School Accountability, Underfunding, and Inefficiency

Technical Appendix

Drew Atchison

Damon Blair

Bill & Melinda Gates Foundation Research Grant INV-080738

June 2025

American Institutes for Research® | AIR.ORG

AIR®
Advancing Evidence.
Improving Lives.

Contents

Exhibits

This document is the technical appendix for the report entitled *School Accountability, Underfunding, and Efficiency: Findings in Brief*. Whereas the main document has a holistic narrative including scope, methodology, findings, and discussion, this document provides more information about methodology and analyses.

Appendix A. Data Sources

To facilitate the analyses, we compiled a comprehensive school-level dataset that includes (a) spending per pupil, (b) student outcomes, (c) student demographics, and (d) other contextual and geographic characteristics of schools that affect spending from the 2017–18 to 2022–23 school years.

The Ohio Department of Education and the Workforce (ODEW) provided detailed fiscal data between 2018 and 2023, allowing us to calculate total spending per pupil for each school as well as categorize spending into the following functions: food services, general administration, instruction, instructional staff support, operations and maintenance, pupil support, school administration, transportation, and other non-specified support. Definitions for these function categories are provided below. Centralized district-level expenditures from each respective category were allocated across schools proportionally to each school's share of the total district enrollment. We additionally compiled data on school improvement funds associated with Section 1003 Part A of ESSA, available through U.S. Department of Education's ED Data Express for the school years 2018 through 2021.

We gathered publicly available school-level outcome data including 4-year graduation rates, math and English language arts (ELA) proficiency rates, and chronic absenteeism from ODEW's report card database. Using these student outcome data, we constructed an "outcome factor score" as a single measure using confirmatory factor analysis. We describe the creation of the outcome factor score in the following subsection.

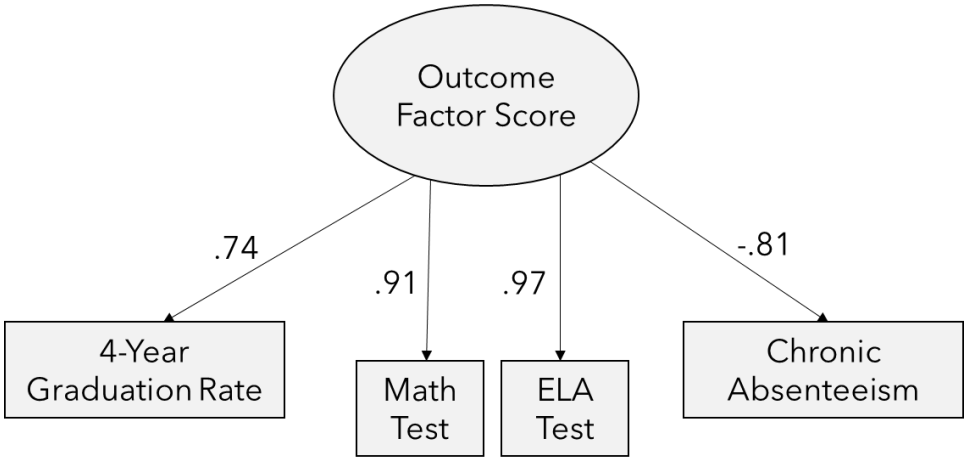
We also compiled a variety of data on school enrollment and student characteristics from ODEW's report card database including counts and percentages of students by race/ethnicity, English learner status, disability status, and grade level. Because of issues related to the distribution of the state's measure of economic disadvantage, we opted to use the Urban Institute's Modified Model Estimates of Poverty in Schools (MEPS) as the primary measure of economic disadvantage. In particular, Ohio's state measure of economic disadvantage identifies many schools as having 100% economic disadvantage due to use of the Community Eligibility Provision, which allows schools to provide universal free meals to students and discontinue tracking eligibility of individual students.

Data on school characteristics including charter status, school type, grade levels served, zip code, and urbanicity were gathered from the National Center for Education Statistics (NCES) Common Core of Data. We used the NCES's Comparable Wage Index for Teachers (CWIFT) as a measure of geographic price differences. We also compiled a number of other contextual variables including the NCES Education Demographic and Geographic Estimates (EDGE) income-to-poverty ratio (IPR), and zip code-level variables (population density, percentage of population that is 65 or older, percentage of population who have a bachelor's degree, percentage of housing units that are vacant) from the 2020 decennial Census.

Outcome Factor Score Creation

We used confirmatory factor analysis estimated using a structural equation model (SEM) to combine four distinct school-level outcomes—English language arts (ELA) proficiency rates, math proficiency rates, chronic absenteeism, and 4-year graduation rates—into a single, comprehensive score called the outcome factor score. This score provides a more holistic representation of a school's performance than any individual measure. The confirmatory factor analysis treats the overall outcome measure as a latent variable, which is estimated to optimally fit the data. Instead of arbitrarily assigning weights to each outcome, the model leverages the existing variation in outcomes in each measure to determine their relative significance to the unobserved aggregate outcome score. This approach facilitates the generation of a factor score even when some individual measures are missing for a certain school. Exhibit A1 illustrates the SEM and standardized factor loadings used to calculate each school's outcome factor scores. All outcomes had strong factor loadings, with ELA test proficiency rates having the strongest factor loadings at .97 and the 4-year graduation rate having the weakest at .74.

Exhibit A1. Outcome Factor Score Structural Equation Model



Note: The values showing the relationship between the outcome factor score and each outcome measure are standardized factor loadings, meaning they represent the increase in outcome in SDs from a one SD increase in the outcome factor score.

Definitions of Spending Categories

Definitions of the spending categories used in addressing RQ2 are shown in Exhibit A2.

Exhibit A2. Ohio Spending Category Code Organization, Respective Function Codes, and Definitions

Spending Category	Spending Function Code	Spending Category Description
Instruction	1100: Regular	Instructional activities designed primarily to prepare pupils for the activities as citizens, family members, and workers, and are contrasted with programs designed to improve or overcome physical, mental, social and/or emotional handicaps.
	1200: Special Instruction	Instructional activities designed primarily to deal with pupil exceptionalities. The special instruction service areas include Pre-primary, Elementary, and Secondary services for the: (1) academically gifted; (2) handicapped; (3) culturally different; (4) disadvantaged; and (5) other special.
	1300: Vocational Instruction	Instructional activities designed to prepare youths and adults, in an efficient and timely fashion, to make informed career choices and to successfully enter, compete, and advance in a changing work world.

Spending Category	Spending Function Code	Spending Category Description
	1900: Other Instruction	Includes instruction not defined previously (e.g., summer remediation, student intervention services, supplemental instruction.)
	4100: Academic Oriented Activities	A combination of subject matter and experiences, usually not provided in a regular class, designed for pupils who wish to pursue satisfying individual/group interest and study in specific aspects of the subject matter provided in a regular class. Frequently emphasized are opportunities for pupils who will enrich their regular classroom and personal lives. Included in this category are (1) Subject Oriented Activities, (2) Language Oriented Activities, (3) Music Oriented Activities, and (4) Honor Societies.
	4300: Occupation Oriented Activities	A combination of subject matter and experiences, usually not provided in a regular class, designed for pupils who wish to pursue satisfying individual/group interest in various occupational areas.
	4600: School and Public Service Co-Curricular Activities	Included here are civic and social oriented activities organized primarily to provide for pupil participation in experiences which relate to governmental bodies, citizen involvement, and school service.
Pupil Support	2100: Support Services – Pupils	Those activities which are designed to assess and improve the well-being of pupils and to supplement the teaching process.
Instructional Staff Support	2200: Support Services – Instructional Staff	Activities associated with assisting the instructional staff with the content and process of providing learning experiences for pupils.
School Administration	2100: Support Services – Pupils*	Those activities which are designed to assess and improve the well-being of pupils and to supplement the teaching process.
	2200: Support Services – Instructional Staff*	Activities associated with assisting the instructional staff with the content and process of providing learning experiences for pupils.
	2400: Support Services – Administration+	Those activities concerned with overall administrative responsibility for a single school, a group of schools, or the entire district.
General Administration	2300: Board of Education	Activities concerned with establishing and administering policy in connection with operating the school district.

Spending Category	Spending Function Code	Spending Category Description
	2400: Support Services – Administration +	Those activities concerned with overall administrative responsibility for a single school, a group of schools, or the entire district.
Operations and Maintenance	2700: Operation and Maintenance of Plant Services	Those activities concerned with keeping the physical plant open, comfortable and safe for use and keeping the grounds, buildings and equipment in an effective working condition and state of repair. This includes activities of maintaining safety in buildings, on the grounds, and in the vicinity of schools.
Transportation	2800: Support Services – Pupil Transportation	Those activities concerned with the conveyance of individuals to and from school, as provided by state law. It includes transportation to school activities and between home and school.
Food Services	3100: Food Service Operations	Those activities concerned with providing food to students and school staff. This service area includes preparing, serving and delivering regular and incidental meals, lunches or snacks in connection with school activities.
Other Non-Specified Support	2500: Fiscal Services	Those activities concerned with the financial operations of the school district. This function includes budgeting, receiving and disbursing, financial accounting, payroll, inventory control, auditing, and fiscal services rendered by persons in the treasurer's office.
	2600: Support Services – Business	Those activities concerned with purchasing, receiving, transporting, exchanging and maintaining goods and services for the school district. This is related to the business manager's operational unit as well as internal service area.
	2900: Support Services – Central	Those activities, other than general administration, which support each of the other instructional and supporting services programs, including planning, research, development, evaluation, information staff, statistical, and data processing services.

Note: All function codes and descriptions can be found in the 2013 Uniform School Accounting System User Manual (Faber 2013). Centralized district-level expenditures from each respective category were allocated across schools proportionally to each school's share of the total district enrollment.

* School Administration category code covers the direction or administration of these support categories (e.g., activities associated with directing and managing services). School-level function codes in this category do not overlap with those included in Pupil Support or Instructional Staff Support categories. Some portion of these expenses may also occur in general administration of the direction or administration of the support activities occurred at the level of the central office.

+ Determination of whether expenditures in this category are categorized as school administration or general administration depends on the subcode and whether the expense occurred at the school or central office level.

Appendix B. Detailed Methodology

In this appendix, we present details about the analyses we employed to address research questions 2, 3, and 4.

RQ2

To examine whether CSI or TSI/ATSI schools received additional fiscal resources, we first conducted descriptive analysis of Section 1003(a) funds. First, we calculated the percentage of CSI and TSI/ATSI schools that received funding within any year between 2019 and 2021. Second, we calculated the average amount that each designation category received each year.

Next, we used a school fixed-effects regression model to compare trends in CSI school spending per pupil relative to non-designated school spending between 2018 and 2023.[1] In addition to examining overall spending, we disaggregated spending into nine function categories (instruction, school administration, etc.). The regression model is as follows:

$$Spending_{sy} = \sum_{y=2019}^{2023} \alpha_y * Year_y + \sum_{y=2019}^{2023} \beta_y * CSI_s * Year_y + \delta_s + \varepsilon_{sy}$$

where $Spending_{sy}$ is the per-pupil spending of school *s* in year *y* (either overall or within a given function category); $Year_y$ is a year indicator for the 2019 to 2023 school years, with the 2018 school year being an omitted year; CSI_s is an indicator of CSI designation based on the 2019 cohort and is interacted with $Year_y$ to show the change in spending over time relative to non-designated schools; δ_s is a vector of school fixed effects; and ε_{sy} is a school by year error term. In this model, 2018 represents the baseline year and is the only year for which we have spending data prior to schools being assigned ESSA accountability designations. The key parameters of interest are the five coefficients for the interactions between the CSI and year indicators, represented by β_y, which represent the change in spending for a given year since 2018 in CSI schools relative to non-designated schools.

RQ3

To examine the additional funding needed to support meaningful gains in student performance in schools identified for improvement, we used cost-function modeling of a form that is

[1] TSI/ATSI schools were excluded from this analysis. To account for districtwide trends in spending, and the fact that CSI schools are overrepresented in some districts, we first centered spending by district and year by subtracting districtwide per-pupil spending from each school's per-pupil spending by year. For the purpose of centering, we grouped charter schools into 16 quasi-districts according to the state's geographic regions.

documented in peer-reviewed literature (Duncombe, 2002; Duncombe et al., 2003; Duncombe & Yinger 1999, 2004, 2011; Kolbe et al., 2021). In particular, we used a cost-function model of the following form:

$$Spending_{sy} = f(Outcomes^{*}_{sy} + Students_{sy} + Input\ Prices_{sy} + Structure_{sy} + Scale_{sy} + Sparsity_{sy} + Inefficiency_{sy})$$

Where $Spending_{sy}$ is a logged measure of school per-pupil operating expenditures in school *s* and year *y*; $Outcomes^{*}_{sy}$ is the outcome factor score – a school-level composite measure of student outcomes that accounts for math and ELA proficiency rates, chronic absenteeism, and 4-year graduation rate (the asterisk denotes that this variable was treated as endogenous and addressed using an instrumental variables approach); $Students_{sy}$ is a vector of student need variables including the school percentages of students who are English learners and who have disabilities as well as school poverty based on the modified MEPS (Gutierrez et al., 2022); $Input\ Prices_{sy}$ is represented by CWIFT, which we re-based for use in Ohio by subtracting the minimum Ohio CWIFT from the index for each district such the minimum of the re-based CWIFT is 0; $Structure_{ij}$ represents the grade configuration of the school as defined by the percentages of students in Grades K to 5 and in Grades 6 to 8 (with the percentages in Grades 9 to 12 being omitted as the reference category); $Scale_{ij}$ represents a series of categorical variables defining the size of the school;[2] $Sparsity_{ij}$ represents a series of variables defining the population density in the zip code of the school;[3] and lastly $Inefficiency_{ij}$ represents a series of variables meant to account for variation in spending across districts that may not be directly related to the measured outcomes included in the model, with these variables being the Herfindahl Index,[4] the percentage of the population in the zip code that is 65 or older, and the percentage of housing units that are vacant within the zip code of the school. The instruments used to predict the outcome variable included a measure of neighborhood poverty of surrounding schools in the same zip code, as well as a zip-code level measure of educational attainment.

After the model was estimated, we used the model parameters to identify the predicted amount of spending per pupil needed for each school to achieve a target outcome level. To generate these predictions, we set the outcome variable to a constant value for all schools representing the target outcome level and we set the variables representing *Inefficiency* to the

[2] School enrollment categories were defined as follows: fewer than 300, 300 to 499, 500 to 799, 800 to 1199, and 1200 or more students.
[3] Population density categories were defined as follows: fewer than 100 people per square mile, 100 to 399, 400 to 799, 800 to 1499, 1500 to 2999, and 3000 or more people per square mile.
[4] The Herfindahl Index is a measure of market share or the presence of other options within a geographic area. The Herfindahl Index is calculated as the sum of schools' squared shares of districtwide enrollment. As such, higher values represent more concentrated market shares and fewer options (i.e., less competition).

statewide averages in the most recent year of the data. The remaining variables representing student needs, input prices, school structure, scale, and sparsity remained at the observed values for each school, allowing the predicted spending levels for each school to reflect the differences in those characteristics based on the estimated parameters for those factors describing their relationship with spending.

We generated spending predictions at two different outcome levels: (a) the statewide average and (b) a lower target, which we set at 0.5 SDs below the state average. The lower performance level is approximately the 25th percentile of performance across all schools in the state. However, 92% of students in CSI schools and 48% of students in TSI schools (based on 2023 designations) attended schools that performed below this level. By contrast, only 18% of the enrollment in non-designated schools attended schools performing below this level. Therefore, the lower performance target represents improvement for most CSI schools and about half of TSI/ATSI schools but is at a level that non-designated schools largely outperform.

Using the predicted spending level at each target level, we calculated the gaps in spending between actual and predicted spending to define the degree to which schools were underfunded with respect to the target outcomes. In our calculations, negative values of the gap represent underfunding with respect to meeting the target outcome level and positive values represent overfunding. We then conducted descriptive analyses examining funding gaps schools, disaggregating the results according to accountability designations.

As one way to validate the cost projections from our cost-function model, we compared district-aggregated cost projections from our model to those estimated by Baker et al. (2025) from their National Education Cost Model. The results of this validation exercise showed that the correlation between the district-aggregated cost projections from our model and those from Baker's National Education Cost Model was 0.94, a very strong correlation.

RQ4

Two schools with the same characteristics and spending or funding levels should have the same level of expected outcomes but may achieve different actual outcomes. In this example, we attribute the differences in actual outcomes to differences in efficiency of resource use. Therefore, in simple terms, we define efficiency as the difference between actual and expected outcomes. We use the following regression model, that includes the funding gap estimated based on the cost-function model, to define each school's expected level of outcomes:

$$Outcomes_{sy} = \sum_{y=2018}^{2023} \alpha_y Year_y + \sum_{j=2018}^{2023} \beta_y FundingGap_{sy} * Year_y + \sum_{y=2018}^{2023} \pi_y FundingGap_{sy}^2 * Year_y + \boldsymbol{X}\theta + \varepsilon_{sy}$$

In this model, $Outcomes_{sy}$ is the outcome factor score for school *s* in year *y*; $Year_y$ is a series of year indicators that allow for year-specific intercepts; $FundingGap_{sy}$ is a measure of the difference between actual spending and predicted spending needed to reach state average outcomes, is also included as a squared term to allow for nonlinearity in the relationship, and is interacted with $Year_y$ allowing for year-specific quadratic relationships between the funding gap and student outcomes; $\boldsymbol{X}$ represents a vector of school-level covariates including school demographics, shares of students by grade level, school size, geographic cost differences, and population density; and ε_{sy} is a school by year residual error term. In this model, ε_{sy} represents efficiency.[5]

Efficiency, defined as the difference between actual and expected outcomes, can also be thought of as the change in school performance if the school performed at average efficiency. After accounting for change in outcomes up to the level of average efficiency, we assume that additional needed change in outcomes would have to be addressed through changes in resource levels. This can most clearly be explained with an example. Suppose a school's aggregate outcome score is -1 and the school's predicted outcome is -0.25. The difference between actual and expected outcomes is -0.75, meaning that the school is relatively inefficient. If the school improved in efficiency to the average, its outcome score would improve from -1 to -0.25. To reach the target of the statewide average, additional funding would be needed but only to cover the portion of underperformance represented by the difference between the predicted outcome and the outcome target (i.e., to get from -0.25 to 0).

After calculating the efficiency measure for each school, we conducted descriptive analyses to examine the extent to which efficiency differs across schools based on accountability designation. In addition, we used the assumptions about the portion of performance that would reasonably be influenced through efficiency versus through additional resources laid out

[5] Although we interpret this as efficiency, there could be other reasons for why observed and expected outcomes may differ related to model specification. First, we are using a limited set of outcome measures. To the extent that schools spend their funding in ways meant to address outcomes beyond those included in our model, we may characterize schools as being less efficient than they are. Second, we may be omitting covariates that explain differences in outcomes across schools. For example, the school demographic measures we include are a measure of poverty rate and students with disabilities and English learner percentages. Student need is likely more nuanced than the information provided by those three variables. Third, we assume our model has an appropriate functional form, which may not be the case.

in the example above to decompose the underperformance of designated schools into the portion due to inefficiency versus underfunding. As a sensitivity check, we examined the robustness of our findings to the exclusion of alternative schools, which are disproportionately identified as CSI schools. Excluding alternative schools did not meaningfully change any of our study findings.

Appendix C. Additional Tables and Figures

In this appendix, we provide additional figures and tables displaying the detailed regression results for the school fixed effects regressions, cost function, funding gap, and efficiency analyses.

Exhibit B1. School Fixed Effects Spending Regressions

	Total	Instruction	Pupil Support	Inst. Staff Support	School Admin.	General Admin.	Oper. and Maint.	Trans.	Food Services	Other
Year: 2019	7.276	9.301	0.363	-0.164	-0.940	-0.997	0.926	-0.738	0.0726	-0.549
	(19.46)	(15.68)	(1.022)	(0.650)	(1.825)	(1.107)	(3.549)	(3.131)	(1.167)	(0.695)
Year: 2020	10.27	8.140	-0.598	-0.747	3.200	-1.491	1.539	0.352	0.631	-0.759
	(23.77)	(19.87)	(1.276)	(1.007)	(2.921)	(1.343)	(3.951)	(3.525)	(1.441)	(0.777)
Year: 2021	-13.39	2.478	-6.821	-5.470*	-6.189	-2.834*	6.167	-0.891	0.548	-0.379
	(39.08)	(34.79)	(3.767)	(2.277)	(3.864)	(1.391)	(6.578)	(3.799)	(2.441)	(0.945)
Year: 2022	23.95	32.47	-2.791	-5.974*	-1.517	-9.975*	7.538	-0.730	3.756	1.176
	(47.20)	(40.74)	(4.293)	(2.343)	(5.080)	(3.033)	(8.259)	(4.106)	(3.276)	(1.112)
Year: 2023	9.907	12.18	-5.995	-4.448	-1.183	-1.902	9.764	-1.392	3.717	-0.838
	(48.79)	(41.16)	(4.548)	(2.593)	(5.382)	(3.367)	(11.14)	(4.074)	(3.168)	(1.062)
Year: 2019 X CSI	42.53	-35.24	7.474	23.18*	30.47	6.481	-0.814	7.092	7.012	-3.128
	(152.8)	(112.5)	(13.28)	(9.286)	(24.54)	(24.41)	(33.87)	(25.97)	(9.697)	(12.59)
Year: 2020 X CSI	10.57	-31.07	5.168	32.66*	9.160	-1.817	27.50	-42.40	13.19	-1.822
	(160.0)	(122.9)	(13.11)	(14.87)	(32.60)	(23.87)	(31.57)	(29.99)	(8.466)	(12.10)
Year: 2021 X CSI	287.0	-39.87	60.97*	53.48*	89.30*	36.87	-29.54	52.95	35.75*	27.08
	(241.9)	(181.2)	(22.23)	(20.05)	(36.05)	(46.13)	(57.42)	(33.31)	(16.39)	(15.44)
Year: 2022 X CSI	471.8	68.59	121.5*	61.16*	98.11*	23.51	6.782	51.64	16.19	24.34
	(267.3)	(198.3)	(30.13)	(23.30)	(36.04)	(53.69)	(63.29)	(32.47)	(16.40)	(16.95)
Year: 2023 X CSI	393.1	63.86	118.5*	73.98*	109.3*	-4.150	-15.05	20.43	13.23	13.13
	(323.8)	(212.6)	(32.00)	(25.83)	(38.07)	(68.51)	(95.92)	(32.27)	(13.21)	(15.84)

	Total	Instruction	Pupil Support	Inst. Staff Support	School Admin.	General Admin.	Oper. and Maint.	Trans.	Food Services	Other
Constant	-16.03	6.993	-3.902	-1.592	-0.0559	0.156	-9.629*	-2.084	-3.471*	-2.443*
	(24.25)	(20.34)	(2.176)	(1.413)	(2.602)	(2.114)	(4.340)	(2.791)	(1.540)	(0.935)
N Schools X Year	14604	14604	14604	14604	14604	14604	14604	14604	14604	14604
N Schools	2434	2434	2434	2434	2434	2434	2434	2434	2434	2434
R^2	0.534	0.529	0.599	0.608	0.590	0.705	0.636	0.735	0.625	0.690

Note. CSI schools are based on 2019 designations. TSI/ATSI schools are excluded from the analysis. Only schools that were represented in the data for all six years (2018 to 2023) were included in the analysis. Standard errors clustered by school are in parentheses. * $p < 0.05$

Exhibit B2. Cost-Function Model, First Stage Prediction of Outcomes

	Coefficient	SE
Income-to-Poverty Surrounding Schools	0.05***	0.01
Population with Bachelor's (Zip Code)	0.81***	0.12
MEPS Poverty Percentage	-4.71***	0.15
% Students with Disabilities	-4.09***	0.28
% English learners	-1.49***	0.17
% K-5 Enrollment	0.35***	0.02
% 6-8 Enrollment	0.27***	0.03
Population Density: 100-399	-0.094***	0.02
Population Density: 400-799	-0.10**	0.04
Population Density: 800-1499	-0.085*	0.04
Population Density: 1500-2999	-0.17***	0.04
Population Density: >3000	-0.14***	0.04
Enrollment <300	-0.03	0.05
Enrollment 300-499	-0.02	0.05
Enrollment 500-799	-0.02	0.04
Enrollment 800-1199	-0.05	0.04
CWIFT Estimate	-1.75***	0.22
Charter School	-0.56***	0.14
Herfindahl Index	0.27*	0.11
% Population 65+	-0.24	0.25
% Vacant	-0.13	0.36
Year: 2019	-0.00	0.01
Year: 2020	-0.01	0.01
Year: 2021	0.00	0.01
Year: 2022	0.05***	0.01
Year: 2023	0.08***	0.01
Constant	1.25***	0.10
Observations	18591	
R^2	0.777	

Note: F test of excluded instruments: F(2,3204) = 51.98. Standard errors are clustered by school. * p < 0.05, ** p < 0.01, *** p < 0.001.

Exhibit B3. Cost-Function Model Effects on Spending (2nd Stage)

	Coefficient	SE
Outcome factor score	0.34***	0.04
MEPS Poverty Percentage	2.34***	0.23
% Students with Disabilities	2.00***	0.21
% English learners	0.60***	0.09
% K-5 Enrollment	-0.23***	0.02
% 6-8 Enrollment	-0.26***	0.02
Population Density: 100-399	-0.01	0.01
Population Density: 400-799	-0.02	0.02
Population Density: 800-1499	0.01	0.02
Population Density: 1500-2999	0.09***	0.02
Population Density: >3000	0.14***	0.02
Enrollment <300	0.20***	0.02
Enrollment 300-499	0.13***	0.02
Enrollment 500-799	0.08***	0.02
Enrollment 800-1199	0.05*	0.02
CWIFT Estimate	1.09***	0.11
Charter School	-0.17*	0.07
Herfindahl Index	-0.10	0.07
% Population 65+	0.74***	0.12
% Vacant	0.78***	0.15
Year: 2019	0.03***	<0.01
Year: 2020	0.05***	<0.01
Year: 2021	0.09***	<0.01
Year: 2022	0.16***	0.01
Year: 2023	0.21***	0.01
Constant	8.37***	0.08
Observations	18591	
R^2	0.107	

Note: Hansen J statistic = 3.178. (p = 0.075). Standard errors are clustered by school. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

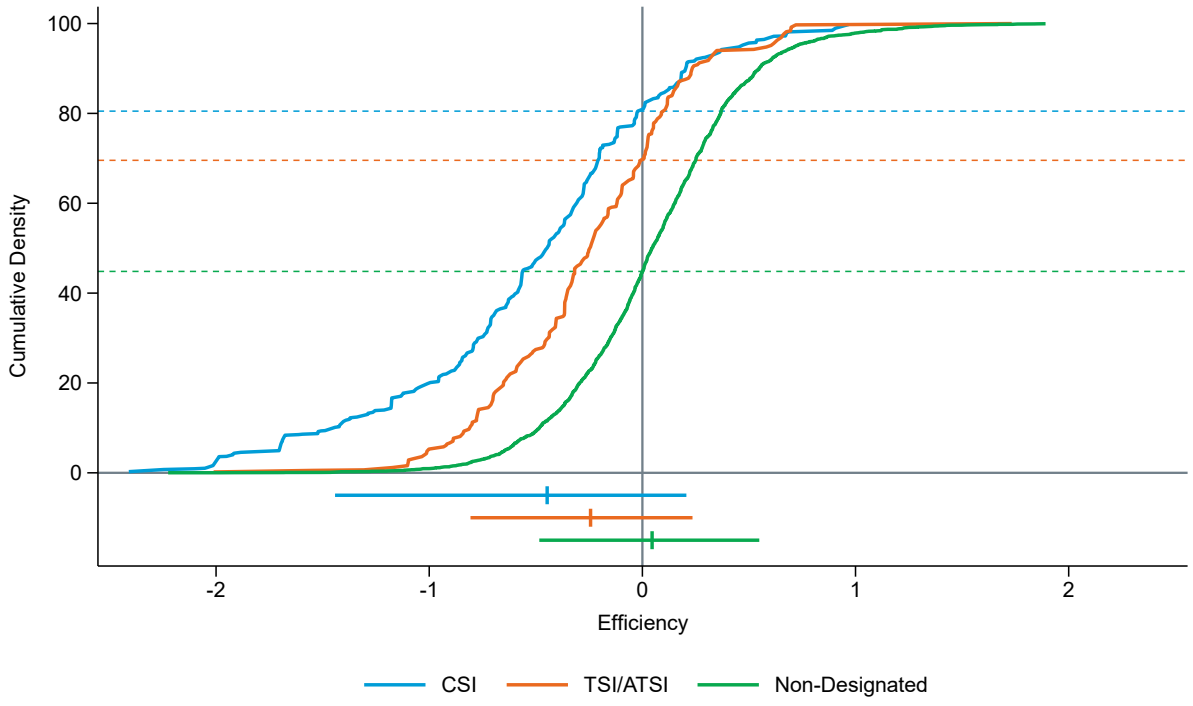
Exhibit B4. Efficiency Regression Model – Predicting Outcomes

	Minimal Model		Preferred Model	
	Coefficient	SE	Coefficient	SE
Funding Gap ($1,000s)	0.148***	0.004	0.010**	0.004
Funding Gap^2	0.0012***	0.0003	0.0005**	0.0002
Year: 2019	-0.002	0.007	0.001	0.006
Year: 2020	-0.018*	0.008	-0.010	0.007
Year: 2021	-0.021	0.011	0.001	0.008
Year: 2022	-0.004	0.012	0.039***	0.010
Year: 2023	0.008	0.012	0.066***	0.011
Year: 2019 X Funding Gap	-0.006*	0.003	-0.003	0.002
Year: 2020 X Funding Gap	0.003	0.003	0.008***	0.002
Year: 2021 X Funding Gap	-0.000	0.004	0.019***	0.002
Year: 2022 X Funding Gap	-0.011**	0.004	0.010***	0.002
Year: 2023 X Funding Gap	-0.029***	0.004	0.003	0.002
Year: 2019 X Funding Gap^2	-0.0001	0.0002	-0.0001	0.0001
Year: 2020 X Funding Gap^2	0.0006*	0.0002	0.0004*	0.0001
Year: 2021 X Funding Gap^2	0.0004	0.0003	0.0005**	0.0002
Year: 2022 X Funding Gap^2	0.0001	0.0003	0.0003*	0.0002
Year: 2023 X Funding Gap^2	-0.0004	0.0003	0.0002	0.0002
MEPS Poverty Percentage			-6.16***	0.38
MEPS Poverty Percentage^2			1.54	0.83
% Students with Disabilities			-3.69***	0.27
% EL Enrollment			-1.31***	0.18
% K-5 Enrollment			0.39***	0.03
% 6-8 Enrollment			0.28***	0.03
Population Density: 100-399			-0.08***	0.02
Population Density: 400-799			-0.08*	0.03
Population Density: 800-1499			-0.01	0.03
Population Density: 1500-2999			-0.07*	0.03
Population Density: >3000			-0.08*	0.04
Enrollment <300			-0.12**	0.05
Enrollment 300-499			-0.07	0.04

	Minimal Model		Preferred Model	
	Coefficient	SE	Coefficient	SE
Enrollment 500-799			-0.07	0.04
Enrollment 800-1199			-0.07	0.04
CWIFT Estimate			-1.05***	0.20
Constant	0.085***	0.013	1.575***	0.055
Observations	19335		19335	
R^2	0.598		0.760	

Note: Standard errors are clustered by school. * p < 0.05, ** p < 0.01, *** p < 0.001

Exhibit B5. Distribution of Efficiency, by Accountability Designation (2023)



Note: Designations based on 2023 designations. Efficiency is measured as the difference between actual and expected outcomes, where expected outcomes are predicted based on regression accounting for the funding gap, school demographics, and other school characteristics. Curved lines ascending from left to right represent the cumulative distribution weighted by each school's enrollment. As such, the cumulative distribution represents the percentage of students attending schools of a given designation at or below a given level of efficiency. The horizontal lines at the bottom of the figure represent the 10th to 90th percentile ranges by designation type with the tick mark representing the median. The dashed horizontal lines represent the percentage of students attending schools of a given designation type with a negative efficiency (i.e., where actual outcomes are below the expected level of outcomes). N of CSI Schools = 279. N of TSI/ATSI Schools = 199. N of Non-Designated Schools = 2,842.

About the American Institutes for Research®

Established in 1946, the American Institutes for Research® (AIR®) is a nonpartisan, not-for-profit institution that conducts behavioral and social science research and delivers technical assistance both domestically and internationally in the areas of education, health, and the workforce. AIR's work is driven by its mission to generate and use rigorous evidence that contributes to a better, more equitable world. With headquarters in Arlington, Virginia, AIR has offices across the U.S. and abroad. For more information, visit AIR.ORG.

AIR® Headquarters
1400 Crystal Drive, 10th Floor
Arlington, VA 22202-3289
+1.202.403.5000 | **AIR.ORG**

28217_06/25