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EdWorkingPaper No. 23-752

How and Why Do Estimates of US Education Finance Progressivity Change with School-Level Finance Data?

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How progressive is school spending when spending is measured at the school-level, instead of the district-level? We use the first dataset on school-level spending across schools throughout the United States to ask to what extent progressivity patterns previously examined across districts are amplified, nullified, or reversed, upon disaggregation to schools. We find that progressivity is systematically greater when we conduct a school-level analysis, rather than district-level analysis. This may be surprising, given the traditional view in public economics that local governments cannot effectively redistribute. We thus probe the data for explanations for this pattern, uncovering evidence that federal policies play an important role in driving within-district progressive allocations. In particular, we can explain about 83% of the within-district contribution to progressivity by the federal component of spending plus allocations that are empirically attributable to special education and English language learning programs. Our findings are thus consistent with the traditional view of redistribution being primarily the purview of central governments, operationalized in this context through mandates.

VERSION: March 2023

Suggested citation: Jang, Heewon, and Richard W. Disalvo. (2023). How and Why Do Estimates of US Education Finance Progressivity Change with School-Level Finance Data?. (EdWorkingPaper: 23-752). Retrieved from Annenberg Institute at Brown University: https://doi.org/10.26300/wgf1-bs77

How and Why Do Estimates of US Education Finance Progressivity Change with School-Level Finance Data?*

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Abstract

How progressive is school spending when spending is measured at the school-level, instead of the district-level? We use the first dataset on school-level spending across schools throughout the United States to ask to what extent progressivity patterns previously examined across districts are amplified, nullified, or reversed, upon disaggregation to schools. We find that progressivity is systematically greater when we conduct a school-level analysis, rather than district-level analysis. This may be surprising, given the traditional view in public economics that local governments cannot effectively redistribute. We thus probe the data for explanations for this pattern, uncovering evidence that federal policies play an important role in driving within-district progressive allocations. In particular, we can explain about 83% of the within-district contribution to progressivity by the federal component of spending plus allocations that are empirically attributable to special education and English language learning programs. Our findings are thus consistent with the traditional view of redistribution being primarily the purview of central governments, operationalized in this context through mandates.

Keywords: school finance, fiscal federalism, fiscal competition

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1 Introduction

Every analysis of the distribution of education spending using aggregate data raises the question: how would our inference change if we had information measured closer to students? In particular, *progressivity* – the extent to which disadvantaged students experience more public education spending than advantaged students (B. Baker et al. 2021; Blagg, Gutierrez, and Terrones 2022) – has been analyzed mostly with school district finance data (Chingos and Blagg 2017), and occasionally with school-level data for specific cities or states (Owens and Maiden 1999; Iatarola and Stiefel 2003; Rubenstein et al. 2007; Knight, Karcher, and Hoang 2022). These aggregate analyses potentially mask important patterns that occur inside school districts under diverse state and district policies across the nation. Indeed, from the perspective of fiscal federalism, school districts may rarely progressively distribute spending across schools, given the possible exit of affluent households (Oates 1972; B. D. Baker and Weber 2016). If this holds true, observed progressivity based on district-level aggregate finance data may not be sufficient to inform how resources are delivered to students. Therefore, more fine-grained, disaggregated data would be valuable to capture the direct experiences of students with educational resources.

Very recently, school-level public education spending data for 2018-19 has been released as the National Education Resource Database on Schools (NERD$). This has been driven by the 2015 ESSA reauthorization of the ESEA, which has required states to report school-level public education spending data for every school (Edunomics Lab 2022). Due to its recency, little is known about how the addition of school-level finance data contributes to our understanding of the distribution of educational resources across the country. Lee, Shores, and Williams (2022) examine progressivity within districts, states, and the nation by combining multiple data sources including NERD$. However, while they harmonize school finance data to accurately describe

resource distributions across different levels of governance, they do not directly focus on the implications of the school-level spending information provided by NERD$. Consequently, it is still unknown whether and how this new addition of school-level finance data alters our estimates of school spending progressivity, as well as what explains the discrepancy.

We thus aim to answer two questions using this first nationwide school-level spending dataset. First, how does our inference about public education spending progressivity change when we move from a district-level aggregate analysis to a school-level analysis? Second, why does it change in the way observed? In light of our research motivation, we use the NERD$ data as our only source of spending information throughout the analysis to ensure that our differences in estimates are driven only by aggregation (district- vs. school-level analysis), rather than differences in data sources (by contrast, the analyses in Lee, Shores, and Williams (2022) vary both by aggregation and data source).

The traditional view in the economics of fiscal federalism is that local governments cannot effectively redistribute (Oates 1972; Hindriks and Myles 2013; B. D. Baker 2012; B. D. Baker and Weber 2016), as school districts compete over wealthy parents by conceding redistributive ground. We may therefore anticipate that the resource allocations across schools within local school districts would be at most flat, or possibly regressive. Yet, we find the exact opposite: nationally, and for nearly every state and disadvantaged subgroup, when we disaggregate the data from district to school, we infer *more progressive* school spending allocations. Moreover, relative to overall progressivity, the within-district contribution – the contribution due to disaggregation to the school-level – is quite large. This pattern appears at odds with the traditional economics view.

However, we argue that this inconsistency is a mirage. In particular, we argue, and show empirically, that federal government policy plays a very important role in *constraining* within-district resource allocations. We show that 83% of the within-district contribution to progressivity can be explained away by the federal component of spending plus allocations that are empirically attributable to special education and English language learning programs, both of which can be interpreted as in large part federal mandates on resource allocations. Consequently, and consistent with theory, it is the central government that is adopting the redistributive policies in this environment, but these policies work through constraints on local government action. Indeed, our results suggest that education spending progressivity in the US is an example of what has been referred to in the public finance literature as a "double budget constraint:" the federal government both influences total expenditures (through intergovernmental grants) as well as directly constrains the allocations of local school districts (Levaggi 2002).

The remainder of the paper is organized as follows. In Section 2, we discuss the education finance policy context in the United States, the public economics theory on redistribution within and across local governments, and the literature on school spending progressivity. Section 3 describes how we measure and decompose progressivity. Section 4 introduces the data we use and how we select our analytic sample. Section 5 describes school spending progressivity in the US, contrasting what we would infer with district-level aggregate data versus what we conclude from school-level data. Given that we find the within-district contribution to progressivity is nearly universally positive (and often relatively large), we explore explanations in Section 6, focusing on the role of the federal government in imposing constraints on local school districts. Section 7 concludes.

2 Context, Research, and Theory on School Spending Between and Within Districts

The financing of the US K-12 public education system continues to be mainly the purview of state and local governments (Brimley Jr, Verstegen, and Garfield 2015, Ch. 8). The federal government contributes less than 10% of spending, with state and local governments contributing roughly equally for the rest (Cornman et al. 2021). This devolution to subnational governments raises substantial concerns about across-jurisdiction inequities due to variation in the capacity and willingness to raise and spend tax revenues on public education.

Especially since the 1970s, state-level school finance reforms have increased spending in more disadvantaged school districts within states, improving low-income students' educational opportunities and economic mobility (Jackson, Johnson, and Persico 2016; Hyman 2017; Lafortune, Rothstein, and Schanzenbach 2018). However, from the 1990s, some federal policymakers and advocates expressed concern that the successful pursuit of across-district school finance equalization might have been reversed by unobserved regressive within-district funding allocations (B. D. Baker 2018, chap. 7).

The economic theories of fiscal federalism suggest that these concerns may be justified. The traditional view in this literature contends that central governments must be responsible for redistribution (Musgrave 1959; Oates 1972). Indeed, Oates (2005) calls this argument part of the "first-generation theory" of fiscal federalism. The argument is based on the premise that local governments are constrained in their ability to redistribute due to the mobility of (higher-income) households. If a local government tries to redistribute within its jurisdiction, it will be at a competitive disadvantage relative to governments that refrain, as affluent households will move out of the redistributor. The same intuition applies to local school district decisions: a school district cannot underfund its schools serving its wealthy families and expect the wealthy

residents to stay. This theory has been suggested by prominent education finance scholars (B. D. Baker 2012; B. D. Baker and Weber 2016). From this perspective, it would be surprising to observe progressive within-district educational resource allocations, at least if school districts were left to their own devices.

However, despite substantial devolution of control to state and local governments, federal policy imposes meaningful constraints on within-district allocations, for example, by requiring equal staffing levels in Title I vs. non-Title I schools (Knight, Karcher, and Hoang 2022). This particular constraint nevertheless leaves the "comparability loophole," where equal staffing levels permit staff of different experiences in different schools and, perhaps, regressive allocations of total dollar spending across schools within districts. We might expect such regressive differences to emerge "mechanically" through teacher turnover or filtering combined with experience-based pay scales (Liebman and Mbikiwa 2016).

A second way federal policy influences resource allocations is through the Individuals with Disabilities Education Act (IDEA), which requires schools to provide "specially defined instruction, and related services, at no cost to parents, to meet the unique needs of a child with a disability" (Legislative Analyst's Office 2013). Although IDEA promises federal support for satisfying these requirements, it has been underfunded relative to its promised support (National Council on Disability 2018), which leads states and school districts to seek their own source of funding for special education services.

A third federal policy influence is via English language learning programs. Since the San Francisco *Lau vs. Nichols* (1974) Supreme Court case, the Civil Rights Act of 1964 has been interpreted as requiring Limited English Proficient (LEP) students to receive additional learning support (Euchner 1984; Petrzela 2010). While there is much heterogeneity across states and

districts in terms of which additional learning supports are provided (and this is the subject of considerable controversy), the court ruling and guidelines issued by the Office of Civil Rights have made clear that school districts must allocate resources to provide additional support for English language learners, which can be interpreted as an additional form of federal control over local allocations.

Recently, the 2015 ESSA has added additional language clarifying the conditions under which school districts would comply with the supplement-not-supplant requirements of Title I. Relatedly, ESSA also requires the reporting of school-level spending. Debates have ensued over how to use the newly-required school-level spending data to reform and enforce the Title I supplement-not-supplant requirement (New America 2023). In our study, we employ the required school-level spending data reported under ESSA and compiled by the NERD$ team.

To date, most nationally-comprehensive analyses of education finance progressivity focus on district-level funding (B. Baker et al. 2021; Blagg, Gutierrez, and Terrones 2022). These analyses do not capture the within-district variation in spending. A group of studies addresses school-level funding progressivity within and between districts using data from a few specific states or districts (Owens and Maiden 1999; Iatarola and Stiefel 2003; Rubenstein et al. 2007). Due to the data limitations, these studies have lacked structural assessment across multiple states. We are not the first to study school spending progressivity across schools using the recently-available NERD$ data. For example, Lee, Shores, and Williams (2022) provide a comprehensive analysis of progressivity using NERD$ data combined with other finance datasets. However, we contribute to informing how disaggregation changes estimated progressivity throughout the country using the first available national dataset. We also provide evidence to explain why the estimates change.

3 Analytic Approach

3.1 Measuring and Decomposing Progressivity

In this paper, we employ the "exposure-based" measure of progressivity (see Jang and DiSalvo 2022 for a discussion of alternative measures). Exposure-based progressivity measures the difference in school funding for the average disadvantaged versus advantaged student (Chingos and Blagg 2017). In this section, we introduce this measure as calculated for a particular state t, and for progressivity between free or reduced-price lunch (FRPL) students and the rest (i.e., nonFRPL). Note that the measure can also be defined for a nation (e.g., by replacing t with nation) or for other subgroups (e.g., racial subgroups, by replacing FRPL status with a racial subgroup).

Formally, let P_t be state-level funding progressivity for state t. P_t is defined as the difference in the average school spending between FRPL and nonFRPL students in the state. Formally, let N_{fs} (or N_{ns}) and N_f (or N_n) be the number of FRPL (or nonFRPL) students in school s and in the entire state, respectively, and $PPSPEND_s$ be school-level per pupil spending in school s. Then the exposure-based progressivity of school funding for state t, denoted as P_t, is computed as

$$\begin{aligned} P_t \quad &= (\text{per pupil spending in the average FRPL students' school}) \\ &\quad -(\text{per pupil spending in the average non-FRPL students' school}) \\ &= \sum_{s\in t} \frac{N_{fs}}{N_f} PPSPEND_s - \sum_{s\in t} \frac{N_{ns}}{N_n} PPSPEND_s = \sum_{s\in t} \left(\frac{N_{fs}}{N_f} - \frac{N_{ns}}{N_n}\right) PPSPEND_s \end{aligned} \qquad (1)$$

This measure of progressivity is analogous to exposure-based measures of school segregation (e.g., differences in exposure to poverty). We can therefore adapt methods from prior studies of school segregation (Reardon and Firebaugh 2002; Jang 2022) to decompose P_t into the shares driven by between-district variation versus within-district across-school variation. Specifically,

letting N_{fd} (N_{nd}) be the number of FRPL (non-FRPL) students in district d, state-level funding progressivity P_t can be decomposed into between-district progressivity (P_D) and a weighted average of within-district progressivity (P_d),

$$P_t = P_D + \sum_{d \in s} w_d P_d \tag{2}$$

Where

$$P_D = \sum_d \left(\frac{N_{fd}}{N_f} - \frac{N_{nd}}{N_n} \right) PPSPEND_d \,;\; P_d = \sum_{s \in d} \left(\frac{N_{fs}}{N_{fd}} - \frac{N_{ns}}{N_{nd}} \right) PPSPEND_s \,;$$

$$w_d = \frac{\pi_d (1 - \pi_d) N_d}{\pi (1 - \pi) N}$$

The within-district component of funding progressivity $\sum_{d \in s} w_d P_d$ is a sum of within-district funding progressivity P_d weighted by within-district student diversity and district size w_d. More diverse districts (measured by the variance of socioeconomic composition, i.e., $\pi_d(1 - \pi_d)$) and larger districts (i.e., N_d larger) get more weight. Note that P_D in Equation 2 is the progressivity statistic we would calculate were we to conduct the analysis at the district level. In other words, P_D is the progressivity statistic that would be calculated if we assumed school districts had equal spending across schools within their jurisdictions. Our analysis is thus to consider P_D in contrast to the addition $\sum_{d \in s} w_d P_d$, which we call the "within-district contribution" to progressivity: it is what happens to our estimate of progressivity *because* we have school-level, rather than district-level, data.

3.2 Adjusting Progressivity for Federal Contributions and Program Participation

To shed empirical light on the relative importance of the federal government in observed progressivity, we re-examine progressivity with alternative measures of per-pupil school

spending. First, we remove all federal contributions to spending. Since the NERD$ data provides federal spending separated from (combined) state and local spending, it is straightforward to remove these contributions. (The NERD$ data does not separately report state and local spending.)

Second, to study the role of federally-mandated programs, we adjust spending for student program participation. We focus on students with disabilities (SWD; defined by Section 504 and IDEA) and limited English proficient (LEP) programs. The NERD$ data unfortunately does not provide direct measures of spending on these programs. Therefore, we instead use regression adjustment to infer, for each state, the contribution of spending due to these programs. In other words, we study to what extent we can explain the within-district state and local progressivity we observe using school-level participation rates in these programs.

Specifically, we estimate school-level per-pupil state and local spending adjusted for the school's participation rates in SWD and/or LEP programs (these rates are provided in the CRDC data). Call this adjusted per pupil state and local spending $PPSPEND_{st}^{adj}$ for school s in state t. In order to ensure adjusted spending is positive, we employ a model of log spending as a function of SWD and LEP program participation. Our complete model is,

$$\log(PPSPEND_{st}) = \alpha_t + \beta_t \%SWD_{st} + \gamma_t \%LEP_{st} + u_{st} \quad (3)$$

We fit this regression model using ordinary least squares. The coefficients α_t, β_t and γ_t are allowed to vary by state t. While this equation is our completely adjusted model, we also include analyses that adjust for one of SWD or LEP only to examine the influence of each control variable individually.

Our goal is to predict spending in each school under the assumption that the school has the state-level mean shares of SWD and LEP. To do this, we calculate adjusted school per-pupil spending as (again, in our complete model),

$$PPSPEND_{st}^{adj} = \exp\left(\alpha_t + \beta_t \overline{\%SWD}_t + \gamma_t \overline{\%LEP}_t + u_{st}\right) \quad (4)$$

This expression for adjusting spending always yields a positive amount of spending. We then repeat our progressivity analysis, calculating progressivity across states and decomposing it into across-district and within-district components, using $PPSPEND_{st}^{adj}$.

4 Data

For our study, we combine three datasets: the National Education Resource Database on Schools (NERD$) data for 2018-19, the Longitudinal School Demographic Dataset (LSDD) for 2018-19, and the Civil Rights Data Collection (CRDC) for 2017-18 (CRDC is not available for 2018-19). Table 1 provides summary statistics on the variables we use from these sources. Columns (1) through (5) provide summary statistics for our analytic sample, and Columns (6) and (7) provide statistics for the original data.

The original school-level data from NERD$ contains information on schools in all states except South Dakota. Panel A of Table 1 provides selected summary statistics for our school-level spending data. We make the following cuts and cleans in extracting our analytic sample from this original data. First, we noticed that the original NERD$ data has extreme outliers in spending, as mentioned in Lee, Shores, and Williams (2022) (see column (6) of Panel A in Table 1). We thus remove schools from our analysis that reported more than $50,000 in spending per pupil. Second, we remove schools with zero reported enrollment. We also replaced recorded negative spending with zero spending; this affects a very small number of schools (between 50

and 70 schools, depending on the spending measure). Note that the sample size is smaller for the data broken down by spending sources (federal versus state and local) because a few states, including Ohio and Oregon, did not report these data.

Of these restrictions, the most consequential is our removal of outlier schools based on spending. The exposure-based progressivity measure is based on means, and so is sensitive to outliers. As shown in Table 1, column (6), there are schools with over 10 million dollars of per-pupil spending, and these schools, if included, would drive the progressivity measures we report.[1] We considered comparing the medians rather than means for our analysis, motivated by this issue. However, we decided to use means for two reasons. First, the decomposition of progressivity that we conduct (described in Equation 2, introduced in Section 3) is only valid for means, and there is no similar decomposition for medians. Second, the median is not commonly employed in social welfare analysis, while the mean corresponds to the utilitarian social welfare function with linear individual student utilities (Weymark, 2016).

Derived from the National Center for Education Statistics (NCES) Common Core of Data (CCD), the LSDD identifies and imputes data anomalies and missing values in the CCD. It provides total student enrollment in schools disaggregated by grade, race (White, Asian, Black, and Hispanic), and FRPL eligibility. Panel B of Table 1 provides summary statistics on these student sociodemographic and enrollment variables. We use LSDD instead of the raw CCD mainly due to its data quality in FRPL counts. For our study, it is essential to obtain accurate values of FRPL counts as our foremost progressivity calculation involves per-pupil spending differences between FRPL and non-FRPL students. However, the CCD has known flaws in their

[1] We considered excluding schools with very low spending per-pupil, but we decided against setting a cutoff for the left-tail since even schools at zero dollars of reported spending per pupil are not pivotal outliers relative to the average.

FRPL counts for a few reasons. First, there has been an unreasonable drop or surge in FRPL counts over the years in a few states (Keaton 2012). Second, since the implementation of the Community Eligibility Provision (CEP) in 2011-12, schools and districts are allowed to count all students as free/reduced-price lunch eligible if more than 40% of their students are directly certified for free meals. The LSDD addresses these issues through exploratory data analysis and multiple imputation (for more details, see Reardon et al. 2022).

In addition, we use the LSDD to classify schools into primary or secondary schools based on the following criteria: a secondary school is any school with a twelfth grade, while a primary school is any school without a twelfth grade but with at least one grade eight or lower. In Panel D of Table 1, we show that the vast majority of schools are classified as primary or secondary in this way (less than 1% of schools remain uncategorized).

Finally, we use two student program participation measures from the CRDC: (a) the percent of students with disabilities (SWD) based on Section 504 and IDEA program participation and (b) the percent of limited English proficient (LEP) students. Summary statistics for these participation rates are provided in Panel C of Table 1. Notice in column (4) that the maxima of these measures are unreasonably high, even in our analytic sample. When we control for these variables, we first replace values that exceed 100% with 100% (i.e., we winsorize at 100%). For this reason, we do not restrict the data to eliminate these outliers.

5 Aggregate versus Disaggregate Progressivity

We now turn to our comparisons of what we infer about progressivity using district-level aggregated data versus what we infer when we disaggregate to the school level. To begin, Figure 1 provides these estimates at the national level. Focusing on the first bar of the figure, we find that nationwide FRPL-NonFRPL progressivity at the district level (the darker shaded bar) is

slightly negative. However, when we include within-district variation in spending, we add the lightly shaded portion of the bar to form total progressivity, represented by the "x" in the figure. Total national FRPL progressivity is modestly positive when measured at the school level. While the overall progressivity and size of the components vary by subgroup comparison, the results show that disaggregation to the school level *increases* inferred progressivity in all cases.

It is important to recognize that the magnitudes of progressivity we infer are not large. Average school spending (Table 1) in our data is approximately $13,000 per pupil (weighting schools equally), while the FRPL-NonFRPL and URM-NonURM gaps in exposure to spending are only about $200 per pupil. Still, relative to this overall progressivity, the within-district contribution appears quite important.

Given that the US arguably consists of 51 separate school finance systems (Brimley Jr, Verstegen, and Garfield 2015, Ch. 7), concerns arise that the results in Figure 1 are an artifact of across-state comparisons. Figure 2 dispels these concerns. In these figures, we repeat the progressivity and decomposition analysis for each state separately, for FRPL-nonFRL and URM-nonURM progressivity. For our purposes, the most important takeaway from these figures is that the lightly shaded gray bars, i.e., the contribution of school-level data, are nearly universally positive. Moreover, relative to total progressivity, the within-district contribution is quite large. The figures further show that most states are (modestly) progressive in their allocations. States where many schools are concentrated in relatively few school districts (e.g., NY, FL, NC) have relatively large increases in progressivity when we disaggregate.

Finally, we split our analysis by grade level, conducting the progressivity and decomposition analysis for primary and secondary schools separately. There are three motivations for splitting the analysis by grade level. First, we may be concerned that our earlier

findings are driven by across-grade variation in spending, perhaps combined with different dropout or retention rates across subgroups, so that high schools are systematically more or less disadvantaged than primary schools and more or less funded (B. D. Baker 2018, chap. 7). Second, we may care about progressivity at the primary school level more than at the secondary school level, if we, for example, believe equality of opportunity should be especially ensured for the youngest children. Third, primary schools are structurally different than secondary schools. There are many more primary schools, and within-school targeting of resources may be less relevant for primary schools as they are less likely to track students. School-level measures of spending are required to shed any light on the progressivity of spending across grade levels since the vast majority of school districts in the US are unified (i.e., serving both elementary and secondary grades).

The results of our primary and secondary progressivity analysis are displayed in Figure 3. First, the figure shows that our main finding, that disaggregation to the school-level increases inferred progressivity, is maintained throughout each grade level and subgroup combination. Second, it is unclear whether primary schools have systematically more or less progressivity than secondary schools. For FRPL, primary schools are less progressive, but for the race and ethnicity splits, primary schools are more progressive.

6 The Role of Federal Policy

Given the traditional view in public economics, discussed in Section 2, that due to intergovernmental competition local governments cannot effectively redistribute, it is arguably surprising that we find consistent evidence that the within-district contribution to progressivity is not only positive, but large relative to overall progressivity (recall Figure 1). Why do local school districts *seem* to be redistributing within their borders?

In this section, we argue local governments only *seem* to be redistributing, and in fact, the primary explanation for these surprising patterns is that the federal government has imposed controls on local government resource allocations that lead to observed within-district progressive allocations. This evidence suggests that the data is in fact consistent with the traditional view in public economics: it is the *central* government that is redistributing, but in this context, it is redistributing, at least partly, via imposing local mandates.

We provide empirical evidence on the relevance of these constraints by recalculating progressivity after spending adjustments that remove (either directly or through regression-adjustment) parts of spending allocations that are plausibly due to federal controls. Our methods were described in subsection 3.2. We find that, nationally, we can explain 83% of the within-district component of FRPL progressivity with these adjustments. We describe our results in more detail in the remainder of this section.

6.1 The Role of Federal Funds, and the Title I "Supplement-not-Supplant" Policy

Since the NERD$ data provides federal spending separated from state and local spending, to shed light on the federal role, we repeat our progressivity analysis removing federal spending from the analysis entirely. Figure 4 shows the results of this analysis. The most striking pattern in the figure is that the contribution of federal funding to overall progressivity is substantial. Indeed, the overall progressivity for three out of four of the analyses switches from positive to negative after we remove the federal contribution.

Examining the figure more carefully in light of our goal, which is to explain the positive within-district contribution to progressivity, we see that when we remove federal spending, the within-district contribution remains positive in all cases, but it substantially smaller. Focusing on the FRPL progressivity, we see that the within-district contribution is cut by about 40% (or about

$101 per pupil). Similarly, the within-district contribution for URM progressivity is also cut by 33% (or about $72 per pupil). In other words, the within-district state and local spending allocations remain progressive, but are much less progressive than total spending (inclusive of federal).

In Figure 5, we examine the within-district contribution to progressivity by state, before versus after removing federal spending, focusing on FRPL-nonFRPL spending progressivity only. This figure shows that our national result is not driven by particular states or by across-state variation. Indeed, in practically all states, the within-district contribution to progressivity falls substantially when we remove federal spending. In the median state (Washington), the within-district contribution falls from $429 to $337, a 21.5% decline.

6.2 The Role of Mandated Educational Programs: Special and English Language Education

Figure 4 makes clear that the federal government plays an important direct role in driving within-district allocations to be progressive, but nevertheless state and local within-district allocations remain progressive. But, as we described in Section 2, Title I and direct federal outlays are not the only way that the federal government constrains local school district allocations. There are also mandates, the most important of which are specific educational programs for students with disabilities (SWD) and limited English proficient (LEP) students.

The results from this analysis are displayed in Figure 6. The "No Fed" bars in the figure repeat the progressivity analysis without federal spending (as in Figure 4), while the "+SWD+LEP Adj" bars additionally adjust this state and local spending according to Equation 3; the bars between these adjust for only SWD or only LEP, respectively. For FRPL and URM progressivity, the SWD and LEP adjustment reduces the within-district contribution of progressivity substantially: by 71% for FRPL, and by 58% for URM. The reductions are more

modest for black-white progressivity. Finally, for Hispanic-white progressivity, the adjustment completely eliminates the within-district contribution; this is mostly driven by the LEP spending adjustment. This pattern is consistent with the high rates of participation of Hispanics in English language learning programs (US Department of Education 2017).

In Figure 7, we examine the within-district contribution to FRPL-nonFRPL progressivity by state, restricting to state and local spending only, before versus after adjusting for SWD and LEP school-level shares. This figure shows that our results are not driven by particular states or by across-state variation. Indeed, in practically all states, the within-district contribution to state and local progressivity falls substantially when we regression adjust for these programs. In the median state (Michigan), the within-district contribution falls from $50 to -$3, a greater than 100% decline.

Taken together, our interpretation is that federal mandates for the funding of these programs tie the hands of local governments, and therefore force the within-district allocations to look progressive, despite interjurisdictional competition. In short, the observed within-district positive contribution to progressivity is, in fact, due to the policies of higher levels of government, rather than school board discretion. This rationalizes this pattern in light of the traditional fiscal federalism intuition that higher levels of government are more capable of redistribution.

7 Conclusion

Since school spending progressivity is concerned with the distribution of educational investments delivered to students, the most accurate estimates of progressivity are those that use spending measured closer to students. Using the first nationwide school-level finance data, this study investigates how estimates of progressivity change when we disaggregate the analysis from

the district- to the school-level. We called this change the "within-district contribution" to progressivity since it reflects how estimated progressivity changes when we include variation in spending across schools within school districts. We studied this nationally, by-state, and for different disadvantaged student subgroups.

Traditional arguments from public economics, based on the theory of fiscal federalism, suggest that school districts in competition would not be able to distribute school spending progressively within their boundaries. If a district tried to do so, it would lose wealthy taxpayers to competing districts. This line of argument does not correspond to our finding that the within-district contribution to progressivity is positive and, relative to the total size of progressivity, quite large. In other words, there is a meaningfully progressive distribution of public education spending inside school districts, apparently contrary to the traditional theory.

However, we find that the traditional theory can still rationalize these patterns. In particular, we show that it is federal government policy, including direct federal contributions to school spending as well as mandated programs for students with disabilities and English language learners, which constrain local school districts to allocate progressively across their schools. In our empirical test, we can explain 83% of the within-district contribution to progressivity through factors plausibly driven by federal policies. In other words, the central government plays an important role in tipping within-district school finance toward a progressive system through both its direct allocations and its mandates on district allocations.

While we typically find progressive allocations based on the school-level spending data, it is important to recognize several caveats of our analysis. First, the school-level spending data we employ contains only current expenditures, not capital expenditures, and the latter may be regressively allocated. Second, we studied dollars of spending without adjusting for student

needs, but the needed amount of public education spending to achieve equitable outcomes is likely to differ by students based on their level of disadvantage; indeed, the observed greater rates of program participation for disadvantaged subgroups reflect greater need (Sweetland 2015; B. Baker 2020). Third, our study only includes reported public expenditure and does not account for unobserved parental contributions to the school, which may be significant and are likely to vary substantially across levels of family disadvantage. Fourth, while we study the implications of disaggregation to the school level, we do not have data on how investments are allocated within schools, which may be important for accurately estimating progressivity and choosing the measure of progressivity (Jang and DiSalvo 2022).

While our study has many caveats and leaves many opportunities for future research, an important policy implication of our analysis is that while the within-district spending allocations are substantially progressive, this does not imply an equity-based argument for greater local control of resource allocations. In fact, we argue that the observed progressive within-district allocations can be largely explained by central government policy. Overall, we would expect less progressive resource allocations if central governments loosened their constraints on local school districts and permitted local authorities more discretion.

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Tables and Figures

Table 1. Summary Statistics, Analytic Sample and Original Data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Analytic Sample					**Original Data**	
Variable	**Mean**	**SD**	**Min**	**Max**	**N**	**Max**	**N**
Panel A: School-Level Spending Per-Pupil (Source: NERD$)							
Total	13,002	5,498	0	49,957	90,361	1.89e+7	91,578
State and Local	11,952	5,299	0	49,390	85,260	1.89e+7	86,469
Federal	956	1,074	0	25,123	85,263	1.58e+6	86,470
Panel B: Student Sociodemographics and Enrollment (Source: LSDD)							
Percent Free/Reduced-Price Lunch (FRPL)	55	26	0	100	90,361	100	94,147
Percent Underrepresented Minority	45	32	0	100	90,361	100	94,147
Percent Black	15	23	0	100	90,361	100	94,147
Percent Hispanic	24	27	0	100	90,361	100	94,147
Total Enrollment	546	450	1	14,306	90,361	14,306	94,147
Panel C: Student Program Participation (Source: CRDC)							
Percent Students with Disabilities (SWD)	16	10	0	200	87,888	300	90,897
Percent Limited English Proficient (LEP)	10	15	0	140	87,888	140	90,896
Panel D: School Grade Level Category (Source: LSDD)							
Is Primary School	0.75	0.43	0.00	1.00	90,249	1.00	93,888
Is Secondary School	0.24	0.43	0.00	1.00	90,249	1.00	93,888
Is Uncategorized	0.00	0.06	0.00	1.00	90,361	1.00	98,026

Notes: All statistics reported are calculated across schools, weighting schools equally. N = Number of schools with non-missing data; SD = standard deviation. The analytic sample has 50 states inclusive of DC (South Dakota is unavailable), but New Hampshire, Ohio, and Oregon data do not include federal funding separately from state and local and are therefore dropped when we require these for analyses. Underrepresented minorities (URM) are defined to be all non-white, non-Asian, racial subgroups.

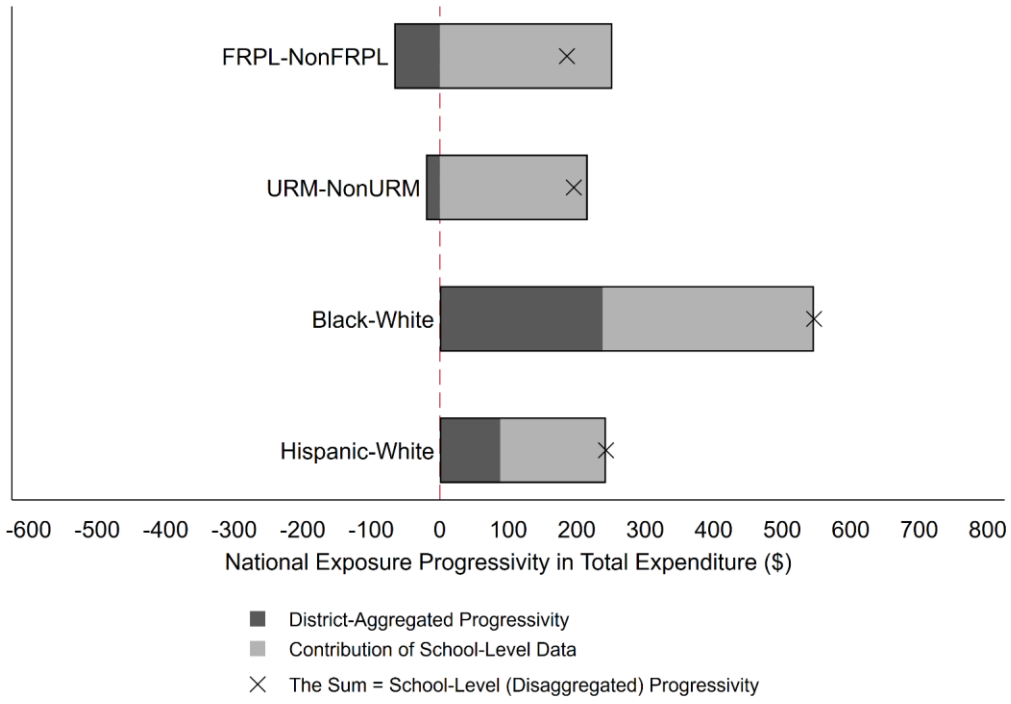

Figure 1: *Progressivity and Disaggregation Nationally.*

Text labels represent the student subgroup for which progressivity is calculated: FRPL-NonFRPL = free/reduced-price lunch versus other students progressivity; URM-NonURM = underrepresented minorities (all racial or ethnic subgroups besides white and Asian, versus the white and Asian subgroups) versus white and Asians progressivity; Black-White = black-versus-white progressivity; Hispanic-White = Hispanic-vs-white progressivity. Figure displays total (exposure-based) progressivity as an "x," while contributors to progressivity are displayed as shaded components of the bar chart. The "District-Aggregated Progressivity" is the amount of progressivity that would be inferred if we use our data aggregated to the district-level, which we call the "between-district contribution;" while the "Contribution of School-Level Data" is how our estimate changes when we use school-level information instead; we also call this the "within-district contribution." Note that state-level total progressivity is at the end of the bar except when the within-district and between-district contributions of progressivity have opposite signs, then total progressivity is the difference between these two components.

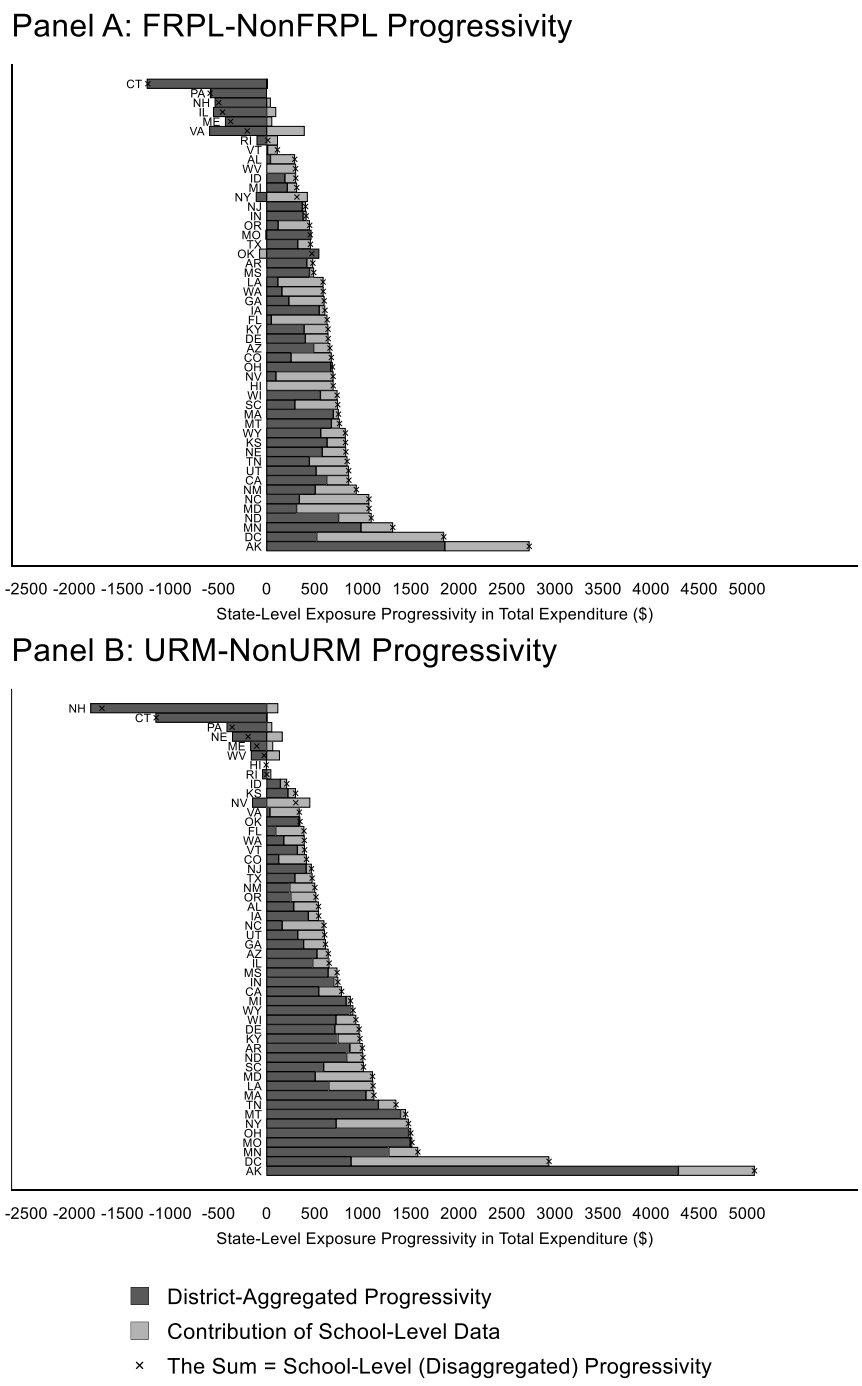

Figure 2: *Free/reduced-price Lunch (FRPL) and Underrepresented minority (URM) Progressivity and Disaggregation by State.*

See notes to Figure 1 for descriptions of the symbology, except that instead of showing progressivity for different subgroups, this figure displays progressivity and its decomposition for different states, for the FRPL-NonFRPL case in Panel A, and for the URM-NonURM case in Panel B (other cases are not included).

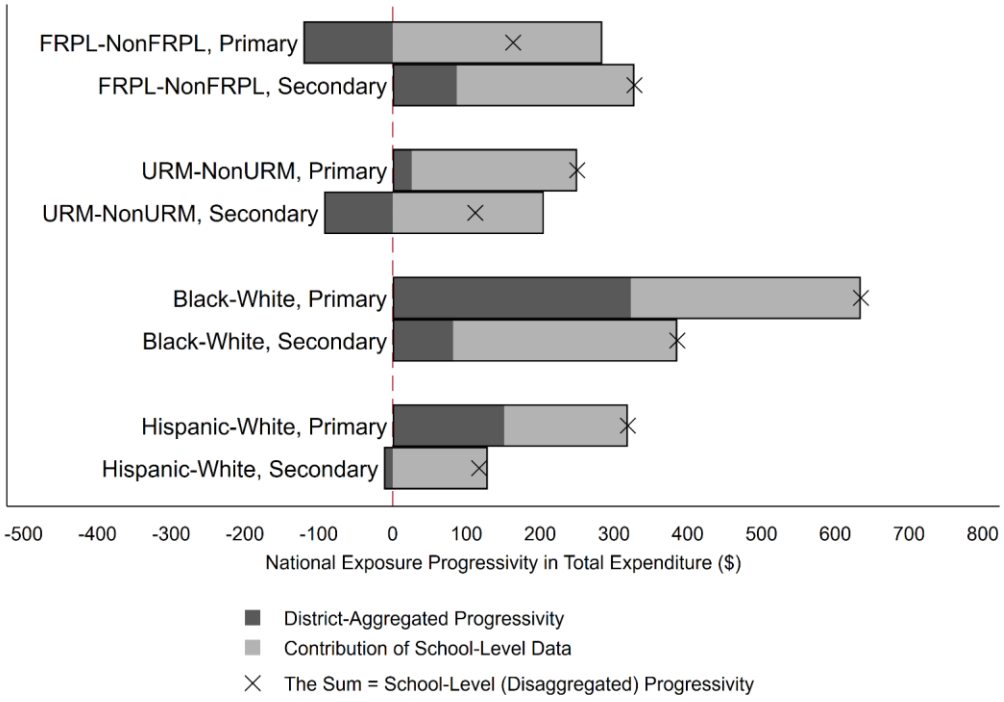

Figure 3: *Progressivity and Disaggregation for Different Grade Levels.*

Figure is analogous to Figure 1, except the progressivity estimates are split by primary schools only, or secondary schools only. We define a secondary school as a school with a twelfth grade. We define a primary school as a school without a twelfth grade, and which contains at least one grade eight or lower. See Table 1, Panel D for a breakdown of school classification, which shows that the vast majority of US schools are classified as either secondary or primary based on this approach.

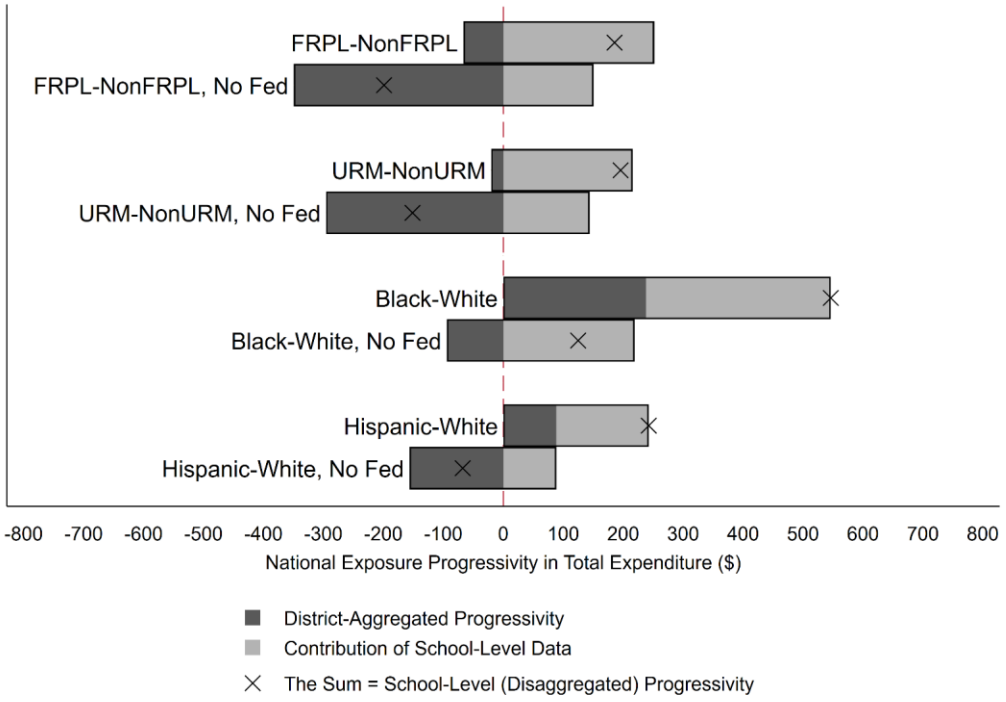

Figure 4: *National Progressivity and Disaggregation, With vs. Without Federal Spending.*

Figure is analogous to Figure 1, except the progressivity analysis is repeated after removing all federal spending (in bars labeled "No Fed").

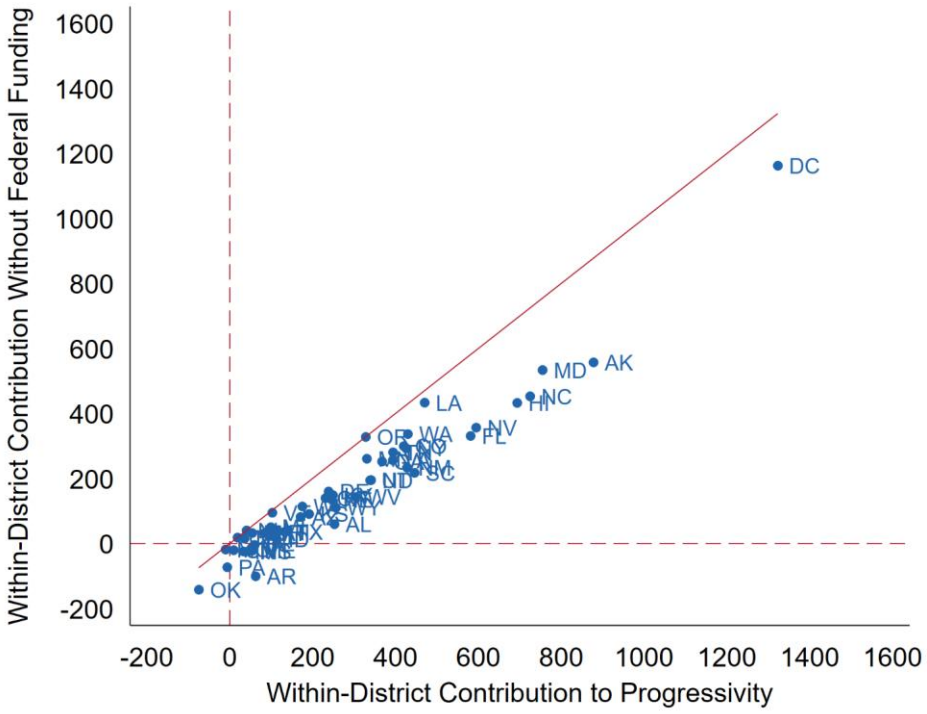

Figure 5: *Contribution of School-Level Data to FRPL-NonFRPL Progressivity By-State, With vs. Without Federal Spending.*

Figure displays the contribution to school-level data to progressivity only, for each state in our data with (inclusive of Washington DC, but excluding the states NH, OH, OR, and SD due to lack of data). Along the x-axis is plotted the within-district contribution for total spending, this is the same as the lightly gray shaded bars in Figure 2. Along the y-axis is what happens to this component when we re-run the progressivity analysis, by state, removing federal funding. Figure includes a 45-degree line and dashed guidelines at the zeroes.

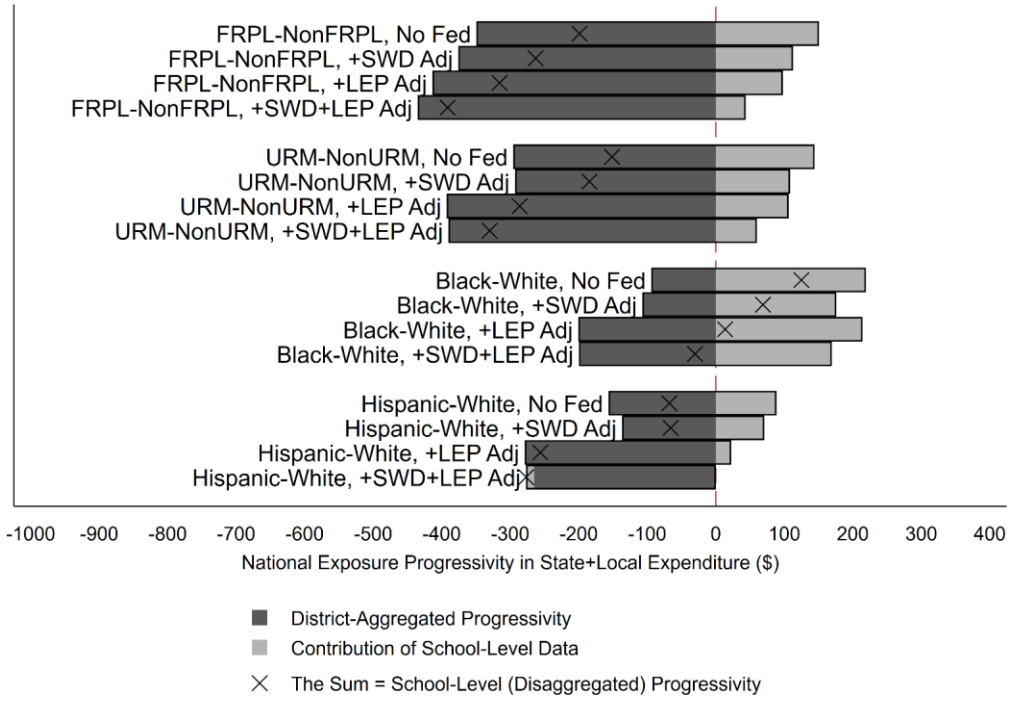

Figure 6: *National Progressivity and Disaggregation, After Removing Federal Spending, and Before vs. After Adjusting for SWD and LEP Shares.*

Figure is analogous to Figure 1, except the progressivity analysis is repeated after removing all federal spending (in bars labeled "No Fed"), and after removing federal spending and additionally adjusting for school-level students with disabilities (SWD) and limited English proficient (LEP) shares (in bars labeled "Adj No Fed").

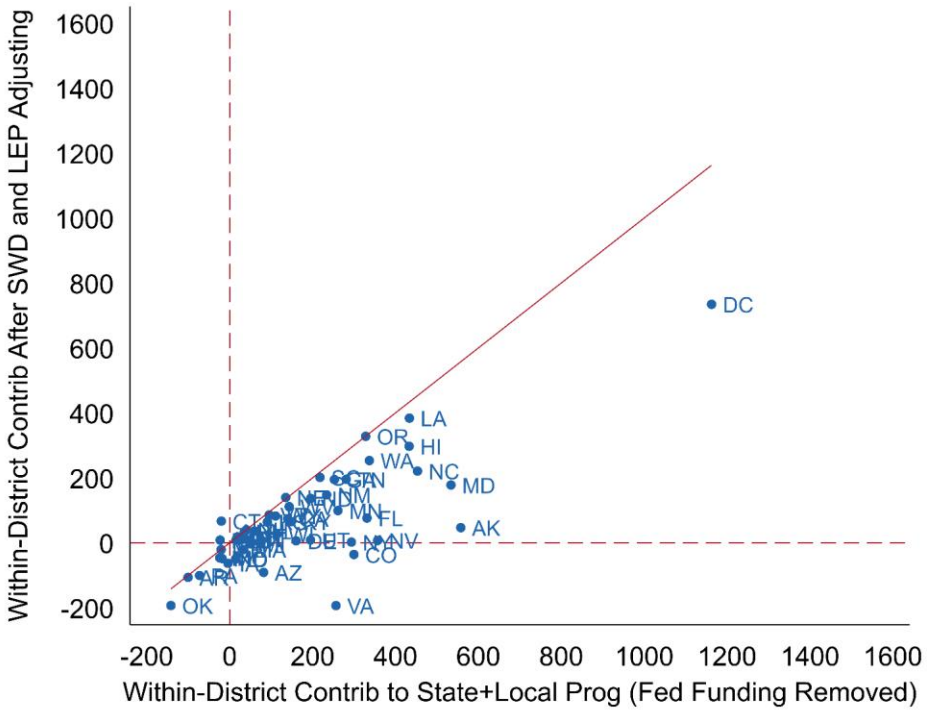

Figure 7: *Contribution of School-Level Data to FRPL-NonFRPL Progressivity By-State, After Removing Federal Spending, and Before vs. After Adjusting for SWD and LEP Shares.*

Figure is analogous to Figure 5, except the x-axis displays the state-level within-district contribution to progressivity after removing federal spending, and the y-axis displays this contribution after removing federal spending and additionally adjusting for school-level SWD and LEP shares. Figure includes a 45-degree line and dashed guidelines at the zeroes.