, https://edbuild.org/content/fault-lines.

5 We link school attendance boundaries to census blocks using centroid matching. In most urban contexts, census blocks are smaller than SABs, so centroid matching generates an accurate representation of the population assigned to a given school. For cases in which census blocks overlap imperfectly with SABs, we assume the block is fully assigned to the SAB in which its centroid is contained.

6 Because the census data are about a decade old, we verify our results using data from the US Census Bureau's Longitudinal Employer-Household Dynamics Origin-Destination Employment Statistics (LODES). These tabulations provide census block–level data and racial and ethnic breakdowns of the formally employed population by residential location for the year 2017. Because this is a selected population, we do not use the LODES files for our main estimates, keeping them instead to confirm that the 2010 Census patterns are not fatally outdated.

7 Our approach to measuring the extent to which the attendance boundary dividing two schools affects segregation is an analogy to the regression discontinuity (RD) research design in econometrics (Lee and Lemieux 2010). In our case, the attendance boundary between two schools is the RD threshold, and the running variable is the distance from a census block to the boundary. We make comparisons between the average demographics of residences within 500 meters of the attendance boundary. Finding a large discontinuity in demographics between residences on each side of a boundary amounts to finding a sharp dividing line in public school access between racial and ethnic groups, one that cannot be easily justified by such concerns as daily commuting burdens.

8 Another option could be pairing schools in some places that would not involve changes to the boundaries so much as changes to grade structures.

9 We execute two additional restrictions to the unequal boundary dataset that affects less than 6.5 percent of school-pair observations in the data: (1) we drop schools for which the enrollment difference in demographics is 25 percentage points smaller than the boundary discontinuity, and (2) we drop neighboring schools that are more than 3.5 miles apart.

10 Because a unique school can be a member of various pairs (it can have various neighbors sharing a boundary line), the fact that we have 2,799 unique schools and 2,373 boundary lines in the final list of racially unequal boundaries means that some schools appear repeatedly in the list (i.e., there are schools that have racially unequal boundary lines on various sides of the SAB polygon). Appendix table A.1 shows that, as a whole, the sample of schools with unequal boundaries has average characteristics that are similar to those of the universe of public schools. They are similar to others in terms of total enrollment and staff composition, as well as student discipline rates. But schools associated with unequal boundaries differ from others in terms of their racial and ethnic composition. They are more likely to educate Black students and are less likely to have a majority-white

student body. This pattern suggests that schools in the unequal boundary sample are more likely to isolate students of color than white students.

11 By ordering our sample in this fashion and then taking averages on either side of the boundary and examining the difference in these averages, this analytical approach mimics the estimate of an RD framework with a zero-order polynomial fit on either side of the discontinuity.

12 We use the FRL count directly as reported by the Common Core of Data, and this means that schools with direct certification programs (in which 100 percent of students get subsidized meals) are not present in the FRL analysis.

13 Matt Barnum, "EdBuild, Nonprofit That Highlighted Funding Disparities, Plans to Close Next Year," Chalkbeat, July 11, 2019, https://www.chalkbeat.org/2019/7/11/21121011/edbuild-nonprofit-that-highlighted-funding-disparities-plans-to-close-next-year.

14 "Mapping Inequality: Redlining in New Deal America," University of Richmond Digital Scholarship Lab, accessed August 30, 2021, https://dsl.richmond.edu/panorama/redlining/#loc=5/39.1/-94.58.

15 To determine whether a HOLC boundary and SAB overlap sufficiently to be considered a line-up, we create a 111-meter radius around each line and take the intersected area. This area acts as a buffer, so that if two lines do not line up exactly but are sufficiently close, we can interpret the two lines as overlapping. We then intersect this area with the original SAB zone lines to determine what portion of the line falls within the 111-meter radius zone and therefore will count as an overlap.

16 See "Dividing Lines—Characteristics of Neighboring Pairs of Public Schools," Urban Institute Data Catalog, accessed September 8, 2021, https://datacatalog.urban.org/dataset/dividing-lines-%E2%80%93-characteristics-neighboring-pairs-public-schools.

17 The Theil Multigroup Entropy Index measures the average extent to which school diversity differs from the diversity of the entire school system. Diversity is defined using the four major racial and ethnic groups and an additional category for other groups. The diversity score measures the extent to which several groups are present in a given school.

18 See the National Historical Geographic Information System technical documentation on geographic crosswalks between decennial census data: "Geographic Crosswalks," IPUMS, accessed August 26, 2021, https://www.nhgis.org/user-resources/geographic-crosswalks.

References

Aaronson, Daniel, Daniel Hartley, and Bhashkar Mazumder. Forthcoming. "The Effects of the 1930s HOLC 'Redlining' Maps."

Abdulkadiroğlu, Atila, and Tayfun Sönmez. 2003. "School Choice: A Mechanism Design Approach." *American Economic Review* 93 (3): 729–47. https://doi.org/10.1257/000282803322157061.

Akbar, Prottoy A., Sijie Li, Allison Shertzer, and Randall P. Walsh. 2019. *Racial Segregation in Housing Markets and the Erosion of Black Wealth*. Working Paper 25805. Cambridge, MA: National Bureau of Economic Research.

Ananat, Elizabeth Oltmans. 2011. "The Wrong Side(s) of the Tracks: The Causal Effects of Racial Segregation on Urban Poverty and Inequality." *American Economic Journal: Applied Economics* 3 (2): 34–66. https://www.doi.org/10.2307/41288628.

Avenancio-Leon, Carlos, and Troup Howard. 2020. *The Assessment Gap: Racial Inequalities in Property Taxation*. Working paper. Washington, DC: Washington Center for Equitable Growth.

Baum-Snow, Nathaniel. 2007. "Did Highways Cause Suburbanization?" *Quarterly Journal of Economics* 122 (2): 775–805.

Baum-Snow, Nathaniel, and Byron F. Lutz. 2011. "School Desegregation, School Choice, and Changes in Residential Location Patterns by Race." *American Economic Review* 101 (7): 3019–46. https://www.doi.org/10.1257/aer.101.7.3019.

Bayer, Patrick, Fernando Ferreira, and Robert McMillan. 2007. "A Unified Framework for Measuring Preferences for Schools and Neighborhoods." *Journal of Political Economy* 115 (4): 588–638.

Bewley, Truman F. 1981. "A Critique of Tiebout's Theory of Local Public Expenditures." *Econometrica: Journal of the Econometric Society* 49 (3): 713–40. https://doi.org/10.2307/1911519.

Billings, Stephen B., David J. Deming, and Jonah Rockoff. 2014. "School Segregation, Educational Attainment, and Crime: Evidence from the End of Busing in Charlotte-Mecklenburg." *Quarterly Journal of Economics* 129 (1): 435–76. https://doi.org/10.1093/qje/qjt026.

Black, Sandra E. 1999. "Do Better Schools Matter? Parental Valuation of Elementary Education." *Quarterly Journal of Economics* 114 (2): 577–99.

Card, David, and Laura Giuliano. 2016. "Universal Screening Increases the Representation of Low-Income and Minority Students in Gifted Education." *Proceedings of the National Academy of Sciences* 113 (48): 13678–83. https://doi.org/10.1073/pnas.1605043113.

Card, David, and Alan B. Krueger. 1993. "Minimum Wages and Employment: A Case Study of the Fast Food Industry in New Jersey and Pennsylvania." Working Paper 4509. Cambridge, MA: National Bureau of Economic Research.

Card, David, and Jesse Rothstein. 2007. "Racial Segregation and the Black-White Test Score Gap." *Journal of Public Economics* 91 (11–12): 2158–84. https://doi.org/10.1016/j.jpubeco.2007.03.006.

Chetty, Raj, and Nathaniel Hendren. 2018. "The Impacts of Neighborhoods on Intergenerational Mobility I: Childhood Exposure Effects." *Quarterly Journal of Economics* 133 (3): 1107–62. https://doi.org/10.1093/qje/qjy007.

Chetty, Raj, Nathaniel Hendren, and Lawrence F. Katz. 2016. "The Effects of Exposure to Better Neighborhoods on Children: New Evidence from the Moving to Opportunity Experiment." *American Economic Review* 106 (4): 855–902. https://doi.org/10.1257/aer.20150572.

Clotfelter, Charles T. 1998. “Public School Segregation in Metropolitan Areas.” Working Paper 6779. Cambridge, MA: National Bureau of Economic Research.

———. 2004. *After* Brown*: The Rise and Retreat of School Desegregation*. Princeton, NJ: Princeton University Press.

DeRoche, Tim. 2020. *A Fine Line: How Most American Kids Are Kept Out of the Best Public Schools*. Los Angeles: Redtail Press.

Frankenberg, Erica. 2013. “The Role of Residential Segregation in Contemporary School Segregation.” *Education and Urban Society* 45 (5): 548–70. https://doi.org/10.1177/0013124513486288.

Frankenberg, Erica, Genevieve Siegel-Hawley, and Sarah Diem. 2017. “Segregation by District Boundary Line: The Fragmentation of Memphis Area Schools.” *Educational Researcher* 46 (8): 449–63. https://doi.org/10.3102/0013189X17732752.

Hasan, Sharique, and Anuj Kumar. 2019. “Digitization and Divergence: Online School Ratings and Segregation in America.” New York: SSRN.

Hoxby, Caroline M. 2000. “The Effects of Class Size on Student Achievement: New Evidence from Population Variation.” *Quarterly Journal of Economics* 115 (4): 1239–85.

Johnson, Rucker C. 2019. *Children of the Dream: Why School Integration Works*. New York: Basic Books.

Kruse, Kevin M. 2005. *White Flight: Atlanta and the Making of Modern Conservatism*. Princeton, NJ: Princeton University Press.

Lafortune, Julien, Jesse Rothstein, and Diane Whitmore Schanzenbach. 2018. “School Finance Reform and the Distribution of Student Achievement.” *American Economic Journal: Applied Economics* 10 (2): 1–26. https://doi.org/10.1257/app.20160567.

Lee, David S., and Thomas Lemieux. 2010. “Regression Discontinuity Designs in Economics.” *Journal of Economic Literature* 48 (2): 281–355.

Lukes, Dylan, and Christopher Cleveland. 2021. *The Lingering Legacy of Redlining on School Funding, Diversity, and Performance*. Working Paper 21-363. Providence, RI: Annenberg Institute for School Reform at Brown University. https://doi.org/10.26300/qeer-8c25.

Lutz, Byron. 2011. “The End of Court-Ordered Desegregation.” *American Economic Journal: Economic Policy* 3 (2): 130–68.

Monarrez, Tomas. 2019. “School Attendance Boundaries and the Segregation of Public Schools in the US.” Paper presented at the Association for Public Policy Analysis and Management’s 41st Annual Fall Research Conference, Denver, CO, November 8.

Monarrez, Tomas, and Matthew Chingos. 2020. “Does School Choice Make Segregation Better or Worse?” Stanford, CA: Stanford University Hoover Institution.

Monarrez, Tomas, Brian Kisida, and Matthew M. Chingos. 2020. “The Effect of Charter Schools on School Segregation.” Working Paper 20-308. Providence, RI: Annenberg Institute for School Reform at Brown University.

Monarrez, Tomas, and David Schönholzer. 2021. “Dividing Lines: Segregation across School District Boundaries in US Metropolitan Areas.” Working paper.

Orfield, Gary, and Erica Frankenberg. 2013. *Educational Delusions? Why Choice Can Deepen Inequality and How to Make Schools Fair*. Berkeley: University of California Press.

Pathak, Parag A. 2011. “The Mechanism Design Approach to Student Assignment.” *Annual Review of Economics* 3:513–36.

reardon, sean, Elena Grewal, Demetra Kalogrides, and Erica Greenberg. 2012. "*Brown* Fades: The End of Court-Ordered School Desegregation and the Resegregation of American Public Schools." *Journal of Policy Analysis and Management* 31 (4): 876–904.

reardon, sean f., and Ann Owens. 2014. "60 Years after *Brown*: Trends and Consequences of School Segregation." *Annual Review of Sociology* 40:199–218.

Richards, Meredith P. 2014. "The Gerrymandering of School Attendance Zones and the Segregation of Public Schools: A Geospatial Analysis." *American Educational Research Journal* 51 (6): 1119–57. https://doi.org/10.3102/0002831214553652.

Rothstein, Richard. 2017. *The Color of Law: A Forgotten History of How Our Government Segregated America*. New York: Liveright Publishing.

Siegel-Hawley, Genevieve. 2013. "Educational Gerrymandering? Race and Attendance Boundaries in a Demographically Changing Suburb." *Harvard Educational Review* 83 (4): 580–612. https://doi.org/10.17763/haer.83.4.k385375245677131.

Sohoni, Deenesh, and Salvatore Saporito. 2009. "Mapping School Segregation: Using GIS to Explore Racial Segregation between Schools and Their Corresponding Attendance Areas." *American Journal of Education* 115 (4): 569–600.

Tiebout, Charles M. 1956. "A Pure Theory of Local Expenditures." *Journal of Political Economy* 64 (5): 416–24.

Welch, Finis. 1987. *New Evidence on School Desegregation*. Santa Monica, CA: Unicon Research Corporation.

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