AMERICAN INSTITUTES FOR RESEARCH®

Equity and Adequacy of New Hampshire School Funding (DRAFT)

A Cost Modeling Approach

AUGUST 2020

Drew Atchison, Jesse Levin *(AIR)* | Bruce Baker *(Rutgers University)* | Tammy Kolbe *(University of Vermont)*

Contents

1. Introduction

In 2019, the New Hampshire General Court passed House Bill 4, creating the *Commission to Study School Funding*. Broadly, the Commission was charged with developing recommendations for reforming the state's existing school funding system in ways that would

- assure a quality education for all New Hampshire public school students;
- improve taxpayer equity in paying for public education; and
- meet the constitutional requirements for the state's role in ensuring that all students have access to an adequate education, regardless of where a student lives or attends school.

In large part, the Commission's charge stems from long-standing concerns on the part of both the legislature and the judiciary regarding persistent inequities across New Hampshire's public schools in students' opportunities to learn. In part, these concerns are rooted in the state's long-standing struggle to define and measure what constitutes an adequate public education for public school students and historically low levels of state funding as a share of total educational costs.[1] The result is a system that heavily relies on local property taxes and does not sufficiently address significant differences across districts in education spending and local tax burden.

These concerns exist within a shifting demographic and policy landscape. In the past decade, New Hampshire has seen both a steady decline in its school-aged population and a diversification of students in terms of both background and needs. At the same time, districts and schools statewide are grappling with implementing new systemic education reforms, some of which have implications for both the cost of and equity in educational opportunities for the state's public school students.

The Commission's enabling legislation outlines minimum topical issues that it must study and consider in its deliberations. In spring 2020, the Commission partnered with the American Institutes for Research (AIR) to assist with these efforts.

Study Overview

The Commission asked AIR to help develop new knowledge about the types and extent of inequities in educational opportunities, as well as identify methodologies and policy frameworks to inform its recommendations. The scope of AIR's work included the following:

- Undertaking a comprehensive review of existing data sources collected by the state with consideration for the usefulness of those data for evaluating disparities in educational opportunities and outcomes
- Summarizing methodologies for evaluating and addressing disparities in educational opportunities applicable to New Hampshire and for making comparisons to other states in terms of funding and governance structures, including prekindergarten and special education

[1] In addition to the state share of education funding being at historically low levels, it is important to note that New Hampshire had the lowest state share of funding in the country at 32.2% in 2016–17 (Snyder, de Brey, & Dillow, 2019).

- Evaluating equity of the current system from both student and taxpayer perspectives by examining relationships between student needs and education spending or student outcomes and examining the relationships between property wealth, tax rates, and education spending
- Estimating cost models that identify the minimum spending necessary to ensure the provision of more equal educational opportunities and outcomes across the state, including projections of the combined local, state, and federal funding that would serve the goals of increased educational equity across the state
- Generating simulated scenarios that demonstrate the necessary state funding and property tax rates necessary for the state to meet its responsibility to provide a constitutionally adequate public education

The multiple study objectives necessitated different activities and analyses. Exhibit 1 summarizes the key tasks and activities that AIR undertook for this study.

Exhibit 1. Overview of Data and Methods Used in Study

Key tasks	Activities
National policy scan and peer state profiles	Produced a set of policy briefs that provided a ▪ national profile of cost factors and funding mechanisms used in state education funding formulae (Kolbe, Atchison, Kearns, & Levin, 2020a) and ▪ detailed analysis for specific states that have previously evaluated disparities and passed reforms or are in the process of doing so (Baker, Atchison, Kearns, & Levin, 2020b; Baker, Kearns, Atchison, & Levin, 2020b; Kolbe, Atchison, Kearns, & Levin, 2020b)
Review of analytical methods	Produced policy briefs that consider methods of evaluating educational equity, adequacy, and costs (Baker, Atchison, Levin, & Kearns, 2020a, 2020b; Baker, Kearns, Atchison, & Levin, 2020a; Baker, Levin, Atchison, & Kearns, 2020).
Equity analysis	Examined the equity in resource distribution among New Hampshire districts, isolating the relationship between funding levels and different types of student needs. Also examined equity from a taxpayer perspective by examining variation in tax rates, property valuation, and spending per student.
Conduct student outcome risk analysis	Undertook empirical analysis that considered aspects of student need that are most highly correlated with differences in student outcomes (in New Hampshire).
Cost function modeling	Estimated cost function models that helped identify how resources should be distributed to provide all students with an equal opportunity to achieve a specified level of outcome.
Develop simulation tool	Created a simulation tool capable of generating simulated projected funding needs based on different scenarios for education costs, generated by cost function models.

The purpose of this report is to summarize the key study findings, including results from the equity analysis, student outcome risk analysis, and cost function modeling.[2] A general framework for understanding and evaluating differences in educational costs among districts guided this work. We describe this framework in the following section.

Differences in the Cost of Education

States are responsible for providing an adequate education for all students. Providing an adequate education to all students necessarily means that educational resource levels should differ across districts, schools, and students according to the needs of students and other contextual characteristics, thus influencing the cost of providing educational services. Students come to school with dissimilar learning needs and socioeconomic backgrounds that require different types and levels of educational supports for them to achieve standards or outcomes deemed adequate. Similarly, schools in different contexts may also require different levels of resources because of scale of operations or the price they must pay for key resources. Dissimilar resource requirements that vary based on student needs and context translate to differences in the cost of education among districts and schools.

A necessary starting point for developing adequate and fair school funding systems is to recognize that the cost of educating students to common standards varies across districts. Cost is the level of spending required for students to achieve a given set of outcome goals. Typically, outcome goals are operationalized as achieving certain targets on state assessments or graduation rates. Cost factors are characteristics of students, schools, and districts that affect the level of spending required to achieve stated goals and are outside the control of local district administrators.[3]

Presently, all states operate school funding formulas and supplemental grants-in-aid programs that attempt to address differences in educational costs across districts. However, there is considerable variation across states in the policies used to adjust for cost differences. Although each state's school funding formula is structured differently, nationally, all state policies (a) recognize a core set of cost factors that contribute to differences in educational costs across districts and (b) use one or more mechanisms to distribute supplemental aid to offset the additional costs introduced by these factors. Together, the cost factors and mechanisms incorporated in school funding formulas comprise the building blocks of state efforts to redistribute educational resources among school districts.

Cost Factors

Exhibit 2 describes the four primary categories of cost factors that affect districts and schools: (a) student need, (b) scale and sparsity, (c) grade range, and (d) price level of inputs.

---

[2] Other project deliverables included nine policy briefs that provide information on specific topics of interest to the Commission. These policy briefs can be found at https://carsey.unh.edu/school-funding-study/resources.

[3] Districts may make many other choices that result in spending differences, but these are not cost differences. These differences include providing more programs and services or smaller classes than might be absolutely necessary to merely achieve the outcome targets in question. These choices may result in achieving higher outcomes or different outcomes (as with arts and athletic programs). These spending differences are not necessarily inefficiencies but are spending choices based on local preferences. They are not, however, considered cost factors for the purposes of developing state education funding policy.

Two types of student need factors—individual student factors and collective population characteristics—impact education costs. Individual students with specific educational needs (e.g., students with disabilities [SWDs], English learners [ELs], and students who are economically disadvantaged) may need specialized programs, services, or interventions to achieve common outcomes. These efforts require additional resources to implement, which come at a higher cost to a district.

Exhibit 2. Cost Factors Considered in School Funding Formulas

Student need	Scale and sparsity	Grade range	Price level of inputs
Individual student characteristics ▪ Economic disadvantage ▪ Disability status ▪ ELs ▪ Gifted and talented **Collective population characteristics** ▪ Concentrations of students living in poverty or ELs	▪ District or school enrollment ▪ Population sparsity or extent of rurality	▪ Differences in academic and nonacademic programming for students in different grades	▪ Geographic differences in resources, including personnel wages and nonpersonnel resources

There are other collective characteristics of the student population, such as the local concentration of student economic disadvantage, that may require schoolwide intervention to achieve common outcomes. For example, a student who is economically disadvantaged may not have a specific educational need to be remediated, but a school population of students who are economically disadvantaged may require smaller classes, early childhood programs, and other services to have an equal opportunity to achieve common goals. These schoolwide interventions also increase the cost to districts with high concentrations of student need.

District structure, organization, and location—particularly the size of a district or school and the population density of the community in which it is located—also may affect costs.[4] For example, research shows that districts with fewer than 100 students operate at almost double the per-pupil cost as districts with 2,000 pupils, and districts with 100–300 students are about 50% more costly (Baker, 2005). Such cost differences are largely attributable to differences in underlying staffing ratios. Similarly, population sparsity can result in higher transportation costs because students must travel further average distances to school.

Educational resources also differ across grade ranges. For example, younger students in early elementary school may require smaller class sizes, which increases cost. High schools, however, often provide specialized courses and extracurricular activities (such as athletics or marching band) that require additional resources.

Lastly, districts within the same state also may need to pay different prices for specific goods and services. Teacher and other employee wages are the most commonly addressed input price factor in

[4] Such characteristics constitute cost factors in circumstances where they are unalterable. For example, economies of scale is a major cost factor for very small schools and districts that are remotely located when they are unable to consolidate to achieve scale (Andrews, Duncombe, & Yinger, 2002).

schooling; that is, the prevailing wage to recruit and retain a similarly qualified teacher may differ across districts within a state.

Exhibit 3 summarizes the extent to which states include different cost factors in their funding formulae.

Exhibit 3. Cost Factors Incorporated in State Funding Formula

Cost factor	Number of states
Student need	
Students with disabilities	50
Economically disadvantaged/at risk	47
ELs	48
Gifted and talented	35
Scale/sparsity	
Geographic location/population density	13
District/school size	26
Grade range	30
Resource prices	11

Note. For additional detail on cost factors incorporated in state funding formulae, see the brief written in support of this study: *State Funding Formulas: A National Review* (Kolbe et al., 2020a). The brief is publicly available for download at https://carsey.unh.edu/sites/default/files/media/2020/06/20-11882_7._primer_policyscan_v3.pdf.

Using Weights to Differentiate Funding

For each cost factor considered, state school finance formulas apply different mechanisms to adjust for differences in cost. The most frequently used mechanisms are (a) single student weights or stipends, (b) multiple student weights, (c) resource-based allocations, (d) cost reimbursement, (e) capitated, and (f) categorical grant programs.[5] Of these mechanisms, funding weights are used by a majority of states to account for the additional costs associated with various student needs.

The most relevant of the mechanisms for our purpose is student weights. Our proposed methodology will result in the estimation of weights that can be applied to student and district characteristics to calculate funding for districts. Many states use some form of weight or additional per-pupil funding adjustments to account for increased costs facing districts serving students with additional educational needs. As an example, the funding weight assigned to students served by a district who are eligible for free and reduced-price lunch (FRPL) might be 0.50, meaning that the district would receive 50% more than the established base per-pupil funding amount for these students. States also may adjust funding using multiple weights or dollar amounts tied to different levels of need. For example, states may use multiple weights of various magnitude corresponding to the amount of time a student has been classified as an EL or differences in students' English proficiency (with larger funding weights assigned to students with lower proficiency). Multiple weights also are used to adjust for differences in costs associated with educating

[5] Detailed descriptions of these various mechanisms can be found in Kolbe et al. (2020a).

SWDs who have different needs (e.g., by disability category or more general categories of mild or moderate disability).

Funding formulas using weights are clear and transparent methods for differentiating funding across districts. Weighted formulas can be easily updated and maintained across time through yearly inflationary adjustments to the base and periodic reviews of the magnitude of the weights. It is therefore not unsurprising how common the use of funding weights has become across state school finance systems.

A Comprehensive System of Education Funding

All states incorporate multiple cost factors and funding mechanisms in their overarching school funding policies. Together, these factors and mechanisms work to provide different types and amounts of supplemental aid to districts to offset differences in education costs. How this is accomplished, however, looks very different across states. Creating a comprehensive system of school funding involves more than simply selecting the cost factors that should be accounted for and determining the mechanisms for distributing funding. As noted in the brief supporting this study, *Evaluating State School Finance Systems: An Introduction* (Baker, Atchison, Levin, et al., 2020a), funding formulas should account for not only differences in cost but also differences in fiscal capacity (or the ability to raise revenue locally).

Presently, New Hampshire's formula adjusts a base, or universal, cost of education for the additional cost of students with greater educational needs, including (a) ELs, (b) students in special education, and (c) students who are economically disadvantaged and students in schools with significant concentrations of those who are economically disadvantaged. However, although base funding is provided to all districts regardless of local revenue capacity, this funding covers only a fraction of overall education spending, and the differential amounts allocated for student needs are relatively meager. As mentioned earlier, most revenue for education in New Hampshire is raised through local property taxes, leaving districts largely to fend for themselves.

A comprehensive system of education funding must address the following issues:

- **What types of cost factors should New Hampshire's funding formula incorporate and what should the magnitude of adjustments be for each cost factor?** Currently, New Hampshire's funding formula adjusts for differences in education costs across districts because of differences in the percentage of SWDs, the extent of student economic disadvantage, and the number of ELs. Although the empirical analysis completed for this study will identify specific factors and cost differentials, state policymakers will still need to decide both whether to incorporate these factors into a revised funding formula and how much influence each cost factor should have on funding levels.
- **What funding mechanisms should New Hampshire use to adjust for cost differences in its formula?** State policymakers have multiple tools at their disposal for making cost adjustments. A necessary consideration for policymakers is how best to align different mechanisms with policy goals for providing state aid.
- **How should a formula account for differences in local capacity to raise revenue?** States often cannot fund the entire cost of an adequate education through state revenues. Many states with a foundation formula use a combination of state and local funding to achieve the state's desired funding targets. The split between state and local funding in these states varies according to the ability of towns or

districts to raise funding locally. We introduced the concept of local effort in the supporting brief, *Providing Adequate Funding Through Equitable Taxation: An Introduction* (Baker et al., 2020a), using New Jersey as an example.

- **How can the state equitably raise revenue to provide for the cost of an adequate education?** In the brief on equitable taxation, we show that the towns with the highest incomes in New Hampshire pay the lowest tax rates to support their schools. The funding of an adequate education should be better shared so that communities with the least wealth do not have to tax themselves exorbitantly to raise sufficient revenue to provide schooling.

Key Findings

The AIR team has comprehensively examined the current system of education funding in the state and conducted analyses that will inform the creation of a new and improved system. We found the following:

- The state's current system is inequitable from both student and taxpayer perspectives. The districts serving the highest proportion of students who are economically disadvantaged spend less, on average, compared with districts serving the fewest such students. Moreover, the districts with the least property wealth per student impose the highest local education tax rates to be able to fund their children's education.
- Economic disadvantage—as measured by FRPL eligibility rates—is a strong indicator of student outcomes, with districts serving higher incidences of students eligible for FRPL performing worse, on average. Districts with higher percentages of students in special education and ELs also perform worse, on average, compared with districts with lower proportions of these students.
- Our cost modeling indicates that districts with higher needs (FRPL eligibility, ELs, and students in special education) and small districts require more spending per student to achieve a common desired level of student outcomes.
- Based on the cost modeling results, we created a weighted funding formula that allocates funding to districts according to the costs facing each district. The formula results in a progressive distribution of funding that would more adequately fund high-need districts.
- The state could more equitably generate revenue for education through a statewide property tax that collects revenue centrally and distributes the revenue according to the formula. This could be paired with a minimum local contribution that goes toward the funding of the formula. Through this funding scheme, districts with lower capacity to raise revenue would receive more revenue from the state, thereby adjusting for disparities in local capacity.

Report Organization

The remainder of this report presents the results of our study. Chapter 2 examines equity from both student and taxpayer perspectives of the current system. Chapter 3 examines the relationship between student needs and student outcomes, helping inform the cost factors included in the cost model. Chapter 4 presents the results of the cost model, the estimation of weights, and the simulation of a new funding formula. Chapter 5 provides the study conclusion.

2. Equity of School Funding

In most states, school funds are distributed via a statewide formula. The details of these formulas vary substantially from state to state, but they are designed, in theory, to accomplish two goals:

- Account for differences in the costs of achieving equal educational opportunity across schools, districts, and the children they serve (e.g., some districts serve larger shares of students who are disadvantaged than others)
- Account for differences in fiscal capacity, or the ability of local jurisdictions to pay for the cost of education (e.g., their ability to raise local revenue, mostly via property taxes)

Municipalities and districts differ with respect to the populations they serve, which manifests itself in differential needs for educational programming and services to offer similar opportunities to students. In addition, they vary widely in terms of wealth, which means their capacity to raise revenues through property taxes also varies widely. Often, although not always, these two factors are linked. That is, districts having less local taxable wealth are likely to have higher concentrations of child poverty in their schools, and child poverty is a determining factor of the cost of providing children with equal opportunity to achieve common outcome goals.

In recent years, researchers and prominent educational organizations have adopted a common understanding that state school finance systems should provide not merely the same but substantially more resources per pupil to districts serving greater shares of children in poverty (Baker & Green, 2008; Baker & Levin, 2014).[6] This conception of equity can be formalized by defining school funding systems that systematically provide more resources (revenue) to districts with the highest student poverty rates as being relatively "progressive."[7] Conversely, those systems that tend to provide fewer resources to districts with the highest student poverty rates are considered to be relatively "regressive." Given the mounting evidence that money matters for educational outcomes (Baker, 2016), maintaining a progressive distribution of resources is an important step toward ensuring that an equal educational opportunity is provided to students.

Key Terms

Progressive: An education funding system that provides more revenue to districts or schools with the highest needs (often operationalized as child poverty rates).

Regressive: An education funding system that provides less revenue to districts or schools with the highest needs (high child poverty rates).

Also, of particular importance in New Hampshire, where revenue is largely generated through local property taxes, is equity to taxpayers. A school funding system that appropriately accounts for differences in fiscal capacity would allow a district with lower fiscal capacity (property valuation per student) to raise a similar overall amount of revenue at a similar tax rate. In other words, districts with less property wealth should not have to tax themselves at higher rates to achieve similar levels of funding.

[6] These educational organizations include The Education Trust, the Urban Institute, and the School Finance Indicators Database.

[7] This report often refers generally to student poverty and in various analyses makes use of measures meant to serve as a proxy for poverty such as student eligibility for FRPL (defined as a student being from a low-income family).

In this section of the report, we examine the existing distribution of education spending in New Hampshire with respect to student needs to examine the progressiveness of the current system of funding. We also look at the variation in tax rates across districts to examine issues of tax equity.

Evaluating Equity of School Funding

Evaluating equity must go beyond simply calculating the existing variation in school or district resource levels (revenue or spending per pupil) or determining whether spending is higher or lower in communities with more or less taxable wealth (fiscal neutrality). More thorough approaches are necessary to distinguish between variation in financial inputs that promotes equal opportunity (equity advancing) and variation that is random, unexplainable, or derived from differences in local wealth (equity eroding).

A starting point for evaluating the equity of financial inputs is regression modeling of inputs with respect to the factors that should explain variation in costs and student need. This type of model shows whether financial inputs are strongly associated with determinants of costs and need. Although child poverty often is a proxy for student need, the standard model of student need has evolved across time to account for multiple factors, including (a) the share of students from families in poverty, (b) the share of students with disabilities, (c) the share of ELs, (d) the distribution of students by grade range, (e) the size of the district, and (f) population density.

Of primary interest is whether and to what extent schools and districts serving needier student populations have access to more financial inputs per student than their less needy peers, after controlling for the other factors that influence costs. That is, is the system progressive with respect to child poverty and is that progressiveness systematic (observed on average across the entire range of student need)? Notably, most state school finance systems are not noticeably progressive in magnitude, and even fewer are systematically progressive.

Equity in New Hampshire

Student Equity

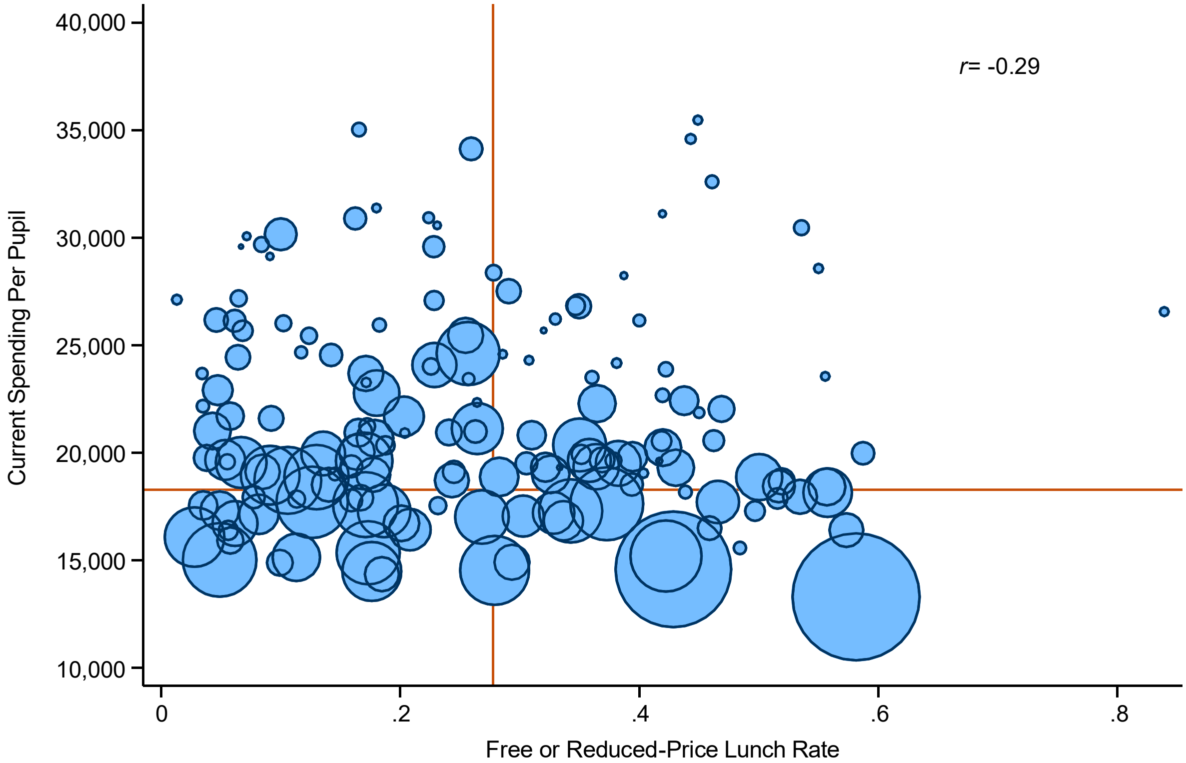
Our examination of student equity looks primarily at the relationship between district-level student poverty—as measured by district student FRPL eligibility rates—and total current spending of districts.[8] Our analysis starts by looking at a visual representation of the relationship between student poverty and spending, followed by a regression-based examination of the relationship, and a comparison of progressiveness across New England states.

Exhibit 4 shows a scatterplot of the relationship between district spending level per student and student poverty. Each dot on the scatterplot represents a district in the 2018–19 school year, where the size of the dot is weighted by total enrollment (i.e., larger dots are districts with more students). The horizontal and vertical lines depict the statewide averages of current spending per pupil and FRPL rate, respectively. As shown, the overall relationship (depicted by the correlation coefficient) is negative, indicating that districts with higher poverty rates spend less, on average, compared with districts with lower poverty

[8] Total current spending excludes capital expenditures such as building construction spending and debt service.

rates. This result and the negative calculated correlation coefficient (-0.29) shows this to be a clear example of a regressive relationship between per-pupil spending and student poverty.

Exhibit 4. Relationship Between Current Spending Per Pupil and Free or Reduced-Price Lunch Rate



Note. The orange lines show statewide averages of both variables. The enrollment weighted correlation coefficient (*r*) equals 0.29. Data come from the New Hampshire Department of Education, 2018–19.

The scatterplot, however, accounts only for a single dimension of factors that potentially affect educational costs and spending (cost factors). A more robust analysis accounts for other aspects that also could affect districts' costs and spending levels, such as other student needs, grade levels served, and district size. To improve the stability of the results, we estimated two models that pool across multiple years. The regression results, shown in Exhibit 5, indicate that districts with higher FRPL rates spend less, even after accounting for other factors that could influence district spending levels. In the most recent years (fiscal years [FY] 2017–2019), a district with a 100% FRPL rate is estimated to spend approximately $3,500 less than an otherwise similar district with a 0% FRPL rate. Given that no districts in New Hampshire have a 100% FRPL rate, a more useful interpretation is that a 10% increase in FRPL eligibility is associated with $350 less in spending, all else being equal.

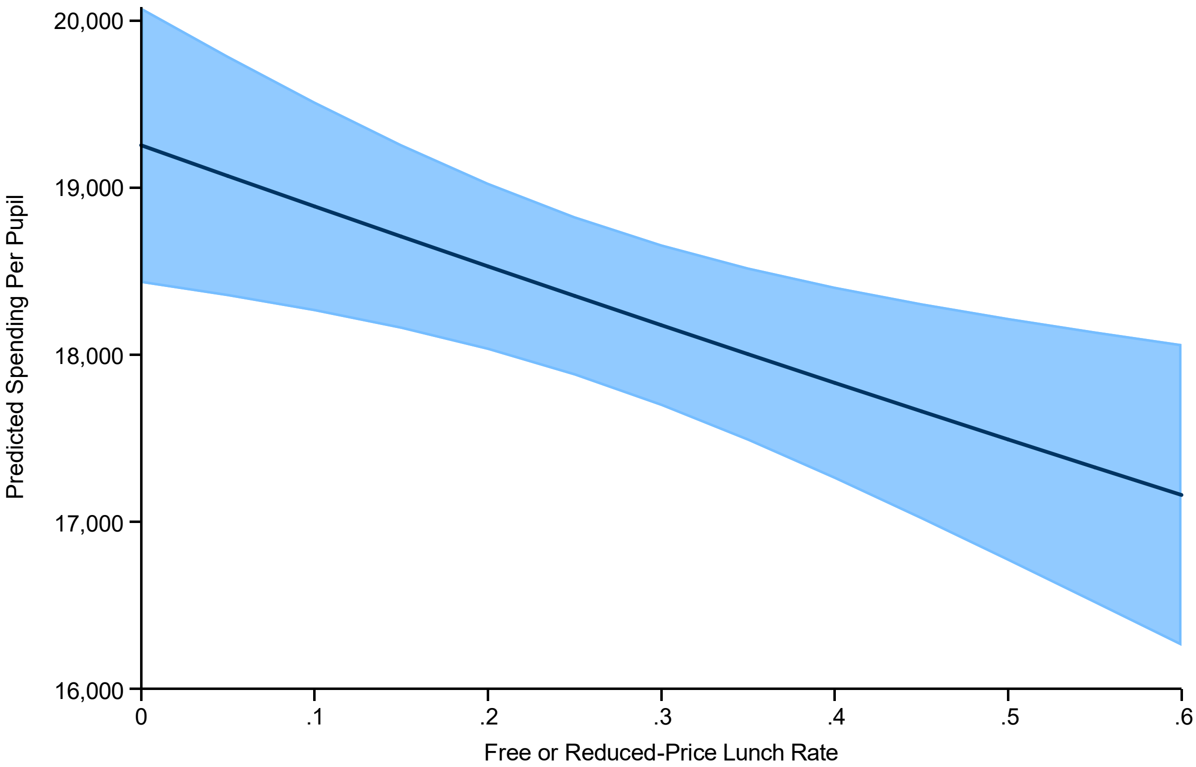
Exhibit 5. Regression Results Examining Equity of Education Spending

Cost factor	FY2009–2019	FY2017–2019
FRPL rate	-2,539.3***	-3,492.2**
Special education rate	17,040.2***	13,192.5*
EL rate	-21,517.9***	-17,688.0**
District enrollment		
≤100	9,607.6***	9,873.3***
101–300	4,681.8***	5,922.0***
301–600	3,441.6***	3,698.8***
601–1,200	2,501.4***	2,453.4***
1,201–2,000	1,381.3***	1,447.8**
Proportion of enrollment in middle school grades	6,010.5***	6,608.8***
Proportion of enrollment in high school grades	793.1	495.6
N	1,765	486
R^2	0.560	0.461

Note. In both models, current spending per pupil is the outcome variable. The first model includes data for all years between FY2009 and FY2019. The second model examines only the three most recent years of available data, from FY2017 through FY2019. Models also controls for population density (inhabitants per square mile) and the school year as a year trend variable. $^{*}p < 0.05$. $^{**}p < 0.01$. $^{***}p < 0.001$.

The relationship between per-pupil spending and FRPL rates estimated by the regression also can be depicted in graphical form (Exhibit 6) and shows a similar pattern of spending with respect to FRPL rates as shown in the scatterplot in Exhibit 4. The lowest poverty districts were estimated to spend slightly more than $19,000 per student in 2018–19, on average, whereas observationally similar districts with the highest poverty levels in the state were estimated to spend slightly more than $17,000 per student, on average—a difference of $2,000 per student.

Exhibit 6. Regression Predicted Spending Per Pupil by Free or Reduced-Price Lunch Rate



Note. Based on the regression model including data for FY2017 through FY2019 with predictions at FY2019 levels.

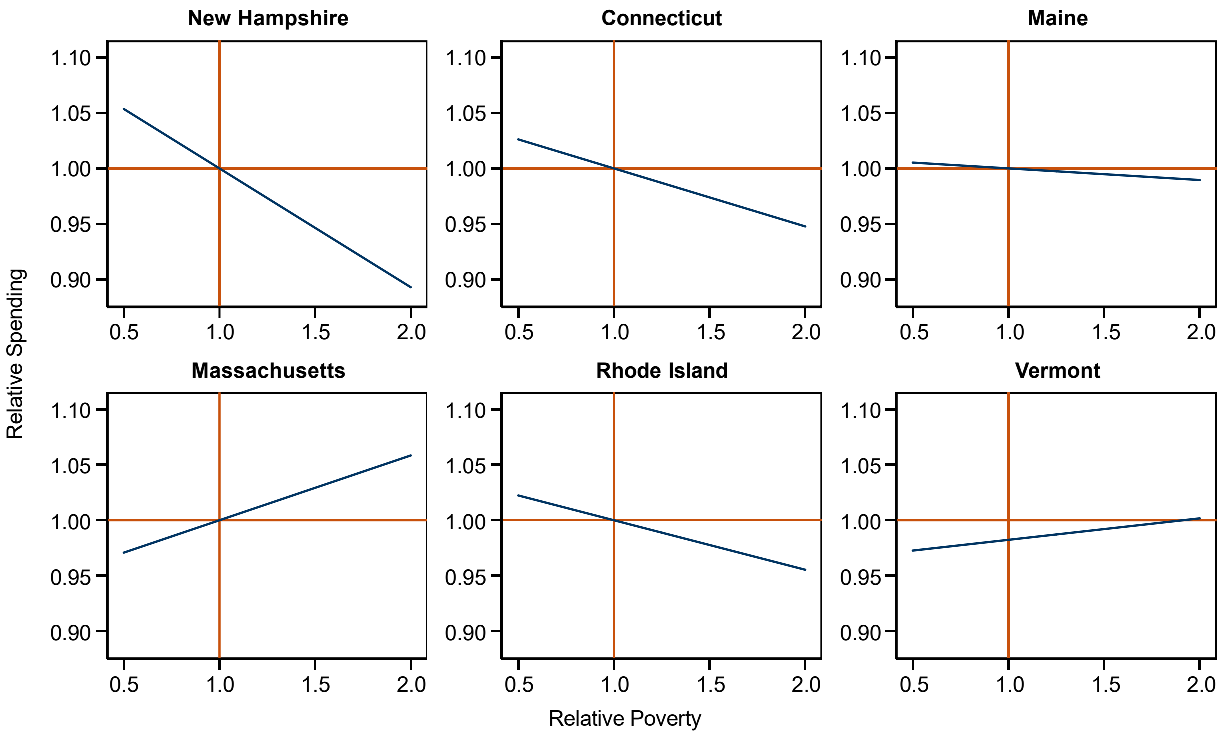
The other coefficients in the model indicate that otherwise similar districts with higher special education rates are expected to spend more and otherwise similar districts with higher rates of ELs tend to spend less. The regression coefficients for both FRPL rates and ELs are opposite of what would be expected if district spending reflected the costs districts face. Higher need districts, with respect to FRPL and EL rates, must face additional student needs with less money.

Using data available nationally, we can compare the progressivity of spending in New Hampshire to that observed in other New England states. Exhibit 7 examines the relationship between relative spending and relative poverty, where both relative spending and relative poverty are measured as ratios relative to the average within a given geographic area.[9] In this figure, a value of 1 on either the relative spending or relative poverty measure represents the average. Values greater than 1 represent above average, and values less than 1 represent below average. The picture for New Hampshire using national data looks similar to what we showed using New Hampshire's own data. Lower poverty districts spend more. on average. than higher poverty districts within the same geographic area. Connecticut and Rhode Island also show a regressive distribution of spending, but neither state is as regressive as the pattern shown in New Hampshire. The patterns shown in Maine and Vermont are relatively flat, indicating a very weak or no

[9] Geographic areas used for this analysis are "labor markets" defined by U.S. Census Core Based Statistical Areas or Places-of-Work areas.

relationship between spending and poverty. Massachusetts shows a progressive relationship, with the highest poverty districts spending more than lower poverty districts in the same geographic area.

Exhibit 7. Progressivity of Spending in New Hampshire Compared With Other New England States



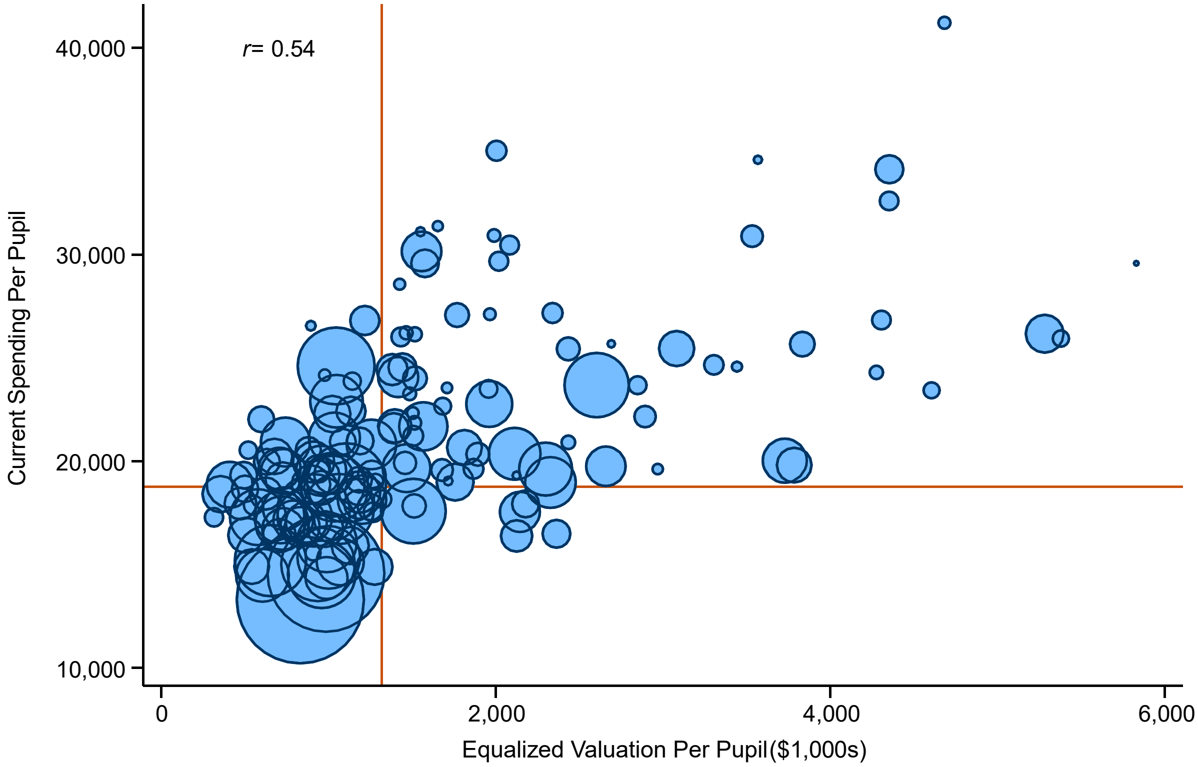
Note. Data are from the 2017–18 school year. Relative spending and relative poverty are expressed as ratios relative to the average within a given labor market (geographic area). Spending is measured on a per-pupil basis. Spending is from the Common Core of Data, and poverty is from the U.S. Census Small Area Income and Poverty Estimates.

Taxpayer Equity

For a system to be equitable for taxpayers, district spending levels should not be systematically related to property wealth, and districts with similar tax rates should be able to raise similar amounts of revenue. To examine whether New Hampshire's education system is equitable to taxpayers, we looked at relationships between district spending per pupil, district property wealth, and district tax rates.

Exhibit 8 is a scatterplot showing the relationship between district spending per student and district property wealth per student (equalized valuation per pupil). The horizontal and vertical orange lines denote the statewide averages for spending per pupil and property wealth per student, respectively. As shown in the figure, districts with higher property values generally spend more per student than those with lower property values. This finding is supported by the positive correlation coefficient of 0.54. Unless the highest wealth districts are taxing themselves at higher tax rates compared with lower wealth districts, this suggests that New Hampshire's system is not equitable to taxpayers.

Exhibit 8. Spending Per Pupil and District Property Wealth Per Pupil

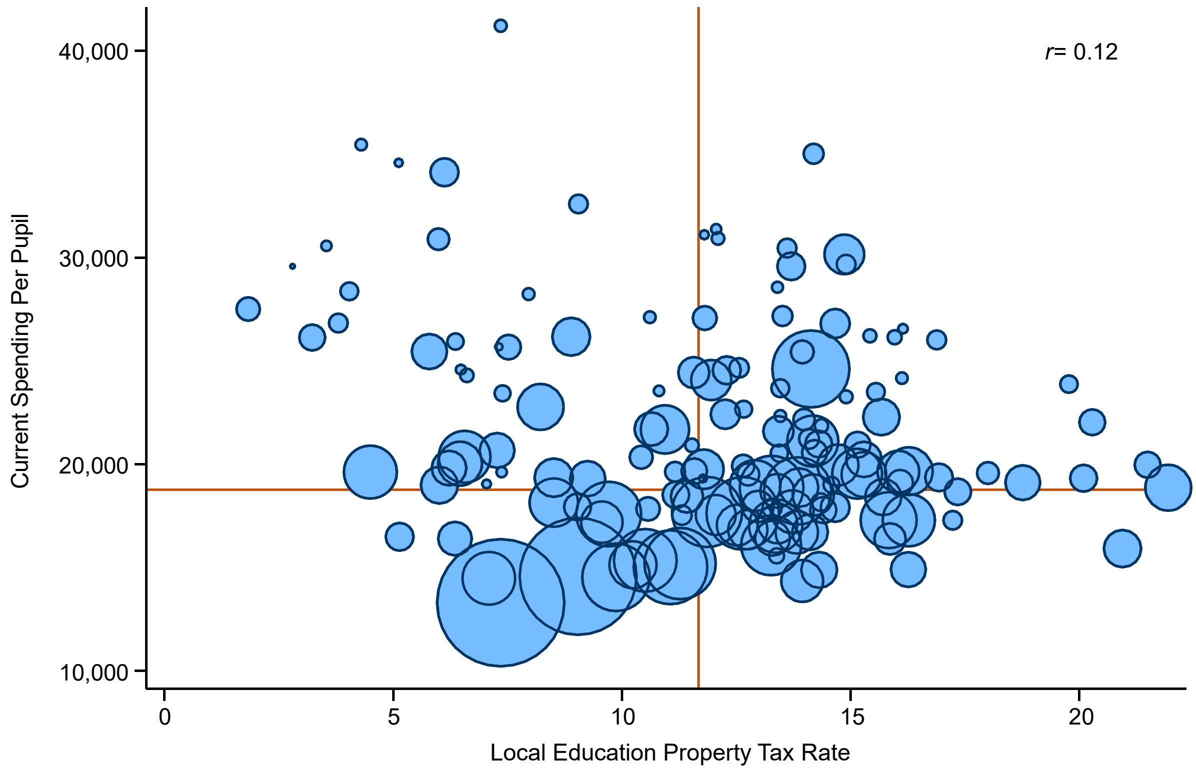


Note. The orange lines show statewide averages of both variables. The enrollment weighted correlation coefficient (*r*) equals 0.54. Data come from the New Hampshire Department of Education, 2018–19.

To provide further evidence, we show the relationship between spending per pupil and local education property tax rate in Exhibit 9 and the relationship between the local education property tax rate and district property wealth in Exhibit 10. Districts with higher local education property tax rates are not achieving higher spending per student and, in fact, often have lower spending per student than districts with lower tax rates. Furthermore, the districts with the lowest property wealth have the highest tax rates.[10]

[10] Formally speaking, the relationship between spending and tax rate is weak with a correlation coefficient of 0.12, whereas the relationship between tax rate and property wealth is relatively strong with a correlation coefficient of -0.41.

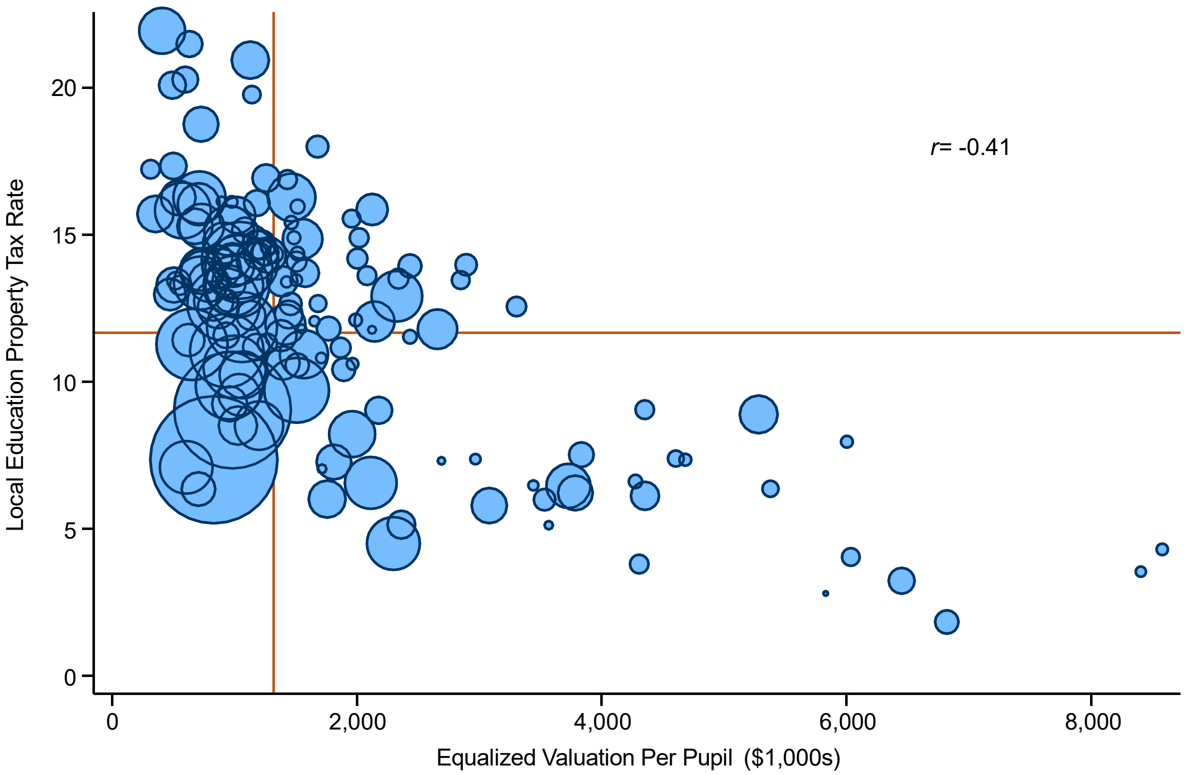
Exhibit 9. Spending Per Pupil and Education Tax Rates



Note. The orange lines show statewide averages of both variables. The enrollment weighted correlation coefficient (*r*) equals 0.12. Data come from the New Hampshire Department of Education, 2018–19.

Combined, this evidence indicates that the lowest wealth districts must tax themselves at much higher rates than wealthier districts and still often do not achieve similar levels of spending per student. Northumberland School District is one of the most striking examples of inequity to taxpayers in the state. Northumberland has the lowest property wealth per student in the state, at approximately $314,000 per student in 2019. To raise $17,383 per student (less than the state average), it approves a local education tax of $17.23 per $1,000 of assessed value. Combined with other local property taxes and the state education property tax, the total property tax rate in Northumberland is $40.79. Both its local education tax rate and overall property tax rate are almost double the state average tax rates. Similar stories play out in other districts with low property wealth including, Berlin, Claremont, Pittsfield, and others.

Exhibit 10. Property Tax Rates and District Property Wealth



Note. The orange lines show statewide averages of both variables. The enrollment weighted correlation coefficient (*r*) equals -0.41. Data come from the New Hampshire Department of Education, 2018–19.

Summary

As noted previously, effective systems for funding education should (a) appropriately account for differences across districts in costs, particularly with respect to student needs, and (b) account for differences across districts with respect to local capacity to raise revenue. The analysis results suggest that New Hampshire's existing system of education funding does not satisfy either criteria.

With regard to student equity, the highest poverty districts in New Hampshire spend less money per student, on average, than more affluent districts. This finding was consistent across a number of analyses including those using New Hampshire school district data and those comparing relative equity in New Hampshire to other states using national data. In addition, New Hampshire's high EL districts also spend less money per student, on average, compared with districts with lower proportions of ELs.

New Hampshire's system of funding also does not sufficiently account for differences in local capacity to raise revenues. Districts with higher property wealth spend more, on average, than districts with lower property wealth. This happens despite low wealth districts setting local education property tax rates that often are well above the state average local education property tax rate. Despite this additional effort, the higher tax rates are still not enough to overcome large disparities in local property wealth, meaning that districts with higher tax rates often spend less per student than districts with lower tax rates.

3. Student Outcomes and Student Needs

Examining the relationship between student outcomes and student needs is important for several reasons. First, demonstrating inequitable outcomes across districts that are related to the types of students they serve justifies the need for funding reform. Previously, we demonstrated that the education funding system in New Hampshire resulted in inequitable spending across districts. However, that is problematic only if the quality of education that students receive (as demonstrated by student outcomes) also differs substantially across districts.

Second, demonstrating that certain student needs or other district contextual factors are related to student outcomes supports the inclusion of these factors in a formula for distributing funding across districts. In other words, if student poverty results in lower student achievement, then it makes sense that districts with higher student poverty rates should receive additional funding to provide supplementary academic services and supports for those students.

In this section of the report, we describe the methods for examining the relationships between student outcomes and student needs and present results demonstrating how student outcomes vary across districts according to the needs of students served in those districts.

Examining Relationships Between Student Outcomes and Student Needs

Our approach to examining the relationship between student outcomes and student needs (outcome equity) is similar to the approach we took to examine equity of inputs. We started by generating some simple unconditional analyses to look at the bivariate relationships between a given measure of student outcome and an individual measure of student need; for example, the relationship between student assessment scores and district student poverty rates. To analyze these bivariate relationships, we calculated correlations and visually examine relationships using scatterplots.

Although these bivariate approaches are informative, they cannot describe a given relationship between a student outcome and a particular student need independent of other needs or characteristics. In other words, if districts with high student poverty rates also tend to have high special education rates, an observed negative relationship between student outcomes and poverty rates could be caused by higher special education rates in high poverty districts, not poverty itself. Therefore, in addition to the bivariate approaches, we used multiple regression analysis to isolate the relationships with outcomes of particular student needs independent of other needs or district characteristics.

Student Outcome Measures

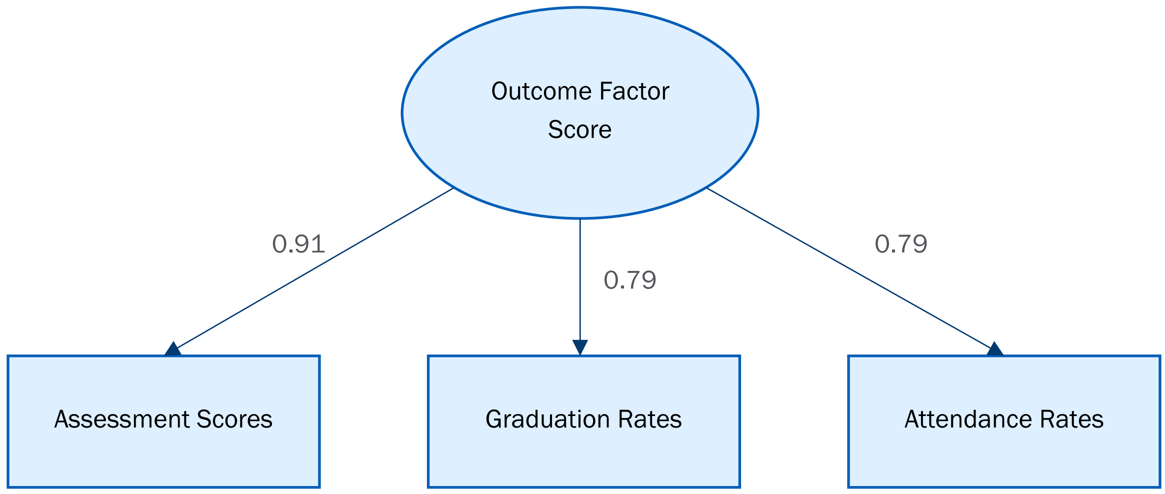
The analyses presented in this section largely use New Hampshire data and are restricted to districts within the state. However, we also did some analysis using national data to examine whether observed relationships between student outcomes and need in New Hampshire differ from other New England states.

For the analyses restricted to New Hampshire districts, we used three outcomes measures (student assessment scores, graduation rates, and attendance rates) to construct an aggregate outcome score that is meant to describe overall district performance.[11] The intent behind combining multiple outcome measures into a single score is to create a more robust measure of student outcomes that reflects the broader goals of education better than any single outcome measure.

To construct the outcome score, we conducted confirmatory factor analysis using a structural equation model that treats the overall outcome measure as a latent (unobserved) variable and estimates the latent variable to best fit the data. In other words, rather than make an arbitrary decision to weight each outcome equally (or choose another arbitrary weighting scheme), the model uses the existing variation in outcomes across each measure to identify the relative importance of each measure to the unobserved aggregate outcome score. Another advantage of this approach is that the statistical program used to construct the factor score can appropriately generate a factor score when some measures are missing. This is particularly relevant in the New Hampshire context, where many districts do not include grades at the high school level, and therefore, do not have graduation rate data.

Exhibit 11 shows the structural equation model used to generate the factor score.[12] The numbers included in the model represent standardized coefficients and describe the change in each individual outcome resulting from a one standard deviation (*SD*) increase in the outcome factor score. A 1 *SD* increase in the outcome factor score is associated with a 0.91 *SD* increase in assessment scores, a 0.79 *SD* increase in graduation rates, and a 0.79 *SD* increase in attendance rates.

Exhibit 11. Structural Equation Model Used to Generate the Factor Score



Note. Calculations based on data for the 2008–09 through 2018–19 school years from the New Hampshire Department of Education.

---

[11] Note that all three outcome measures are included as indicators of an adequate education under current New Hampshire State statute (see NH Rev Stat § 193-E:3, 2018 available at http://www.gencourt.state.nh.us/rsa/html/XV/193-E/193-E-mrg.htm).

[12] Assessment scores, graduation rates, and attendance rates were standardized prior to inclusion in the model. Assessment scores were standardized within grade, subject, and school year and then aggregated to a single score by calculating an average weighted by the number of test takers. Graduation rates and attendance rates were transformed to a logit scale to make the variables continuous rather than truncated and then standardized. Attendance rates were first standardized by grade level (elementary, middle, and high school) and then averaged based on enrollment by grade level.

As shown in Exhibit 12, the resulting outcome factor score is strongly correlated with each individual outcome measure, even though the correlations between the individual outcome measures are far more modest. Exhibit 12 shows both unweighted and enrollment weighted correlations between each outcome measure. When weighted by enrollment, the outcome factor score has a correlation of 0.96 with assessment scores, 0.83 with graduation rates, and 0.80 with attendance rates.

Exhibit 12. Correlations Between Outcome Measures

Outcome measure	Outcome factor score	Assessment scores	Graduation rate	Attendance rate
Outcome factor score	1.00/1.00			
Assessment scores	0.92/0.96	1.00/1.00		
Graduation rate	0.75/0.83	0.56/0.72	1.00/1.00	
Attendance rate	0.65/0.80	0.33/0.64	0.48/0.62	1.00/1.00

Note. Unweighted correlations are presented to the left of the forward slash, and enrollment weighted correlations are presented to the right of the forward slash. Calculations are based on data for the 2008–09 through 2018–19 school years from the New Hampshire Department of Education.

For the national data used in comparing New Hampshire to other states in the New England region, we use an outcome index created by researchers at Stanford University as part of the Stanford Education Data Archive (SEDA), which uses assessment data from each state along with National Assessment of Education Progress (NAEP) data to create a standardized measure of performance that intends to make performance measures comparable across states.[13]

Student Outcomes and Need

Exhibit 13 shows the correlations between various measures of student need and student outcomes. The first three rows of the table show the correlations between three measures of student need typically measured for schools and districts (incidence rates of FRPL, ELs, and SWDs) and the four student outcome measures. We also included several additional measures that are intended to measure economic disadvantage. Compared with other measures of economic disadvantage, FRPL is most strongly correlated with student outcomes. When weighted by enrollment, the correlation between FRPL and the combined outcome factor score is -0.84, which is a very strong negative correlation. The next strongest correlate with student outcomes is the income-to-poverty ratio, measured by the U.S. Department of Education. The measures of median household income and housing value reported by the U.S. Census show similar positive but slightly weaker correlations with student outcomes. These strong positive correlations indicate that communities with higher incomes tend to have better student outcomes. EL and special education rates also are negatively correlated with student outcomes, although less strongly than measures of economic disadvantage.

[13] The SEDA data are publicly available for download at https://cepa.stanford.edu/content/seda-data.

Exhibit 13. Correlations Between Student Need Measures and Student Outcome Measures

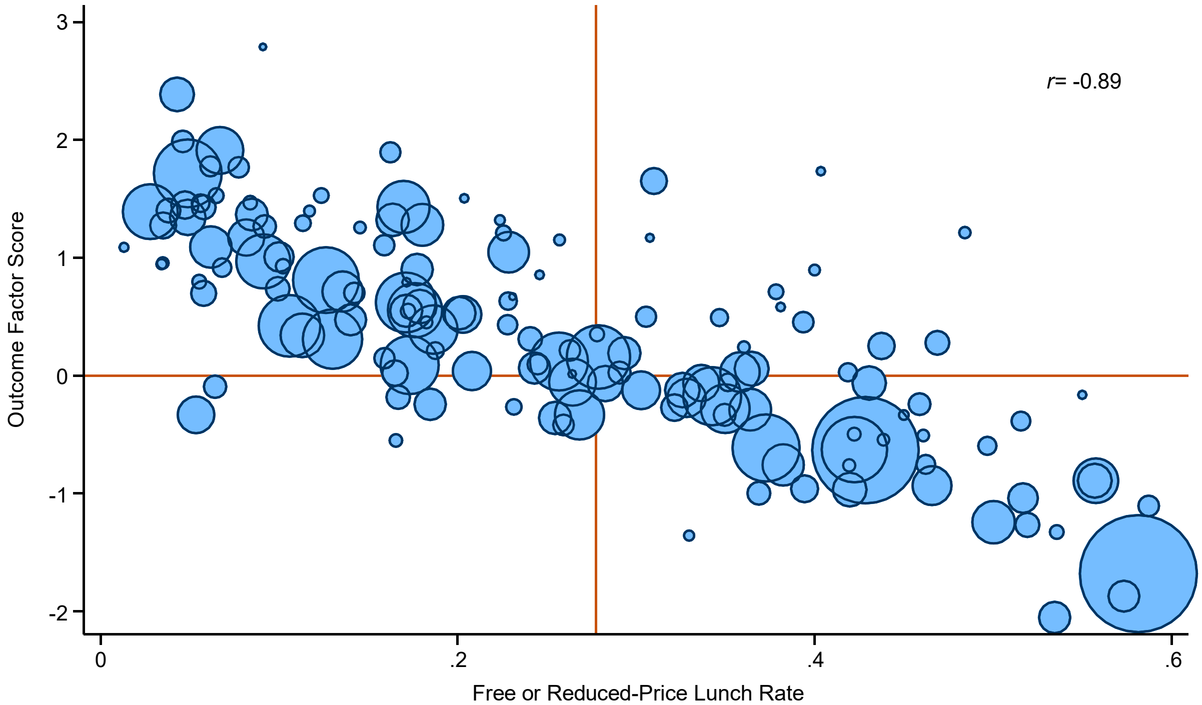
Student need measure	Outcome factor score	Assessment scores	Graduation rate	Attendance rate
FRPL rate	-0.71/-0.84	-0.68/-0.80	-0.51/-0.70	-0.37/-0.68
EL rate	-0.13/-0.55	-0.11/-0.51	-0.18/-0.48	-0.10/-0.47
Special education rate	-0.37/-0.43	-0.38/-0.46	-0.30/-0.32	-0.15/-0.28
Mean income-to-poverty ratio	0.65/0.78	0.63/0.76	0.43/0.63	0.34/0.59
Mean poverty (Small Area Income and Poverty Estimates)	-0.48/-0.74	-0.47/-0.71	-0.31/-0.58	-0.24/-0.62
Median household income	0.61/0.70	0.61/0.69	0.42/0.57	0.30/0.52
Median housing value	0.63/0.67	0.65/0.69	0.45/0.57	0.27/0.44

Note. Unweighted correlations are presented to the left of the forward slash, and enrollment weighted correlations are presented to the right of the forward slash. Calculations are based on data for the 2008–09 through 2018–19 school years from the New Hampshire Department of Education, the U.S. Department of Education, and the U.S. Census Bureau.

Scatterplots are another helpful way to visually examine relationships between student needs and outcomes. As shown in Exhibit 14, there is a clear strong negative linear relationship between student outcomes (measured by the combined factor score) and poverty (measured by the FRPL rate), with a correlation coefficient of -0.89. The districts with the lowest FRPL rates typically have student outcomes that are 1–2 *SD* above the state average. Districts with the highest FRPL rates typically have student outcomes that are 1–2 *SD* below the state average. Although the relationship between student outcomes and poverty is quite strong in New Hampshire, the observed pattern is typical of the New England region. Exhibit A.1 in Appendix A shows the relationship between student outcomes and FRPL rates using national data to compare the relationship in New Hampshire to other New England states. The observed relationship between student outcomes and FRPL rates in New Hampshire mirrors that of the remaining New England states.

Exhibits A.2–A.5 in Appendix A are scatterplots showing the relationships between student outcomes and both special education rates and EL rates, using New Hampshire and national data, respectively. Again, patterns observed in New Hampshire are generally similar to those in New England as a whole. The pattern of ELs with respect to student outcomes is notable because it allows us to see that the majority of New Hampshire districts have very few ELs. Manchester clearly stands out on the graph of ELs because it not only has the highest EL rate in the state by a clear margin but also is particularly low performing on the student outcome measure.

Exhibit 14. Relationship Between Student Outcomes and Free or Reduced-Price Lunch Rate



Note. The horizontal and vertical lines depict the statewide averages of the student outcome factor score and FRPL rate, respectively. The enrollment weighted correlation coefficient (*r*) equals -0.89. Data come from the New Hampshire Department of Education, 2018–19.

Exhibit 15 shows the relationships between district characteristics and student outcomes using multiple regression. All three student need variables (FRPL, EL, and special education rates) are strongly negatively associated with student outcomes. This means that each student need variable has an independent effect on student outcomes after accounting for the correlations between those variables.

The model also includes population density, indicators of district size, and proportions of enrollment by grade levels. Population density has a significantly negative relationship with three of the four student outcome measures (overall outcome score, assessment scores, and graduation rates). This is most likely picking up the effect of Manchester, which is the most densely populated district in the state and has low student outcomes. There is no clear pattern between district size or grade shares and student outcomes.

Exhibit A.6 in Appendix A shows how different measures of poverty or economic disadvantage perform in a multiple regression model. The R^2 value of the model using FRPL rates is higher than in the models using alternative measures, indicating the FRPL rate explains more variation in student outcomes than the other measures. This, along with the correlation analysis showing the strong relationship between student outcomes and FRPL, supports the use of FRPL over other measures of economic disadvantage for the cost modeling analysis and subsequent estimation of funding weights.

Exhibit 15. Regression Results Examining Relationships Between District Characteristics and Student Outcomes

	Outcome factor score	Assessment scores	Graduation rate	Attendance rate
FRPL rate	-4.318***	-1.178***	-3.919***	-3.125***
EL rate	-3.546***	-0.815***	0.134	-5.167***
Special education rate	-4.650***	-1.711***	-2.210*	-1.225*
Natural logarithm of population density	-0.0809***	-0.0226***	-0.160***	-0.0178
Enrollment categories				
≤ 100	-0.113	-0.0256	0.157	-0.0480
101–300	0.137	0.0363	0.398	0.0737
301–600	-0.0635	-0.0117	0.106	-0.138*
601–1,200	0.00207	0.0218	-0.0292	-0.165**
1,201–2,000	-0.154***	-0.0415***	-0.0560	-0.190***
Proportion of enrollment in middle school grades	-0.189	0.0306	0.728	-0.871***
Proportion of enrollment in high school grades	0.0926	0.0245	0.550*	-0.0669
Constant	2.339***	0.639***	1.967***	1.376***
N	1597	1597	725	1750
R^2	0.761	0.710	0.539	0.509

Note. Data includes FY2009 through FY2019. Models include year fixed effects. Data for the 2008-09 through 2018-19 school years come from the New Hampshire Department of Education and the U.S. Census Bureau (population density only).
*p < 0.05. **p < 0.01. ***p < 0.001.

Summary

To examine the relationship between student needs and outcomes, we constructed an aggregate outcome measure at the district level using student assessment scores, graduation rates, and attendance rates. Our analysis demonstrates that student needs as indicated by FRPL, EL, and special education rates are strongly negatively related to student outcomes in New Hampshire. This suggests that students in districts serving these high-need students are not being provided an equal opportunity to learn as students in districts serving fewer students with additional needs.

Along with prior evidence presented that education funding in New Hampshire is not distributed equitably, the unequal distribution of outcomes suggests that a more equitable funding system that allocates more resources to districts serving larger shares of students eligible for FRPL, ELs, and students in special education is necessary for the state to provide all its students an equal opportunity to achieve.

4. The Education Cost Model and Estimation of Funding Weights

Addressing the funding necessary to provide an equal opportunity for an adequate education requires that we first determine a desired level of outcomes and estimate the levels of spending associated with achieving this outcome level for all students in the state regardless of their needs or setting in which they attend school. That is, we must first establish some "adequacy targets" for spending that are unique to each district and then compare current spending levels to these targets.

The evaluation of equity presented earlier measures the existing distribution of spending or resources across districts with respect to student needs or other structural or geographic differences. Therefore, it is not sufficient to generate adequacy benchmarks, which show the level of resources needed to meet a target level of achievement for all students. To examine adequacy (or equal opportunity), we will use a cost function approach (a cost model) that incorporates student outcomes along with common cost factors (e.g., student needs, district enrollment size) as predictors of spending within a regression model. The cost model estimates spending at a constant desired student outcome level across all districts while retaining each district's observed level of other cost factors. In this way, the cost model identifies what the distribution of spending should be for all districts to achieve a common desired level of student outcomes, while also accounting for differences across districts in student needs and other structural and geographic differences that drive costs. Along with a few additional steps, the cost model can estimate funding weights that can inform the creation of a funding formula.[14]

The remainder of this chapter is organized as follows. First, we describe the cost model methodology in more detail to provide a foundation for the main analysis. Next, we present the results of the cost model and the subsequent estimation of funding formula weights. Finally, we show how the funding formula derived from the cost model and weight estimation would be used to equitably and adequately distribute funding to New Hampshire's districts and towns to provide an equal opportunity for all students to achieve.

Estimating Costs Through Cost Modeling

The AIR study team developed a three-step process for using education cost models to inform the design, redesign, or recalibration of state school finance formulas. This process was recently used in Vermont (Kolbe, Baker, Atchison, & Levin, 2019):

- **Step 1:** Estimate an education cost model (ECM) with historical district-level panel data using rigorous, standard statistical methods. This model determines the predicted cost of meeting defined student outcome targets, accounting for differences in a host of factors related to student needs and district characteristics that drive educational costs (cost factors).
- **Step 2:** Generate a set of formula weights to determine the relative importance of different cost factors in the funding formula. These weights are generated by fitting a statistical model of the relationship between the predicted costs from the cost model in Step 1 and cost factors commonly found in state aid formulas (e.g., measures of student need, district enrollment size, and degree of geographic remoteness).

---

[14] For additional information on alternative approaches to estimating the cost of an adequate education, see *Costing Out an Adequate Education: A Primer* (Baker, Levin, et al., 2020).

- **Step 3:** Apply the weights generated in Step 2 in a formula simulation to generate district-level adequacy projections.

In Step 1, the study team estimated an ECM using data on operational education spending,[15] outcomes such as student achievement, and a variety of factors influencing the cost of achieving these outcomes.[16] The ECM allowed us to generate the predicted cost per pupil of achieving a predetermined outcome for districts for which we have complete data for the years included in the model.

The ECM included some necessary complexities along with some more basic elements. The dependent measure in the cost model is a measure of per-pupil spending. Also included are factors that affect the differential cost of achieving any given level of outcome and assumed to be outside the control of districts: (a) variation in student needs, (b) geographic variation in the price levels of educational inputs (e.g., teacher salaries), and (c) structural or geographic factors such as district size and population density.

The goal of the ECM is to determine the relationship between spending and student outcomes across districts while accounting for the various cost factors. Therefore, the cost-function model must include measured student outcomes. The relationship between spending and student outcomes is circular, meaning that increased spending can drive student outcomes, but higher outcomes also may drive increased spending (e.g., by making the district more attractive, leading to increased property values and locally raised revenue). The ECM uses appropriate statistical techniques to account for the circular relationship between outcomes and spending.

Lastly, education spending includes expenditures that contribute to student outcomes (represented by the cost portion of spending) and expenditures not related to student outcomes (represented by inefficiency). Specifically, districts may make investments that do not necessarily contribute to the outcomes under consideration (e.g., significant investments in programming, drama, or extracurricular activities may not affect the student outcomes under consideration such as student achievement), and the model should account for this potential inefficiency. The ECM does so by including efficiency controls that predict increased spending behavior but do not contribute to higher outcomes. Common controls used for this purpose include measures of district fiscal capacity and local monitoring of public spending. Once we accounted for these statistical complexities, we can use our model to predict per-pupil spending levels needed (i.e., costs) for each district to achieve specific outcome targets. More technical detail regarding cost modeling is in Appendix B.

---

[15] Operational spending refers to expenditures devoted to the ongoing operation of a district and generally excludes large-scale capital investments in buildings and land, which regularly require long-term financing.

[16] The dominant modeling approach in recent peer-reviewed literature is one in which (a) the dependent measure is a measure of current operating expenditures per pupil; (b) the potential simultaneous determination of the dependent spending measure and the assumed independent measure of student outcomes (endogeneity) requires a statistical approach called an instrumental variables technique, where the exogenous portion of the student outcomes variable is isolated using measures of the competitive context within which local public school districts operate; and (c) attempts are made to control for inefficiencies in the spending measure (spending that does not affect the outcomes included in the model) by including measures of variations in fiscal capacity and local monitoring of public spending. This approach is largely the product of years of peer-reviewed cost function estimation by William Duncombe, John Yinger, and colleagues of the Maxwell School at Syracuse University (Duncombe, 2002; Duncombe, Lukemeyer, & Yinger, 2003; Duncombe & Yinger, 2004, 2011).

In Step 2, we took the district-level predicted cost estimates corresponding to a level of outcome that is considered adequate and identify a smaller set of cost factors that will be used as weights in a simulated funding formula. We then fit a weight estimation model that relates these factors to the predicted costs, with the purpose of generating a set of weights that can simulate per-pupil costs for all districts in future years, using updated district data and an assumed inflation rate. The weight estimation model produces a base per-pupil cost, which represents the predicted cost per pupil for a district that faces none of the factors that put upward pressure on cost (e.g., a large district in a population-dense area with no students who are economically disadvantaged, ELs, or students with disabilities). Formula weights are calculated as the differential cost per pupil for a given cost factor divided by the base per-pupil cost. Formula weights have a simple interpretation as the percentage increase in the cost of providing an adequate education when the associated cost factor is present. For example, a calculated formula weight for student economic disadvantage of 0.65 would indicate that it costs 65% more than the base cost per pupil to provide a student who is economically disadvantaged an opportunity to achieve at the adequate outcome standard.

In Step 3, the study team used the formula weights estimated in Step 2 to build a simulation that generates per-pupil spending projections for all districts. The difference between these cost estimates and the most recent available data on operational spending determines current spending gaps, the change in spending needed to achieve target outcomes. This type of simulation, which is based on a formula derived from an empirically estimated ECM, can be translated directly into legislation and incorporated into state finance systems. Many state school finance formulas take a similar form to the formulas used to simulate the distribution of dollars in our simulations, including New Jersey's School Funding Reform Act and Kansas's School District Finance Act. Current efforts are under way in Vermont to pass legislation based on recommendations and simulations that came out of a study of school funding in Vermont using the approach outlined here (Kolbe et al., 2019).

Using this process, we estimated two models: (a) a regional cost model that uses national data and includes New Hampshire as well as contextually similar New England states and (b) a New Hampshire specific model using data collected mostly from the New Hampshire Department of Education. The regional model has the advantage of using a larger number of districts from multiple states. For statistical analyses underlying cost modeling, a larger number of districts can help produce more precise and accurate estimates of costs. However, the regional model relies on national data, which means that the measures used might not exactly match New Hampshire's own data, and the amount of time it takes to collect and process national data means the most recent school year represented in the national data is 2015–16.

The New Hampshire specific model has the advantage of using New Hampshire's own data, which local stakeholders are familiar with and is more current. In addition, we could incorporate multiple student outcomes with New Hampshire's data, whereas the regional model uses only a measure of student assessments.

Setting Outcome Targets

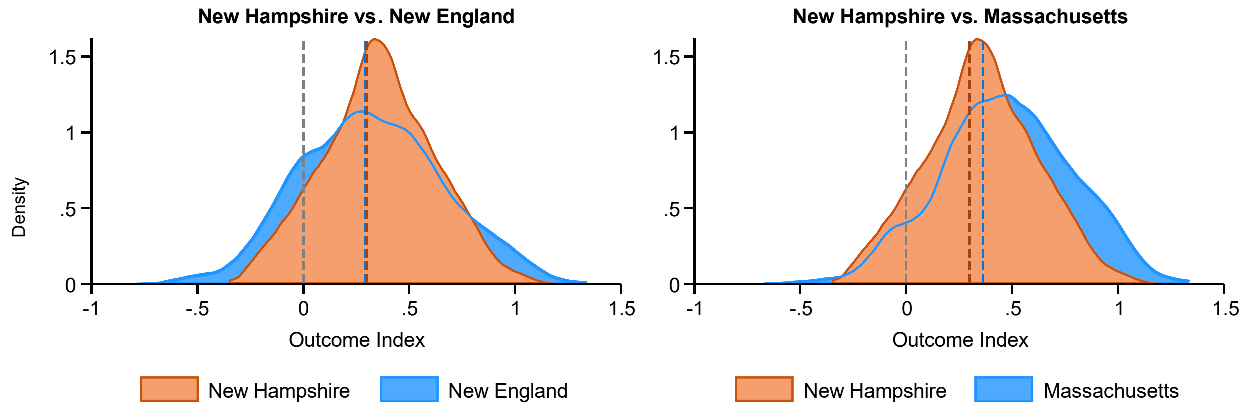
Prior to estimating the cost model, we had to determine an appropriate target outcome level to represent an adequate education. As described in the supporting brief drafted for this study (*Setting Outcome Goals and Standards: From a Formal to Functional Definition of Adequacy* [Baker, Atchison, Kearns, et al., 2020a]), we compared New Hampshire outcomes on the NAEP and an estimate of performance from

SEDA to other New England states. We also used publications that crosswalk performance levels on NAEP to proficiency benchmarks on the Smarter Balanced Assessment Consortium (SBAC) assessments to understand whether New Hampshire students exceeded SBAC proficiency rates, on average, which are intended to represent college and career readiness (Rahman et al., 2019).

The results of these comparisons show that New Hampshire's students already perform on par with other New England students, and New England students perform well above the national average. Furthermore, in the past decade of NAEP, New Hampshire's students have generally exceeded proficiency levels set by SBAC, suggesting that New Hampshire's students are already college and career ready, on average. Moreover, New Hampshire's performance levels approach those of Massachusetts, which has been the top-performing state on NAEP for a number of years (see Exhibit 16).

This analysis of performance levels, along with the already high levels of education spending in New Hampshire, suggest that New Hampshire's average student performance and level of spending are adequate. Therefore, we set the performance target at the New Hampshire state average for the purpose of our cost analysis. As a point of reference for those familiar with New Hampshire's districts, Contoocook Valley, John Stark Regional, Fall Mountain Regional, Pembroke, and Mascoma Valley Regional all performed at about the state average according to our combined student outcome factor score (see Exhibit 17).

Exhibit 16. Distribution of Performance in New Hampshire Districts Relative to Other New England States and Massachusetts



Note. The set of states in New England includes Massachusetts, Maine, Rhode Island, and Vermont. The vertical dashed gray line at 0 represents national average outcomes. The vertical dashed orange line represents the enrollment weighted average outcome index for New Hampshire. The vertical dashed blue line represents the enrollment weighted average outcome index for New England and Massachusetts, respectively. The left panel shows that the New Hampshire and New England average outcome indexes are almost identical (i.e., the vertical dashed orange and blue lines more or less overlap).

Exhibit 17. Districts Near the State Average on the Outcome Factor Score

District name	Outcome factor score	Assessment score (Z-score)	Graduation rate	Graduation rate (Z-score)	Elementary attendance rate	High school attendance rate	Attendance rate (Z-score)
Contoocook Valley	-0.06	-0.10	91.1%	0.13	95.7%	91.6%	0.08
John Stark Regional	0.02	-0.07	92.7%	0.42	—	92.8%	-0.08
Fall Mountain Regional	0.03	-0.05	92.6%	0.39	95.1%	91.8%	-0.22
Pembroke	0.04	-0.04	90.9%	0.09	95.3%	92.7%	-0.05
Mascoma Valley Regional	0.06	-0.13	94.1%	0.71	95.3%	94.0%	0.22

Note. Calculations are based on data from the New Hampshire Department of Education, 2018–19.

The Cost of Adequacy

To estimate the cost of providing an adequate education, we estimated a New Hampshire specific model and a regional model that included districts from other New England states. The results of the two models were quite similar. Both models indicated that achieving higher student outcomes costs more, and both models indicated that districts with higher shares of students eligible for FRPL, students in special education, and ELs have higher costs to achieve a common outcome level compared with districts with lower incidences of these student needs. Furthermore, both models indicated small districts have higher per-pupil costs compared with larger districts. Both models also indicated that having a larger share of students in upper grade levels (at the middle and high school levels) costs more. The regional model, however, indicated that students in middle grades cost the most, with students in high school grades costing only slightly more than elementary students. Lastly, both the New Hampshire and regional models indicated that there was no increase in cost associated with sparsely populated areas or geographic price differences. Exhibit 18 summarizes the New Hampshire and regional cost model results in terms of the direction with which each characteristic or factor influences cost (↑ upward influence, ↓ downward influence, and ↔ no significant influence). Exhibits B.6 and B.7 in Appendix B show the detailed cost model results.

Exhibit 18. New Hampshire and Regional Cost Model Summary

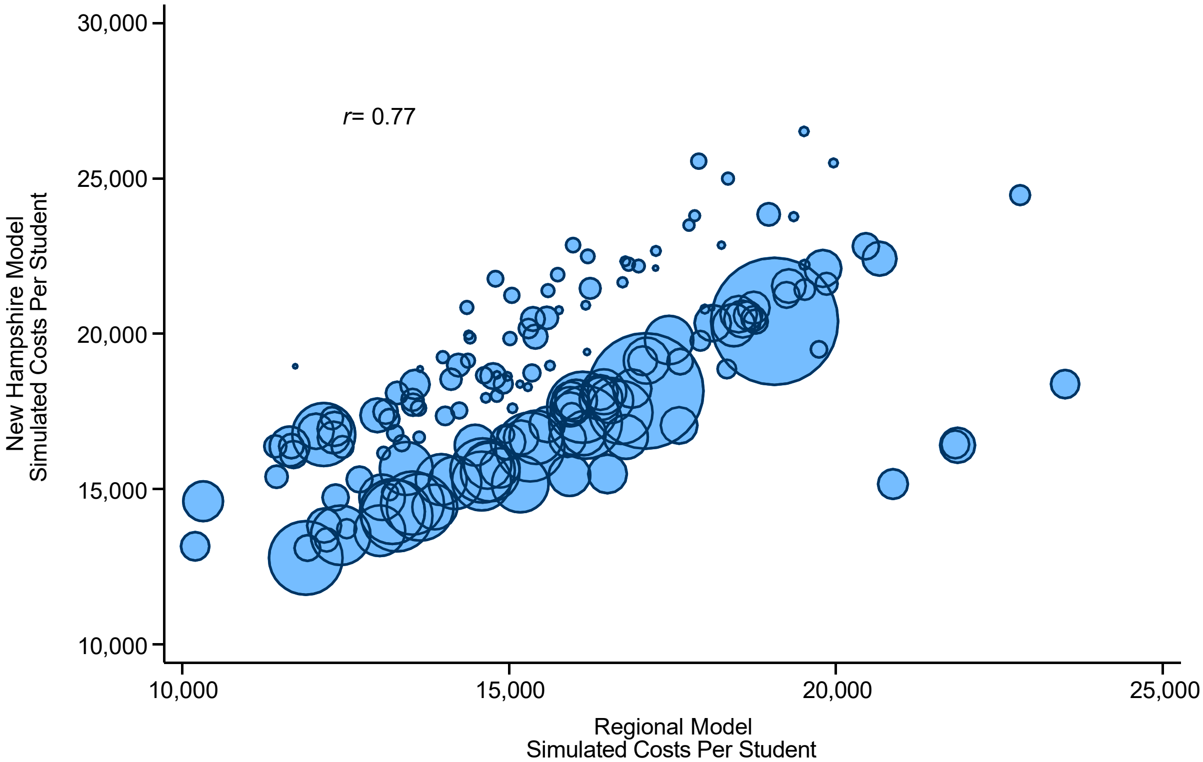
Characteristic/cost factor	New Hampshire model	Regional model
Student outcomes	↑	↑
FRPL	↑	↑
Special education	↑	↑
ELs	↑	↑
Small districts	↑	↑
Sparsely populated areas	↔	↓
Upper grade levels	↑	↑
Geographic price differences	↔	↔

Note. Arrows represent the relationship of the given characteristic or cost factor with costs. Arrows pointing up (↑) represent an increase in cost with an increase in the given characteristic. Double-headed horizontal arrows (↔) represent no significant relationship. Arrows pointing down (↓) represent a decrease in cost with an increase in the given characteristic. Calculations are based on data from the New Hampshire Department of Education for the New Hampshire model and data from the U.S. Department of Education and the U.S. Census Bureau for the regional model.

Further exploration suggests that the lack of relationship between population density (sparsely populated areas) and cost is likely the strong correlation between district size and population density. In other words, the increased costs associated with small districts are already capturing any increased costs that might be associated with districts in low population density areas.

In addition to the consistency between models in the variables that increase cost, there is a relatively strong congruence between models in the distribution of costs across districts. Exhibit 19 shows a scatterplot of the costs simulated from each cost model. The simulated costs shown are generated after the estimation of weights (described in more detail later) and the application of weights from both models to 2019 New Hampshire data. There is a clear positive relationship between the two models, resulting in a correlation of 0.77. There also are some clear differences. In particular, the New Hampshire specific model suggests a larger increase in cost for small districts. This is evident from the vertical separation in costs between small and large districts.

Exhibit 19. Comparison of Simulated Per-Pupil Costs in New Hampshire Districts From the New Hampshire and Regional Cost Models

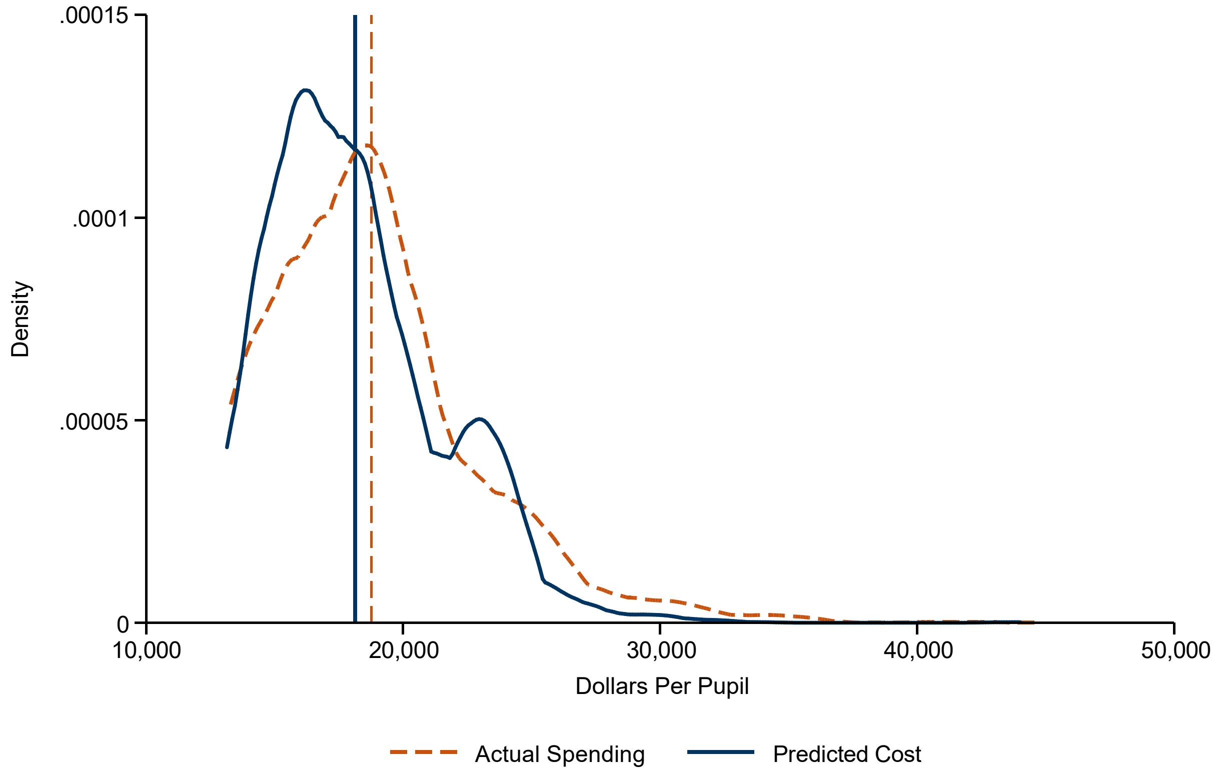


Note. The simulated costs represent the costs calculated by applying the weight estimated from both models to New Hampshire 2018–19 data. The enrollment weighted correlation coefficient (*r*) between the calculated costs from two models equals 0.77. Calculations are based on data from the New Hampshire Department of Education for the New Hampshire model and data from the U.S. Department of Education and the U.S. Census Bureau for the regional model, 2018–19.

Despite some differences, the general consistency between the New Hampshire and regional models gives us confidence that the cost estimates from the New Hampshire model are valid. There also are several advantages of the New Hampshire cost model that have led us to emphasize the results of the New Hampshire model over the regional model, including the availability of (a) more recent data; (b) a more robust outcome measure; and (c) New Hampshire's own data on education spending, student needs, and student outcomes. In particular, the use of New Hampshire's own data will make it more seamless to translate the recommendations stemming from the subsequent weight estimation into policy. For this reason, the subsequent presentation will consist of results generated by the New Hampshire model.

Exhibit 20 shows the distribution of predicted costs from the New Hampshire cost model for the 2018–19 school year. Because we chose to estimate the costs associated with achieving the existing New Hampshire average outcome, we would not expect to see predicted costs substantially exceed levels of actual spending. Unsurprisingly, this is what the results show. The exhibit shows the statewide averages of actual spending per pupil and predicted costs per pupil in 2018–19 to be between $18,000 and $19,000. The overall distributions of actual spending and predicted costs across districts are also quite similar, with both spending and cost measuring approximately $13,000 per student on the low end of the distribution and with smaller shares of districts above $30,000 per student on the high end (these tend to be very small districts).

Exhibit 20. Distribution of Actual Spending and Predicted Costs



Note. The vertical orange and blue lines represent the statewide averages for actual spending and predicted cost, respectively. Calculations are based on data from the New Hampshire Department of Education, 2018–19.

Although the overall distribution of predicted costs looks similar to the distribution of actual spending, our model indicates that some districts should receive much more funding to achieve current state average outcome levels, whereas others receive more funding than required to achieve the current state average outcome level. As shown in Exhibit 21, some districts are substantially underfunded, in some cases by as much as $10,000 per student. These districts also tend to perform well below the state average outcome level. The large dot that clearly stands out in the lower left-hand side of the figure is Manchester, which has an outcome score 1.77 *SD* below the state average outcome score. Our model indicated that Manchester is underfunded by almost $10,000 per student.

Exhibit 21. Outcome Gaps and Funding Gaps

Note. The orange lines show statewide averages of both variables. The enrollment weighted correlation coefficient (*r*) equals 0.73. Calculations are based on data from the New Hampshire Department of Education, 2018–19.

The clear relationship between the outcome gaps and funding gaps also serves as validation that our model is performing as it should in producing reasonable cost estimates by indicating those districts that require more or less funding to meet average student outcomes because of the levels of cost factors (student needs and contextual characteristics) they face. Districts that are currently performing at or near the statewide average outcome level also generally have actual spending levels at or near their predicted cost. Districts that perform above the state average outcome level generally spend more than the predicted cost of achieving an average outcome level. Likewise, districts that achieve below state average outcome levels generally spend less than the predicted cost of achieving an average outcome level. Certainly, some districts are highly achieving, but our model indicated that they spend less than what our model predicted they should, and some districts are poorly performing but spend more than our model indicated they should. It could be that these districts have unique circumstances that the data included in our model did not capture. However, in general, the model appears to perform well in identifying higher costs for districts that need additional funding the most.

Estimating Weights

To convert the cost predictions into a set of weights that can be incorporated into a funding formula, we first selected a set of variables that proved to be significant predictors of cost and would be easily incorporated into a funding formula. These variables included the following:

- FRPL rates
- EL rates
- Special education rates
- Indicators of district size
- Percentages of students by grade level

As a second step, we excluded sources of funding or expenditures that would not be accounted for in a state-level education funding formula, which included federal revenue and special education catastrophic aid. Federal revenue is typically targeted to districts through established federal formulas. A pot of money for extremely high-need students in special education often is necessary for students with severe disability, for which the funding of services would place substantial (potentially insurmountable) burden on the district without additional aid. Transportation funding is another funding source that some states choose to fund outside the general funding formula through a separate categorical funding or a cost-reimbursement program. To provide New Hampshire policymakers the option of whether to fund transportation through the general formula or as a separate categorical program, we estimated weights both including and excluding transportation expenditures.

After selecting the variables to include and adjusting cost predictions to exclude spending from federal sources, special education catastrophic aid spending, and transportation spending (for the models that exclude transportation), we ran a weight estimation model that can be used to generate weights (Exhibit 22). The coefficients estimated by the weight estimation model represent the additional cost per student for a one-unit increase in the given variable. Because each variable included in the model is either proportions or indicators taking on values of 0 or 1, they can be interpreted as the incremental cost for an individual student with a given characteristic. For example, the first model that accounts for transportation spending suggests that each student eligible for FRPL costs $8,751 more than an otherwise similar student who is not FRPL eligible.

The constant term represents the estimated 2018–19 spending level for a district with no additional cost factors: a district with no students eligible for FRPL, no students in special education, no EL, in the largest size category, and enrolling only elementary students. Therefore, the constant term also represents what would be the base per-pupil cost for 2018–19.

Exhibit 22. Weight Estimation Model

Cost factor	Predicted cost per pupil including transportation	Predicted cost per pupil excluding transportation
FRPL rate	8,751	8,972
Special education rate	25,183	24,796
EL rate	12,898	14,983
Enrollment categories (reference group is above 2,000 students)		
≤ 200	6,363	5,855
201–600	3,357	3,141
601–1,200	2,549	2,519
1,201–2,000	1,431	1,375
Grade-specific enrollment proportions (reference group is elementary grades)		
Proportion of enrollment in middle grades	8,305	8,267
Proportion of enrollment in high school grades	2,483	2,803
Constant	5,868	4,973
N	1,754	1,754
R^2	0.983	0.982

Note. Both models exclude federal revenue and catastrophic aid spending from the predicted cost. In addition to the coefficients shown, a year trend variable centered on 2019 also was included in the model. The regression model is weighted by student enrollment. All coefficients are statistically significant at $p < .001$, largely a result of regressing many of the same variables from the ECM on predictions from that model. Calculations are based on data from the New Hampshire Department of Education, 2008–09 through 2018–19.

To convert the regression coefficients to weights that can be used in a funding formula, we simply divided each coefficient by the constant term (Exhibit 23). For example, dividing the FRPL coefficient in Exhibit 22 from the model that accounts for transportation by the corresponding constant term equals 1.49 (i.e., $8,751/$5,868 = 1.49) denotes that a student eligible for FRPL costs almost 1.5 times as much as a student with no additional cost factors. The weights, therefore, represent the additional cost for a student with a given characteristic relative to the base cost (the cost for a student with no additional weights applied). The advantage of converting dollars to weights is that a formula can easily be updated on a yearly basis by adjusting the base cost per pupil (to account for inflation, for example) and applying the existing weights to the new base.

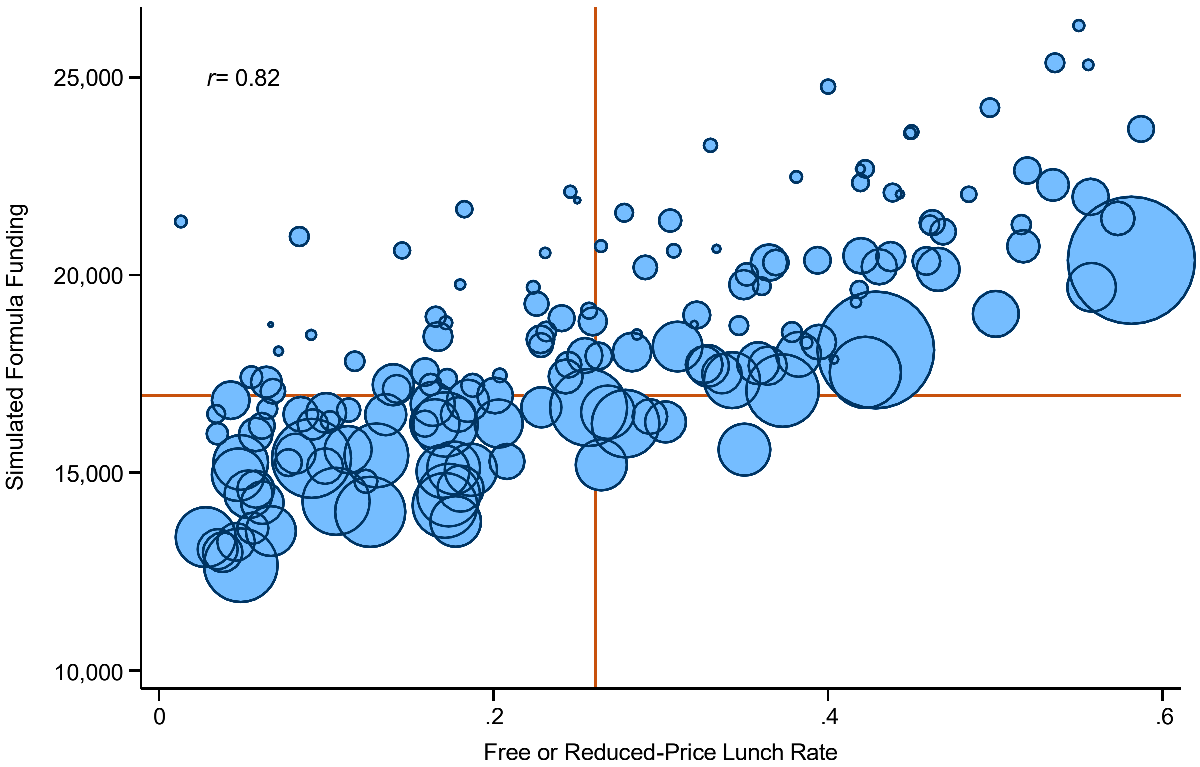
Exhibit 23. Estimated Base Per-Pupil Costs and Formula Weights

	Including transportation	Excluding transportation
Base per pupil cost	$5,868	$4,973
Weights		
FRPL rate	1.49	1.80
Special education rate	4.29	4.99
EL rate	2.20	3.01
Enrollment categories (reference group is greater than 2,000 students)		
≤ 200	1.08	1.18
201–600	0.57	0.63
601–1,200	0.43	0.51
1,201–2,000	0.24	0.28
Grade-specific enrollment proportions (reference group is elementary grades)		
Proportion of enrollment in middle grades	1.42	1.66
Proportion of enrollment in high school grades	0.42	0.56

Note. The base per-pupil cost represents the estimated base for the 2018–19 school year.

After estimating the weights, we calculated new cost predictions based on the weights to further examine the distribution of dollars across districts according to the estimated weights. To distinguish these predictions based on the simpler weight estimation model from the predictions generated directly by the cost model, we call the former the simulated costs or formula funding. Exhibit 24 shows the simulated formula funding by district in relation to FRPL rates. The distribution of simulated funding is strongly progressive and distributes more funding per student, on average, to districts serving larger percentages of students who are economically disadvantaged. In other words, if districts were funded according to the estimated weights, the system would be quite progressive.

Exhibit 24. Relationship Between Simulated Formula Funding and Free or Reduced-Price Lunch Rates



Note. Simulated formula funding excludes federal revenue and catastrophic aid spending. Transportation spending is included in this figure. The orange lines show statewide averages of both variables. The enrollment weighted correlation coefficient (*r*) equals 0.82. Calculations are based on data from the New Hampshire Department of Education, 2018–19.

Exhibit 25 compares average per-pupil spending and simulated formula funding across districts within the FRPL quintile.[17] When we compare the distributions of simulated formula funding to actual spending across districts in this fashion, we see that low-poverty districts (as proxied by FRPL rates) typically spend far more than their simulated funding levels, whereas the highest poverty districts spend substantially less than their simulated funding levels (Exhibit 25). Specifically, actual spending on the average student in the highest need (Quintile 5) districts is $15,939 per student, but simulated funding is $21,423 per student, a difference of $5,484 per student. This represents an average shortfall across the highest need districts in the amount of spending necessary to allow students an equal opportunity to achieve the statewide average student outcomes of 25.6%.[18] In contrast, actual spending on the average pupil for the lowest need (Quintile 1) districts is $18,873 compared with an average simulated funding measure of

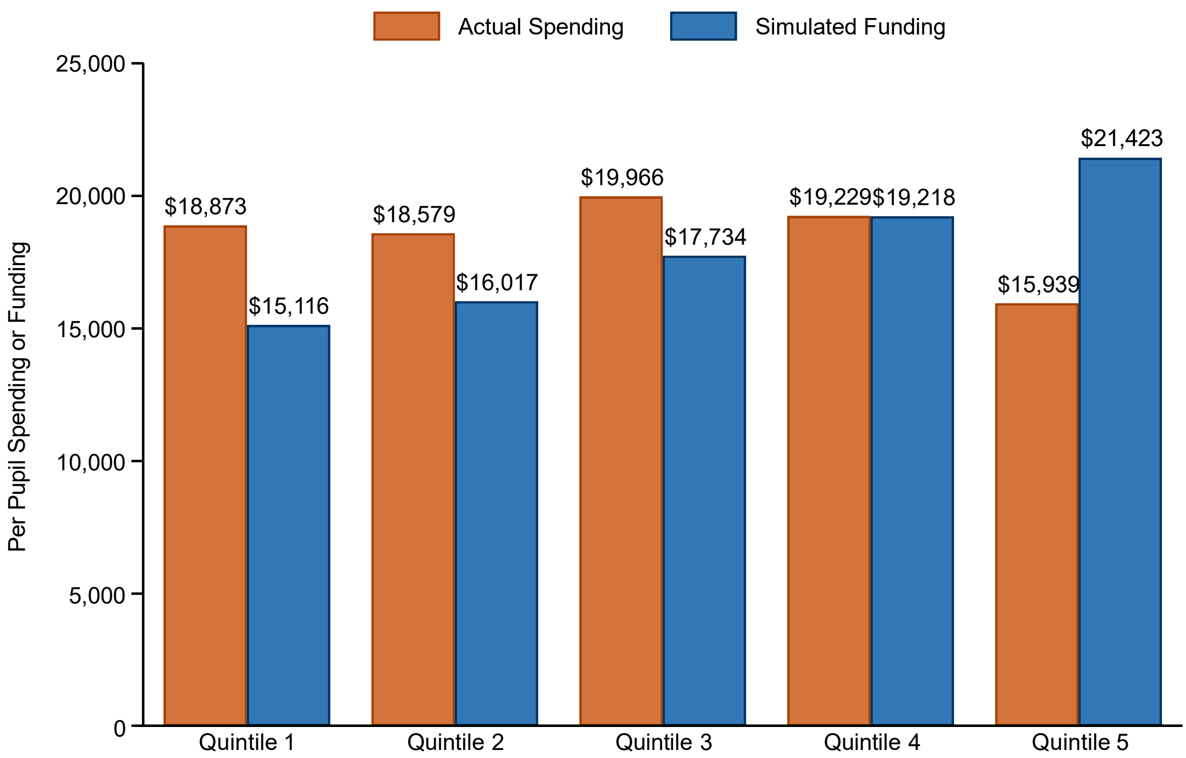
---

[17] Categorizing districts by FRPL quintile is done by first sorting by the percentage of FRPL and separating them into five groups with roughly equal numbers of districts in each so that Quintile 1 contains the 20% of districts in the state with the lowest FRPL rates, Quintile 2 contains the 20% of districts with the next higher FRPL rates, . . . and Quintile 5 contains the 20% of districts in the state with the highest FRPL rates.

[18] The calculation of the Quintile 5 shortfall is as follows: ($21,423 – $15,939)/$21,423 = 0.256.

$15,116, or $3,757 (24.9%) more than what is deemed necessary to provide an opportunity for students to achieve statewide student outcomes.[19]

Exhibit 25. Per Pupil Actual Spending and Simulated Funding by Free or Reduced-Price Lunch Quintile



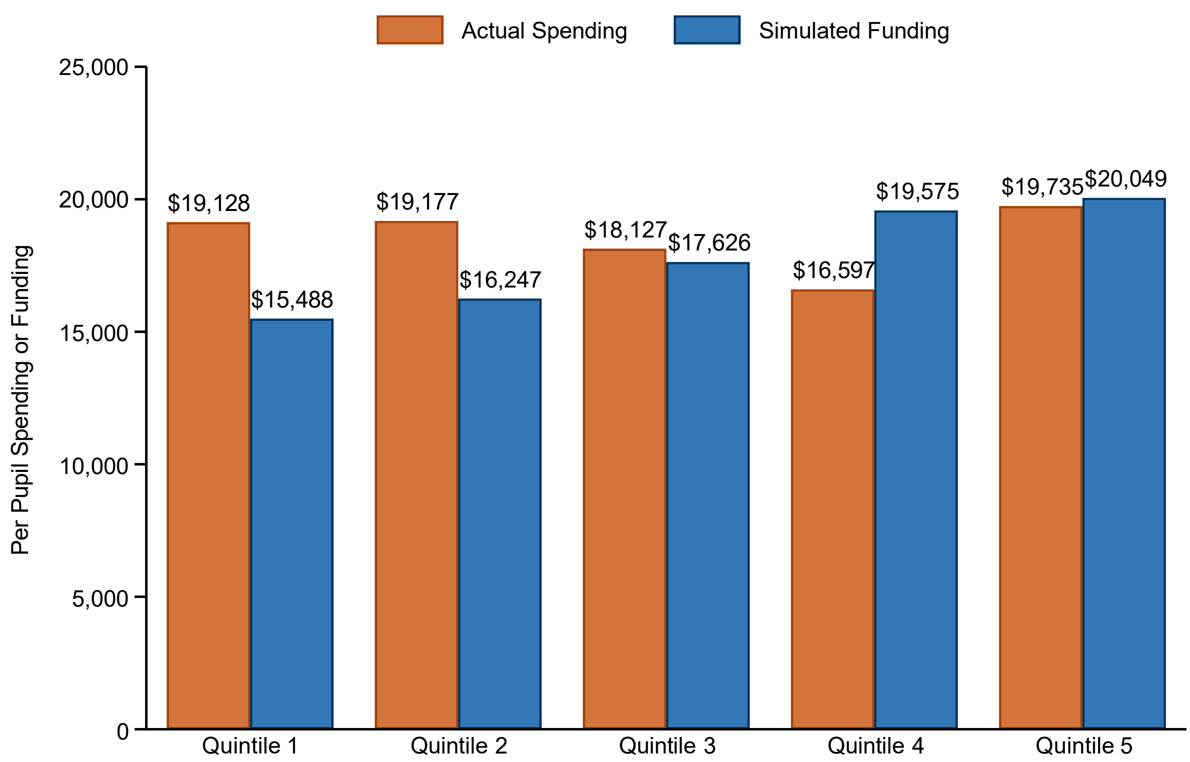
Note. Quintiles were calculated at the district level based on FRPL rates. Each quintile represents approximately 20% of the districts in the state. Quintile 1 represents districts with the lowest FRPL rates; Quintile 5 has the highest FRPL rates. Averages within quintiles are weighted by enrollment. Calculations are based on data from the New Hampshire Department of Education, 2018–19.

A similar pattern can be observed with respect to the distribution of actual spending per pupil and simulated funding across districts with respect to the special education quintile (Exhibit 26). The distribution of simulated funding shows a clear pattern, where districts with higher special education rates are projected to receive more funding on average. However, districts in the lower three special education quintiles spend more on a per-pupil basis than do their simulated funding amounts, on average. Districts in the top two special education quintiles face funding deficits, with simulated funding exceeding their actual spending levels.

---

[19] The calculation of the Quintile 1 overspending is as follows: ($15,116 – $18,873)/$15,116 = –0.249.

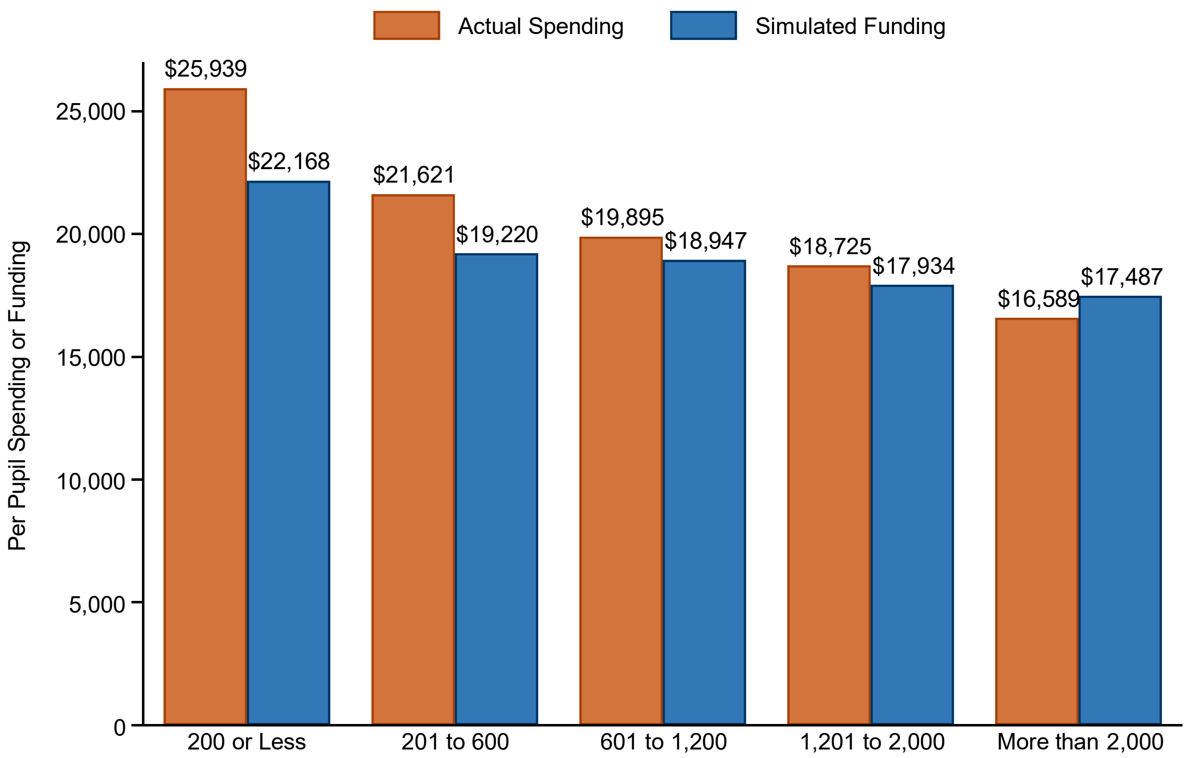
Exhibit 26. Per Pupil Actual Spending and Simulated Funding by Special Education Quintile



Note. Quintiles were calculated at the district level based on special education rates. Each quintile represents approximately 20% of the districts in the state. Quintile 1 represents districts with the lowest special education rates; Quintile 5 has the highest special education rates. Averages within quintiles are weighted by enrollment. Calculations are based on data from the New Hampshire Department of Education, 2018–19.

Lastly, we compare actual spending and simulated funding according to district size categories (Exhibit 27). Simulated funding across districts decreases with size, from an average of more than $22,000 per student in districts with 200 or fewer students to an average of $17,487 in districts with more than 2,000 students. Although the simulated funding provides more to small districts, actual spending in small districts remains higher than simulated funding. Actual spending in districts with 200 or fewer students, for example, is almost $26,000 per student on average (almost $3,800 more per student than simulated funding levels). This suggests that small districts, under the current system of funding in New Hampshire, are spending more than is necessary to provide an equal opportunity for students to meet statewide average outcomes. In the largest districts, by contrast, simulated funding exceeds actual spending by approximately $900 per student.

Exhibit 27. Per Pupil Actual Spending and Simulated Funding by District Size Category



Note. Averages within a district size category are weighted by enrollment. Calculations are based on data from the New Hampshire Department of Education, 2018–19.

Simulating a New Funding Formula

Simulating Funding

The analysis thus far has focused on district-level data and the student attending each district. However, the funding of education in New Hampshire occurs at the town level. In some cases, multiple towns come together to form conglomerate, or regional, districts. In other cases, students in individual towns will send their students to multiple districts—for example, one district for elementary school students and a different district for middle school and high school students. Therefore, to more closely model how a funding formula would work in New Hampshire, we applied the funding weights to data at the town level.

For most data elements, the transition from district-level data to town-level data was not an issue. New Hampshire's current calculation of adequacy grants under its current funding system uses average daily membership (ADM) at the town level and the ADM of students eligible for FRPL, students in special education, and ELs to distribute differentiated aid to towns. For the simulated funding formula, we can simply apply the relevant student need weights to these counts of students by need category. The department also collects and reports data on enrollments by resident town, disaggregating enrollments by elementary, middle, and high school grade levels. We used these enrollments to identify the percentage of students by grade level in each town to apply the estimated grade level weights. Lastly, we used a crosswalk of towns and districts that included enrollments by district and town to identify the percentages of students by town that attended districts in each size category. In most cases, all students within a given district attend the same district. Applying the crosswalk was relevant only where students within the same town attended multiple districts and the two districts were in different district size categories. In Holderness, for example, 69% of the students attend its own elementary district that has less than 200 students, and 31% of its students attend Pemi-Baker Regional High School District, which is in the 601–1,200 student category.

Once we created a town-level dataset with all the elements included in the weight estimation model, we simply applied the base and weights to the town data elements. As described earlier, because the most recent year of data collected for the cost model was in 2018–19 dollars, the base per-pupil amount (the constant) estimated from the weight estimation model also was in 2018–19 dollars. To update the base to 2019–20, we inflated the base by 2.5%, which is the average yearly inflation rate indicated by the year trend coefficient in the cost model. This inflated the base to $6,015 when transportation is included and $5,097 when transportation is excluded.

The simulator tool that we created first calculates weighted ADM. The formula for calculating weighted ADM is as follows:

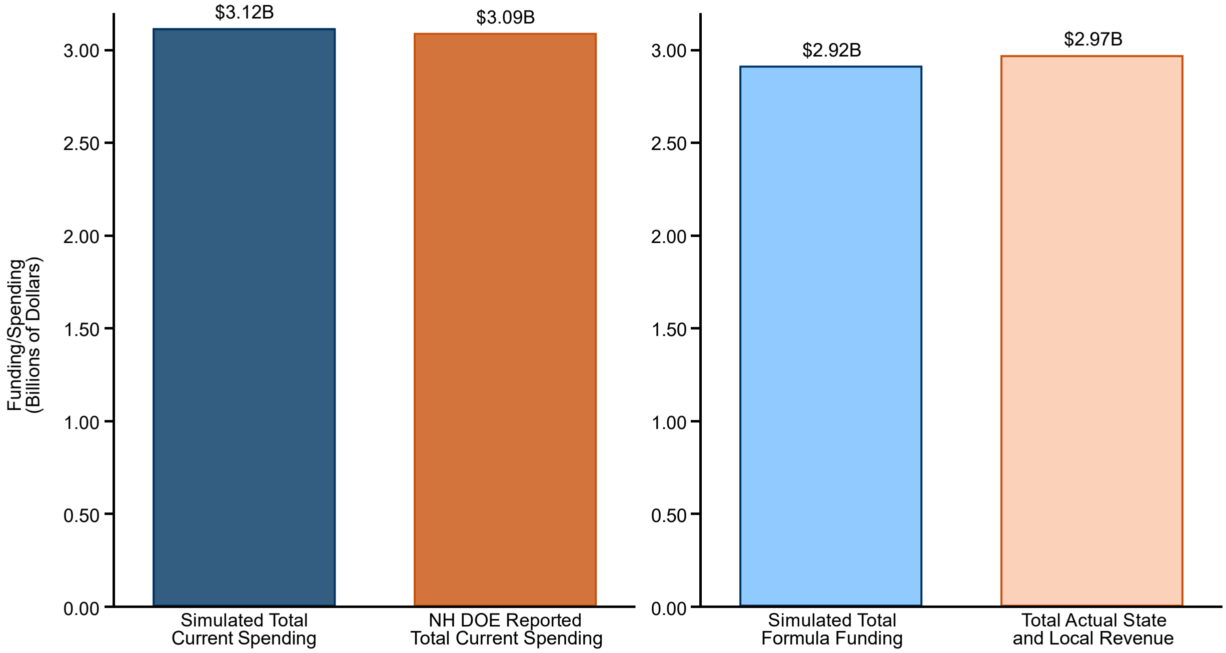
$$Weighted\ ADM = ADM + \sum_{w=1}^{9} ADM * Pct_w * Weight_w$$

where ADM is the average daily membership; Pct_w is the percentage of overall ADM for which weight category w applies (an FRPL rate of 14%, for example), and $Weight_w$ is the applicable weight for weight category w. We then calculated total simulated funding for each district, which is calculated by multiplying the total weighted funding by the base amount per pupil. Funding per pupil can then be calculated by dividing the total simulated funding by the town's ADM.

As a validation of our funding simulations, we calculated the total funding distributed to towns and compared it with estimates of New Hampshire's current levels of education spending and funding (see Exhibit 28). As a reminder, our assumption for the cost model is that New Hampshire's state average level of outcomes is adequate, given that the state is among the top-performing states nationally on achievement tests. Therefore, we expect the level of funding distributed through our simulated formula to be comparable to existing levels of education funding for current operations. The first comparison was between simulated and actual total current spending. To derive a simulated level of total current spending, we added federal revenue and catastrophic aid to the total formula funding summed across all towns. Our simulated total current spending was $3.12 billion compared with $3.09 billion reported by the New Hampshire Department of Education for 2019–20.

Our second comparison was between simulated total formula funding and the actual state and local revenue provided to towns. To calculate actual state and local revenue, we added up revenues from the statewide property tax, the local education tax, and the adequacy grant. These amounts were based on the 2018–19 valuation and tax rate data (the most recent on the New Hampshire Department of Education website at the time of data collection) and the 2019–20 adequacy grants to towns. Simulated total formula funding amounted to $2.92 billion, and total actual state and local revenue amounted to $2.97 billion. In both sets of comparisons, our simulated levels were less than 2% different from the actuals.

Exhibit 28. Comparison of Simulated Spending and Funding to Estimates of Actual Spending and Funding



Note. NH DOE is New Hampshire Department of Education. Simulated total current spending is the sum of simulated total formula funding, federal revenue, and catastrophic aid. NH DOE reported total current spending in the 2019–20 estimated elementary and secondary current expenditures from the *Estimated Expenditures of School Districts* report. Total actual state and local revenue is the sum of revenues from the statewide property tax, the local education tax, and the adequacy grant.

Simulating Revenues and Tax Rates

After simulating funding to towns, we also conducted some simulations of revenues and tax rates necessary to raise the simulated formula funding. Our revenue simulations relied heavily on a statewide property tax, where all revenue raised through the statewide property tax can be distributed according to a funding formula to districts. In other words, revenue from the statewide property tax does not stay within local towns and districts. This is a deviation from how the statewide property tax currently works, where towns keep all revenue raised by the statewide property tax, even if it is in excess of the currently calculated adequate funding level.

Our revenue simulations also establish a minimum local contribution. We modeled the minimum local contribution as the amount of local education revenue raised from a uniform minimum local education tax rate. The revenue collected through the minimum local contribution goes toward the funding of the simulated cost of an adequate education. The state then is responsible for funding the difference in revenue between the total required for an adequate education and the amount raised locally through the minimum local contribution. The establishment of minimum local contributions is a common way that states fund education and allows states to account for variation in local revenue capacity in the funding of education.

The simulator indicates that $2.95 billion is needed in state and local revenue to fund the formula under our proposed base per pupil cost and the corresponding funding adjustment weights, transportation (if excluded from the formula), and special education catastrophic aid. If we use as an example a $5.00 per $1,000 tax rate to define the minimum local contribution, the revenue raised from the minimum local contribution would decrease the state's funding obligations by $937 million, leaving approximately $2 billion in remaining state obligation (Exhibit 29).[20] If we assume that $602 million of state revenue comes from non-property tax state revenues, that leaves $1.4 billion that would need to be funded through a statewide property tax. A statewide property tax of $7.24 per $1,000 of equalized valuation would then be required to raise the remainder of the state's obligation. Adding together the minimum local contribution tax rate and the statewide property tax rate results in an overall education tax of $12.24 per $1,000. Using the 2018–19 actual town tax rates as a comparison, under this scenario 70% of towns would see a reduction in property tax rates under the proposed revenue structure.

Exhibit 29. Example Revenue Scenario With a $5.00 per $1,000 Minimum Local Education Tax

Description	Amount
Local revenue components	
Minimum local contribution rate (per $1,000 of assessed value)	$5.00
Reduction in state obligation from minimum local revenue	$937,461,833
State funding obligations	
Total proposed formula revenue	$2,915,379,635
Total proposed catastrophic aid revenue	$32,000,000
Total state obligation (excess of local revenue contribution)	$2,009,917,802
State revenue components	
Non-statewide property tax Education Trust Fund appropriations (FY 2019)	$601,909,000
Revenue needed from statewide property tax	$1,408,008,802
Statewide property tax rate (per $1,000 of assessed value) required to raise revenue	$7.24
Total education tax rate (per $1,000 of assessed value)	$12.24

Note. Districts may choose to levy local education taxes that are higher than the minimum local education tax rate.

To further illustrate how a minimum local contribution would work, Exhibit 30 shows how the scenario would play out in six towns. The towns are generally arranged in order of increasing local capacity to raise revenue. For Berlin, the proposed funding formula indicates they should get $24.1 million in state and local funding. A $5.00 per $1,000 local tax rate only raises $2.0 million. The remaining $22.1 million is the state's funding obligation. For Berlin, 92% of total state and local revenue through the formula would

[20] With a tax rate of $5.00 per $1,000, 24 towns would raise more than the adequacy target. For these towns, we assume a lower minimum local education tax at a rate required to raise the adequacy target. As the minimum local contribution rate increases, more towns will be able to raise the adequacy target completely based on the minimum local contribution; meaning that more towns will have minimum local education tax rates that are less than the set rate.

come from the state. As we move down the list, we see that as district local capacity increases (and formula funding per pupil decreases), the state's obligation decreases as a percentage of formula funding. For Wolfeboro, the last district on the list, the minimum local revenue contribution is able to fully fund the simulated formula funding. For this reason, Wolfeboro's simulated minimum local education tax is only $4.05—the tax rate necessary to raise the entire simulated formula funding. The state has no remaining funding obligation for Wolfeboro.

Exhibit 30. Example of $5.00 Minimum Local Revenue Scenario In Select Towns

Town name	Total simulated formula funding	Simulated formula funding per pupil	Actual state and local revenue per pupil	Simulated minimum local education tax	Simulated local revenue raised	Simulated remaining state obligation	Simulated percentage of formula funding from state	Simulated combined education tax	Actual combined education tax
Berlin	$24,135,873	$22,686	$16,395	$5.00	$2,026,527	$22,109,346	92%	$12.24	$17.42
Barrington	$24,516,118	$18,134	$16,700	$5.00	$5,652,379	$18,863,739	77%	$12.24	$16.04
Hooksett	$30,367,782	$16,268	$16,404	$5.00	$10,321,209	$20,046,573	66%	$12.24	$12.98
Conway	$21,021,944	$17,744	$18,130	$5.00	$8,812,290	$12,209,653	58%	$12.24	$10.44
Gilford	$17,254,936	$17,753	$20,104	$5.00	$10,229,027	$7,025,909	41%	$12.24	$9.15
Portsmouth	$35,322,819	$15,754	$17,635	$5.00	$30,695,102	$4,627,717	13%	$12.24	$6.48
Wolfeboro	$9,069,988	$12,756	$23,652	$4.05	$9,069,988	$0	0%	$11.29	$7.51

Note. Actual state and local revenue per pupil is the sum of the 2019–20 adequacy grant and local and state property tax revenue based on the 2018–19 tax rates and property valuations. Wolfeboro's simulated minimum local education tax rate is $4.05 rather than $5.00 because that is the tax rate required to raise the full simulated formula funding amount.

These town-by-town scenarios also show how the proposed revenue generation would affect tax rates. For Berlin, which has an actual combined education property tax rate (state and local) of $17.42, property taxes would be reduced substantially (assuming the town did not elect to increase its local education tax rates above the minimum local contribution). Berlin also would raise more revenue that they currently raise from state and local sources through the proposed formula. For towns with lower costs (as estimated by the funding weights) and with higher local revenue capacity, tax rates would increase under the proposed scenario, and they would get less in state and local funding. Unless a policy was created that prohibited towns from raising additional local revenue, they could do so. However, they would have to raise their tax rates even further. Formula funding for Portsmouth, for example, amounts to $15,754 per student, where they currently receive $17,635 per student in state and local funding. They could elect to keep their funding levels at $17,635 per student, but they would have to increase their local education tax rate to $5.69 per $1,000 rather than the minimum local education tax rate of $5.00 per $1,000.

Another option would be to raise the entire adequacy target through a statewide property tax (Exhibit 31). Under this option, after subtracting $602 million in non-property tax state revenue, the state would have to raise $2.35 billion from a statewide property tax. A uniform statewide property tax rate of $12.05 per $1,000 of equalized valuation would allow the state to raise the required revenue. The statewide property tax under this scenario is lower than the combined minimum local education tax and statewide property tax under the prior scenario because all districts pay the full statewide property tax. In the prior scenario, recall that some districts were not required to pay the full minimum local education tax if they were able to raise enough in local revenue from a lower local education property tax to pay for the full formula amount. For most of these districts, the statewide property tax under the scenario with no minimum local contribution is actually higher than their combined state and local property taxes under the prior scenario. The additional revenue raised from these high property wealth districts helps lower the statewide property tax for the remaining districts that did pay the full minimum local contribution in the prior scenario.

Exhibit 31. Example Revenue Scenario With No Reliance on Local Revenue

Description	Amount
Local revenue components	
Minimum local contribution rate (per $1,000 of assessed value)	$0.00
Reduction in state obligation from minimum local revenue	$0
State funding obligations	
Total proposed formula revenue	$2,915,379,635
Total proposed catastrophic aid revenue	$32,000,000
Total state obligation (excess of local revenue contribution)	$2,947,379,635
State revenue components	
Non-statewide property tax Education Trust Fund appropriations (FY 2019)	$601,909,000
Revenue needed from statewide property tax	$2,345,470,635
Statewide property tax rate (per $1,000 of assessed value) required to raise revenue	$12.05
Total education tax rate (per $1,000 of assessed value)	$12.05

Note. Under this scenario, the entire funding formula target amount would be funded through state revenue sources. Districts may choose to raise additional revenue through local education property taxes.

Further Considerations Regarding Revenues and Taxes

The proposed revenue scenarios are admittedly simple. Policymakers might want to consider additional considerations with respect to raising revenue to fund a state funding formula.

- **What is the appropriate minimum local contribution?** We presented only two scenarios: one with a $5.00 minimum local education tax rate and the other with no minimum local contribution. A myriad of options exist in between. A higher minimum local contribution reduced the burden for revenue collection and distribution for the state. However, as discussed, with a higher minimum local contribution, a larger share of districts will raise enough revenue locally to fully fund the proposed formula amount. This results in a minimum local education tax rate that is less than the effective minimum local education tax rate for these districts, while also lowering the statewide education tax for all districts. The result is a lower combined state and local education property tax rate for these property-wealthy districts compared with districts that must pay the full minimum local education tax rate.

- **What policies, if any, should be established for towns that want to raise more than the minimum local contribution?** Currently, no policies are in place that would prevent towns from raising additional revenue locally above whatever minimum local contribution that may be enacted. However, there are equity considerations resulting from unequal capacity to raise revenue locally across towns. An equivalent increase in tax rates will result in more revenue per student in property-wealthy towns compared with property-poor towns. Some states have put policies in place that attempt to equalize yield across jurisdictions so that equivalent increases in tax rates would generate equivalent amounts of revenue per student. Texas and Kansas, for example, have tiered funding formulas, where the first tier operates as a foundation formula, similar to the weighted funding formula proposed here. The second tier applies to districts that choose funding levels above the amounts generated under the first tier and attempts to equalize funding capacity by setting some guaranteed minimum or equalized yield for a given increase in tax rates (Kansas Legislative Research Department, 2014; Texas Education Agency, 2014).

In addition to these considerations, we understand that the Commission also is examining issues related to tax relief for individuals who would pay a high percentage of their income in property taxes and the implications of fully collecting and redistributing revenue from a statewide property tax on the burden of state agencies as well as cash flow for districts.

Summary

We used cost models to examine the cost of achieving a common outcome set at New Hampshire's current average outcome levels. A New Hampshire specific cost model and a regional cost model that included districts in surrounding New England states provided similar results. They both indicated that higher shares of students who are economically disadvantaged (as measured by FRPL rates), ELs, and students in special education increase district costs; small districts face higher costs; and enrollment in upper grade levels (the middle and high school grades, relative to elementary grades) have higher costs.

Using the results of the cost model, we estimated weights for the various cost factors that were found to significantly increase the costs of districts. The weights, along with a base per-pupil cost, can be used to create a funding formula that distributes dollars to districts or towns. The proposed funding formula results in a progressive distribution of funding across districts that is clearly linked to the needs and characteristics of districts and the students they serve.

Revenue to pay for the level of funding indicated by the funding formula could be raised through a statewide property tax or a combination of a statewide property tax and a minimum local education property tax.

5. Conclusion

New Hampshire's current system of funding is not working for large segments of New Hampshire's students and taxpayers. Specifically, communities with higher poverty rates and lower property wealth are doubly penalized under New Hampshire's current system. Students in these communities, on average, receive fewer resources in the form of funding than students in wealthier communities. Taxpayers in these communities do their best to provide for their children, often levying higher local education property taxes than residents of wealthier communities.

Inequities also manifest themselves in outcomes. The negative relationship between districts' aggregated student outcomes and student poverty (proxied by FPRL rates) is clear and strikingly linear. As district poverty rates increase, student outcomes decrease. This relationship holds even after accounting for other district factors that also may be related to poverty, such as special education rates, EL rates, and district size. Although district poverty rates appear to be the strongest predictor of district outcomes, special education rates and EL rates also have independent effects on student outcomes.

The strong relationships between student needs and student outcomes as well as the regressive relationship between funding and student poverty make clear the need for a redesigned funding system that provides more resources to districts with higher student needs. The analyses examining equity of spending and outcomes, however, do not show how much more should be spent on students with differing needs. To understand how much more districts should be spending according to various cost factors (student needs as well as scale of operations, grade ranges, and price of inputs), we conducted cost modeling that generates a predicted cost for each district, holding student outcomes at a common outcome level. The cost model results demonstrate that educational costs increase for districts with higher shares of students who are economically disadvantaged, students in special education, and ELs. Costs also are higher for small districts and districts that serve higher proportions of students in upper grade levels (middle and higher school grades).

We used the cost predictions to estimate weights for each characteristic that proved influential in the cost model; then we subsequently used the weights to model what a new funding formula could look like. The proposed funding formula results in a progressive and purposeful distribution of funding that provides more resources to districts with the highest costs.

Simulations of revenue demonstrate that a more equitable system of taxation could be designed through a statewide property tax that centrally collects and redistributes funding to districts according to the formula. The statewide property tax could be paired with a minimum local contribution that would share the cost of funding the formula between municipalities and the state, without sacrificing equity in the distribution of funding.

The findings presented in this report point out the problems with the current system and are intended to guide the design of an improved system. Although we did not examine the multitude of options the state could take in designing a new system, we presented several viable options that would much improve the current system in affording an equal opportunity to achieve for all New Hampshire's students.

References

Andrews, M., Duncombe, W., & Yinger, J. (2002). Revisiting economies of size in American education: Are we any closer to a consensus? *Economics of Education Review, 21*(3), 245–262.

Baker, B. D. (2005). The emerging shape of educational adequacy: From theoretical assumptions to empirical evidence. *Journal of Education Finance, 30*(3), 259–287.

Baker, B. D. (2011). Exploring the sensitivity of education costs to racial composition of schools and race-neutral alternative measures: A cost function application to Missouri. *Peabody Journal of Education, 86*(1), 58–83.

Baker, B. D. (2016). *Does money matter in education?* (2nd ed.). Washington, DC: Albert Shanker Institute.

Baker, B., Atchison, D., Kearns, C., & Levin, J. (2020a). *Setting outcome goals and standards: From a formal to functional definition of adequacy.* Washington, DC: American Institutes for Research.

Baker, B., Atchison, D., Kearns, C., & Levin, J. (2020b). *State finance reform vignettes: Kansas.* Washington, DC: American Institutes for Research.

Baker, B., Atchison, D., Levin, J., & Kearns, C. (2020a). *Evaluating state school finance systems: An introduction.* Washington, DC: American Institutes for Research. Retrieved from https://carsey.unh.edu/sites/default/files/media/2020/06/20-11882_2._primer_equityanalysis_air_formatted_v6.pdf

Baker, B., Atchison, D., Levin, J., & Kearns, C. (2020b). *Using cost modeling to inform education funding formulas.* Washington, DC: American Institutes for Research. Retrieved from https://carsey.unh.edu/sites/default/files/media/2020/06/20-11882_3._primer_usingcostmodeling_air_formatted_v3.pdf

Baker, B., & Green, P. (2008). Conceptions of equity and adequacy in school finance. In H. F. Ladd & E. B. Fiske (Eds.), *Handbook of research in education finance and policy* (pp. 203–221). New York, NY: Routledge.

Baker, B., Kearns, C., Atchison, D., & Levin, J. (2020a). *Providing adequate funding through equitable taxation: An introduction.* Washington, DC: American Institutes for Research. Retrieved from https://carsey.unh.edu/sites/default/files/media/2020/06/20-11882_6._primer_taxequityfiscalneutrality_air_formatted_v4.pdf

Baker, B., Kearns, C., Atchison, D., & Levin, J. (2020b). *State finance reform vignettes: New Jersey.* Washington, DC: American Institutes for Research. Retrieved from https://carsey.unh.edu/sites/default/files/media/2020/06/20-11882_5._primer_statevignettes_new_jersey_air_formatted_v3.pdf

Baker, B., & Levin, J. (2014). *Educational equity, adequacy, and equal opportunity in the Commonwealth: An evaluation of Pennsylvania's school finance system.* San Mateo, CA: American Institutes for Research.

Baker, B., Levin, J., Atchison, D., & Kearns, C. (2020). *Costing out an adequate education: A primer.* Washington, DC: American Institutes for Research. Retrieved from https://carsey.unh.edu/sites/default/files/media/2020/06/20-11882_1._primer_costestimation_formatted_air_v4.pdf

Duncombe, W. (2002). *Estimating the cost of an adequate education in New York* (Center for Policy Research Working Paper 44). Syracuse, NY: Syracuse University.

Duncombe, W., Lukemeyer, A., & Yinger, J. (2003). Financing an adequate education: A case study of New York. In W. Fowler (Ed.), *Developments in school finance: 2001–02* (pp. 127–154). Washington DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics.

Duncombe, W., & Yinger, J. (1999). Performance standards and educational cost indexes: You can't have one without the other. In H. F. Ladd, R. Chalk, & J. S. Hansen (Eds.), *Equity and adequacy in education finance: Issues and perspectives* (pp. 260–297). Washington, DC: National Academy Press.

Duncombe, W., & Yinger, J. (2004). *How much more does a disadvantaged student cost?* (Center for Policy Research Working Paper 60). Syracuse, NY: Syracuse University.

Duncombe, W., & Yinger, J. (2011). Are education cost functions ready for prime time? An examination of their validity and reliability. *Peabody Journal of Education, 86*(1), 28–57.

Kansas Legislative Research Department. (2014). *School District Finance and Quality Performance Act and bond and interest state aid program.* Topeka, KS: Author.

Kolbe, T., Atchison, D., Kearns, C., & Levin, J. (2020a). *State funding formulas: A national review.* Washington, DC: American Institutes for Research. Retrieved from https://carsey.unh.edu/sites/default/files/media/2020/06/20-11882_7._primer_policyscan_v3.pdf

Kolbe, T., Atchison, D., Kearns, C., & Levin, J. (2020b). *State finance reform vignettes: Vermont.* Washington, DC: American Institutes for Research. Retrieved from https://carsey.unh.edu/sites/default/files/media/2020/06/20-11882_5._primer_statevignettes_vermont_air_formatted_v7_ed.pdf

Kolbe, T., Baker, B., Atchison, D., & Levin, J. (2019). *Pupil weighting factors report.* Burlington, VT: University of Vermont.

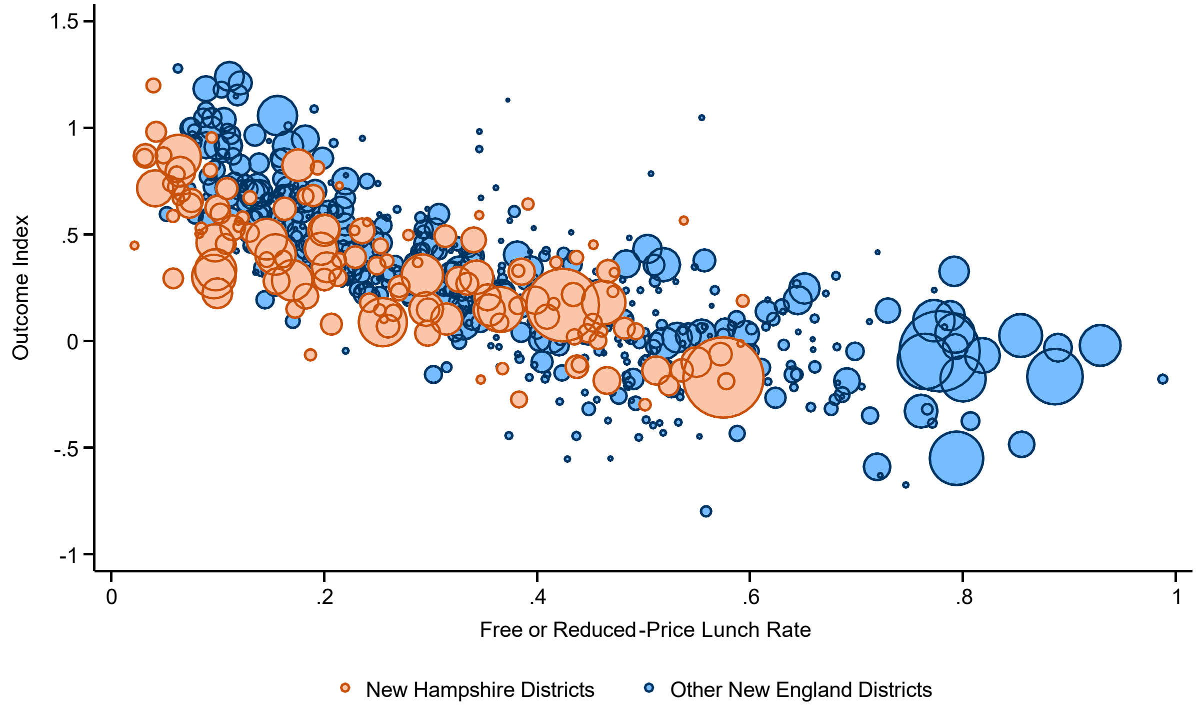
Rahman, T., Bandeira de Mello, V., Fox, M. A., & Ji, C. S. (2019). *Mapping state proficiency standards onto the NAEP scales: Results from the 2017 NAEP reading and mathematics assessments* (NCES 2019-040). Washington, DC: National Center for Education Statistics.

Snyder, T. D., de Brey, C., & Dillow, S. A. (2019). *Digest of education statistics 2018* (NCES 2020-009). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics.

Texas Education Agency. (2014). *School finance 101: Funding of Texas public schools.* Austin, TX: Author.

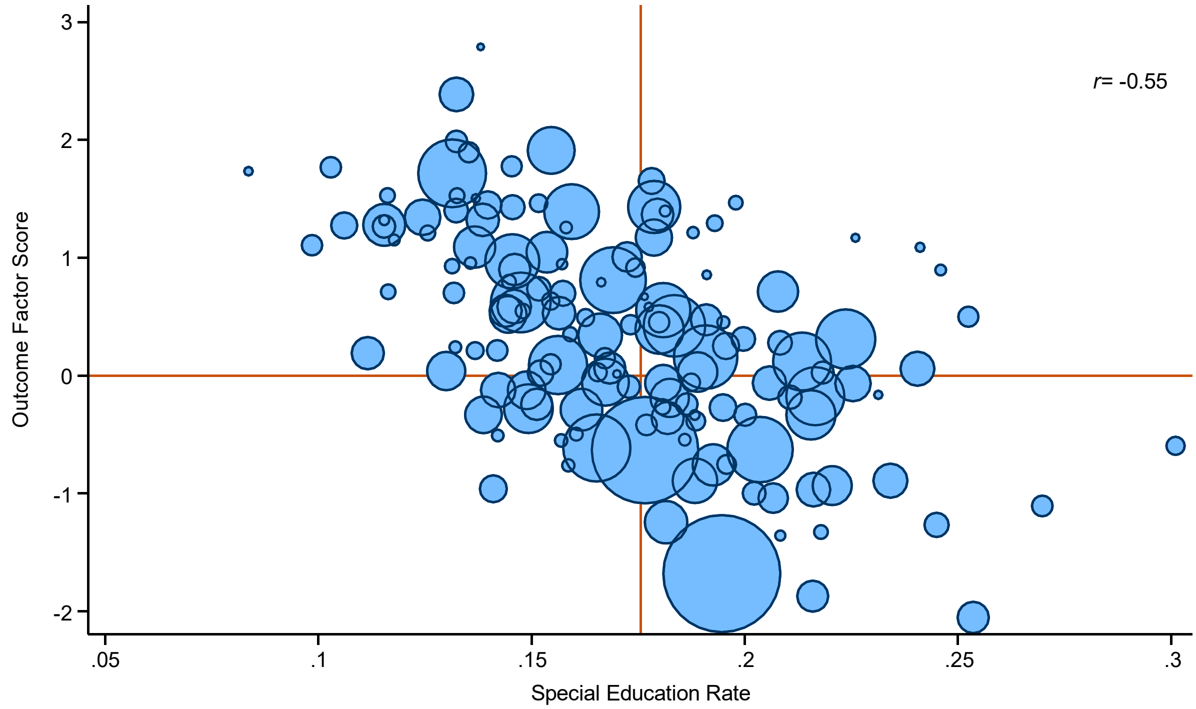
Appendix A. Additional Exhibits on Student Outcomes and Student Needs

Exhibit A.1. Relationship Between Student Outcomes and Free or Reduced-Price Lunch in New England States Using National Data



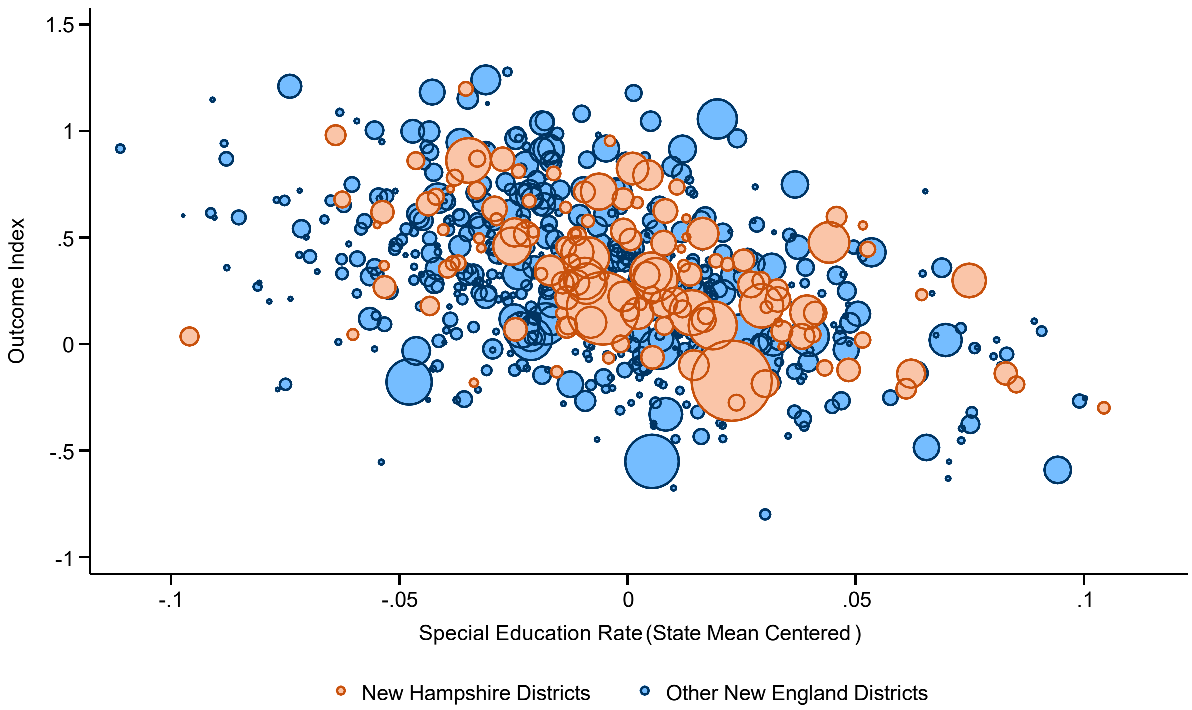
Note. Data come from the U.S. Department of Education's National Center for Education Statistics and the Stanford Education Data Archive, 2015–16.

Exhibit A.2. Relationship Between Student Outcomes and Special Education Rates



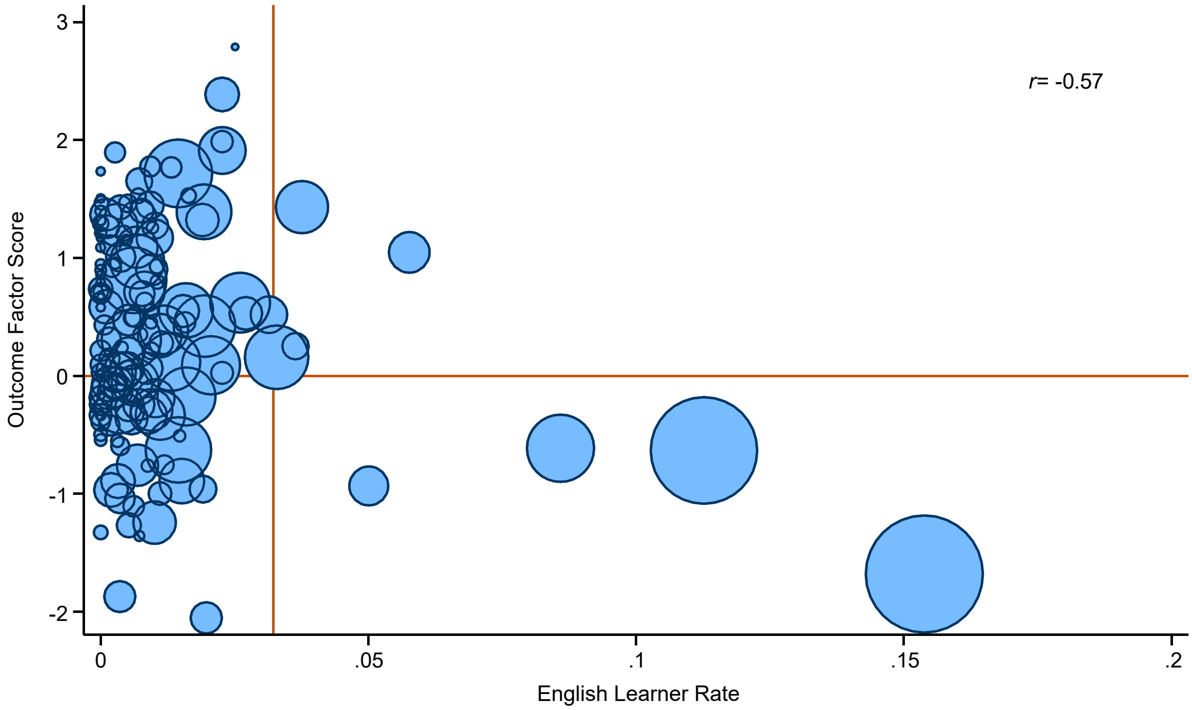
Note. The orange lines show statewide averages of both variables. The enrollment weighted correlation coefficient is represented by *r*. Data come from the New Hampshire Department of Education, 2018–19.

Exhibit A.3. Relationship Between Student Outcomes and Special Education Rates in New England States Using National Data



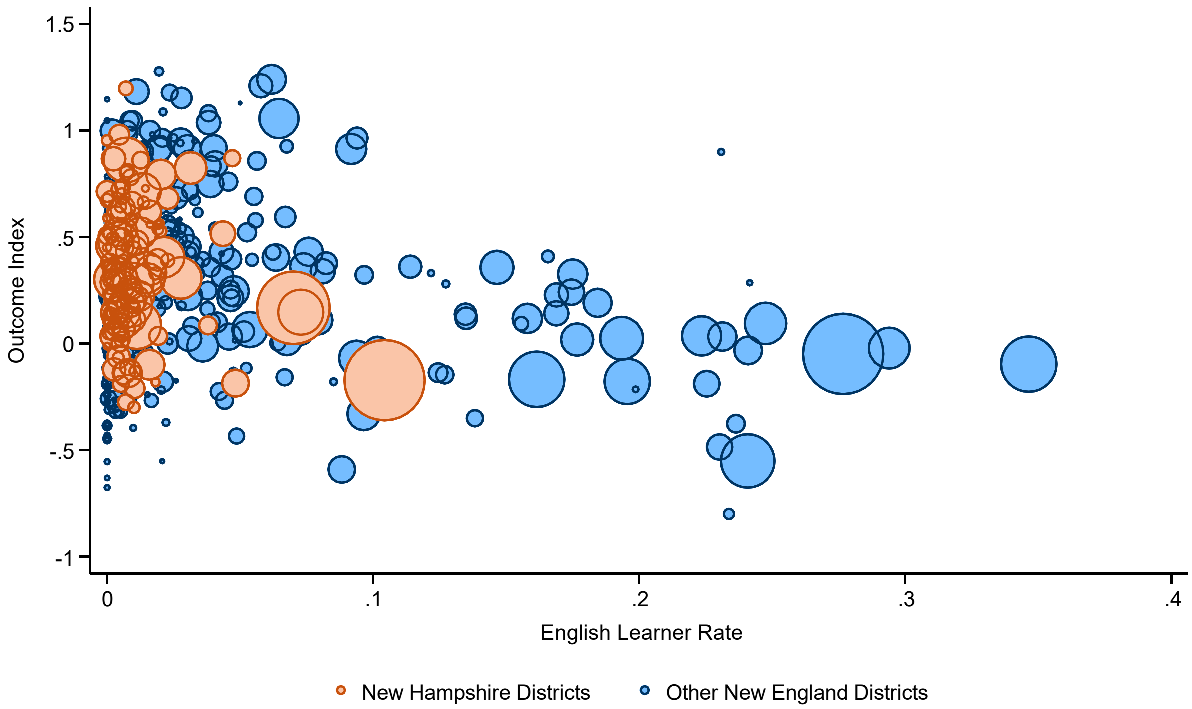
Note. Data come from the U.S. Department of Education's National Center for Education Statistics and the Stanford Education Data Archive, 2015–16.

Exhibit A.4. Relationship Between Student Outcomes and English Learner Rates



Note. The orange lines show statewide averages of both variables. The enrollment weighted correlation coefficient is represented by *r.* Data come from the New Hampshire Department of Education, 2018–19.

Exhibit A.5. Relationship Between Student Outcomes and English Learner Rates in New England States Using National Data



Note. Data come from the U.S. Department of Education's National Center for Education Statistics and the Stanford Education Data Archive, 2015–16.

Exhibit A.6. Regression Results Comparing the Relationship Between Different Poverty Measures and Student Outcomes

	Model 1	Model 2	Model 3
FRPL rate	-4.318***		
Income-to-poverty ratio		0.533***	
Poverty rate			-9.200***
EL rate	-3.546***	-8.599***	-8.533***
Special education rate	-4.650***	-4.774***	-7.656***
Population density (natural log)	-0.0809***	-0.123***	0.0289
Enrollment categories			
≤ 100	-0.113	-0.410*	0.223
101–300	0.137	0.0555	0.432***
301–600	-0.0635	-0.148**	0.0627
601–1,200	0.00207	-0.143***	0.138**
1201–2,000	-0.154***	-0.237***	-0.0747
Proportion of enrollment in middle school grades	-0.189	-0.462*	0.538*
Proportion of enrollment in high school grades	0.0926	-0.0386	0.479***
Constant	2.339***	-0.203	1.773***
N	1,597	1,605	1,605
R^2	0.761	0.754	0.643

Note. The outcome for each model is the outcome factor score. Models also include year dummy variables. The only difference between models is the use of different measures of student economic disadvantage. Therefore, the difference in R^2 values across models denotes the difference in the ability of economic disadvantage variables in explaining student outcomes. Data come from the New Hampshire Department of Education, the U.S. Department of Education, and the U.S. Census Bureau, 2008–09 through 2018–19.
*$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.

Appendix B. Further Explanation and Additional Exhibits on the Education Cost Model

Issues in Cost Modeling

The goal of education cost modeling, whether for evaluating equal educational opportunity or producing adequacy cost estimates, is to empirically establish reasonable guideposts for developing more rational school finance systems. Historically, funding levels for state school finance systems have been determined more by political will and economic capacity than any empirical measures of the true cost of producing educational outcomes. In this limited approach, the budget constraint—or total available revenue—and total student enrollment have been the key determinants of the foundation level or basic allotment. To some degree, this will always be true: States and localities will always have some limit on the amount of revenues they can collect and distribute for public schools. But reasonable estimates of the cost of producing desired outcomes, such as those produced in creating this report, may influence the appetite for additional taxes or the redistribution of revenue by revealing the misalignment between costs and actual spending levels.

Reasonable estimates of cost may assist legislators in setting spending levels consistent with outcome demands and outcome goals that are attainable at desired spending levels. Reasonable estimates of cost also may assist courts in determining whether current funding levels and distributions (or the minimum educational achievement goals, for that matter) are unreasonable, insufficient, or otherwise substantially misaligned with constitutional or other legal requirements.

Estimating Cost Models

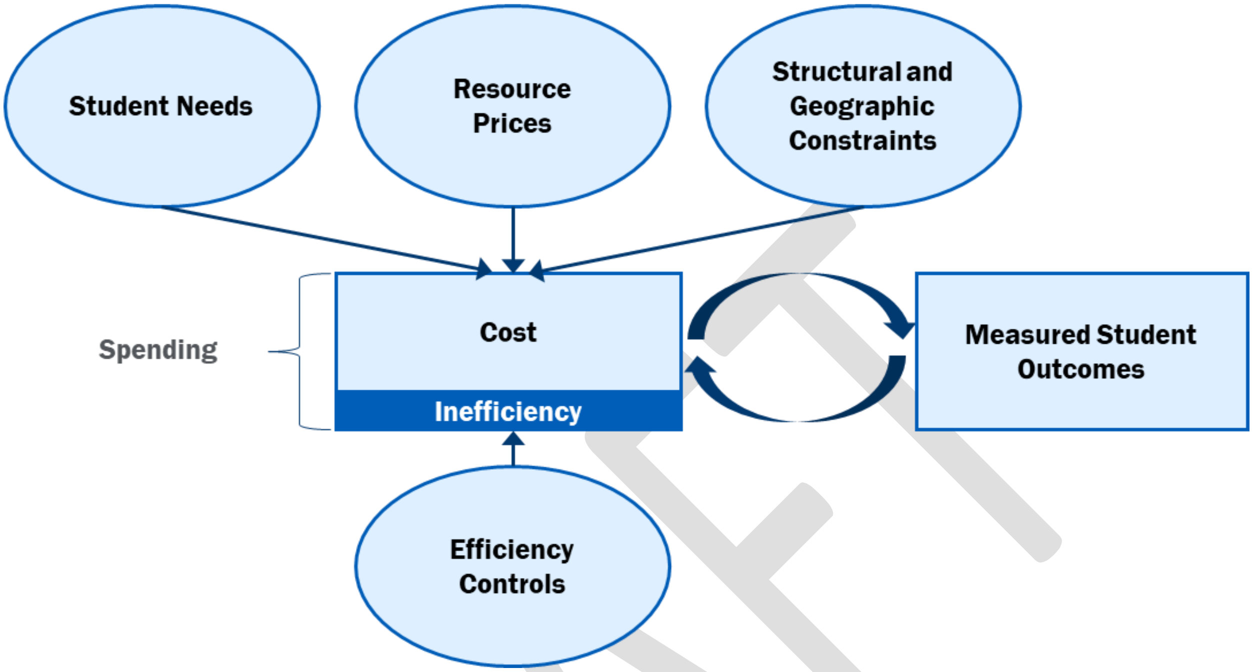
The dominant modeling approach in recent peer-reviewed literature is one in which

- the dependent measure is a measure of current operating expenditures per pupil;
- student outcome measures are treated as endogenous and instrumented using measures of the competitive context within which local public school districts operate; and
- attempts are made to control for inefficiencies in the spending measure by including measures of variations in fiscal capacity and local public monitoring.

This approach is largely the product of years of peer-reviewed cost function estimation by William Duncombe, John Yinger, and colleagues of the Maxwell School at Syracuse University (Duncombe and Yinger, 1999, 2011). Here, we provide the rationale for this approach.

Exhibit B.1 provides an overview of these three issues. Our goal is to elicit from district spending data the cost of achieving specific outcome levels. We are setting up a model in which we predict spending levels from educational outcomes and other factors, rather than predicting outcomes from spending levels. As such, we must take statistical steps to correct for the fact that spending is influenced by outcomes, whereas, simultaneously, outcomes also are affected by spending (the circular/feedback loop relationship in the figure). More spending can lead to better student outcomes because increased funding can be used to reduce class sizes, recruit better qualified personnel, provide support services, and so on.

Exhibit B.1. Education Cost Model Components



Note. Student needs usually include measures of economic disadvantage, ELs, and students with disabilities. Resource prices refer to the exogenously determined geographic variation in the price of resources (e.g., teacher salaries). Structural and geographic constraints often include the size of districts or schools (economies of scale) and population density (to measure rurality or sparsity). Efficiency controls often include measures of fiscal capacity, degree of competition (e.g., from neighboring districts), and public monitoring of public spending.

However, higher outcomes in a community may drive increased spending; homeowners desire to have their schools perceived as high performing, thus keeping their property values relatively high. In this case, there is no clear causal direction: the two factors affect each other simultaneously. The relevant statistical approach to isolate the effect of outcomes on spending (distinct from the effect of spending on outcomes) is to use a two-stage model, in which we use exogenous (outside the loop) measures of each district's competitive context to correct for endogeneity (inside the loop feedback) in the outcome measure.

In general, the main (second stage) equation of the education cost function is one in which a measure of current operating expenditures is expressed as a function of the outcomes achieved at those expenditure levels, the students served by districts, a measure of variation in competitive wages (*Input Prices*) for teachers, structural characteristics of the district such as grade ranges served, the size of the district (perhaps coupled with other location factors such as sparsity or remoteness), and any factors that might produce inefficiencies in the spending measure. The equation may be expressed as follows:

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

where *Spending* is a measure of current per pupil operating expenses*; Outcomes* are the outcome measure(s) of interest*,* with the asterisk denoting that the outcomes are endogenous; *Students* is a matrix of student need and demographic characteristics*; Input Prices* is a measure of geographic variation in the prices of key inputs to schooling such as teacher wages*; Structure* is a matrix of district structural characteristics such as grade ranges served*; Scale* is a measure of economies of scale usually expressed in terms of student enrollments and, in some cases, also addressing population sparsity; *Inefficiency* is a matrix of variables intended to account for differences in spending across districts that are unrelated to the measured outcomes (described below); and, the subscripts *d* and *j* denote district and year, respectively.

Relative Efficiency

Another issue we must deal with is the fact that not all district spending may be efficient, or by statistical definition, spending that contributes directly to the measured outcomes included in the model. In any given district, some part of current spending contributes directly to the measured student outcomes used in the model, given the students served and the structure, size, and location of the district. The objective of the cost function is to identify the levels of spending associated with achieving specific outcome levels under different circumstances and across varied student populations, holding factors associated with inefficiency constant.

In the modeling approach used here, we include measures that the research literature identifies as predictors of differences in district spending not directly associated with outcomes (i.e., inefficiencies). These include measures of local district competition and measures influencing local public monitoring of public expenditures (share of aid coming from nonlocal sources and proportions of the local population that is school aged). It is important to understand that, in statistical terms, correcting for inefficiency in a cost model is an omitted variables bias problem. That is, we are simply trying to identify factors that explain differences in spending that are neither associated with legitimate cost differences nor with differences in outcomes, such that we can set those factors to a constant level (average) when projecting cost estimates.

However, there will always likely remain some variation in spending in relation to outcomes that is either random (a function of unexplained variation in either the spending or outcome measures) or nonrandom but not captured by the measures available that were included in the model.

Predictable Component

The predictable share of inefficiency is that share of variation in spending that can be at least partially explained by our indirect predictors of inefficiency. Using our New Hampshire cost model, we can test the influence of the efficiency measures on predicted per pupil costs. The efficiency measures include a measure of the share of revenue received from federal sources, a measure of the share of the population that is school aged, and a measure of enrollment concentration among districts in the labor market.[21]

---

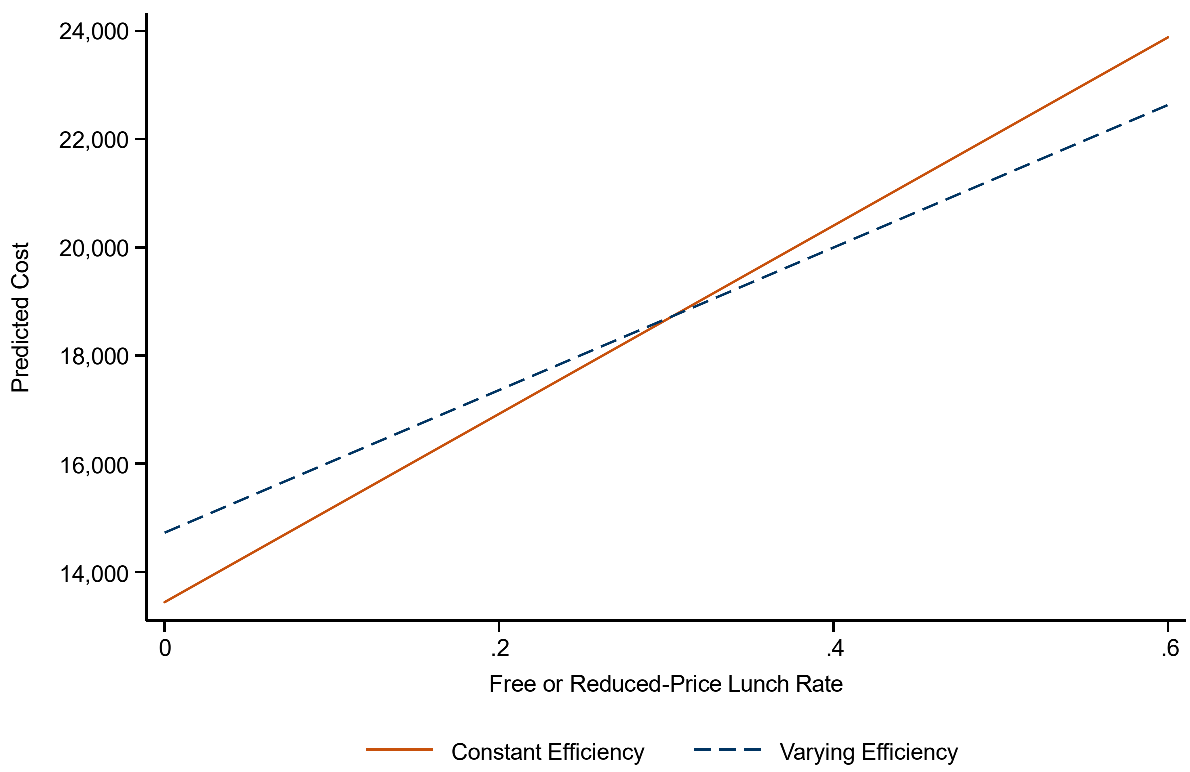
[21] As a measure of schooling market concentration we use a Herfindahl Index defined as the sum of the squared district shares of enrollment within the labor market.

Correlations between local fiscal capacity measures and student need measures precluded us from being able to include additional fiscal capacity measures.[22]

If we generate spending predictions by allowing these factors to vary as they presently do across districts, the predictions produced would include differences in efficiency which are a predictable function of these factors (i.e., projecting spending by including rather than equalizing inefficiency). We can compare those spending predictions to spending predictions generated if we constrain all districts to assume average values of the efficiency characteristics (i.e., if we expect districts to produce common outcomes at the same levels of efficiency).

Exhibit B.2 compares projections holding efficiency measures constant versus projections allowing efficiency measures to vary. The figure shows that districts with smaller shares of children from low-income families would typically spend more than necessary to achieve the same outcomes, or at least more than they would if they had average efficiency predictors.

Exhibit B.2. Predicted Costs Per Pupil Comparing Predications That Hold Efficiency Variables Constant or Allow Them to Vary



Note. Lines represent best fit lines. Constant efficiency estimates fix efficiency variables at the average. Varying efficiency estimates allow efficiency to vary across districts at their observed levels for efficiency variables. Calculations are based on data from the New Hampshire Department of Education, 2018–19.

---

[22] There exists a relatively strong relationship whereby districts with less fiscal capacity tend to have greater student needs.

Districts with larger shares of children from low-income families tend to be more efficient in their production of outcomes, at least given the outcomes under consideration. As such, if their costs are estimated at holding efficiency predictors at averages, their cost predictions are slightly higher than their current spending.

The findings in Exhibit B.2 are consistent with prior literature applying cost modeling with indirect efficiency controls. Districts with greater local fiscal capacity and lower levels of student need typically face less pressure to focus resources on maximizing narrowly assessed outcomes. They have more latitude and more ability to spend on other things, which may be of value to their local communities but are not picked up in the outcome measures (e.g., a competitive lacrosse team or an exceptional orchestral program). As such, we urge caution in use of the term *inefficiency,* which has a very narrow definition in the context of cost function analysis, meaning expenditures that do not translate directly to differences in the measured outcomes included the model. Our use of inefficiency in this narrow sense does not necessarily imply “wasteful spending.”

Error Component

Exhibit B.3, also included in the main body of the report as Exhibit 21, shows the relationship between spending gaps (relative to the cost, at average predictable efficiency of producing average outcomes) compared with existing outcome gaps. A clear and relatively strong pattern exists here, whereby districts with large spending gaps have larger outcome gaps, and districts that spend more than needed to achieve average outcomes tend to achieve more than average outcomes. Exhibit B.4 shows a similar relationship for New Hampshire in the context of other New England districts (2016).

That said, the pattern does not follow a perfect diagonal line intersecting at zero on both the *x* and *y* axes, nor do all of the plotted districts lie in the lower left and upper right quadrants. Rather, there are also districts in the upper left and lower right quadrants, and there is variation across districts in all quadrants. That is, even at the same estimated spending gap (more or less spending than predicted adequate cost), there are differences in the distance between districts’ actual outcomes and the outcome target). This variation can encompass a number of factors and should not be overinterpreted. In our regional model, this variation should especially not be overinterpreted as indicating real differences in the relative efficiency of public school districts in one state versus another.

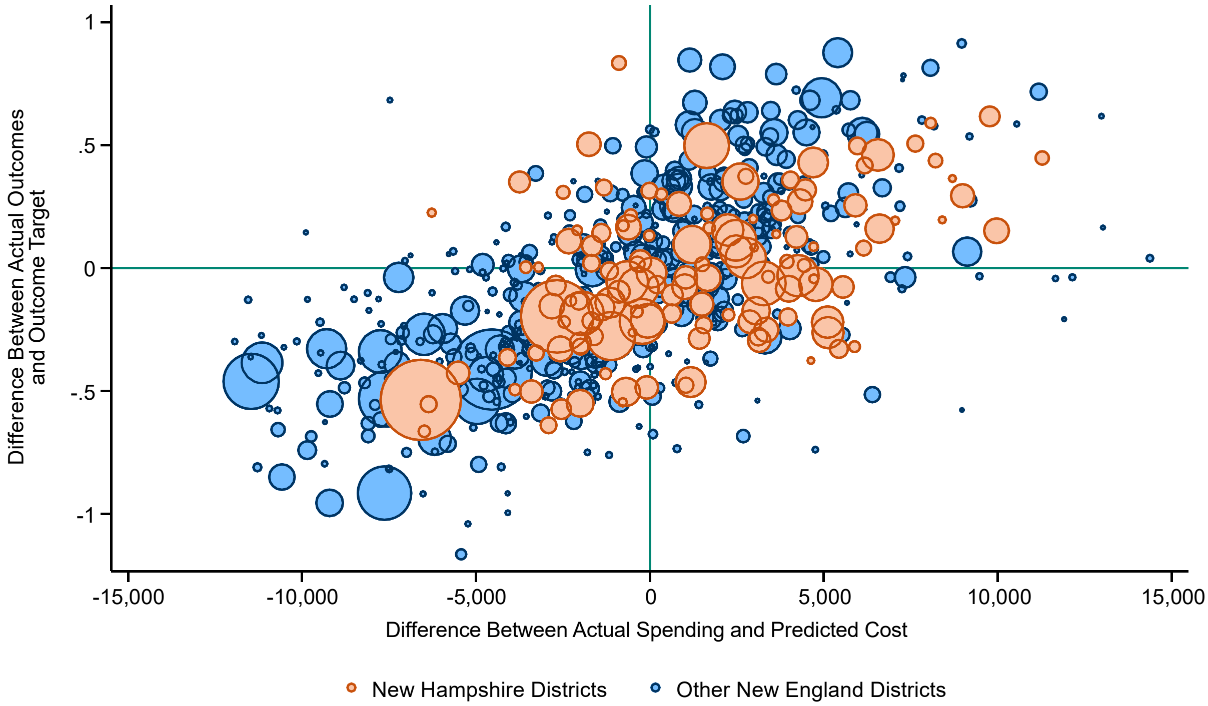
This may in part be the case, but we are unsure how much this is attributable to at least three significant categories of factors that may influence these estimates (remaining omitted variables bias, measurement error in inputs or outcomes, and real differences in inefficiency).

- **Remaining Omitted Variables Bias.** First and foremost, cases where districts have spending lower than needed to achieve average outcomes but higher than average outcomes (upper left quadrant), or vice versa, might be a result of unobserved (unmeasured, not included in model) important differences in costs, either in terms of student characteristics or other exogenous environmental factors that we do not observe. Our models herein are relatively simple and clearly do not capture everything that might affect cost differences, say, between schooling in New Hampshire and schooling in Massachusetts, or even from the northern reaches of New Hampshire to areas of the state that fall within the greater Boston metropolitan area. It would be implausible to determine the perfect, complete model for all districts. Nonetheless, the models seem to do a reasonable job at predicting cost variation in relation to outcomes and offer a huge advancement for guiding the distribution of state dollars.

Exhibit B.3. Outcome Gaps and Funding Gaps Estimated From the New Hampshire Model

Note. The orange lines show statewide averages of both variables. The enrollment weighted correlation coefficient is represented by *r*. Calculations are based on data from the New Hampshire Department of Education, 2018–19.

Exhibit B.4. Outcome Gaps and Funding Gaps Estimated From the Regional Model



Note. The green lines show statewide averages of both variables. Calculations are based on data from the U.S. Department of Education and U.S. Census Bureau, 2015–16.

- **Measurement Error in Inputs or Outcomes (systematic or random).** Outcome measures, like state assessment scores, even when aggregated up to the district level, contain measurement error. That is, our models may not capture random variation. There also may be differences in the measurement of relevant expenditures across districts either because of reporting irregularities or different relationships between district and school organizational structure and the provision of services to students. The latter may be explainable but also unique down to the anecdotal level of individual districts or schools that are simply "different" (e.g., Pinkerton Academy). When it comes to regional models, equating outcome and spending data across state lines becomes even more complicated, and inferences about between-state differences should be approached with caution. The Stanford Education Data Archive takes methodologically groundbreaking steps to equate school assessments across varied state testing regimes. Our cursory review of the spatial patterns of differences between adjacent districts along state borders, however, suggests that their methods and/or the underlying data are imperfect in achieving this goal. Similar concerns exist with equating current spending measures, despite attempts by the U.S. Census Bureau and National Center for Education Statistics to provide guidance to state officials regarding specific chart of account codes to be included in this measure. If outcomes of a group of districts in a state are systematically underestimated and/or spending is systematically overestimated, these districts may be misplaced in the overall distribution of districts nationally. These differences led to the omission of Connecticut from many regional analyses of New England included in this study.

- **Real Differences in Inefficiency.** It is reasonable that for any two districts serving otherwise similar student populations and facing similar external cost pressures, they might achieve different outcomes even while spending the same amount. Spending the same but achieving more (on the measured outcomes) would indicate greater efficiency in producing those measured outcomes. Ideally, we would have complete models with sufficiently accurate and precise measures of inputs and outcomes to isolate these real differences in inefficiency. But even in this case, we must be careful to understand what we mean by differences in efficiency. As mentioned earlier, some districts may spend more to achieve the same measured outcomes because they are spending on other things valued by their communities or constituents. These expenditures may not translate directly to shifts in reading and mathematics scores and thus would be "inefficient" per the model specifications herein.

Although there may be legitimate differences in the relative efficiency of districts—or entire states—identified by these models, we suspect that some of the variation seen in these scatterplots (e.g., districts in the upper left and lower right) is attributable to the first two issues noted here: omitted variables bias and measurement error. Indeed, these models are imperfect and incomplete; but these models can still provide reasonable broad policy guidance regarding the relative adequacy of school spending toward achieving common outcomes, a perspective on interstate disparities in school funding not previously available.

More Detail and Consideration

Here we provide a reporting of technical details from our models and some insights on the decision process involved in selecting a final model. Cost model estimation, including model selection for policy guidance, is a lengthy iterative process that involves balancing technical and statistical concerns with practical concerns regarding usefulness for guiding policy. It is rare to find an ideal cost model that both yields perfect statistical diagnostic features and produces reasonable findings and projections to guide policy. This is partly why we use both regional and state-specific models to better understand the patterns of variation in needs and costs across districts, possible measures to use for evaluating risk and cost across districts, and potential measures to translate cost models into actionable policy.

Steps in Identifying a Model

- Identify a model in which the main regression model describing spending yields estimated coefficients on the major cost factors which (a) are of the expected direction and (b) are of reasonable magnitude.
- Identify a model wherein the collection of instruments selected are sufficiently valid (predict a significant share of variation in the potentially endogenous outcome measure as indicated by Partial $F > 10$) but not overidentified (do not belong in the main equation describing spending) as indicated by Hansen J ($p > .10$).
- Identify a model wherein some additional variation in spending is captured by one or more measures related to fiscal capacity, local public monitoring, and/or competition density (indirect inefficiency controls).

Instruments and Efficiency Controls

Identifying those factors that are exogenous (outside the control of the observed district) and statistically influence outcomes of the observed district (are "valid") but, at the same time, are measures that should be excluded from the main cost model (second stage regression) involves both conceptual and statistical considerations. Conceptually, a long line of similar studies by Duncombe and Yinger (e.g., 2004, 2011) and Baker (2011) have used measures of the characteristics of surrounding districts, including demographic, economic, and even outcome characteristics of those districts. The idea is that the outcomes of neighboring districts may place competitive pressure on the observed district. These "over the fence" comparisons may influence outcomes beyond other discrete measures of the district itself, which are included in the main model. Our regional model uses the income-to-poverty ratio (from the Neighborhood Poverty Index) and the proportion of students who are Black or Hispanic, for all other districts in the same regional labor market (a geographic delineation from the Education Comparable Wage Index (ECWI) produced by Lori Taylor of Texas A&M[23]). Our New Hampshire specific model replaces the racial demographic measure with a measure of the mean outcome index of all other districts in the same regional labor market. New Hampshire labor markets are identified as follows:

- Hillsborough County, Manchester-Nashua Metropolitan Statistical Area
- Belknap and Carroll Counties
- Cheshire and Sullivan Counties
- Coos and Grafton Counties
- Merrimack County
- Rockingham County[24]
- Rockingham and Strafford Counties, Metropolitan Division

This approach to regional clustering was useful in our analyses (and worked better statistically) because these clusters aggregate small population counties. We also attempted county-level versions of the same measures.

Exhibit B.5 compares key components of our final models, where the New Hampshire specific model is the one from which our eventual policy simulations and recommendations are developed.

---

[23] See https://bush.tamu.edu/research/taylor-cwi/ for more information on the ECWI.
[24] The districts included in the Rockingham County labor market are Auburn School District, Derry School District, Londonderry School District, and Windham School District.

Exhibit B.5. Key Components of Our Final Regional and New Hampshire Cost Models

Measure category	Measure	Regional	New Hampshire
Outcomes	Standardized assessments (Grades 3–8, mathematics and reading)	X	X
	Graduation rates		X
	Attendance rates		X
Instruments	Labor market neighbors' outcomes		X
	Labor market neighbors' percentage of Black or Hispanic	X	
	Labor market neighbors' income-to-poverty ratio	X	X
Student needs	FPRL rate	X	X
	EL rate	X	X
	Special education rate	X	X
Scale	Small district size	X	X
	Population density	X	
Grade ranges	Percentage of students in prekindergarten	X	
	Percentage of students in middle school grades		X
	Percentage of students in high school grades	X	X
Price of inputs	Education Comparable Wage Index	X	X
Efficiency controls	Herfindahl Index (sum of squared district shares of enrollment within the labor market)	X	X
	Percentage of population that is between 5 and 17 years old	X	X
	Ratio of median housing values to labor market neighbors	X	
	Share of revenue from federal sources		X

Note. The assessment outcomes for the New Hampshire model also included assessment scores for Grade 11.

Exhibit B.6 provides the output of the second stage (main cost model) regressions for the New Hampshire specific model with relevant diagnostics.

Exhibit B.6. Second Stage Estimates for the New Hampshire Cost Model

Variable	Outcome: Natural log of spending per pupil	
	Coefficient	Standard error
Student outcome factor score	0.178*	0.097
FRPL rate	0.690*	0.383
Special education rate	1.659***	0.481
EL rate	0.875	0.861
Enrollment categories		
≤ 200	0.376***	0.066
201–600	0.208***	0.051
601–1,200	0.159***	0.046
1,201–2,000	0.096**	0.044
Proportion of enrollment in middle grades	0.548***	0.154
Proportion of enrollment in high school grades	0.168**	0.083
Comparable Wage Index for Teachers	-0.086	0.123
Year trend	0.025***	0.003
Share of population ages 5–17	0.098	0.584
Federal revenue as share of total spending	-1.377**	0.655
Herfindahl Index (sum of squared district shares of enrollment within the labor market)	0.233	0.194
Constant	9.141***	0.303
Number of observations	1,597	
R^2	0.337	

Note. Excluded instruments: labor market neighbors' income-to-poverty ratio, labor market neighbors' outcome scores. Partial R-squared of excluded instruments: 0.0510. F-test of excluded instruments: $F(2, 154) = 13.88$. Hansen J statistic (overidentification test of all instruments): 1.977, Chi-sq(1) p-value = 0.1597.
*$p < 0.1$. **$p < 0.05$. ***$p < 0.01$.

Exhibit B.7 provides the output of the second stage (main cost model) regression for the regional model with relevant diagnostics.

Exhibit B.7. Second Stage Estimates for the Regional Cost Model

Variable	Outcome: Natural log of spending per pupil	
	Coefficient	Standard error
Outcome index	0.670***	0.159
Comparable Wage Index	-0.130	0.101
FRPL rate	0.525***	0.127
State mean-centered SWD rate	1.963***	0.252
EL rate	1.218***	0.203
Proportion of enrollment in prekindergarten	-0.158	0.221
Proportion of enrollment in high school grades	0.675***	0.055
Enrollment categories		
≤ 100	0.389***	0.077
101–300	0.327***	0.035
301–600	0.226***	0.029
601–1,200	0.153***	0.024
1,201–1,500	0.173***	0.030
1,501 to 2,000	0.114***	0.023
Log of population per square mile	0.026**	0.012
Share of population ages 5–17	2.488***	0.720
Median housing value	0.002	0.048
Herfindahl Index (enrollment proportions of labor market)	-0.203*	0.117
Year trend	0.016***	0.003
Constant	8.978***	0.138
Number of observations	5,541	
R^2	0.169	

Note. Excluded instruments: labor market neighbors' income-to-poverty ratio, labor market neighbors' proportion of students who are Black or Hispanic. Partial *R*-squared of excluded instruments: 0.0478. *F*-test of excluded instruments: $F(2, 697) = 28.27$. Hansen J statistic (overidentification test of all instruments): 0.090, Chi-sq(1) *p*-value = 0.7646.
*$p < 0.1$. **$p < 0.05$. ***$p < 0.01$.

Limitation of the Cost Model Estimates

There is a limitation of the cost model estimates. Specifically, they provide guidance regarding the general levels of funding increases that would be required to produce measured outcomes at a certain level, assuming that districts can absorb the additional resources without efficiency loss—in other words, assuming that efficiency of outcome production remains constant. This is not always the case: districts may use additional revenues for all sorts of programs or services. This additional spending may be inefficient only in the sense that it does not contribute to improving the educational outcomes we measure. That is not to say this spending does not help districts achieve other goals important to the community or society in general: spending on sports programs, for example, may be desirable but does not necessarily increase statewide accountability test scores. Cost models, therefore, are limited by the outcome measures employed within them.

Despite this limitation, cost model estimates, as well as the recommendations of professionals and expert panels, can still serve to provide useful, meaningful information to guide the formulation of more rational, equitable, and adequate state school finance systems.

To learn more about AIR's research on education finance, contact Jesse Levin at jlevin@air.org

AMERICAN INSTITUTES FOR RESEARCH®

1000 Thomas Jefferson Street NW
Washington, DC 20007-3835
202.403.5000

About the American Institutes for Research

Established in 1946, with headquarters in Washington, D.C., the American Institutes for Research (AIR) is a nonpartisan, not-for-profit organization that conducts behavioral and social science research and delivers technical assistance, both domestically and internationally, in the areas of education, health, and the workforce. **For more information, visit www.air.org.**

12685_08/20