The Distribution of School Resources in The United States: A Comparative Analysis Across Levels of Governance, Student Sub-groups, And Educational Resources

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Abstract

Levels of governance (the nation, states, and districts), student subgroups (racially and ethnically minoritized and economically disadvantaged students), and types of resources (expenditures, class sizes, and teacher quality) intersect to represent a complex and comprehensive picture of K-12 educational resource inequality. Drawing on multiple sources of the most recently available data, we describe inequality in multiple dimensions. At the national level, racially and ethnically minoritized and economically disadvantaged students receive between $30 and $800 less in K-12 expenditures per pupil than White and economically advantaged students. At the state and district levels, per-pupil expenditures generally favor racially and ethnically minoritized and economically disadvantaged students compared to White and economically advantaged students. Looking at nonpecuniary resources, minoritized and economically disadvantaged students have smaller class sizes than their subgroup counterparts in the average district, but these students also have greater exposure to inexperienced teachers. We see no evidence that district-level spending in favor of traditionally disadvantaged subgroups is explained by district size, average district spending, teacher turnover, or expenditures on auxiliary staff, but Black and Hispanic spending advantage is correlated with the relative size of the Black and Hispanic special education population.

Introduction

In recent years, both popular media and academic scholarship have offered conflicting conclusions about U.S. school funding distributions. A report from *The Heritage Foundation* (2011) shows that Black students receive more funding than White students, while a report from EdBuild (2019) finds that Black students receive much less money than White students. Similarly, *The Economist* (2017) and the *Urban Institute* (Chingos & Blagg, 2017) report that students living in poverty receive more education funding relative to nonpoor students, but articles from the Education Law Center, Rutgers University (Baker, et al. 2018a; Baker, et al., 2018b), and *The Atlantic* (2016) argue that states spend less on students living in poverty. What is especially confusing about these contradictory inferences is that they rely on the same underlying data and similar methodological approaches.

These conflicting accounts have added confusion to an already complex debate about how schools are—and how they should be—funded. In this paper, we provide a detailed description of how funds are distributed among schools, districts, and states and track the distributions of other resources related to school quality, including teacher counts and counts of novice teachers. We look at these distributions at different levels of governance: within districts, within states, and nationally. We examine how funding and teacher resources are distributed to Black and Hispanic versus White students and to poor compared to nonpoor students to gauge whether distributions are progressive (favoring disadvantaged students) or regressive (favoring advantaged students). By studying three dimensions that determine distributional progressivity—governance level, resource type, and student group comparison—we provide comprehensive descriptions of how educational funding and resources are distributed in the U.S. Our goal with this work is to draw attention to the complexity of assessing K-12 resource distributions and offer clarity to help reconcile these conflicting accounts of funding inequality. Ultimately, we hope this work will help structure policy initiatives that can improve distributions of funding and important school resources.

We find that specifying different combinations of governance level, student subgroup comparison, and resource type can materially change conclusions about funding and resource equity. Each of these three dimensions are important factors in determining whether a resource is progressively or regressively distributed. For example, our results show that, at the national level, Black, Hispanic, and economically disadvantaged students receive less funding than White and economically advantaged students (with Hispanic students receiving much less funding than white students). This result is mostly due to the proportion of Black, Hispanic, and economically disadvantaged students who attend school in states that spend less on education.

However, when we change the unit of analysis from the national level to the state or district—levels of governance mostly responsible for how funding is distributed to students—the pattern largely reverses. In the average district, Black, Hispanic, and economically disadvantaged students have more funding than White and economically advantaged students, respectively. Across districts, the same holds for Black and economically disadvantaged students: in the average state, Black and Hispanic students receive more per pupil spending than White students, and economically disadvantaged students receive more funding than economically advantaged students. Though, notably, the amount of additional spending Hispanic students receive is much lower than what Black and economically disadvantaged students receive.

These results show how inferences of funding equity made based on an analysis that uses a particular specification for governance level or student subgroup comparison do not necessarily hold when these specifications change. The same applies when we turn our analysis from funding distributions to resource distributions. When we specify class size as a resource, we find that historically disadvantaged students have smaller class sizes, but when we change the resource specification to novice teachers, we find regressivity, as historically disadvantaged student subgroups in our analysis are disproportionately exposed to inexperienced teachers.

We emphasize several contributions of this work. First, although data on school-level spending have historically been limited, newly available national data offer opportunities to track spending distributions across multiple levels of governance: within districts, within states, and across the country.[1] Second, we conduct our analysis using multiple resource variables in addition to spending and document that progressive spending distributions do not always translate to progressive resource distributions. This component of our analysis illustrates the limits to what modest additional funding can purchase for historically disadvantaged students. Third, we conduct our analysis for multiple student group comparisons: Black and Hispanic versus White students and economically disadvantaged versus economically advantaged students. State funding formulas often target economic disadvantage through categorical aid grants and by directing state revenues to low property wealth districts, but do not make similar provisions based on race or ethnicity. Our results reveal how the omission of these categories can leave spending inequities unaddressed. Finally, we describe which district-level characteristics predict variation in district-level progressivity.

Conceptual framework

An assessment of distributional progressivity depends on the intersection of three factors: governance level, student group, and resource type (e.g., Berne & Stiefel, 1979, 1999; Odden & Picus, 2019). We describe how funds are distributed to schools within districts, to districts within states, and to states across the country. We also describe distributions of teachers and novice teachers. The term distribution does not

[1] We also provide one of the first analyses using school-level finance data from two sources, the Civil Rights Data Collection and the National Education Resource Database on Schools (NERD$). While we cannot compare the two data sources directly, as the CRDC provides only salary expenditures and NERD$ provides only current expenditures, Table 1 (Panel C) uses both data sources to describe within-district expenditures. While the two data sources show similar patterns in terms of both direction and magnitude in Table 1, Tables A1 and A2 show that NERD$ contains extreme outliers.

imply that a central governmental agency is deciding to distribute a resource in a particular way; rather, we mean distribution in the statistical sense, i.e., how much of the resource one group receives relative to another. Lastly, when we find that more is spent on Black, Hispanic, or economically disadvantaged students, we term the spending distribution "progressive", and when more is spent on White or economically advantaged students, we refer to the spending distribution as "regressive."[2] Here we outline how each of these three factors contributes to a holistic description of school resource inequality.

Governance levels

The following stylized example serves to illustrate how selecting a certain governance level for analysis can affect inferences about progressivity. Figure 1 shows a hypothetical nation containing two states, State A and State B, each with two higher-spending and two lower-spending districts. Dotted lines within these districts represent schools, and blue and orange squares represent students. State B contains more orange students than State A and spends less per pupil. The nation overall in this example thus allocates spending in favor of blue students, since most orange students are concentrated in the lower-spending state.

Looking within the states, however, the inference shifts. Most orange students in States A and B are concentrated in the higher-spending districts, Districts 1 and 3, which spend $12,000 and $8,500 per pupil compared to $8,000 and $6,500 per pupil in Districts 2 and 4. States A and B, therefore, allocate funds in favor of orange students. This illustration is an example of Simpson's paradox, wherein each individual state allocates resources favoring one group (orange students), but the overall population (the nation) allocates resources favoring another group (blue students). In effect, analyzing resource distributions at different levels of governance can lead to different inferences regarding the distribution of resources to specific groups.

This example also illustrates the importance of considering how students are distributed across districts and schools and the functional importance of segregation. In State A, orange students in District 1 are distributed equally, comprising 25% of the student population in all four schools. Thus, even though the schools spend different amounts per pupil, $13,000 versus $11,000, this spending inequality favors neither blue nor orange students. Spending is distributed across schools the same way in District 3, with two schools spending $13,000 per pupil and two spending $11,000 per pupil; however, orange students are

[2] We use the term "progressive" rather than "equitable" because, where we find that districts or states spend more on Black, Hispanic, or economically disadvantaged students, we make no claim that the amount of spending is sufficient. We also recognize the terms progressive and regressive have a traditional meaning that refers specifically to how tax levies and disbursements are distributed based on economic status (e.g., income). Here, we use it more broadly to refer to how K-12 educational resources are distributed based on race, ethnicity, and economic status.

concentrated in one of the higher-spending schools, creating a within-district inequality favoring orange students. Thus, segregation is a necessary condition for resource inequality to exist, and it is therefore to be expected that increasing segregation increases resource inequality (e.g., Sosina & Weathers, 2019).

[Figure 1]

Historically, data constraints have limited researchers' ability to analyze across these different levels of governance, especially for allocations among schools within districts. Before Every Student Succeeds Act mandated school-level finance reporting, only a handful of districts published data on how they distributed funding. We use newly available data to track funding and resource distributions within districts (across schools), within states (across districts), and nationally. Analyzing distributions across multiple levels of governance allows us to show how inferences regarding funding and resource progressivity vary.

Student group comparison

Inferences about distributional progressivity will also depend on the student groups used for comparison. In this analysis, we compare how resources are distributed to Black versus White students, Hispanic versus White students, and poor versus nonpoor students. Black, Hispanic, and low-income students have fewer opportunities and face disadvantages in their pursuit of educational opportunities (Ladson-Billings, 2006; Carter & Welner, 2013) in comparison to White and higher-income students. We therefore choose to track resource distributions to these students.

We measure economic disadvantage using two sources of data, free and reduced-price lunch and Census-based estimates from the Small Area Income and Poverty Estimates (SAIPE). Both data sources have documented advantages and disadvantages as poverty indicators. Free and reduced-price lunch (FRL) only weakly tracks true poverty (Fazlul et al., 2021; Domina, et al., 2018). The federal government also recently began offering Community Eligibility Provisions, which allow schools and districts whose student populations consist at least 40% of students who qualify for federal food and income assistance programs to give all students free school meals. The Community Eligibility Provision holds numerous benefits (e.g., Ruffini, 2021), but has made FRL a still less reliable measure of poverty (Chingos, 2016). Nevertheless, many states continue to use FRL counts in their funding formulae to demarcate economic disadvantage and allocate state aid (FRAC, 2017). Moreover, selection into FRL is thought to capture persistent features of poverty that correlate with student academic outcomes (Domina, et al., 2018; Michelmore & Dynarski, 2017). Finally, FRL is the only available data source for school-level poverty for all schools in the United States, meaning that FRL as a poverty indicator is necessary for us to conduct our school-level analysis. However, because FRL is not a wholly reliable measure of poverty, we also use the SAIPE, which measures proportions of school-age children living in poverty. SAIPE is considered a reliable and policy-relevant measure; indeed, part of Title I funds are allocated using data from the SAIPE. SAIPE are not available at the school level, but measure poverty more accurately at the district and state levels than FRL.

Resource type

It is also important to analyze multiple educational resources to gain a full understanding of educational resource inequality. In this analysis, we examine distributions of funding and teacher quality. Funding is integral to student success (see Jackson, 2020 for a review of recent causal studies) but is not sufficient to determine access to educational quality. Teachers are the most important in-school contributors to student success (Chetty et al., 2014; Rockoff, 2004), and though the research is not unequivocal (e.g., Angrist, et al., 2019), numerous studies have demonstrated substantial benefits to low student-teacher ratios (Dynarski, et al., 2013; Finn, et al., 2005; Krueger, 1999; Krueger and Whitmore, 2001) and teacher experience (Chetty et al., 2014; Podolsky, et al., 2019). We therefore include teacher-to-student ratios and novice teacher-to-student ratios alongside total expenditures to describe distributions of different educational resources.

Lastly, even in states where funding is distributed progressively, certain expenditure categories and revenue streams may not be equitably distributed. Capital spending is usually governed by specific state rules related to district property wealth and increasing capital spending is often subject to district votes. These rules can lead to regressive distributions of capital spending even in states that distribute overall funding distributions are progressive. Capital spending's role in the education production function is unclear. Lafortune and Schönholzer (2017) and Rauscher (2019) observe positive impacts on student achievement in California following the narrow passage of capital bonds, allowing multiple years for effects to develop. However, in Wisconsin, Baron (forthcoming) finds null effects from similar capital bonds while also allowing multiple years for effects to develop. The meta-analysis conducted by Jackson and Mackevicius (2021), which includes these studies, tests capital spending's effects on student achievement and is also inconclusive. It is likely that the contexts in which these facilities are newly constructed or repaired mediates these effects, which is an important area for future study. Regardless, inequality in new construction and capital expenditures generally is likely to fuel ongoing complaints about unequal educational spending and litigation

Connecting the dots: How governance, subgroups, and resource types intersect to determine distributional progressivity

Inferences regarding resource inequality depend on the specific intersection of governance level, student group comparison, and resource type being considered. Many states and districts factor low-income status in their funding formulae (Chingos & Blagg, 2017), creating progressive funding distributions for economically disadvantaged students. These funding formulae do not, however, explicitly include provisions for students belonging to racially or ethnically marginalized groups (Poterba 1997; Ladd & Murray 2001), and many other factors, such as district size, sparsity, and special education enrollment, contribute to categorical aid, which, taken together, make it possible for regressive or non-progressive distributions for racially or ethnically minoritized student populations. On the other hand, Black and Hispanic students tend to be concentrated in lower-income neighborhoods (Reardon, et al., 2015), so categorical aid for economically disadvantaged students may spill over to these minoritized groups—though the amount of aid they receive may be much less.

An assessment of resource inequality for any given subgroup can change, moreover, when looking across, as opposed to within, states. Average state K-12 spending varies dramatically among states and is strongly correlated with state-level poverty (Cascio & Reber, 2013). If states serving more low-income students spend less on education, or if low-income students are concentrated in regressive states, then school funding across states will be regressive for economically disadvantaged students. Indeed, Hispanic students, for example, are heavily concentrated within just two states, Texas and California (Saenz, 2004; authors' calculations). And because Texas and California are comparatively low-spending, Hispanic students may also be subject to regressive national funding distributions.

Finally, the resource we investigate for a given subgroup and level of governance will also influence how we think about resource inequality. Though total educational expenditures are fundamental for analyzing resource inequality, a dollar is not necessarily equally efficacious in all places. For instance, schools serving more low-income and racially and ethnically minoritized students have more difficulty hiring and retaining high-quality teachers when quality is measured by contributions to student test scores (i.e., value added) or years of experience (Goldhaber & Lavery, 2015; Goldhaber et al., 2018). Thus, even in districts where total expenditures are allocated progressively, the distribution of teacher quality may be regressive. Similarly, capital expenditures are subject to district votes and, in some cases, depend on a district's assess property values, which can lead to regressive distributions of capital spending even where overall spending is progressive (Biasi, et al., 2021).

Data

To estimate educational resource inequality across states, within states, and within districts for multiple student subgroups and educational resources, we use four different sources of education data and a government survey of poverty estimates. We focus our analysis on the most contemporary publicly available data, from the 2017-18 year. Our primary data source for district funding is the 2017-18 Local Education Agency financial survey (F-33) from the U.S. Department of Educations' National Center for Education Statistics. From the F-33, we use district-level variables for total expenditures and capital outlays. We focus our analysis on regular school districts and supervisory unions, which means we exclude state-operated agencies, charter school districts, and specialized public school districts.

Our primary data sources for school funding are the 2017-18 Civil Rights Data Collection (CRDC) from the Office of Civil Rights and the 2018-19 National Education Resource Database on Schools (NERD$) from the Edunomics Lab at Georgetown University.[3] From the CRDC, we use school-level variables for total personnel expenditures, total teacher salary expenditures, full-time equivalent (FTE) teacher counts, and novice FTE teacher counts (where novice is defined as having fewer than three years of experience). To complement these school-level data, we leverage the newly available NERD$ dataset, which compiles school-level spending data. From this dataset, we obtain per-pupil total expenditures.

All spending variables are converted into 2017-18 academic year dollars using Consumer Price Index (CPI) based on Shores and Candelaria (2019). After CPI conversion, to account for regional differences in the costs of hiring teachers, all finance variables are then adjusted using the district-level Comparable Wage Index (CWI) for Teachers (Cornman et al, 2019).[4] One consequence of using the CWI is that our data are restricted to local education agencies that have a geographic border, which means we do not include charter schools in our analysis. Lastly, we convert these CPI- and CWI-adjusted dollars to per-pupil amounts. For F-33 expenditures, we use fall membership of the same academic year provided by the F-33; for CRDC variables, we use CRDC total school-based enrollment to calculate per-pupil expenditures and teacher-to-student ratios; from NERD$, we use the per-pupil amounts they provide directly.

To estimate funding inequality between student subgroups, we obtain school-level student counts for different racial, ethnic, and economic subgroups, which come from the NCES' Common Core of Data (CCD)[5] and the CRDC for the 2017-18 and 2018-19 years. Both CCD and CRDC have enrollment by race and ethnicity (Black, White, Hispanic), but only the CCD has school-level enrollment data for poor and non-poor subgroups (measured by free and reduced-price lunch eligibility). When describing race/ethnic differences for a given resource, we use the CRDC racial/ethnic data for CRDC resources (i.e., CRDC

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[3] Data tables for finance variables available at:
F-33: https://nces.ed.gov/ccd/files.asp#FileNameId:5,VersionId:13,FileSchoolYearId:32,Page:1
NERD$: https://edunomicslab.org/our-research/financial-transparency/
,and CRDC: https://www2.ed.gov/about/offices/list/ocr/data.html. The 2017-18 CRDC and 2018-19 NERD$ are the most recently available data for school-level expenditures from these different sources, and there is no year in which these datasets overlap.

[4] CWIFT is a geographic cost measure that estimates the wages of college-educated non-teacher workers and normalizes the values such that the mean wage in the U.S. is equal to 1, higher wages are greater than 1, and lower wages are less than 1. Expenditures and revenues are then adjusted by this normalized estimate of comparable wages. In districts where college-educated workers are paid greater than the national average, the value of an educational dollar will be decreased, to reflect the relative costs required of the district to hire college-educated workers locally. CWIFT data available at : https://nces.ed.gov/programs/edge/Economic/TeacherWage. Other cost factors would also be useful to include but there is no systematic way to make these adjustments, since those cost differentials have not been empirically estimated as has been done with the CWI.

[5] CCD data tables are downloaded through the Urban Institute education data API.

personnel expenditures, FTE teacher counts, and novice teacher counts) and the CCD racial/ethnic data for the NERD$ resource (i.e., NERD$ total expenditures). Finally, to complement the socioeconomic analysis, we also obtain measures of child poverty from the Small Area Income and Poverty Estimates (SAIPE) for the 2017-18 and 2018-19 academic years; these data are only available at the district level.[6] We note that these data do not allow us to observe the joint distribution of economic disadvantage and race.

We construct a dataset from these five sources that reflects the three dimensions of distributional progressivity: levels of governance, student subgroup comparisons, and resource types. We use data from the F-33 for estimating resource gaps across the U.S. and within states and data from NERD$ and the CRDC to estimate resource gaps within districts, as these are the only sources with school-level spending and teacher data. All finance data sources have per-pupil expenditure and revenue outliers, though data from the CRDC and NERD$ have more extreme outliers than the F-33. To adjust for these outliers, we apply a conservative winsorizing (see Tukey, 1960) by replacing values greater than five times the 99th percentile with the value of five times 99th percentile.[7]

Methods

We estimate spending gaps as follows:

$$Y_{lju} = \beta^{\text{fe}} group_{lju} + \Delta_u + \epsilon_{lju} \qquad [1]$$

where Y indicates per-pupil resource (e.g., expenditures) levels for the lowest governance level l (e.g., a school) for group j (paired Black-to-White, Hispanic-to-White, or economic disadvantage-to-advantage student subgroups). Subscript u is the upper level of governance, which is the level of aggregation for the fixed effect. We can estimate gaps in the outcome of interest for the country by selecting u as the nation (or by excluding the fixed effect); we can obtain an average gap for states or districts by setting u as a state-level or a district-level fixed effect, respectively, denoted by Δ_u. Because our data are cross-sectional, we adjust ϵ_{igu} for heteroskedasticity but not serial correlation.

To estimate this model with aggregate data it is necessary to reshape the data so that there are two observations per *l* (i.e., lower levels of governance), where each row contains the per pupil resource amount and the enrollment of each group *j*. Then, an indicator variable is set to one for the row of data indicating the target group's enrollment (e.g., Black) and set to zero for the reference group's enrollment (e.g., White).

6 Available at SAIPE: https://www.census.gov/programs-surveys/saipe.html

7 In Appendix Tables A1 and A2, we describe outliers present in both the NERD$ and CRDC, respectively. The NERD$ dataset contains outliers with much larger per-pupil magnitudes than the CRDC. In addition, outliers in NERD$ tend to be concentrated in a few districts, whereas CRDC outliers are distributed somewhat evenly among districts. In Appendix Tables A3 and A4, we present sensitivity estimates where we manipulate the stringency of our winsorization routine and by trimming the data instead of winsorizing. Winsorizing with different levels of stringency or trimming the data has little impact on our estimates.

Finally, in the regression, we weight the regression by enrollment which generate the average difference in group means at the level of governance specified in the fixed effect Δ_u, or, when the fixed effect is excluded, for the country. In the Technical Appendix: Calculating Resource Gaps at Different Levels of Governance with Aggregate Data, we provide more detail on our methodological approach.

Results

The main findings of this study are presented in Table 1 as resource inequality summary statistics by group pairing. Values greater than zero indicate progressivity in the resource distribution, whereas negative values show regressivity.[8] We report mean and standard error statistics of resource inequality for three different governance levels. Panel A presents the average resource inequality within the U.S., and Panels B and C show inequality within states and districts, respectively, using fixed-effects weighting. In each panel, different resource categories are included.

Across the entire U.S. (Panel A), resource distribution is mostly regressive. Black, Hispanic, and free or reduced-price lunch eligible students receive lower per-pupil total expenditures and capital expenditures than White and non-FRL students. Specifically, Black and FRL students receive about $35 and $149 less per pupil than White and non-FRL students, respectively, and Hispanic students receive $794 less per pupil than White students. Our gap estimates using SAIPE instead of FRL to measure poverty indicate progressivity, with children in poverty receiving $325 more per pupil than children not in poverty. Therefore, our assessment of national inequality as a function of economic disadvantage is sensitive to which measure of economic disadvantage is preferred. As discussed, the SAIPE better measures true child poverty and will better capture Title I disbursement, but FRL captures aspects of state funding policy and persistent poverty that may be missing from the SAIPE.

[Table 1]

Within states (Panel B), Black, Hispanic, and economically disadvantaged students receive higher per-pupil expenditures than White and economically advantaged students, respectively. On average, Black and Hispanic students receive $514 and $115 more per pupil than White students, respectively, and FRL students and children in poverty (based on the SAIPE) receive $334 and $529 more than non-FRL student and non-poverty children, respectively. For all our subgroup comparisons, spending is much more

[8] The signs indicated here hold except in the case of shares of novice teachers, where negative values indicate progressivity and positive values indicate regressivity.

progressive within rather than across states. Finally, our estimates for capital expenditures are regressive for all subgroups and across all levels of governance.[9]

Results from Panel B should not be used to gloss over important heterogeneity across states in the progressivity of their spending. Figures 2a and 2b illustrate the per-pupil expenditure gaps in each state by student subgroup comparison (Figure 2a shows gaps for Black-White and Hispanic-White students, and Figure 2b shows gaps for FRL-non-FRL students and poverty-nonpoverty children), along with 95% confidence intervals. FRL-non-FRL and Pov-non-Poverty gaps show the general progressivity at the state level, whereas for Black-White and Hispanic-White gaps, many more states allocate expenditures per pupil regressively.[10] This heterogeneity is likely due to the vast differences in weights states use to provide categorical aid to student populations (e.g., economic disadvantage) and district types (e.g., rural districts). Indeed, as shown Biasi (forthcoming) and Shores et al. (2021) have shown, state-specific responses to school finance reforms are heterogeneous, and we would expect this type of heterogeneity to track the specific changes to the funding formula states instituted.[11]

[Figure 2A]

[Figure 2B]

At the district level (Table 1, Panel C), our results largely correspond to the estimates we obtain for states. Total expenditure data from NERD$ indicate overall progressivity: Black and Hispanic students receive $487 and $266 more per pupil than White students, respectively, and FRL students receive $355 more than non-FRL students. Personnel and teacher expenditures reported in the CRDC show less

[9] In Appendix Tables A5 and A6, we present results at the national and state levels, respectively, for additional K-12 resource variables and incorporating regression adjustment. At the national and state levels, total revenue and total expenditure differences are nearly identical for all subgroup comparisons. Current elementary and secondary expenditures are nearly identically regressive at the national level and progressive at the state level, though progressivity at the state level is reduced by 25% to 50%, depending on the subgroup. Controlling for special education and rural and city enrollment percentages (by race, when possible) reduce the progressivity of our estimates—i.e., indicate greater resource inequality—at the national and state levels, though the signs of our unconditional estimates are never reversed.

[10] Another version of these figures, with the states sorted alphabetically, is shown in Appendix Figure 1.

[11] Another source of heterogeneity that we explore in Appendix Figure 2 and Appendix Table A7 comes from high spending school districts with large racially/ethnically minoritized and economically disadvantaged student populations. Using a jackknife methodology, we estimate national- and state-level gaps for total CWI-adjusted per pupil expenditures, excluding one district at a time, with replacement. Figure A2 shows the distribute of the national gap for each jackknife estimate. As is evident, more than 80% of gap estimates are unaffected by excluding a single district. However, when NYC School District is excluded, where 3% of the total US Black student population attends school, the national Black-white gap estimate is much more regressive at -$395.00. NYC school district has similar effects on national gap estimates for Hispanic and FRL students but not children in poverty (as measured by SAIPE) or state-level gap estimates.

progressivity overall than NERD$, though we cannot disambiguate whether this difference results from the data source or the expenditure type, since CRDC does not record total expenditures and NERD$ does not report personnel or teacher expenditures.[12]

For teacher and novice teacher counts, Black, Hispanic, and FRL students have more full-time equivalent (FTE) teachers per 100 students than White and non-FRL students, respectively. These gap estimates range from 0.18 to 0.26, meaning that disadvantaged student subgroups have, on average, about 2 more FTE teachers per 1000 students than their counterparts (equivalent to about 5% of a standard deviation). These same subgroups, however, have more exposure to novice teachers. Novice teacher estimates range from 0.08 to 0.15, meaning that disadvantaged subgroups have about 1 additional novice teacher per 1000 students than their counterparts (equivalent to about 10% of a standard deviation). This last result aligns with prior knowledge on teacher retention, as evidence shows that teacher turnover rates are higher in schools with more economically disadvantaged and racial/ethnic minority students (e.g., Ingersoll, 2001; Loeb et al., 2005).

This pattern becomes clearer when we regress district-level gaps in exposure to novice teachers against district-level gaps in exposure to FTE teachers. In Table 2, Panel A we see that in districts where Black, Hispanic, and FRL students have more FTE teachers than White and non-FRL students, respectively, they also have more novice teachers. The estimates are nearly identical for each of the student subgroups at about 0.20. This means that when Black, Hispanic or FRL students have 10 additional teachers per 100 students than White or non-FRL students, they also have about 2 more novice teachers per 100 students than their White or non-FRL counterparts. In Panels B and C of Table 2, we further show that progressivity in teacher salaries corresponds to progressivity in class sizes and regressivity in exposure to novice teachers. One thousand dollars in additional funding for disadvantaged groups yields about 1 additional FTE and 0.2 additional novice teachers. In effect, these results suggest that about 20 percent of the teaching personnel that disadvantaged subgroups receive is for novice teachers.[13]

[Table 2]

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[12] Additional results using alternative data specifications are shown in the Appendix, Tables A8 – A10. In Table A8, we exclude the CWI adjustment. State-level and national-level estimates are much more progressive for racial/ethnic resource gaps, and more regressive for economic disadvantage gaps. In Table A9, we calculate state- and national-level estimates using only the school-level expenditure data from NERD$ and CRDC. State-level estimates using NERD$ data are very similar to estimates using F-33; data from the CRDC show less progressivity. At the national-level, all the estimates are more progressive when using school-level expenditure data. In Table A10, we replicate the state- and national-estimates from Table 1 but for years 2013-14 and 2015-16. The magnitudes of progressivity and regressivity have changed modestly over time but none of the overarching patterns shown in Table 1 have changed.

[13] Results reported in Table 2 are nearly identical when controls and fixed effects are excluded and in unweighted regressions.

To better understand which types of districts are more progressive than others, we regress district-level total personnel spending gaps from the CRDC against the natural logarithm of enrollment, total district expenditures, percent poverty, discipline (school resource officers and security personnel) and support (psychologists and social workers) staff per 100 students (in levels and gaps), and special education students (the percent of students in the district who receive IDEA funding; in levels and gaps). We choose these predictors because each represents a district-level characteristic that might account for why a subgroup in the district would receive additional aid. For these predictors, our interest is in whether the direction and magnitude of the bivariate relationship changes our interpretation of the average level of within-district progressivity observed in Table 1. For log enrollment, perhaps larger districts allocate resources regressively, as some case studies have shown (e.g., Condron & Roscigno, 2003), meaning that the observed progressivity is especially concentrated in small districts. For district-level per-pupil expenditures, it may be that districts with lower spending tend to be those that distribute funding more progressively, which would mean that the disadvantaged subgroups are only likely to benefit in districts where total spending is lower. For discipline and support staff, perhaps districts that are more progressive are those that contribute larger allocations to auxiliary personnel, meaning that observed progressivity is partially offset by expenditures to non-instructional staff. Finally, progressivity may be correlated with the size of the special education population, which would indicate that the observed progressivity is being driven by contributions to special populations.

[Figure 3]

In Figure 3, we plot the beta coefficients from regressions in which the predictor is standardized to be mean zero with a standard deviation (SD) of one to facilitate comparisons across variables. Our outcome in these regressions is the district-level gap using total personnel spending from the CRDC; regression results are weighted by district enrollment.[14] For the most part, we reject the idea that district-level progressivity is explained by spending that would not go directly to Black, Hispanic, or FRL students. First, larger districts tend to be more progressive. A 1-SD increase in log enrollment corresponds to about $70 to $100 more spending for Black, Hispanic, or FRL students. Second, districts with greater total spending are more progressive. A 1-SD increase in total expenditures per pupil corresponds to about $25 to $75 more spending for Black, Hispanic, or FRL students. Third, progressivity is not greater in districts with more discipline and support staff—either in levels of gaps—meaning that additional dollars going to traditionally

[14] The displayed coefficients are nearly identical, both in magnitude and sign, when using district-level estimated gaps taken from NERD$ data.

disadvantaged students are not being spent on these auxiliary personnel. Finally, though there is no relationship between progressivity and the proportion of the special education population, we do observe a correlation between Black-White special education gaps and Black-White spending gaps. These magnitudes are relatively small—a 1-SD increase in the special education gap corresponds to $17 of additional spending for Black students and $37 for Hispanic students—and not enough to explain the level of progressivity we observe among districts, on average.

Discussion: Policy Implications

Our results offer a framework for reconciling conflicting accounts about the distribution of education funding and resources in the U.S. Mapping the different conclusions regarding equitable funding distributions onto our framework—accounting for governance level, student group comparison, and resource type—shows how analyses that seek to answer questions of distributional equity can draw opposing conclusions. In fact, our estimates largely track with existing findings, even as conclusions based on these findings diverge.

In terms of funding, an analysis from EdBuild (2019) found that districts with at least 75 percent non-White students had revenues that were, in total, $23 billion less than districts with at least 75 percent White students. This analysis necessarily incorporates a comparison across state lines, though which states are directly implicated is not clear. Though our approach differs, we also find that, nationally, Black and Hispanic students receive much less than White students. Indeed, if we re-estimate our national-level model but compare White spending to Black and Hispanic spending combined, we obtain an estimate of negative $526.00; multiplying this number bv the total Black and Hispanic K-12 enrollment in the US yields an estimate of $11.0 billion, amounting to the total spending gap between White and non-White students. Likewise, previous findings at the state and district levels show that most states and districts distribute more funding to higher-poverty than lower-poverty districts/schools (Chingos & Blagg, 2017; Knight, 2017; Shores & Ejdemyr, 2017). Our results largely corroborate these prior findings, making clear the importance of identifying the level of governance in the analysis.

The variation in our results underscores the importance of looking across multiple dimensions of inequality that work in concert to determine resource progressivity or regressivity. Policies aimed at achieving equitable resource distributions must consider how the three elements we include here—governance level, student group comparison, and resource type—intersect. Each of these three factors comes with a specific set of considerations, constraints, and opportunities. Different levels of governance have different policy levers at their disposal and face specific constraints and limitations. Each student group faces their own set of historical and institutional factors in their communities that contribute to their educational needs.

And the distributions of some educational resources are easier to influence than others through targeted policies.

From our results, we identify three critical policy areas:

1. At the national level, Black, Hispanic, and FRL students receive less total spending per pupil than White and non-FRL students (between about $35 to $794 per pupil). Our back-of-the-envelope calculation suggests that these gaps could be eliminated with $300 million, $10.6 billion, and $3.7 billion, respectively.[15]
2. At the state level, Hispanic students are benefiting much less than other student subgroups from current provisions in state funding formulae. Though Black and economically disadvantaged students receive more total spending than White and economically advantaged students (between about $300 to $500 per pupil), Hispanic students receive only $115 more per-pupil funding than White students on average.
3. At the district level, Black, Hispanic, and FRL students continue to have greater exposure to inexperienced teachers on average, and about 20% of the additional spending on teachers going to these students at the district level is being used to hire inexperienced teachers. In short, the teacher quality gap is not being remedied by progressivity in the distribution of educational expenditures.

To remedy these inequalities in educational resources, policies will need to be tailored to each level of governance, subgroup population, and resource type. For example, the Biden administration's proposal to expand Title I to $36.5 billion could effectively close K-12 total spending gaps if those funds were targeted effectively and structured to prevent states from substituting their own contributions with federal funds (see, e.g., Gordon & Reber, 2020).

At the state level, policy solutions are less clear, especially since gaps in funding for Hispanic students have not been widely documented (Jimenez-Castellanos, 2010). Changes to funding formula that target ethnicity directly are unlikely, but additional aid to English Language Learners and block grants to regions (e.g., rural areas) where Hispanic students primarily attend schools represent potential paths forward (Jimenez-Castellanos & Topper, 2012).

Improving measures of resource equity beyond spending introduces additional challenges. The difficulty in recruiting and retaining experienced teachers in schools with more economically disadvantaged and minoritized students is an entrenched feature of K-12 schooling that is difficult to target through policy change. Governance structures are ill-equipped to change the geographic distribution of the labor force, which creates difficulties for districts and schools trying to attract high-quality teachers from a local pool

[15] To obtain these numbers, we multiply total K-12 enrollment for Black, Hispanic, and FRL students and multiply those enrollment numbers by the gap magnitudes shown in Table 1 Panel A.

of teachers. Policies must also confront widespread preferences in the teacher labor supply for academically and socially advantaged students. Our estimates speak to these challenges: even with spending distributed progressively, on average, within districts, disadvantaged students are still more likely to have novice teachers. Moreover, Table 1 shows that salary expenditures favor Black, Hispanic, and FRL students by about $85 per pupil. Extrapolating from these estimates using a 16-to-1 student-teacher ratio (the national average according to the NCES)[16] shows that even in an all-Black, -Hispanic, or -FRL classroom, a teacher's salary would only be about $1,360 higher than a teacher's salary in an all-White or all-non-FRL classroom. This salary benefit is much smaller than some high-profile initiatives to encourage more experienced teachers to move to hard-to-staff schools (Martin, 2007). Given that salary expenditures only weakly encourage more experienced teachers to move to economically disadvantaged schools (Hanushek et al., 1975; Loeb & Page, 2000), the current level of progressivity for salary expenditures at the district level is likely to be inadequate.

Conclusion

We synthesize K-12 resource inequality across three dimensions—level of governance, student subgroup comparison, and resource type—and estimate distributional progressivity at different intersections of these three dimensions. We show that inferences regarding whether resource distributions are progressive or regressive change meaningfully across all three of these dimensions—national estimates of spending progressivity are markedly different from within-state and within-district estimates; spending inequalities between Hispanic and White students are very different, especially at the national and state levels, from inequalities between Black and White and economically disadvantaged and advantaged students; and distributions of novice teachers are regressive even where spending distributions are progressive. This framework, and the estimates we generate using it, can inform debates on school resource distributions, reveal bottlenecks where current policies governing resource distribution fall short, and are relevant for structuring new policies aimed at improving distributional equity. Because we see this work as ongoing, we provide details about data and methodology so that similar comprehensive descriptions of resource distributions can be feasibly generated as new data emerge so that a "national report card" of K-12 resource inequality can be generated and disseminated.

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[16] https://nces.ed.gov/surveys/ntps/tables/ntps1718_fltable06_t1s.asp

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Figure 1: Stylized Representation of School Spending Distribution between States and among Districts

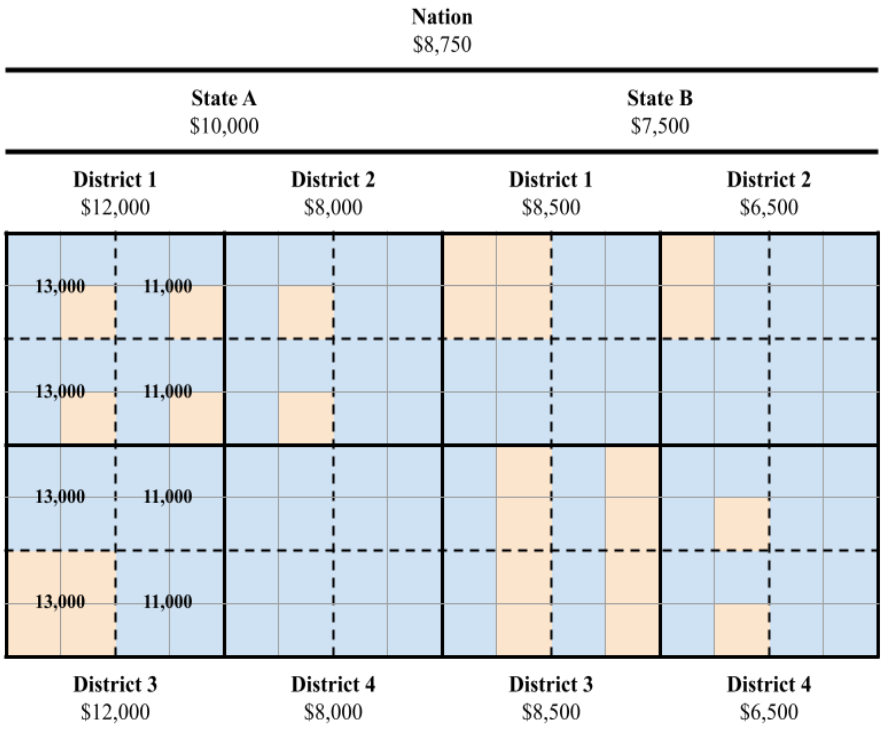


Figure 2A: State-level total expenditure gaps: Black-White and Hispanic-White

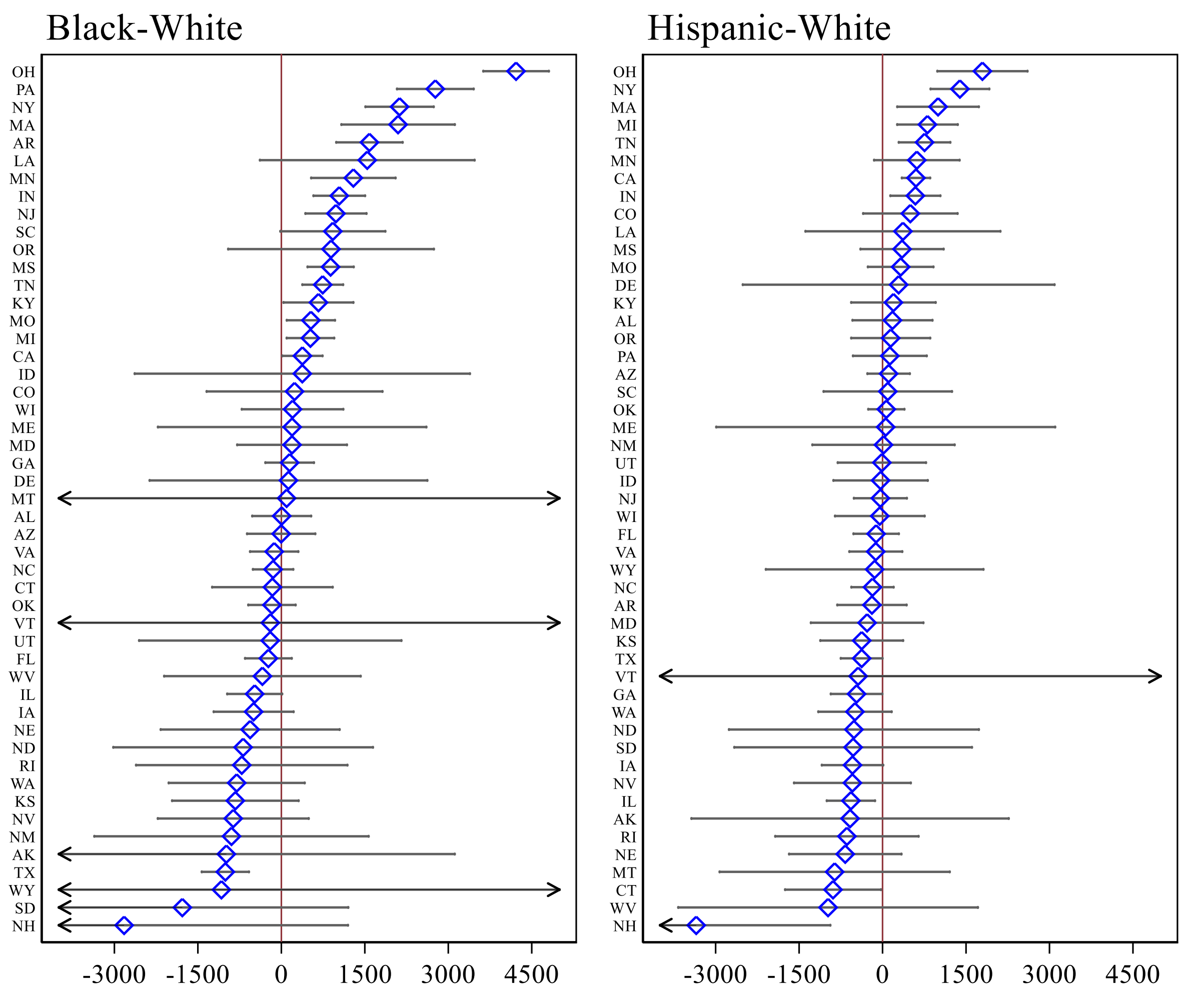


Figure 2A- The above figure shows the fixed-effect weighted gap in total expenditure with 95% CI, by group pairings: Black-White and Hispanic-White. Samples include student counts from the CCD for the 2017-18 academic year and district expenditures from the F-33 for the 2017-18 academic year. All outliers are winsorized to be equal to 5 times the value at the 99th percentile. Student counts are from the CCD for the 2017-18 academic year and district expenditures from the F-33 for the 2017-18 academic year. The 95% CIs are censored if the range area would stretch the x-axis.

Figure 2B: State-level total expenditure gaps: FRL-nonFRL andPov-NonPov

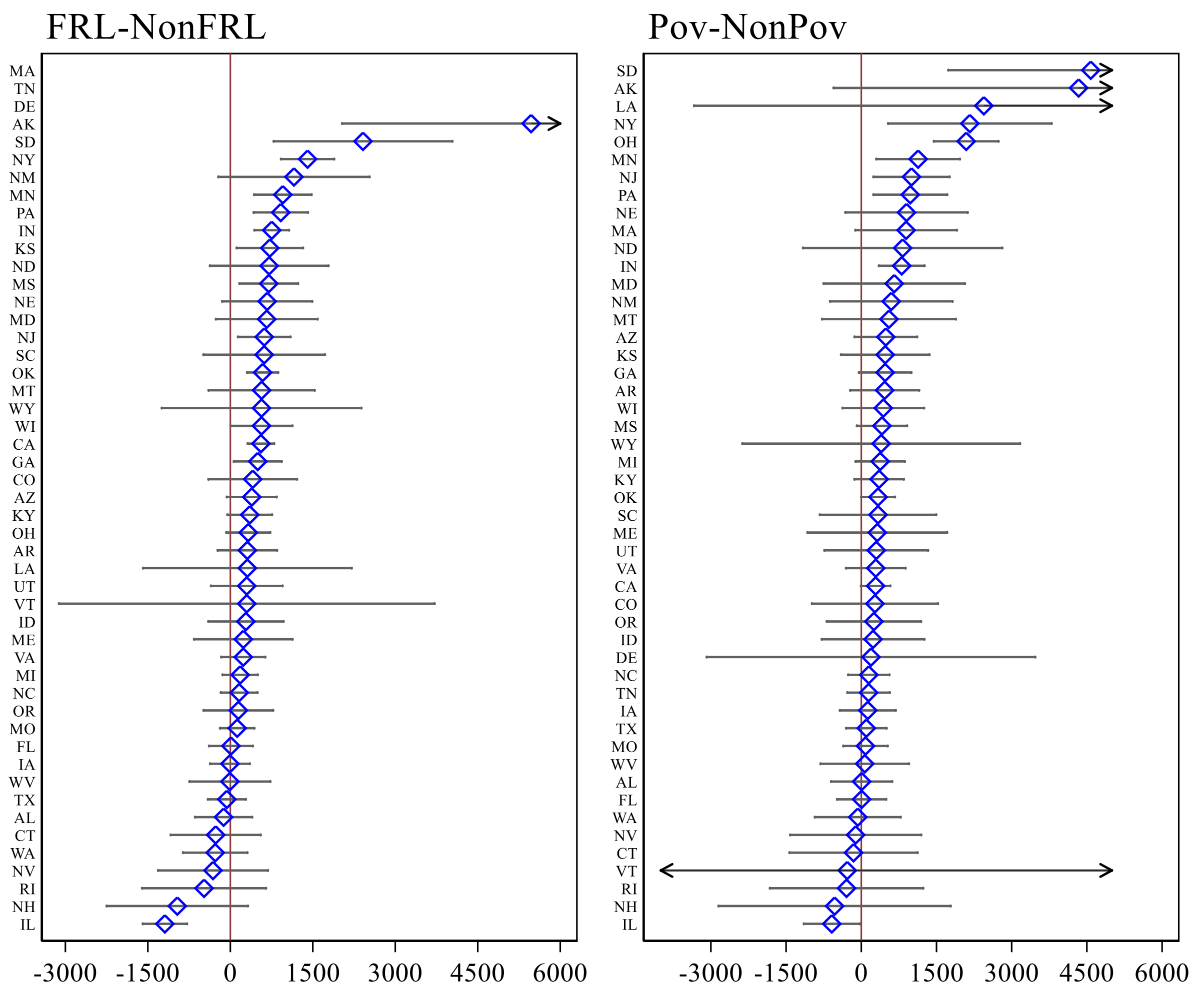


Figure 2B- The above figure shows the fixed-effect weighted gap in total expenditure with 95% CI, by group pairings: Black-White and Hispanic-White. Samples include student counts from the CCD for the 2017-18 academic year and district expenditures from the F-33 for the 2017-18 academic year. All outliers are winsorized to be equal to 5 times the value at the 99th percentile. NonFRL and Poverty-NonPoverty group pairings. Samples include student counts from the CCD for the 2017-18 academic year and district expenditures from the F-33 for the 2017-18 academic year. For the Pov-NonPov measure, we use SAIPE estimates for the 2017-18 academic year. All outliers are winsorized to be equal to 5 times the value at the 99th percentile. DE, TN, and MA do not have FRL reports in the 2017-18 CCD. The 95% CIs are censored if the range area would stretch the x-axis.

Figure 3: Correlates of District Gap Estimates

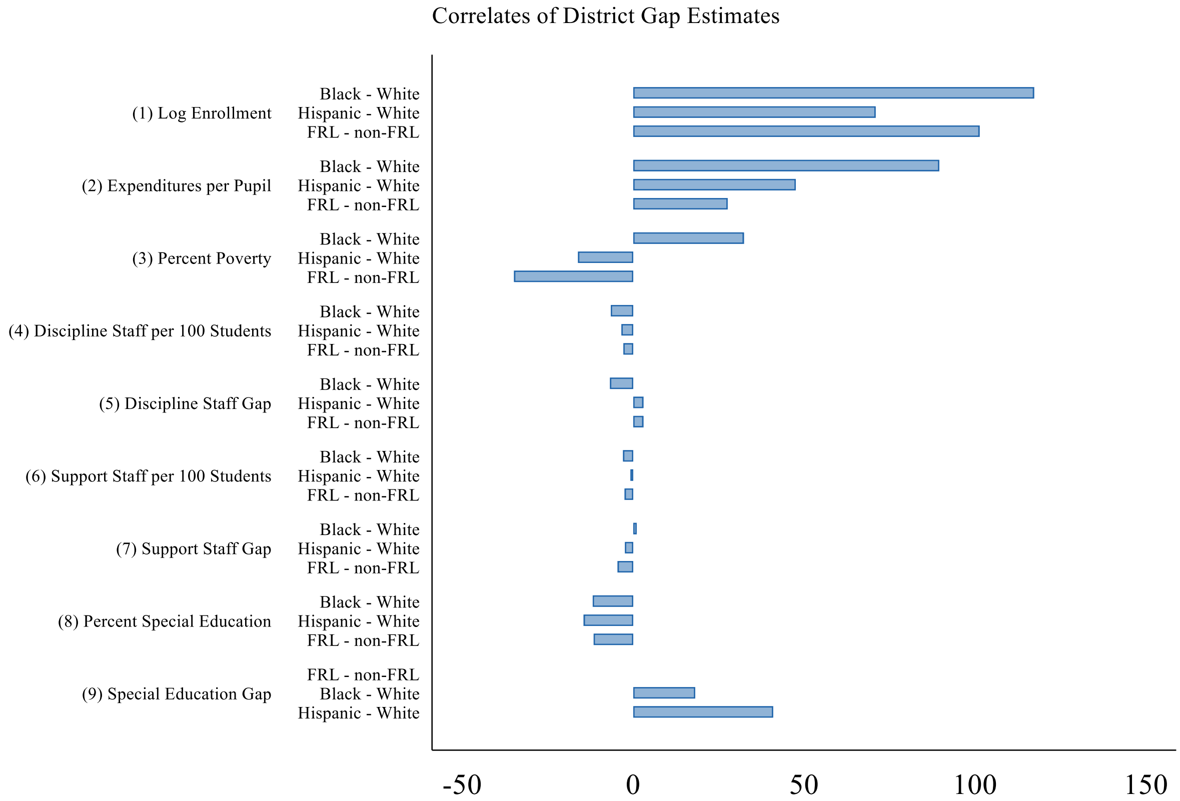


Figure 3 – The above figure shows the estimated bivariate relationship between the district-level total personnel spending gap and each element from (1) through (5). We obtain log enrollment and special education students (IDEA) counts from CCD at 2017-18 academic year, and per-pupil expenditure is obtained from F-33 for the same sample year. Discipline staff and support staff counts are collected from 2017-18 CRDC. All predictors are standardized to be mean 0 with a standard deviation of 1.

Table 1: Resource Inequality Summary Statistics, by Group Pairing

	Black-White		Hispanic-White		FRL-Non-FRL (CCD)		Poor-Non-poor (SAIPE)	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Panel A: Within U.S.								
Total expenditure	-35.10	76.58	-794.20	64.29	-149.09	64.64	325.18	101.68
Capital outlays	-154.31	28.70	-34.72	24.47	-130.08	23.15	-75.13	29.62
N	24,169		25,406		24,322		25,880	
Panel B: Within States								
Total expenditure	513.68	53.32	114.50	47.69	334.41	41.98	529.49	75.52
Capital outlays	-75.67	28.99	-105.97	26.61	-115.85	22.63	-55.28	28.59
N	24,169		25,406		24,322		25,880	
Panel C: Within Districts								
Total expenditure	486.54	21.42	265.85	18.89	354.76	16.68	-	
N	316,132		330,456		306,688		-	
							-	
Personnel salary	232.06	21.63	126.95	17.56	190.98	15.08	-	
Teacher salary	89.46	13.04	69.80	10.21	95.92	9.58	-	
Teachers	0.26	0.01	0.18	0.01	0.24	0.01	-	
Novice teachers	0.15	0.00	0.09	0.00	0.08	0.00	-	
N	345,190		357,538		332,684		-	

Notes: All monetary resources are converted into 2017-18 academic year dollar and use the CWI. Teachers and Novice teachers indicate the total number of teachers (or novice teachers) per 100 students. Samples include 2017-18 F33 and CRDC, and 2018-19 NERD$. The source for expenditures in Panels A and B is the F-33; for teachers and novice teachers in Panels A through C is the CRDC. In Panel C, total expenditures is from the NERD$ dataset and all other resources are from the CRDC. All outliers are winsorized to match values at the 5×99^{th} percentile.

Table 2: Predictors of gaps in exposure to FTE and novice teachers

	Black - White	Hispanic - White	FRL - nonFRL
Panel A: Gaps in Exposure to Novice Teachers			
Gaps in Exposure to FTE Teachers	0.18***	0.2***	0.18***
	(0.02)	(0.02)	(0.02)
Panel B: Gaps in Exposure to FTE Teachers			
Gaps in Teacher Salaries (in $1000s)	1.11***	1.04***	1.25***
	(0.07)	(0.08)	(0.07)
Panel C: Gaps in Exposure to Novice Teachers			
Gaps in Teacher Salaries (in $1000s)	0.16***	0.2***	0.17***
	(0.03)	(0.03)	(0.04)
N	11,278	12,250	12,145

Notes: All regressions control for state fixed effects, log enrollment, and the percent of the population that receives special education services. Regressions are weighted by district enrollment.

Technical appendix: Calculating Resource Gaps at Different Levels of Governance with Aggregate Data

An inequality statistic that compares average levels of a resource for one group relative to another group at any level of governance can be written as:

$$Ineq_u = \frac{1}{N_1}\sum_{l=1}^{L}(\phi_{1l} \cdot Y_l) - \frac{1}{N_2}\sum_{l=1}^{L}(\phi_{2l} \cdot Y_l) \qquad (1)$$

The subscripts u and l indicate upper and lower levels of governance, respectively. For example, using school-level data to calculate the average resource inequality within a district containing L schools, l indicates a given school in the district, and u indicates the district. The upper level contains N_j students in group $j \in \{1, 2\}$, where $j = 1$ for Black, Hispanic, or economically disadvantaged students and $j = 2$ for White or economically advantaged students. Y_l represents total resources (e.g., expenditures) at the lower level; and ϕ_{jl} represents the proportion of students from subgroup j = 1 that are in the lower level. The first term, where j = 1, therefore represents the share of school resources for Black, Hispanic or poor students, and the second term represents the share of resources for non-poor or White students (j = 2). This statistic can generate national (across-state) estimates (using school- or district-level data), within-state (across-district) estimates (using school- or district-level data), or within-district (across-school) estimates (using school-level data).

To summarize how much resource inequality there is on average across states or districts, one is faced with a choice about how to weight these state- or district-level observations. Four weighting schemes are prevalent: 1) equal weights, 2) enrollment weights, 3) inverse-variance weights, or 4) fixed-effects weights. One advantage of fixed effects weighting is that it allows us to estimate subgroup inequality gaps directly in a regression framework and obtain a standard error for the gap estimate. Though fixed effects regressions are commonplace, the implicit fixed effects weight is often disregarded. When the predictor variable is binary (as is the case when we have two subgroups), the fixed effect estimator is a weighted sum of the differences between subgroups $j \in \{1, 2\}$, which can be written as follows (Angrist and Krueger, 1999; Wooldridge, 2005):

$$E[\beta^{fe}] = \sum_1^u \left[\left(\frac{n_{ju}\sigma^2_{j=1u}}{\sum_1^u n_{ju}\sigma^2_{j=1u}}\right)\widehat{Ineq_u}\right] \qquad (2)$$

In this expression, $E[\beta^{fe}]$ is the fixed effects weighted average of the state- or district-specific estimates of student subgroup inequality, where the difference in resources for any subgroup pairs $j \in \{1, 2\}$ calculated at any level of governance (u) is represented by $\widehat{Ineq_u}$. Taking the sum (Σ_1^u) of the weighted $\widehat{Ineq_u}$ yields the fixed effect estimate $E\left[\beta^{fe}\right]$. The weights are defined as $\left(\frac{n_{ju}\sigma_{ju}^2}{\sum_1^u n_{ju}\sigma_{ju}^2}\right)$, and the sum of these weights is equal to 1. The numerator of the weight represents the product of total enrollment for groups $j \in \{1,2\}$ and the variance of the reference group's enrollment (*j=1*) for subgroups $j \in \{1,2\}$ in governance level *u* (i.e., the level of governance at which the inequality is calculated). The denominator of the weight represents the product of the enrollments and variances for subgroups $j \in \{1,2\}$ of all states or districts at the upper level of governance.

To estimate our model with aggregate data it is necessary to reshape the data so that there are two observations per *l* (i.e., lower levels of governance), where each row contains the per-pupil resource amount and the enrollment of each group *j*. Then, an indicator variable is set to one for the row of data indicating the target group's enrollment (e.g., Black) and set to zero for the reference group's enrollment (e.g., White). Finally, in the regression, we weight the regression by enrollment which generate the difference in group means described in Equation 1.

Appendix Tables: Comparing NERD$ Outliers and CRDC Outliers

In Tables A1 and A2 we provide description about the prevalence of outliers—defined as being 5x, 2.5x, 2x, 1.5x, or 1x the 99th percentile nationally—among school districts, using data from the CRDC and NERD$. There are a few takeaways from these tables. First, for NERD$, the 99th percentile of total spending is $41,667 compared to $27,662 for CRDC; thus, outliers for NERD$ will be larger by construction. Second, the majority of outliers in NERD$ are contained in select districts. For example, when outliers are defined as 5x the 99th percentile, 90% of all outliers are contained in districts with 50% of school-level observations also outliers. For the CRDC, outlier values are distributed more evenly across schools. Practically, this means that the NERD$ data should be easier to edit and clean, given the concentration of outliers in particular districts.

[Table A1]

[Table A2]

Appendix: Additional Results

We also estimate resource inequality gaps with different data. Tables A3 through A5 present those results. First, we describe how results change when we manipulate the stringency of the outlier criteria. These values range from .9x the 99th percentile to 5x the 99th percentile, in increments of 0.1, where .9x represents the least data removed and 5x represents the most data we move. We show the mean, minimum, and maximum gap estimate across these different sample restrictions in Table A3. We apply the same sample restrictions but instead of winsorizing we trim the data. These results are shown in Table A4. Next, we present results that include additional expenditure and resource variables (Tables A5 and A6, for national- and state-level estimates, respectively). Here, we include total revenues, current elementary and secondary expenditures, and current instructional expenditures. In addition, we present gap estimates that control for variables associated with differential costs, including special education percent enrollment, rural and city percent enrollment. When available, we include the subgroup-specific percentages; see table notes. In Table A7, we show the distribution of estimates for the total expenditures gap for all subgroups at the national- and state-levels, in which each regression excludes one district at a time with replacement. In Table A8, we estimate the inequality gap without CWI adjustment. In Table A9, we estimate the Panels A and B of Table 1 again, but this time using school-level data (i.e., NERD$ and CRDC). Table A10 presents the inequality gap in 2013-14 and 2015-16 academic years. The total expenditure and total revenue in previous years follow a similar pattern as shown in Table 1, regressive nationally and progressive within states. In Figure A1, we present the state-level gap estimates sorted alphabetically for Black-White, Hispanic-White, FRL-nonFRL, and Pov-nonPov. In Figure A2, we display the distribution of the Black-White gaps at the national level with estimates taken from a leave-one-out jackknife as described in Table A7.

Table A1: Summary for NERD$ Outlier

Resource: NERD$ total expenditure, Outlier 5: Pct. all outliers 0.110; 99th ptile = $41667

Pct. Total Outliers in District with 90% Outliers 41.30; Num. dists with 90% Outliers 3
Pct. Total Outliers in District with 80% Outliers 41.30; Num. dists with 80% Outliers 3
Pct. Total Outliers in District with 70% Outliers 71.74; Num. dists with 70% Outliers 5
Pct. Total Outliers in District with 60% Outliers 83.70; Num. dists with 60% Outliers 7
Pct. Total Outliers in District with 50% Outliers 90.22; Num. dists with 50% Outliers 10

Resource: NERD$ total expenditure, Outlier 2.5: Pct. all outliers 0.196; 99th ptile = $41667

Pct. Total Outliers in District with 90% Outliers 30.06; Num. dists with 90% Outliers 6
Pct. Total Outliers in District with 80% Outliers 34.97; Num. dists with 80% Outliers 7
Pct. Total Outliers in District with 70% Outliers 52.15; Num. dists with 70% Outliers 9
Pct. Total Outliers in District with 60% Outliers 53.99; Num. dists with 60% Outliers 10
Pct. Total Outliers in District with 50% Outliers 58.90; Num. dists with 50% Outliers 14

Resource: NERD$ total expenditure, Outlier 2: Pct. all outliers 0.257; 99th ptile = $41667

Pct. Total Outliers in District with 90% Outliers 26.17; Num. dists with 90% Outliers 13
Pct. Total Outliers in District with 80% Outliers 29.91; Num. dists with 80% Outliers 14
Pct. Total Outliers in District with 70% Outliers 42.99; Num. dists with 70% Outliers 16
Pct. Total Outliers in District with 60% Outliers 48.13; Num. dists with 60% Outliers 19
Pct. Total Outliers in District with 50% Outliers 52.80; Num. dists with 50% Outliers 24

Resource: NERD$ total expenditure, Outlier 1.5: Pct. all outliers 0.429; 99th ptile = $ 41667

Pct. Total Outliers in District with 90% Outliers 19.89; Num. dists with 90% Outliers 26
Pct. Total Outliers in District with 80% Outliers 22.13; Num. dists with 80% Outliers 27
Pct. Total Outliers in District with 70% Outliers 33.61; Num. dists with 70% Outliers 30
Pct. Total Outliers in District with 60% Outliers 36.69; Num. dists with 60% Outliers 33
Pct. Total Outliers in District with 50% Outliers 42.30; Num. dists with 50% Outliers 43

Resource: NERD$ total expenditure, Outlier 1: Pct. all outliers 0.999; 99th ptile = $41667

Pct. Total Outliers in District with 90% Outliers 19.71; Num. dists with 90% Outliers 95
Pct. Total Outliers in District with 80% Outliers 24.04; Num. dists with 80% Outliers 98
Pct. Total Outliers in District with 70% Outliers 27.40; Num. dists with 70% Outliers 100
Pct. Total Outliers in District with 60% Outliers 29.45; Num. dists with 60% Outliers 105
Pct. Total Outliers in District with 50% Outliers 39.66; Num. dists with 50% Outliers 137

Notes: Table A1 reports the outliers in NERD$ total expenditure. For example, in the top panel, we define outliers as values larger than 5 times the 99^{th} percentile. Here, 11% of the whole sample is classified as outliers, 90.22% of these outliers are concentrated in 10 districts, and at least 50% of schools in these districts contain outliers.

Table A2: Summary for CRDC Outlier

Resource: CRDC personnel salary, Outlier 5: Pct. all outliers 0.114; 99th ptile = $27662

Pct. Total Outliers in District with 90% Outliers 8.08; Num. dists with 90% Outliers 5
Pct. Total Outliers in District with 80% Outliers 8.08; Num. dists with 80% Outliers 5
Pct. Total Outliers in District with 70% Outliers 8.08; Num. dists with 70% Outliers 5
Pct. Total Outliers in District with 60% Outliers 14.14; Num. dists with 60% Outliers 7
Pct. Total Outliers in District with 50% Outliers 34.34; Num. dists with 50% Outliers 17

Resource: CRDC personnel salary, Outlier 2.5: Pct. all outliers 0.231; 99th ptile = $27662

Pct. Total Outliers in District with 90% Outliers 6.50; Num. dists with 90% Outliers 9
Pct. Total Outliers in District with 80% Outliers 6.50; Num. dists with 80% Outliers 9
Pct. Total Outliers in District with 70% Outliers 6.50; Num. dists with 70% Outliers 9
Pct. Total Outliers in District with 60% Outliers 12.50; Num. dists with 60% Outliers 12
Pct. Total Outliers in District with 50% Outliers 30.50; Num. dists with 50% Outliers 30

Resource: CRDC personnel salary, Outlier 2: Pct. all outliers 0.326; 99th ptile = $27662

Pct. Total Outliers in District with 90% Outliers 6.03; Num. dists with 90% Outliers 13
Pct. Total Outliers in District with 80% Outliers 6.03; Num. dists with 80% Outliers 13
Pct. Total Outliers in District with 70% Outliers 6.03; Num. dists with 70% Outliers 13
Pct. Total Outliers in District with 60% Outliers 12.41; Num. dists with 60% Outliers 18
Pct. Total Outliers in District with 50% Outliers 29.43; Num. dists with 50% Outliers 41

Resource: CRDC personnel salary, Outlier 1.5: Pct. all outliers 0.515; 99th ptile = $27662

Pct. Total Outliers in District with 90% Outliers 6.05; Num. dists with 90% Outliers 23
Pct. Total Outliers in District with 80% Outliers 6.05; Num. dists with 80% Outliers 23
Pct. Total Outliers in District with 70% Outliers 6.95; Num. dists with 70% Outliers 24
Pct. Total Outliers in District with 60% Outliers 15.25; Num. dists with 60% Outliers 33
Pct. Total Outliers in District with 50% Outliers 30.04; Num. dists with 50% Outliers 65

Resource: CRDC personnel salary, Outlier 1: Pct. all outliers 1.001; 99th ptile = $27662

Pct. Total Outliers in District with 90% Outliers 7.04; Num. dists with 90% Outliers 44
Pct. Total Outliers in District with 80% Outliers 7.04; Num. dists with 80% Outliers 44
Pct. Total Outliers in District with 70% Outliers 7.50; Num. dists with 70% Outliers 45
Pct. Total Outliers in District with 60% Outliers 16.38; Num. dists with 60% Outliers 66
Pct. Total Outliers in District with 50% Outliers 33.45; Num. dists with 50% Outliers 134

Notes: Table A2 reports the outliers in CRDC personnel salary. For example, in the top panel, we define outliers as values larger than 5 times the 99th percentile. Here, 11.4% of the whole sample is classified as outliers, 34.34% of these outliers are concentrated in 17 districts, and at least 50% of schools in these districts are outliers. The total share of outliers in the data is almost the same in both NERD$ and CRDC by construction because outliers are based on the sample distribution, but the distribution of those outliers is more concentrated in a handful of districts in NERD$ relative to the CRDC.

Table A3: Sensitivity of Per Pupil Expenditure Estimates to Winsorizing

Group	Published Estimate	Mean	SD	Min	Max	Average Observations Affected
Panel A: Within US						
Black-White	-35.10	-44.42	9.34	-67.87	-33.38	252
Hispanic-White	-794.20	-791.14	2.93	-794.89	-784.35	276
FRL-Non-FRL (CCD)	-149.09	-152.15	3.15	-160.21	-148.75	267
Poor-Non-Poor (SAIPE)	325.18	278.73	45.89	216.48	348.52	293
Panel B: Within States						
Black-White	513.68	509.82	3.72	500.73	515.87	252
Hispanic-White	114.50	108.45	9.59	89.89	123.08	276
FRL-Non-FRL (CCD)	334.41	329.52	4.80	318.50	334.74	267
Poor-Non-Poor (SAIPE)	529.49	489.80	38.01	439.10	551.75	293

Notes: Column 1 repeats estimates of the inequality in total expenditure from Table 1. See notes to Table 1 for details. In column 2, average of inequality estimates after winsorizing are presented. We winsorized the data by multiplying 5, 4, 3, 2, 1, 0.95, and 0.9 to 99th percentile for top coding, and 0.1, 0.25, 0.5, 0.75, 1 1.05, and 1.1 to 1st percentile for bottom coding. Including no winsorizing, we get the mean of 64 estimates in total (8*8). The minimum and maximum values are presented in column 4 and 5. All monetary resources are converted into 2017-18 academic year dollar and use the CWI. Sample includes 2017-18 F-33.

Table A4. Sensitivity of Per Pupil Expenditure Estimates to Trimming

Group	Published Estimate	Mean	SD	Min	Max	Average Observations Affected
Panel A: Within US						
Black-White	-35.10	-89.53	62.85	-217.31	-29.63	252
Hispanic-White	-794.20	-788.52	4.52	-796.76	-776.87	276
FRL-Non-FRL (CCD)	-149.09	-172.86	28.23	-233.10	-148.75	267
Poor-Non-Poor (SAIPE)	325.18	221.11	64.87	116.86	348.61	293
Panel B: Within States						
Black-White	513.68	502.01	11.44	474.08	521.07	252
Hispanic-White	114.50	96.47	21.59	54.88	131.64	276
FRL-Non-FRL (CCD)	334.41	317.97	14.76	281.09	334.74	267
Poor-Non-Poor (SAIPE)	529.49	450.39	47.67	385.79	551.82	293

Notes: Column 1 repeats estimates of the inequality in total expenditure from Table 1. See notes to Table 1 for details. In column 2, average of inequality estimates after trimming are presented. We trimmed the data by multiplying 5, 4, 3, 2, 1, 0.95, and 0.9 to 99th percentile for top coding, and 0.1, 0.25, 0.5, 0.75, 1 1.05, and 1.1 to 1st percentile for bottom coding. Including without trimming estimates, we get the mean of 64 estimates in total (8*8). The minimum and maximum values are presented in column 4 and 5. All monetary resources are converted into 2017-18 academic year dollar and use the CWI. Sample includes 2017-18 F-33.

Table A5: National Inequality Summary Statistics, by Group Paring

	Black - White		Hispanic - White		FRL - Non-FRL (CCD)		Poor - Nonpoor (SAIPE)	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Panel A: Unconditional Gap								
Total Expenditures	-35.10	76.58	-794.20	64.29	-149.09	64.64	325.18	101.68
Total Revenues	-72.93	73.85	-913.45	61.60	-102.70	62.54	355.78	102.57
Elementary/Secondary Expenditure	-56.26	58.42	-851.58	49.71	-55.98	49.83	229.38	74.63
Capital outlays	-154.31	28.70	-34.72	24.47	-130.08	23.15	-75.13	29.62
Instructional expenditure	-167.98	39.04	-542.63	33.91	-132.28	34.29	29.13	49.04
Panel B: Regression Adjusted Gap								
Total Expenditure	-483.89	79.25	-1118.39	65.80	-473.41	58.02	-20.78	94.38
Total Revenues	-443.90	76.34	-1183.29	62.74	-429.03	54.62	16.59	94.92
Elementary/Secondary Expenditure	-263.89	60.39	-1011.85	50.70	-279.19	42.83	-0.99	66.61
Capital Outlays	-212.15	30.38	-64.34	26.10	-137.61	23.47	-85.19	30.79
Instructional expenditure	-455.21	38.95	-790.72	33.11	-314.52	29.03	-115.03	43.12

Notes: The table presents spending gap estimates for additional school resources at the national level. Panel A shows unconditional gap between group paring, and Panel B shows an adjusted gap using continuous controls. Controls include special education and city and rural enrollment percentages. For race/ethnicity, all controls are included as group-specific percentages. For FRL, special education is not available disaggregated by economic advantage but rural and city is available. For poverty, none of the variables are disaggregated. All monetary resources are converted into 2017-18 academic year dollar and use the CWI. Sample includes 2017-18 F-33.

Table A6: Within State Inequality Summary Statistics, by Group Paring

	Black - White		Hispanic - White		FRL - Non-FRL (CCD)		Poor - Nonpoor (SAIPE)	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Panel A: Unconditional Gap								
Total Expenditures	513.68	53.32	114.50	47.69	334.41	41.98	529.49	75.52
Total Revenues	442.67	47.46	97.72	41.56	384.27	37.61	551.54	75.63
Elementary/Secondary Expenditure	235.22	34.37	73.29	30.64	340.42	27.08	396.25	49.00
Capital outlays	-75.67	28.99	-105.97	26.61	-115.85	22.63	-55.28	28.59
Instructional expenditure	9.00	20.45	51.47	18.46	114.37	16.11	143.00	27.18
Panel B: Regression Adjusted Gap								
Total Expenditure	373.49	56.44	83.57	48.86	147.50	41.64	233.30	76.30
Total Revenues	376.55	49.89	105.14	42.23	194.60	36.90	263.54	77.08
Elementary/Secondary Expenditure	291.55	36.17	153.97	31.23	237.53	26.53	222.16	49.08
Capital Outlays	-91.55	31.05	-113.76	27.57	-110.00	23.03	-53.80	29.68
Instructional expenditure	-74.61	21.43	-5.85	18.66	27.87	15.75	47.61	27.28

Notes: The table presents spending gap estimates for additional school resources at the national level. Panel A shows unconditional gap between group paring, and Panel B shows an adjusted gap using continuous controls. Controls include special education and city and rural enrollment percentages. For race/ethnicity, all controls are included as group-specific percentages. For FRL, special education is not available disaggregated by economic advantage but rural and city is available. For poverty, none of the variables are disaggregated. All monetary resources are converted into 2017-18 academic year dollar and use the CWI. Sample includes 2017-18 F-33.

Table A7: Distribution of National- and State-Level Gap Estimates Dropping One District

	Full Sample Estimate	Leave One Out Jackknife Gap Estimate					
		Mean	Median	SD	IQR	Min	Max
Panel A: Within-US							
Black-White	-\$35.10	-\$35.10	-\$35.10	3.00	0.07	**-\$394.94**	\$18.12
Hispanic-White	-\$794.20	-\$794.20	-\$794.20	2.92	0.07	**-\$1,166.66**	-\$738.87
FRL-non-FRL	-\$149.09	-\$149.09	-\$149.09	2.22	0.02	**-\$430.42**	-\$130.12
Poor-non-Poor	\$325.18	\$325.18	\$325.18	1.68	0.03	**\$147.83**	\$341.77
Panel B: Within-State							
Black-White	\$513.68	\$513.68	\$513.68	1.02	0.03	**\$441.43**	\$574.17
Hispanic-White	\$114.49	\$114.49	\$114.50	0.96	0.02	**\$9.95**	\$156.55
FRL-non-FRL	\$334.41	\$334.41	\$334.41	0.61	0.02	**\$278.66**	\$369.44
Poor-non-Poor	\$529.49	\$529.48	\$529.49	0.71	0.02	**\$465.12**	\$549.84

Notes: Gap estimates for each subgroup at the national- and state-levels are estimated iteratively, dropping one district at a time. The mean, median, standard deviation (SD), interquartile range (IQR), minimum, and maximum gap estimate are shown. None of the statistics indicating central tendency or even variation are sensitive to excluding a single district. However, the minimum gap estimates are sensitive. As we illustrate in Figure A2, the minimum gap estimates are almost exclusively affected by the exclusion of the NYC school district. NYC enrolls 3% of Black, Hispanic, and economically disadvantaged students nationally, and is a much higher spending district (about \$30,000 CWI adjusted) than the national average. Excluding NYC makes the national gap estimate about \$400 less progressive and the state-level gap estimate about \$100 less progressive. Dropping other individual districts has no such impact on our estimates.

Table A8: Resource Inequality Summary Statistics, by Group Pairing (w/o CWI)

	Black-White		Hispanic-White		FRL-Non-FRL (CCD)		Poor-Nonpoor (SAIPE)	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Panel A: Within U.S.								
Source: F33								
Total expenditure	432.56	78.82	401.92	71.13	-205.60	72.39	98.59	105.39
Capital outlays	-133.51	24.35	45.76	21.19	-143.93	20.15	-90.03	27.67
N	29,514		30,776		28,524		25,880	
Panel B: Within States								
Source: F33								
Total expenditure	932.99	57.53	504.48	57.93	183.68	52.06	369.67	72.53
Capital outlays	-56.70	24.48	-87.73	23.05	-135.22	19.61	-66.59	26.51
N	29,514		30,776		28,524		25,880	
Panel C: Within Districts								
Source: NERD$								
Total expenditure	452.23	21.49	263.13	18.88	330.83	16.99		
N	168,254		175,107		164,296			
Source: CRDC								
Personnel salary	219.53	18.38	124.55	15.12	179.96	13.04		
Teacher salary	86.70	11.57	69.46	9.29	92.99	8.72		
N	173,671		179,407		166,547			

Notes: We estimate the same group pairing gaps in school resources as Table 1 but without CWI adjustment. FTE teachers and novice teachers are not included in this table since they are not subject to CWI adjustment. All monetary resources are converted into 2017-18 academic year dollar. Samples include 2017-18 F33 and CRDC, and 2018-19 NERD$. Within the entire United States, the distribution of resources is progressive or not different from zero. This change is noticeable since we have clear regressivity with CWI adjustment. Within states and within districts have a similar pattern with the results of Table 1 since they show clear progressivity. Within states, the distribution of capital expenditure still favors White or economically advantaged students, consolidating the findings from Table 1 and previous literature. (Biasi et al., 2021)

Table A9: Resource Inequality Summary Statistics, by Group Pairing (w/ School-Level Data)

	Black-White		Hispanic-White		FRL-Non-FRL (CCD)	
	Mean	SE	Mean	SE	Mean	SE
Panel A: Within U.S.						
Source: NERD$						
Total expenditure	-90.61	40.94	-349.36	41.06	214.86	41.54
N	158,865		165,514		155,396	
Source: CRDC						
Personnel salary	-66.54	21.97	-456.69	17.78	-15.61	17.81
Teacher salary	-171.86	13.69	-410.49	10.79	-116.50	11.41
N	165,037		170,783		159,090	
Panel B: Within States						
Source: NERD$						
Total expenditure	489.08	38.97	81.43	43.02	474.44	39.35
N	158,865		165,514		153,396	
Source: CRDC						
Personnel salary	39.40	21.79	-80.90	18.81	165.87	17.01
Teacher salary	-83.57	13.08	-114.33	10.88	19.76	10.56
N	165,037		170,783		159,090	

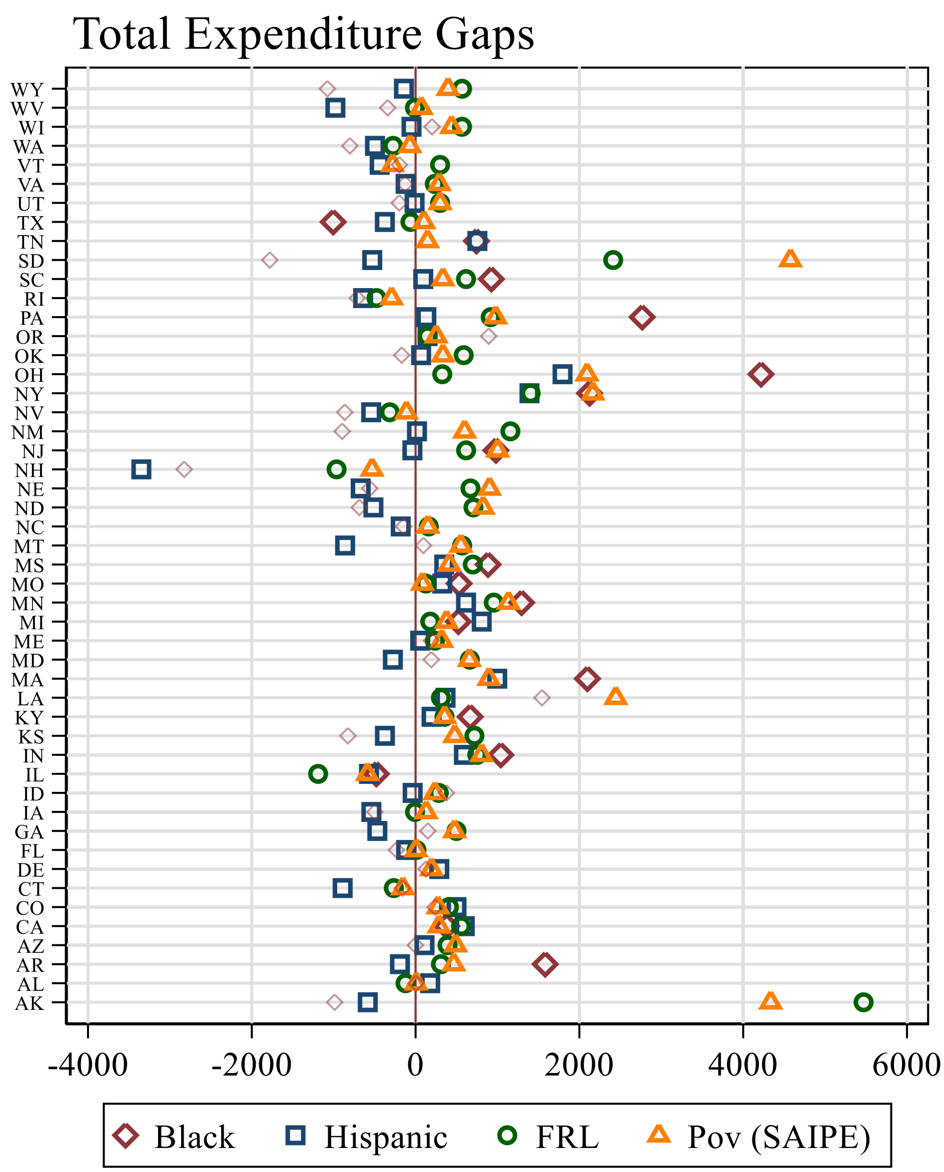
Notes: The above table presents the resource inequality gap at the national level and state level, as in Panel A and Panel B of Table 1 but use school level data (NERD$ and CRDC). All monetary resources are converted into 2017-18 academic year dollar, and adjusted using CWI estimates. In terms of total expenditure, the distribution is regressive across states but progressive within states in general. The FRL-Non-FRL gap is slightly progressive at the national. Personnel salary gaps and teacher salary gaps are regressive for all group pairings at the national level, but this tendency is less clear at the state level. Black students have more personnel salary expenditure within states but less for teacher salary. Hispanic students receive less funding both in personnel salary and teacher salary at the state level, while FRL students get more than their counterparts.

Table A10: Resource Inequality for 2013-14 and 2015-16 Academic Year

	Black-White		Hispanic-White		FRL-Non-FRL (CCD)		Poor-Nonpoor (SAIPE)	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Panel A: 2015-2016 Academic Year								
A1: Within U.S.								
Total expenditure	-37.42	74.44	-962.47	64.44	-344.92	62.13	146.44	79.89
Total revenue	-172.36	70.35	-934.77	60.09	-346.10	58.22	140.29	75.38
Instructional expenditure	-123.18	38.49	-543.16	33.55	-224.98	32.76	3.83	42.37
Capital outlays	-177.99	27.79	-112.62	23.90	-122.50	21.60	-83.96	26.54
N	24,205		25,336		25,182		2,5801	
A2: Within States								
Total expenditure	416.46	51.13	87.77	48.48	319.56	40.90	383.14	50.42
Total revenue	291.19	44.15	41.48	41.69	326.82	35.78	375.78	44.98
Instructional expenditure	13.04	19.76	74.87	18.00	124.11	15.43	119.10	19.11
Capital outlays	-101.60	28.01	-120.30	26.00	-115.61	21.24	-63.76	25.60
N	24,205		25,336		25,182		25,801	
Panel B: 2013-2014 Academic Year								
B1: Within U.S.								
Total expenditure	175.98	72.53	-1198.33	62.92	-241.32	59.72	146.07	76.39
Total revenue	-18.36	70.89	-1399.71	60.95	-365.08	57.99	70.10	74.73
Instructional expenditure	-79.17	37.22	-744.05	32.62	-245.53	31.11	-40.22	39.69
Capital outlays	-50.73	23.53	-22.63	20.39	-13.98	18.32	15.60	22.76
N	24,129		25,270		25,595		25,287	
B2: Within States								
Total expenditure	521.16	52.31	149.25	49.18	403.32	40.17	451.18	50.38
Total revenue	369.69	48.49	31.44	45.20	313.51	37.28	391.81	47.61
Instructional expenditure	17.65	20.41	48.53	18.57	113.35	15.13	126.03	18.68
Capital outlays	-5.81	23.97	-10.64	22.53	-4.76	18.05	20.02	22.24
N	24,129		25,270		25,595		25,287	

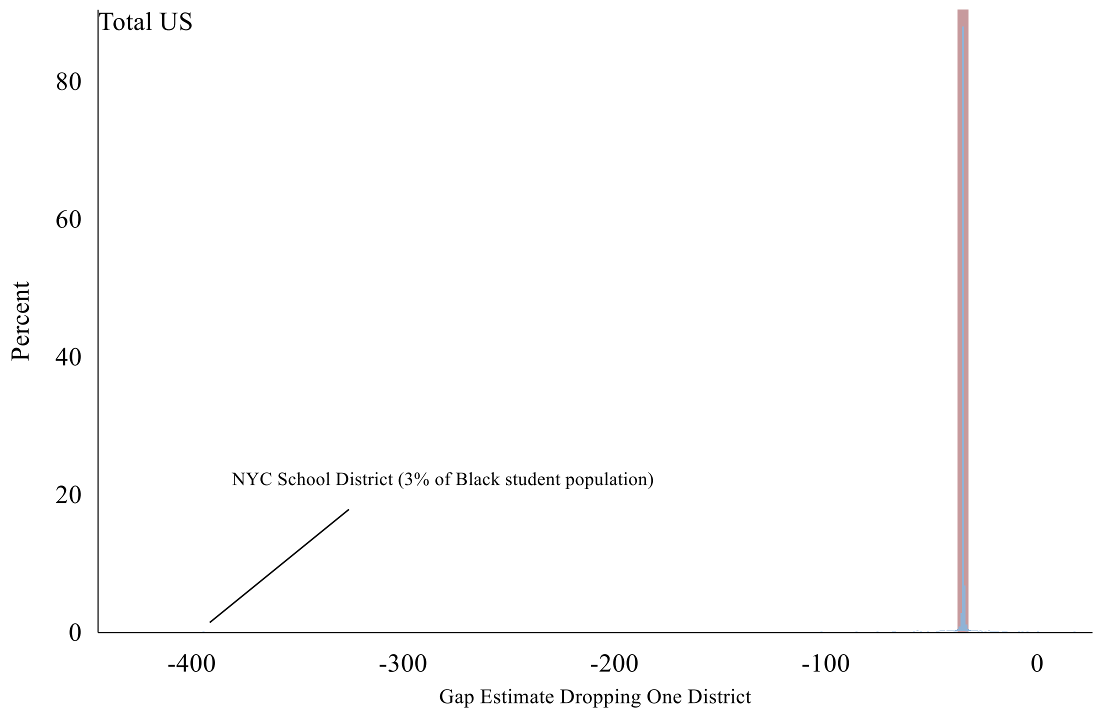
Notes: The table reports the resource inequality gaps for each group pairing at the national level and the state level, but this time, it uses 2013-14 and 2015-16 academic year data. All monetary variables are obtained from F-33 report and converted into 2017-18 academic year dollar and use CWI. The total expenditure and total revenue show the similar pattern that we see in Table 1. The resource distribution is regressive in state level and progressive in state level for Black-White, Hispanic-White and FRL-Non-FRL group pairings. Poor-Nonpoor gap using SAIPE is also same as table 1, which favors disadvantaged group across and within states. However, instructional expenditure and capital outlays show general regressivity at the national level, and capital outlays is regressively allocated at the state level. Some estimates in Poor-Nonpoor gaps are positive, but most of them are not statistically significant.

Figure A1: Total Expenditure Gaps, sorted Alphabetically



Notes: The above figure shows the fixed-effect weighted gap in total expenditure with 95% CI, for all group pairings, sorted alphabetically. Samples include student counts from the CCD for the 2017-18 academic year and district expenditures from the F-33 for the 2017-18 academic year. All outliers are winsorized to be equal to 5 times the value at the 99th percentile. NonFRL and Poverty-NonPoverty group pairings. Samples include student counts from the CCD for the 2017-18 academic year and district expenditures from the F-33 for the 2017-18 academic year. For the Pov-NonPov measure, we use SAIPE estimates for the 2017-18 academic year. All outliers are winsorized to be equal to 5 times the value at the 99th percentile. DE, TN, and MA do not have FRL reports in the 2017-18 CCD. Solid markers indicate statistical significance at 10% levels; faded markers indicate not statistically significant at 10% levels.

Figure A2: Distribution of the Black-White Spending Gap at the National Level, Excluding One District at a Time



Notes: The above figure shows the distribution of Black-White spending gap using jackknife methodology, i.e., eliminating one district iteratively with replacement. In more than 80% of iterations, the Black-White gap is unaffected by dropping a single district. However, when NYC school district is dropped from the sample, the national Black-White spending gap decreases by nearly $400. For detail, see footnotes 11 and Table A7.