# Understanding the Cost of Providing Adequate Educational Opportunity in Oregon

**Submitted to:**
Oliver Droppers | Deputy Director for Policy Research
Legislative Policy and Research Office
Oregon State Capitol
900 Court St NE Rm. 453
Salem, OR 97301
(503) 986-1520

**Submitted by:**
Christopher D. Brooks | Researcher
Jesse Levin | Principal Research Economist
Brad Salvato | Research Assistant
*American Institutes for Research*

Bruce D. Baker | Professor
*University of Miami*

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# Introduction

In this report, we employ a cost function analysis to estimate the cost of an adequate education for all students in Oregon. A key driver in this analysis is the concept of educational adequacy, which is used to frame the determination of the funding necessary to deliver an adequate education. For this report, we define an adequate education as one that provides an equal opportunity for a student to achieve a set of desired outcomes. Adequate funding is the level of funding necessary to give all students an equal opportunity to achieve this target set of outcomes, regardless of their specific needs or the characteristics of the school they attend, both of which may affect the cost of reaching the target outcomes. Using this framing, our analysis determines cost differentials of providing an adequate education associated with various student needs and the differences in the contexts in which they learn. Supporting the provision of an adequate education necessarily requires that funding be differentiated across school districts to address the varying costs associated with the specific levels of student needs being served and other contextual characteristics of schools and districts that influence the cost of producing student outcomes.

Our analysis leverages administrative records on Oregon's public school system from the 2014–15 to 2022–23 school years to answer four primary research questions:

1. What student, school, and district characteristics are most strongly correlated with student outcomes?
2. What is the association between educational revenues and student, school, and district characteristics, including measures of student need and local wealth and income?
3. What are the predicted costs of providing all Oregon public K-12 schools an equal opportunity to realize current statewide average academic outcomes and a higher outcome target that better represents adequate performance levels?
4. How could a funding formula be designed to appropriately distribute an adequate funding level to each school district in Oregon according to the level of student needs they face and other contextual factors?

To answer these questions, we employed a four-stage analysis. In the first stage, we identify measures of educational need, such as percentages of student who are English learners (EL), with a disability (SWD), or are economically disadvantaged, as well as other school and district characteristics that are associated with educational outcomes. In the second stage, we examine the associations between school funding and spending and student needs and school and district characteristics in Oregon's K-12 public schools to determine the extent to which funding and spending is equitably distributed across districts. In the third stage, we use these findings to predict the costs associated with providing an education that is adequate, meaning that all schools have the ability to achieve the specified target outcome levels. Finally, our fourth stage develops a funding formula, using a multiplicative student enrollment-based weights model, for distributing an adequate level of funding for each school district in Oregon to meet the target outcome levels.[1] Following these main analyses we offer two supplemental analyses of: (a) adequate cost of capital expenditures and (b) a comparison of the cost estimates produced from our cost model to both current expenditure levels in Oregon and the estimated adequate costs produced by the Quality Education Model (QEM). We then conclude by summarizing and discussing the findings.

## Description of Data

Administrative data provided directly by the Oregon Department of Education (ODE) or gathered from the ODE website were essential to the analyses in this report. These data were supplemented by several other data sources maintained by the National Center for Education Statistics (NCES), U.S. Census Bureau, and the School Finance Indicators Database. The administrative data used for this study, described in the following paragraphs and referenced throughout this report, include expenditures, enrollments, student outcomes, school characteristics, and geographic contextual information. The enrollment and outcome data are for school years 2014–15 through 2021–22. The fiscal data containing education expenditures are from the school years 2017–18 through 2021–22.

### *Enrollments, School Characteristics, Student Outcomes, and Geographic Context*

The enrollment data used in this report were provided by the ODE. Individual data files reported school-level enrollments, which in some analyses are aggregated to the district level each year. School-level enrollments are also disaggregated by student characteristics including students with disabilities (SWD), ELs, economically disadvantaged students, and by grade level. Using these disaggregated enrollments, we calculated the percentages of students in each school within each of these student groups and by grade. In district-level analysis, we calculate percentages by totaling school-level counts to the district level in each year and dividing by total district enrollment.

Different types of student disabilities have different levels of cost for schools and districts on average. To account for this, we constructed three types of cost-based SWD counts and

[1] See Appendix A for a more detailed conceptual overview of these analyses and how they contribute to estimating the cost of an adequate education.

percentages (Low, Middle, and High) based on disability groupings suggested in analyses included in the Special Education Expenditure Project (Chambers et al., 2003). Low-cost disabilities include (a) specific learning disability and (b) speech or language impairment. Middle-cost disabilities include (a) developmental delay, (b) emotional disturbance, (c) intellectual disability, or (d) other health impairment. High-cost disabilities include (a) autism spectrum disorder, (b) deaf–blindness, (c) hearing impairment, (d) multiple disabilities, (e) orthopedic impairment, (f) traumatic brain injury, and (g) visual impairment.

Our measures of student outcomes include school-aggregated student test scores, chronic absenteeism rates, and four-year graduation rates, all provided by the ODE. Test scores are for math and English Language Arts (ELA) end-of-grade testing in grades 3 through 8 and grade 11. Chronic absenteeism rates are defined as the share of a school that missed 10% or more of the total school days in the school year. Four-year graduation rates are the percentage of students who earned a regular or modified diploma within four years of entering 9th grade.

We used several other publicly available data sources to gather for describing schools' geographic contexts and student needs. In some analyses, we use the National Center for Education Statistics (NCES) *Income to Poverty Ratio* from the Neighborhood Poverty Index database, which measures average family income in school neighborhoods relative to the federal poverty thresholds for various family sizes and structures (NCES (n.d. -b). We also collect from NCES district-level data describing geographic differences in the price levels of educational staff called the Comparable Wage Index for Teachers (CWIFT) (NCES, n.d. -a). We also gathered data from the U.S. Census Bureau (2021), including estimates of children 5 to 17 in families below the poverty income threshold in Oregon school districts and zip-code-level reports of population density per square mile.

### *Fiscal Data*

Fiscal data used in this report were provided by ODE. The fiscal data contained expenditures for each district and school, organized by the state's chart of accounts. Using these data, we calculated school-level spending per pupil for each school in the state, which consisted of the following steps:

1. We removed non-current expenditures, which includes capital expenditures, debt service, and internal services funds to ensure expenditures reflected the current resources spent on educating students and to avoid double counting.
2. We isolated expenses that were directly attributed to specific school sites within the data and calculated the total amount of spending attributed to each individual school.
3. We calculated the total amount of spending not assigned to individual schools for each district.

4. We assigned district-level spending (overhead) to individual schools proportional to each school's share of district total enrollment.
5. We calculated the amount of direct expenditures by Education Service Districts (ESDs) on each school district (excluding transfers from ESDs to districts to avoid double counting), disaggregated by spending on general education and spending on special education.
6. We assigned ESD spending on districts to individual schools proportional to each school's share of district total enrollment for ESD spending on general education and proportional to each school's share of total SWD enrollment ESD spending on special education.
7. We divided the total spending, including district overhead and ESD expenditures, by school-level enrollment totals to calculate expenditures per student for each school.

Information on the funding source included in the expenditure data allows us to further distinguish spending per pupil supported by federal versus state and local revenue sources.

### *Schools Excluded from the Analysis*

For most of the analyses presented in this report, we excluded schools that, according to our measures of spending, had total expenditures that were less than $5,000 per pupil or more than $50,000 per pupil. Examining the small number of schools omitted by this decision indicated that these schools likely had abnormal spending patterns or underlying data issues that did not make them appropriate for our analytic sample. However, any schools with reported demographic and district context information are included in our estimates of our weights model and projections of total district-level cost in the fourth stage of our analyses, as well as in the supplemental analyses on total statewide adequate education costs.

# 1. Student Needs and Outcomes in Oregon

In this section, we report on a risk/needs analysis of Oregon public schools. We have constructed a panel of data containing 1,154 to 1,172 schools per year from the 2014–15 to 2022–23 school years. We begin with a discussion of the construction of our student outcome factor score for Oregon schools. Next, we explore what measures of student needs and characteristics are associated with the outcome factor score. Finally, we investigate other school- and district-level characteristics associated with the outcome factor score.

## Outcome Factor Score

To characterize the outcomes of schools across the various outcomes, we constructed an aggregate outcome score meant to describe overall school performance. The intent behind combining multiple outcome measures into a single score is to create a more robust indicator of school performance that reflects a broader set of educational goals than any single outcome measure. To construct the outcome score, we conducted confirmatory factor analysis using a measurement model that treats the overall outcome measure as a latent (i.e., unobserved) variable and estimates the latent variable to best fit the data. 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 even when individual measures are missing for some schools. For example, only schools serving Grade 12 students have a graduation rate reported and our outcome factor score can accommodate schools that do not have this measure.

Exhibit 1 shows the model used to generate the factor scores along with the standardized factor loadings for each outcome measure included. Our factor score includes the following measures, as reported by the Oregon Department of Education:

- School-level math and reading scores from end-of-grade standardized tests in grades 3-8 and in grade 11.
- School-level chronic absenteeism rates, defined as the share of students that are absent for more than 10% of total school days each year.
- School-level graduation rates, defined as the percentage of students who earned a regular or modified diploma within four years of entering the ninth grade.

The numbers included in the outcome factor model represent standardized coefficients and describe the change in each individual outcome resulting from a one standard deviation increase in the outcome factor score.

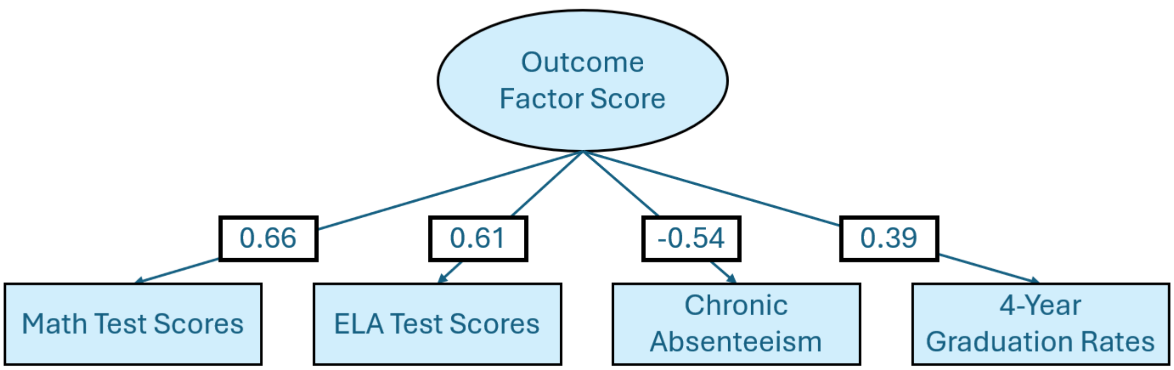
As shown in Exhibit 1, math and ELA assessment scores generate the strongest factor loadings with magnitudes of 0.66 and 0.61 respectively. Chronic absenteeism rates are the next strongest factor loading, at -0.54, with a negative sign indicating that higher chronic absenteeism rates correlate with worse school outcomes. Lastly, four-year graduation rates have a factor loading of 0.39. Once constructed, the outcome factor score has a mean of zero and a standard deviation of one.

To demonstrate that the outcome factor score is working as intended, we show the correlation between the outcome factor score and several student outcomes in Exhibit 2. The outcome factor score is moderately to strongly correlated to each of the outcomes included in the correlation table. By contrast, not all outcomes included are strongly correlated with each other. For example, the correlation between graduation rates and standardized test scores in

ELA and math are only 0.203 and 0.240, respectively. This indicates that the outcome factor score is a better representation of the collection of outcomes included than any individual outcome measure.

Exhibit 3 provides the distribution of the outcome factor score across Oregon schools (weighted by enrollment) in 2022–23. The outcome factor is a standardized value, with a mean of 0 and a standard deviation of 1. Cost predictions later in this report will be set to the cost of achieving current average outcomes (0) and one standard deviation above current average outcomes (+1).

### Exhibit 1. Measurement Model Used to Generate the Outcome Factor Score




*Note.* The model is weighted by enrollment. The model also allowed for the error terms between math z scores and reading z scores to be correlated. 4-year graduation rates were transformed using a logit transformation. All variables were then standardized as z scores prior to inclusion in the model. All factor loadings are statistically significant ($p$ < .001).
*Source.* Calculations based on data from the ODE.

### Exhibit 2. Correlations Between Components of the Outcome Factor Score

| | Outcome factor score | ELA Z score | Math Z score | Chronic absenteeism | 4-year graduation rate |
|---|---|---|---|---|---|
| **Outcome factor score** | 1.000 | | | | |
| **ELA Z score** | 0.663 | 1.000 | | | |
| **Math Z score** | 0.744 | 0.674 | 1.000 | | |
| **Chronic absenteeism** | -0.733 | -0.261 | -0.307 | 1.000 | |
| **Graduation rate** | 0.608 | 0.203 | 0.240 | -0.488 | 1.000 |

*Source*. The ODE.

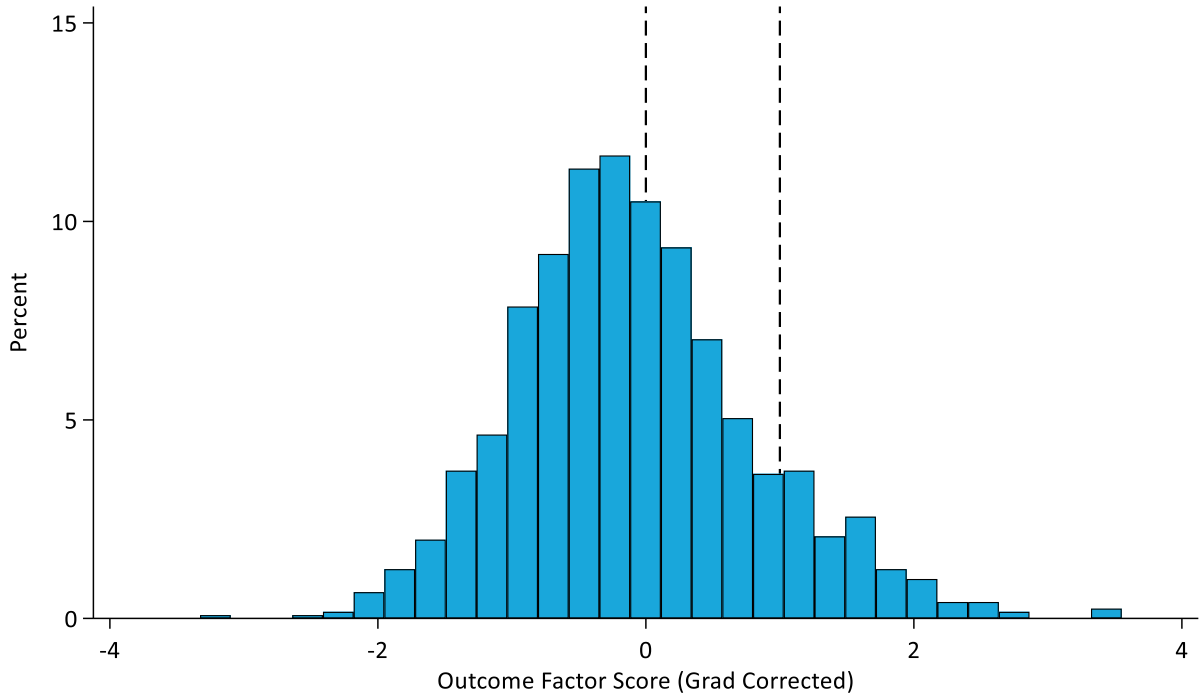
Exhibit 4 describes outcomes for schools with outcome factor scores +/- 0.25 from both outcome targets used in our cost function analysis for the 2022–23 school year. The bottom of each column reports the number of schools with an outcome factor score within the score band for this school year. Because not all outcome measures apply or are available for all schools, the "count" column reports the number of schools with available outcome data for each measure.

Exhibit 4 shows that schools with an outcome factor score between –0.25 and 0.25 have average standardized ELA and math test scores slightly below the statewide average, a chronic absenteeism rate of 36.0%, and a graduation rate of 84.6%. Schools with outcome factor scores between 0.75 and 1.25 have average standardized test scores in ELA and math approximately one standard deviation above the statewide mean, a chronic absenteeism rate of 26.7%, and a graduation rate of 89.36%.[2] These numbers suggest that the outcome factor score is an effective measure of performance, as all outcome variables improve among higher-performing schools near our target of one standard deviation above mean outcomes.

To contextualize the numbers in Exhibit 4 with real-world targets, Oregon's approved consolidated state plan under the federal Every Student Succeeds Act (ESSA) set long-term outcome targets of 80% proficiency rates in ELA and math and a 90% graduation rate by the 2026-27 school year (ODE, 2023). Schools with outcome factor scores near either of our outcome targets were not meeting the long-term goals in the 2022-23 school year. However, the higher-performing schools, with outcome factor scores near one, were notably closer to these long-term goals, being approximately halfway between the outcomes of schools with average outcome factor scores and the long-term outcome targets. Schools with outcome factor scores near 0 also fall well below the target graduation rate of 90%. However, schools with outcome factor scores near 1 have an average graduation rate of 89.36%, much closer to the statewide long-term goal. Finally, while the ESSA plan does not set targets for chronic absenteeism, the national average chronic absenteeism rate was 28% in the 2022–23 school year. Oregon schools with outcome factor scores between 0.75 and 1.25 were slightly below this rate at 26.7%, while schools with average outcome factors scores were well above this rate at 36.0% (ED, 2025). These data suggest that defining adequacy as one standard deviation above the mean outcome factor score is an appropriate outcome target. This implies targets for

[2] Notably, the average graduation rates in both bands tend to be higher than the statewide average in recent years of approximately 80%. This likely reflects the fact that graduation rates were the outcome measure least correlated with the outcome factor score.

**Exhibit 3. Distribution of Outcome Factor Score (Bars) and Outcome Targets (Dashed Lines), School Years 2014–15 to 2022–23**




*Note.* Outcome factor scores are calculated at the school-level using a measurement model based on standardized measures of end-of-grade math and reading test scores, chronic absenteeism rates, and graduation rates. The dashed vertical lines at 0 and 1 represent the outcome goals in our cost analysis.
Source. The ODE.

**Exhibit 4. Average School-Level Outcomes by Outcome Target Level, School Year 2022–23**

| Outcome measure | Average performing schools (Outcome factor score = -0.25 to 0.25) | | Higher performing schools (Outcome factor score = 0.75 to 1.25) | |
|---|---|---|---|---|
| | Mean | Count | Mean | Count |
| **ELA test score (std.)** | 0.091 | 272 | 1.062 | 104 |
| **Math test score (std.)** | -0.042 | 272 | 1.105 | 104 |
| **ELA proficiency rates** | 42.4% | 268 | 60.2% | 103 |
| **Math proficiency rates** | 32.0% | 268 | 55.6% | 103 |
| **Chronic absenteeism rate** | 36.0% | 275 | 26.7% | 105 |
| **Graduation rate** | 84.6% | 75 | 89.4% | 27 |
| **Number of observations** | 275 | | 105 | |

*Note.* Math and ELA scores are standardized (mean=0; standard deviation=1) with reported averages representing standard deviations from the mean. Counts represent the numbers of school observations in the 2022–23 school year.
Source. The ODE.

chronic absenteeism rates that are just below the national average, as well as graduation rates that are slightly less than the long-term target listed in Oregon's ESSA plan and standardized ELA and math proficiency rates that are closer to the long-term ESSA targets.

While we estimate costs for both outcome targets, our preferred target, and focus of our recommendation in this report, is raising all student outcomes to one standard deviation above the statewide average outcome factor score.

## Outcome Factor Score and Student Needs

Exhibit 5 below shows the correlations between each of our need factors and the outcome factor score across schools in the 2022–23 school year. Table entries with "(school)" in the label are measures available at the school level, while those with "(district)" are available only at the district level.

The table includes five different measures of economic disadvantage. First, we use the share of children reported as economically disadvantaged in the data provided by the ODE. Second, we use neighborhood *income-to-poverty ratios* from NCES (n.d. -b). Third, we use district-level estimates of children aged 5 to 17 in families below the poverty income threshold from the U.S. Census Bureau. Our fourth and fifth measures are constructed by fitting models to predict the school-level percentage of economic disadvantage with combinations of other measures. The first predicted measure is an economic disadvantage index (EDI) based on a model that includes: (a) the income to poverty ratio, (b) the census poverty rate, and (c) the comparable wage index for teachers (CWIFT), from NCES (n.d. -a).[3] Our second predicted EDI adds the share of school enrollment that is Hispanic and the share of school enrollment that is Black, each of which is individually negatively correlated with the outcome factor score.[4]

We also report the correlations between the outcome factor score and the share of school enrollment that has one or more disability, further broken out by the share of students with low-, middle-, or high-cost disabilities, and the shares of school enrollment that are EL, Black, and Hispanic.

Among all two-way correlations with the outcome factor score reported in Exhibit 5, the strongest negative correlation is with our second predicted EDI, which embeds racial

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[3] We include the CWIFT because it captures differences in wages across regions within the state that may reflect differences in the quality of living attainable at a given wage. Our own earlier work showed the importance of using regional wage adjustments for setting poverty income thresholds. Including this measure in our model provides an indirect correction to the income/poverty thresholds used in other measures in the model. See Baker, B. D., et al. (2013).

[4] See Appendix B for a detailed summary of how the two EDI measures were constructed.

composition differences. All other correlations are in the expected direction and generally of a relevant and important magnitude. Note that the income-to-poverty index runs in the opposite direction of other measures, with higher values indicating higher local incomes relative to the poverty income threshold. Hence, the positive coefficient indicates that schools in higher income-to-poverty ratio neighborhoods tend to have higher outcome factor scores.

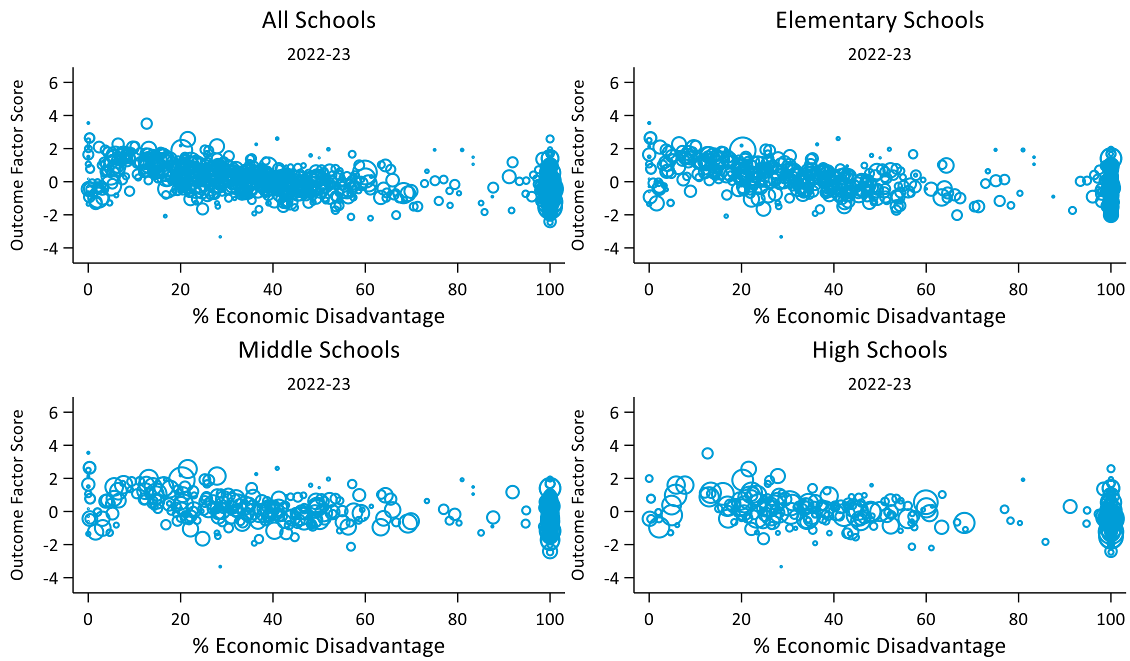
### Exhibit 5. Correlations Between the Outcome Factor Score and Student Needs Characteristics, 2022–23 School Year

| Need factor | Source | Outcome factor score |
|---|---|---|
| % Economic disadvantage (school) | ODE | -0.516 |
| Income-to-poverty ratio (school) | NCES (EDGE) | 0.508 |
| Census child poverty (district) | Census (SAIPE) | -0.288 |
| Predicted EDI (school) | Constructed | -0.477 |
| Predicted EDI (school) [includes race] | Constructed | -0.614 |
| % SWD (school) | ODE | -0.416 |
| Low cost | Constructed | -0.279 |
| Middle cost | Constructed | -0.381 |
| High cost | Constructed | -0.167 |
| % EL (school) | ODE | -0.469 |
| % Hispanic (school) | ODE | -0.488 |
| % Black (school) | ODE | -0.175 |

*Note.* Labels (district) and (school) represent the level at which the variable is reported in our data. Correlations are weighted by total enrollment in each school.
*Source*. The ODE; NCES, n.d.-b; U.S. Census Bureau, 2021.

Exhibits 6 and 7 reveal the value of using our EDI compared to the directly collected economic disadvantage shares. Exhibit 6 plots the economic disadvantage shares for all schools, and schools by grade level, against the outcome factor score. In each case, we can see the negative relationship between outcome factor score and economic disadvantage shares. However, the data on economic disadvantage illustrate stark discontinuities across the scatter plots. There is a clear trend from 0% to approximately 60% economic disadvantage and then very few schools with reported economic disadvantage rates from 60% to 99%, with a substantial cluster of schools at 100%. This is likely due to the Community Eligibility Provision in the federal Child Nutrition Program, which allows schools with high incidence of economic disadvantage to certify all enrolled students as eligible for free- or reduced-price lunches, even if every student is not actually economically disadvantaged. This means that the economic disadvantage rates reported by the ODE may not actually be accurate proxies for the actual economic needs of students within each school.

### Exhibit 6. Scatter Plots of Reported Economic Disadvantage Versus Outcome Factor Score, School Year 2022–23

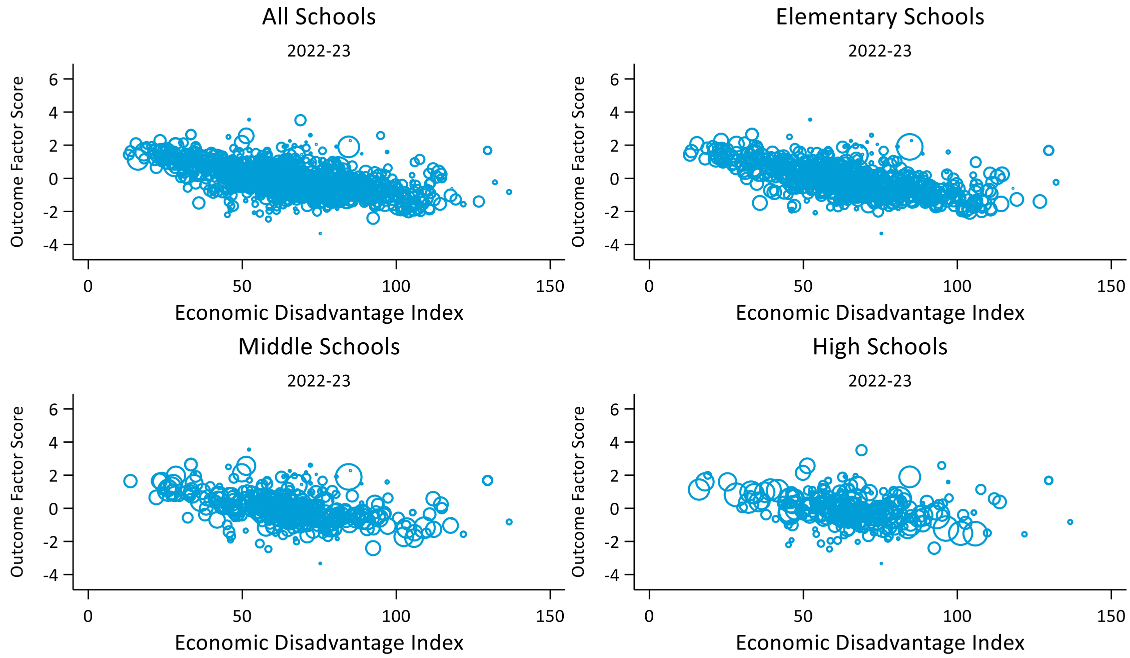



*Note*. Plotted points are weighted by student enrollment so that larger circles indicate greater total enrollment in each school.
*Source*. Calculations based on data from the ODE.

Exhibit 7 recreates the plots in Exhibit 6 but maps our second EDI measure (i.e., that takes into account race), rather than the ODE-reported rates of economic disadvantage, on the horizontal axis.[5] As noted previously, the EDI uses alternative variables to predict economic disadvantage in each school. These variables do not have the same pattern of clustering at 100% as ODE-reported economic disadvantage.[6] Therefore, we observe that the distribution of economic disadvantage no longer exhibits clustering at 100%. This suggests that some of the schools clustered at 100% economic disadvantage in Exhibit 6 have their true values that lie between the gap between 60% and 100%. When taken together, the exhibits indicate that the stronger correlation between the EDI and the outcome factor score, relative to ODE-reported economic disadvantage and the outcome factor score reported in Exhibit 6, is due in part to ODE-reported economic disadvantage rates having substantial clustering at 100%. These exhibits also suggest that the EDI is a more accurate measure of economic need in each school.

[5] See Appendix B for a more detailed overview of the construction of the EDI.
[6] Also, note that the EDI is not scaled to a percentage bounded by 0 and 100, but rather to the relative need of a school, and in instances of the greatest economic need, can produce estimates that are above 100.

## Exhibit 7. Scatter Plots of Economic Disadvantage Index Versus Outcome Factor Score, School Year 2022–23




*Note.* Plotted points are weighted by student enrollment so that larger circles indicate greater total enrollment in each school.

*Source.* Calculations based on data from the ODE; NCES, n.d.-b; U.S. Census Bureau, 2021.

Exhibit 8 provides the first of two regression analyses of the relationship between our student need factors and the outcome factor score. Model 1 uses a set of student need characteristics that includes ODE-reported economic disadvantage rates. Model 2 uses the same set of characteristics but substitutes ODE-reported economic disadvantage rates for our preferred second EDI measure that takes into account race. The first takeaway from Exhibit 8 is that the amount of variation in the outcome factor score explained ($R^2$) by Model 2 (0.467) is higher than Model 1 (0.394) so that the former is our preferred model.

Exhibit 8 highlights several other notable associations between student needs and the outcome factor score. The shares of school enrollment that are with low or middle cost disabilities or are EL are negatively associated with the outcome factor score in both models. For example, in Model 2, a school that has 100% EL enrollment is expected to have an outcome factor score that is 0.657 standard deviations lower than a school with 0% EL enrollment.

**Exhibit 8. Regression of the Outcome Factor Score on Student Need Measures**

| DV = Outcome factor score | Model 1 | | Model 2 | |
|---|---|---|---|---|
| | Coefficient | Standard error | Coefficient | Standard error |
| % economic disadvantage (school) | -0.824*** | 0.135 | | |
| EDI (school) [includes race] | | | -1.719*** | 0.195 |
| % students with low-cost disabilities (school) | -4.259*** | 0.687 | -4.373*** | 0.581 |
| % students with middle-cost disabilities (school) | -7.147*** | 0.656 | -6.606*** | 0.640 |
| % students with high-cost disabilities (school) | -0.334 | 0.956 | -0.728 | 1.048 |
| % EL (school) | -1.399*** | 0.258 | -0.657*** | 0.219 |
| Time | -0.001 | 0.008 | 0.012* | 0.006 |
| Constant | 1.315*** | 0.148 | 1.829*** | 0.154 |
| Number of observations | 10,218 | | 10,149 | |
| $R^2$ | 0.394 | | 0.467 | |

*Note*. *** p<.01. Estimates are weighted by total school enrollment. Reported standard errors are robust, clustered at the district level. All percentage variables range from 0-1. Labels (district) and (school) represent the level at which the variable is reported in our data.
*Source*. The ODE; NCES, n.d.-b; U.S. Census Bureau, 2021.

The second set of regressions presented in Exhibit 9 adds a series of district contextual factors and again estimates models that include ODE reported economic disadvantage rates (Model 1) and that replaces this with the second EDI measure we generated (Model 2). Model 2 using EDI instead of reported economic disadvantage rates again predicts a larger share of variation in the outcome factor score than does the Model 1 which is based on reported economic disadvantage ($R^2_{Model\ 2}$ = 0.489 versus $R^2_{Model\ 1}$ = 0.429). The student needs coefficients are generally in the same direction and of a similar magnitude as in Exhibit 8. In terms of school and district characteristics, children in school districts with enrollments between 301 and 2000 tend to perform less well, relative to children in districts with enrollment of more than 2,000. For example, according to Model 2, a district with an enrollment between 301 and 600 students is expected to have an outcome factor score that is 0.210 standard deviations lower than a district with more than 2,000 students, holding all else in the model constant. Further, in Model 2, children in the most sparsely populated districts tend to perform better than children in districts with a density of more than 100 people per square mile. Often we find that due to the composition of our outcome factor score, schools at different grade ranges show systematically different scores. This appears to be the case in Oregon as well, as in Model 2, the share of students in grades 9-12 is positively associated with the outcome factor score.

## Summary of the Risk/Needs Analysis of Oregon Public Schools

The major takeaways of this first analysis are as follows:

- The EDI measure that accounts for race performs better than alternatives when predicting the outcome factor index score.
- The EDI measure that accounts for race has a statistically significant negative relationship with the outcome factor score when controlling for a host of other factor associated with student need and district context.
- Above and beyond the EDI, other measures such as shares of children with disabilities and shares who are EL also exhibit negative relationships with the outcome factor score.
- Select district size categories and population density categories, as well as grade range, show significant differences in average outcomes.

These findings guide our variable selections in the analyses that follow, most notably when it comes to cost modeling.

## Exhibit 9. Regression of the Outcome Factor Score on Student Needs and School and District Contexts

| DV = Outcome factor score | Model 1 | | Model 2 | |
|---|---|---|---|---|
| | Coefficient | Standard error | Coefficient | Standard error |
| **Student factors (school)** | | | | |
| % economic disadvantage | -0.671*** | 0.105 | | |
| EDI | | | -1.847*** | 0.158 |
| % students with low-cost disabilities | -3.767*** | 0.548 | -3.534*** | 0.505 |
| % students with middle-cost disabilities | -7.104*** | 0.709 | -7.372*** | 0.665 |
| % students with high-cost disabilities | -1.041 | 1.023 | -0.195 | 1.020 |
| % EL | -2.099*** | 0.269 | -0.623*** | 0.226 |
| **School factors (school)** | | | | |
| Enrollment size | | | | |
| Under 100 | -0.096 | 0.087 | -0.120 | 0.086 |
| 101 to 300 | -0.049 | 0.040 | -0.048 | 0.041 |
| >300 | (Reference) | | (Reference) | |
| Grade distribution | | | | |
| % in grades 9 to 12 | -0.080** | 0.035 | 0.065* | 0.034 |
| % in grades 6 to 8 | -0.129* | 0.072 | 0.092 | 0.066 |
| % in Grades K–5 | (Reference) | | (Reference) | |
| **District and location factors (district)** | | | | |
| Enrollment size | | | | |
| Under 100 | -0.121 | 0.136 | -0.161 | 0.140 |
| 101 to 300 | -0.096 | 0.091 | -0.138 | 0.099 |
| 301 to 600 | -0.159* | 0.082 | -0.210*** | 0.081 |
| 601 to 1,200 | -0.141** | 0.066 | -0.169** | 0.069 |
| 1,201 to 2,000 | -0.155** | 0.075 | -0.151** | 0.074 |
| >2,000 | (Reference) | | (Reference) | |
| **Population density** | | | | |
| Under 10 per square mile | 0.182 | 0.132 | 0.447*** | 0.140 |
| 11 to 50 per square mile | -0.094 | 0.101 | -0.051 | 0.095 |
| 51 to 100 per square mile | -0.127 | 0.087 | -0.153* | 0.082 |
| >100 per square mile | (Reference) | | (Reference) | |
| CWIFT centered on Oregon minimum | 1.375* | 0.797 | -0.533 | 0.674 |
| Time | 0.000 | 0.007 | 0.017*** | 0.006 |
| Constant | 1.192*** | 0.163 | 1.975*** | 0.157 |
| Number of observations | 10,218 | | 10,149 | |
| $R^2$ | 0.429 | | 0.489 | |

*Note.* *$p$ < .1. **$p$ < .05. ***$p$ < .01. Estimates are weighted by total school enrollment. Reported standard errors are robust, clustered at the district level. All percentage variables range from 0–1. Coefficients for categorical variables are interpretable relative to the reported (Reference) group. (District) and (School) represent the level at which the variable is reported in our data.

*Source.* The ODE; NCES, n.d.-b; U.S. Census Bureau, 2021.

## 2. Variations in the Existing Levels of Current Spending in Oregon

The following section reports on our spending analysis of Oregon public schools. In this analysis we are interested in (1) whether school spending varies with respect to student needs (evidence of which signifies equitable variation) and (2) whether school spending varies with respect to wealth, income, and tastes of local communities (evidence of which signifies inequitable variation). The previous section identified the most relevant measures of student need, based on available data.

### Spending and Student Need

We begin in Exhibit 10 by reporting the correlations between total spending (including federal aid) per pupil and spending from state and local sources to student population characteristics in the 2022–23 school year and. Again, "(school)" denotes that the data are reported at to the school level and "(district)" at the district level. Both sets of correlations generally indicate that expenditures are associated with higher concentrations of district need. However, no correlation is above 0.2 or below –0.2, indicating these relationships are not especially strong. Exhibit 10 also indicates that generally student needs measured at both the school or district levels are more strongly correlated with expenditures when federal funding is included, which aligns with the fact that federal funding is typically targeted towards higher-need populations.

In Exhibit 11, we use scatter plots to visualize the association between total expenditures per-pupil and school-level rates of reported economic disadvantage (left) and the EDI measure

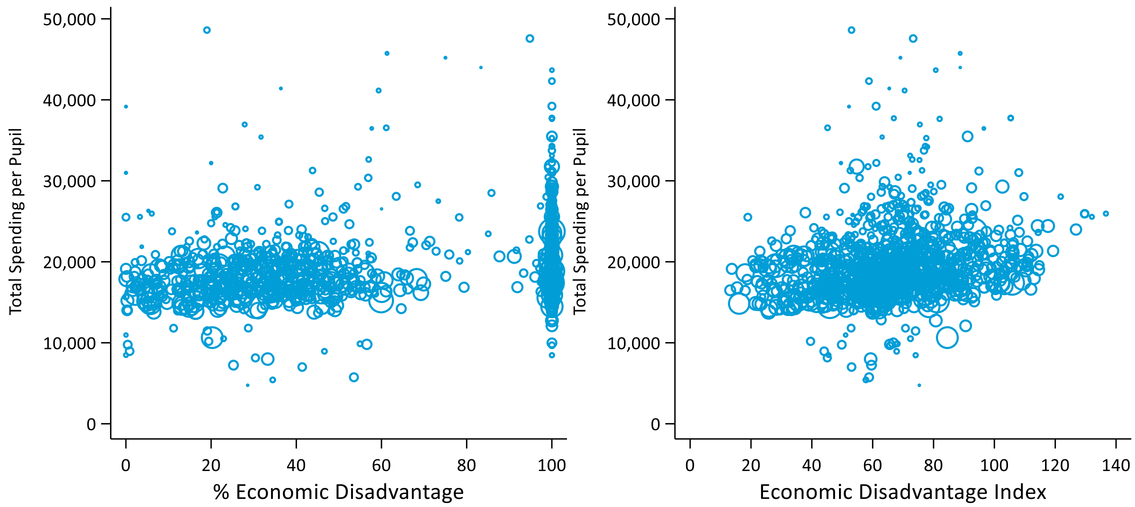
**Exhibit 10. Correlations Between Student Needs and School Spending Per Pupil, School Year 2022–23**

| Student factor | Source | Total expenditures per pupil | State and local expenditures per pupil |
|---|---|---|---|
| % Economic disadvantage (school) | State | 0.186 | 0.114 |
| Income-to-poverty ratio (school) | NCES (EDGE) | -0.057 | 0.009 |
| Census child poverty (district) | Census (SAIPE) | 0.167 | 0.005 |
| EDI (school) [includes race] | Constructed | 0.137 | 0.037 |
| % students with disabilities (school) | State | 0.163 | 0.148 |
| % students with low-cost disabilities (school) | Constructed | 0.176 | 0.139 |
| % students with middle-cost disabilities (school) | Constructed | 0.093 | 0.100 |
| % students with high-cost disabilities (school) | Constructed | 0.024 | 0.037 |
| % EL (school) | State | 0.097 | 0.067 |

*Note*. Expenditure figures are calculated at the school level. Labels (district) and (school) represent the level at which the variable is reported in our data. Correlations are weighted by total enrollment in each school.
*Sources*. Oregon Department of Education; NCES, n.d.-b; U.S. Census Bureau, 2021.

(right). On average, both economic disadvantage measures show small positive correlations with total spending per pupil. Exhibit 12 shows when only expenditures from state and local sources are considered, the association between economic need and spending is weaker (the plotted points follow a slightly flatter pattern). In general, the current funding model in Oregon does not appear to lead to substantial differentiation in state and local expenditures per pupil with respect to either the ODE-reported economic disadvantage rates or the EDI measure.

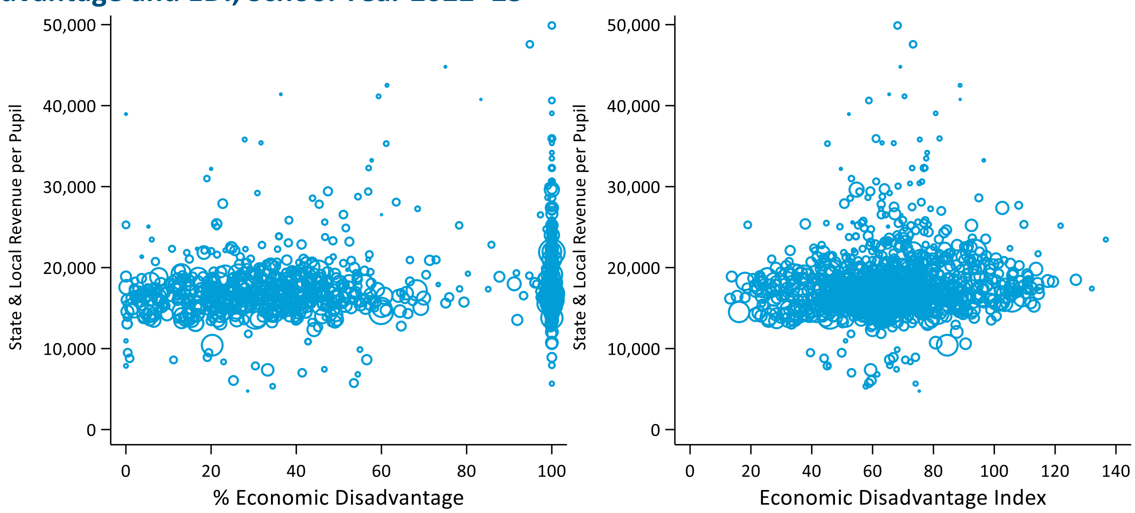
**Exhibit 11. Total Expenditures Per Pupil by Reported Economic Disadvantage and EDI, School Year 2022–23**




*Note.* Plotted points are weighted by student enrollment so that larger circles indicate greater total enrollment in each school.

*Source.* Calculations based on data from the ODE; NCES, n.d.-b; U.S. Census Bureau, 2021.

**Exhibit 12. Expenditures from State and Local Sources per Pupil by Reported Economic Disadvantage and EDI, School Year 2022–23**




*Note.* Plotted points are weighted by student enrollment so that larger circles indicate greater total enrollment in each school.

*Source.* Calculations based on data from the ODE; NCES, n.d.-b; U.S. Census Bureau, 2021.

In Exhibit 13, we display multivariate regressions describing the relationships between school and district characteristics and student need factors and total spending from local, state, and federal sources. Again, Model 1 uses ODE-reported economic disadvantage, whereas Model 2 uses the preferred EDI measure that accounts for race.

In Model 1, per-pupil spending appears to be higher in schools with higher rates of economic disadvantage, on average, when controlling for all other listed covariates. Likewise, in Model 2, the association between EDI and spending per pupil, while still positive, is slightly less strong. Spending is systematically higher in schools with larger shares of children with disabilities across all cost categories. For example, in Model 2, a district that has 100% low-cost SWD is expected to spend $9,851 per pupil more than a district with no low-cost SWD. Notably, there is no statistically significant relationship between share of EL students and total spending in either model.

Spending is also expected to be higher in very small and small schools, in schools serving children in upper grades (9–12), and in very small districts. For example, a district with fewer than 100 students enrolled is expected to spend $20,286 more per pupil than a district with more than 2,000 students enrolled, all else equal. Spending differences by district enrollment size level off at 300 or more students. In states with cold weather and mountainous terrain, it may be reasonable to consider both the role of school size and district size in affecting costs that are outside of state or district control. A district, for example, may cover a large geographic area and may by necessity (of travel safety) run multiple small, distant schools. In such instances, consolidating schools to benefit from economies of scale may not be feasible. Thus, the costs associated with the diseconomies of scale of operating extremely small schools must be considered.

Together, these analyses suggest some logical relationships between total spending and both a) school and district size and b) student need factors including children with disabilities and disadvantage as measured by the EDI. However, schools serving a higher rate of EL students do not have higher expenditures, on average.

### Exhibit 13. Regression of Spending as a Function of Student School and District Factors

| ‘ | Model 1 | | Model 2 | |
|---|---|---|---|---|
| | Coefficient | Standard error | Coefficient | Standard error |
| **Student factors (school)** | | | | |
| % economic disadvantage | 2,141.115*** | 755.821 | | |
| EDI [includes race] | | | 1,958.906** | 898.020 |
| % students with low-cost disabilities | 7,599.883*** | 2,835.920 | 10,242.358** | 4,106.179 |
| % students with middle-cost disabilities | 10,060.292** | 4,731.930 | 11,514.277*** | 4,368.103 |
| % students with high-cost disabilities | 7,926.002** | 3,143.754 | 9,044.343*** | 3,444.778 |
| % EL | 150.225 | 2,154.408 | 404.396 | 1,274.876 |
| **School factors (school)** | | | | |
| Enrollment size | | | | |
| Under 100 | 4,559.354** | 1,755.727 | 4,450.685** | 1,787.235 |
| 101 to 300 | 1,539.859*** | 217.145 | 1,556.747*** | 222.943 |
| >300 | (Reference) | | (Reference) | |
| Grade distribution | | | | |
| % in Grades 6–8 | -478.841*** | 181.701 | -562.458*** | 170.900 |
| % in Grades 9–12 | 800.505*** | 243.586 | 648.017*** | 228.744 |
| % in Grades K–5 | (Reference) | | (Reference) | |
| **District factors (district)** | | | | |
| Enrollment size | | | | |
| Under 100 | 21,768.307*** | 5,026.614 | 21,939.683*** | 5,027.993 |
| 101 to 300 | 5,969.457*** | 1,377.461 | 5,956.689*** | 1,388.588 |
| 301 to 600 | 843.414 | 561.606 | 858.151 | 596.155 |
| 601 to 1,200 | 77.895 | 405.133 | 59.641 | 412.436 |
| 1,201 to 2,000 | -302.424 | 339.318 | -408.117 | 365.197 |
| >2,000 | (Reference) | | (Reference) | |
| **Population density** | | | | |
| Under 10 per square mile | 174.278 | 666.590 | -3.860 | 675.201 |
| 11 to 50 per square mile | 80.502 | 601.478 | 189.511 | 569.621 |
| 51 to 100 per square mile | -542.922 | 532.424 | -407.335 | 489.114 |
| >100 | (Reference) | | (Reference) | |
| CWIFT centered on Oregon minimum | 6,251.296 | 5,950.143 | 6,601.487 | 5,244.325 |
| Time | 927.087*** | 41.852 | 935.771*** | 64.442 |
| Constant | 16,720.929*** | 821.002 | 16,514.495*** | 984.041 |
| Number of observations | 10,768 | | 10,699 | |
| $R^2$ | 0.362 | | 0.353 | |

*Note.* ***p* < .05. ****p* < .01. Estimates are weighted by total school enrollment. Reported standard errors are robust, clustered at the district level. All percentage variables range from 0–1. Coefficients for categorical variables are interpretable relative to the reported (Reference) group. (District) and (School) represent the level at which the variable is reported in our data.

*Source*. The ODE; NCES, n.d.-a; NCES, n.d.-b; U.S. Census Bureau, 2021.

## Spending, Wealth, and Income

An equitable school funding system should make it so that district spending levels are not systematically related to local property wealth or the taste preferences of the local population. Here we explore several measures that have in some settings been shown to be positively associated with funding per pupil, such as median household incomes, net assessed property value (NAV) per pupil, and the share of the population that is between the ages of 5 and 17. We also explore measures for which we might expect a negative association with funding per pupil, such as the share of property value that is held in personal property and the share of the population that is more than 65 years old. We also examine the extent to which education funding is associated with higher labor costs using the CWIFT.

In Exhibit 14, we examine the correlations between measures of wealth and local preference factors and district-level expenditures. Correlations between spending per pupil and individual measures of household income, taxable property wealth (personal shares of that wealth), and other factors that often predict school spending variation are generally modest, suggesting some level of wealth neutrality in the state. Further, median household is negatively correlated with spending, while NAV per pupil is positively associated with expenditures. To the extent that discretionary revenues are raised via property taxes, we would expect this latter relationship.

In Exhibits 15 and 16, we report the estimates from multivariate regressions of district-level educational total expenditures and expenditures from state and local sources on wealth and local preference factors, respectively. The regression results reveal that on average, total spending per pupil is positively associated with taxable property wealth but negatively associated with median household income.

The findings in Exhibit 15 also show that the share of taxable wealth held as personal property is negatively associated with total spending. This makes sense, given that a larger personal and/or primary residential share of property wealth means that a larger share of each dollar in revenue, or spending, is paid by the local residents who may have a say in setting local tax rates for discretionary revenue. Larger shares of populations over the age of 65 are also negatively associated with total spending per pupil, as might be expected.

The models in Exhibit 16 show the same measures in relation to state and local expenditures per pupil. The resulting patterns are similar, including higher spending in higher property wealth districts but lower in higher income districts, lower spending where personal share of property is larger, and lower spending where those over age 65 constitute a larger share of the population.

### Exhibit 14. Correlations Between Economic Context Factors and Spending, School Year 2022–23

| | Total expenditure per pupil | State and local expenditure per pupil | Median household income | NAV per pupil | % of NAV in personal property | % of population 5–17 years old | % of population over 65 | CWIFT |
|---|---|---|---|---|---|---|---|---|
| Total expenditure per pupil | 1 | | | | | | | |
| State and local expenditure per pupil | 0.863 | 1 | | | | | | |
| Median household income | -0.256 | -0.108 | 1 | | | | | |
| NAV per pupil | 0.258 | 0.312 | 0.221 | 1 | | | | |
| % of NAV in personal property | 0.024 | -0.003 | -0.115 | 0.066 | 1 | | | |
| % of population 5–17 years old | -0.060 | -0.070 | -0.192 | 0.024 | 0.153 | 1 | | |
| % of population over 65 | -0.102 | -0.125 | -0.373 | 0.041 | -0.145 | 0.035 | 1 | |
| CWIFT | 0.027 | 0.123 | 0.555 | 0.216 | 0.016 | -0.201 | -0.684 | 1 |

*Note.* All measures are reported at the district level. Correlations are weighted by total enrollment in each school. SFID is the School Finance Indicators Database (Baker et al., 2024). Percentage of assessed value that is personal property = (manufactured structures assessed value + personal property assessed value) / total assessed value)
*Source*. The ODE; Baker et al., 2024; NCES, n.d.-a.

### Exhibit 15. Regressions of School Spending on Measures of District Wealth and Income

| DV = Total district spending per pupil | Nominal total district spending per pupil | | ln(of total district spending per pupil) | |
|---|---|---|---|---|
| | Coefficient | Standard error | Coefficients | Standard error |
| Median household income | -0.087*** | 0.028 | -0.407*** | 0.103 |
| NAV per pupil | 0.003*** | 0.001 | 0.131*** | 0.046 |
| % of NAV that is personal property | -9,789.123** | 4,899.818 | -0.732** | 0.326 |
| % population between five and 17 years old | -7,932.651** | 3,853.829 | -0.526** | 0.259 |
| County population 65 and over (%) | -16,277.186** | 6,705.103 | -1.130** | 0.450 |
| CWIFT centered on Oregon minimum | 1,656.229 | 3,464.820 | 0.229 | 0.227 |
| Time | 902.718*** | 39.203 | 0.064*** | 0.002 |
| Constant | 25,778.930*** | 2,117.696 | 12.834*** | 0.950 |
| Number of observations | 1,266 | | 1,266 | |
| $R^2$ | 0.663 | | 0.720 | |

[a] indicates that the variable used in model was transformed as a natural logarithm.
*Note.* *$p < .1$. **$p < .05$ ***$p < .01$. Estimates are weighted by total school enrollment. Reported standard errors are robust, clustered at the district level. All percentage variables range from 0–1.
*Source*. The ODE; Baker et al., 2024; NCES, n.d.-a.

**Exhibit 16. Regressions of Expenditures from State and Local Sources Per-Pupil on Measures of District Wealth and Income**

| DV = Total district revenue per pupil | Nominal total district spending per pupil | | ln(total district spending per pupil) | |
|---|---|---|---|---|
| | Coefficient | Standard error | Coefficient | Standard error |
| Median household income | -0.075*** | 0.025 | -0.370*** | 0.098 |
| NAV per pupil | 0.003*** | 0.001 | 0.128*** | 0.044 |
| % NAV that is personal property | -9,341.769** | 4,437.163 | -0.722** | 0.307 |
| % population between five and 17 years old | -7,459.289** | 3,502.102 | -0.518** | 0.245 |
| County population 65 and over (%) | -14,365.628** | 6,336.166 | -1.048** | 0.437 |
| CWIFT centered on Oregon minimum | 2,816.341 | 3,228.043 | 0.295 | 0.218 |
| Time | 725.891*** | 32.999 | 0.054*** | 0.002 |
| Constant | 23,180.394*** | 1,930.620 | 12.359*** | 0.893 |
| Number of observations | 1,249 | | 1,249 | |
| $R^2$ | 0.613 | | 0.665 | |

[a] indicates that the variable used in the model was transformed as a natural logarithm.
*Note.* *$p$ < .1. **$p$ < .05 ***$p$ < .01. Estimates are weighted by total school enrollment. Reported standard errors are robust, clustered at the district level. All percentage variables range from 0–1.
*Source*. The ODE; Baker et al., 2024; NCES, n.d.-a.

## Summary of the Spending Analysis of Oregon Public Schools

The major findings of our spending analysis are as follows:

- Total spending and spending from state and local sources are positively associated with school-level shares of SWD and economic disadvantage.
- School-level EL rates are not associated with differences in either measure of spending.
- Schools and districts with enrollments below 300 tend to have higher spending levels per pupil.

Further, with respect to wealth, income and preferences of local communities (e.g., inequitable variation):

- Both measures of spending are positively associated with taxable property wealth but negatively associated with median household income.
- Tax price measured as the share of the additional dollar of revenue paid by local residents is negatively associated with spending.
- Districts with larger elderly populations spend less on average.

## 3. Estimating Costs and Cost Variation to Achieve Common Outcomes in Oregon

We now report the findings from our cost function analysis. This analysis builds on the results reported above and develops findings regarding how much funding is necessary for Oregon to provide an adequate education for all the K-12 students it serves. The cost model at the center of this analysis estimates the cost of achieving a target outcome level assuming average efficiency and how those costs vary across districts according to their student needs and other cost factors. Our cost model estimates are based on total expenditures from local, state, and federal sources. Outcomes are measured using the outcome factor score described previously.[7]

The cost model requires that we select student need factors and district characteristics for estimation. Based on the advantages of the preferred EDI measure relative to the ODE-reported economic disadvantaged rate, we opt to use the EDI, along with the share of enrollment that is SWD (broken out into three severity categories: low-cost, middle-cost, and high-cost) or EL, and measures of district size, school grade range, population density, and local labor costs (CWIFT). Evidence from Exhibit 9 also suggests that the share of students with a high-cost disability is not a strong predictor of outcomes and therefore we opt to collapse middle- and high-cost disabilities into a single variable.

Our cost model also includes factors that might affect spending choices that are not directly associated with the measured outcomes. Measured school outcomes such as test scores, attendance, or graduation rates do not encompass the full scope of the purpose or aims of public schooling. However, as a cost function is constrained to predicting measures that are readily quantified and publicly available, we must predict costs while netting out local preferences on spending for other purposes not captured in our observed outcomes and other possible determinants of inefficiency, including competition density and local public monitoring (Duncombe et al., 1997; Grosskopf et al., 2014). We identified a set of factors to be used as indirect efficiency measures that predict additional spending variation, above and beyond spending variation associated with the outcomes accounted for in our model. These include a Herfindahl Index (sum of squared school shares of districtwide enrollment), the ratio of median housing values to labor market averages, total assessed property value per pupil, the district-level percentage of net assessed value that is personal property, and the GINI index (a measure of county level wealth inequality that details the extent to which total household incomes are equally distributed within counties [more equality] or are concentrated among a smaller share

[7] The section Step 2a. Developing a School-Level Cost Function Model for Projecting the Cost of Adequate Education in Appendix A provides a detailed description of the cost function model at the heart of this analysis.

of the overall population [less equality]).[8] Our predicted costs using the estimated cost function set these efficiency factors to the statewide averages so that our projections of the spending associated with achieving target outcome levels can be understood as being for a district of average wealth, income, tastes, tax prices, and other efficiency pressures.

## Estimating the Cost Model

Exhibit 17 presents our cost model estimates, where the model was fit to the natural logarithm of school-level per pupil spending as the dependent variable. Our model illustrates that:

- Higher outcomes, as measured by the outcome factor score, are associated with greater costs, all else equal.
- Costs are higher for achieving common outcomes in schools where our EDI measure is higher.
- Larger shares of children with disabilities are associated with greater costs of producing outcomes.
- Costs are higher in schools where EL shares are higher.
- Districts with enrollments lower than 1,200 students have higher costs per pupil than districts with more than 1,200 students, and the increase in cost becomes greater as the district enrollment falls below 1,200.

We use the above model in Exhibit 17 to predict for each school the level of spending (cost) associated with achieving two separate target outcome standards based on the outcome factor score: (1) reaching the statewide average and (2) one standard deviation above the statewide average. Then, we calculate the *funding gap* for each school defined as the difference between current spending and predicted adequate cost. The scatter plots in Exhibit 18 chart the relationship between the school-level funding gap and *outcome gap* (defined the difference between actual outcome and the target outcome) for the two outcome standards. The dashed horizontal line denotes where the funding gap equals 0; that is where a school has exactly enough funding to cover the predicted adequate cost of reaching the outcome goal. Left of this line indicates there is not enough funding to meet adequate cost and to the right that there is more than enough funding to meet adequate cost. Similarly, the horizontal dashed line represents an outcome gap of 0, with values above it denoting actual school performance that exceeds the target outcome standard and values below actual performance that is lower than the standard.

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[8] The efficiency controls were derived from data obtained from the ODE, NCES, and Census.

### Exhibit 17. Cost Function Model Estimates

| DV = (ln) School total spending per pupil with district overhead | Coefficient |
|---|---|
| Outcome factor score (school) | ↑ |
| **Student needs (school)** | |
| EDI | ↑ |
| % students with low-cost disabilities | ↑ |
| % students with middle- and high-cost disabilities | ↑ |
| % EL | ↑ |
| **School and district factors** | |
| Grade range distribution (school) | |
| % in Grades K–8 | (Reference) |
| % Grades 9–12 | ↑ |
| District enrollment (district) | |
| Under 100 | ↑ |
| 101 to 300 | ↑ |
| 301 to 600 | ↑ |
| 601 to 1,200 | ↑ |
| >1,200 | (Reference) |
| (ln)Population density (district) | ↔ |
| CWIFT centered on Oregon minimum (district) | ↔ |
| **Efficiency factors (district)** | |
| Herfindahl index | ↔ |
| Ratio of median housing values to labor market avg. | ↓ |
| Total assessed value per pupil (ln) | ↑ |
| % NAV that is personal property | ↓ |
| GINI index (census income) | ↑ |
| Time (Base year = 2025) | ↑ |
| Number of observations | 9,002 |
| $R^2$ | 0.383 |
| Partial F (instruments) | 28.795 |
| Hansen J (p-value) | .822 |

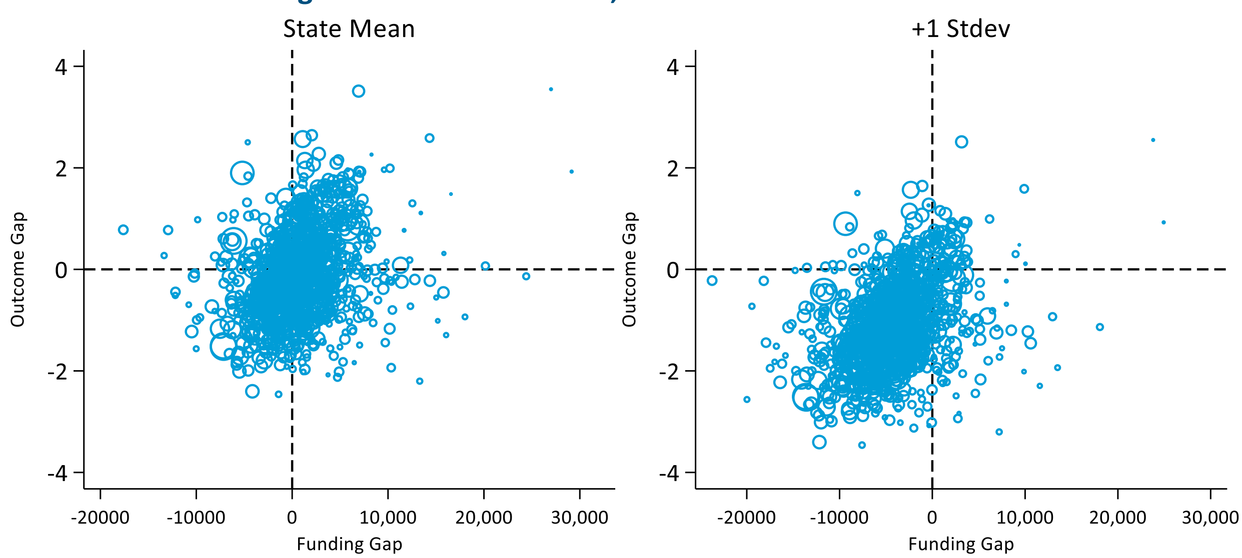
*Note*. Arrows represent the relationship of the given cost factor characteristic with costs. Arrows pointing up (↑) represent a statistically significant (at the 5%-error level) increase in cost associated with an increase in the given characteristic. Double-headed horizontal arrows (↔) represent no significant relationship. Arrows pointing down (↓) represent a statistically significant (at the 5%-error level) decrease in cost associated with an increase in the given characteristic. Estimates are weighted by total school enrollment. Standard errors for the model are robust, clustered at the district level. All percentage variables range from 0–1. Coefficients for categorical variables are interpretable relative to the reported reference (Reference) group. The reference school serves students in grades K-8 with enrollment greater than 1,200. (District) and (School) represent the level at which the variable is reported in our data.

*Source.* The ODE; Baker et al., 2024; NCES, n.d.-a; NCES, n.d.-b; U.S. Census Bureau, 2021.

The left-hand panel of the exhibit provides a validity check on our model by comparing estimated funding deficits to actual outcomes. If the model works as expected, we should see that schools with spending levels above their predicted costs tend to have outcomes that are above the target outcome standard. Likewise, schools with spending levels below their predicted costs should, on average, have outcomes below the outcome target standard. Exhibit 18 shows that this is indeed the case. Generally, schools that spend less than needed to achieve the statewide average outcome level (i.e., those to the left of the vertical dashed line) have lower-than-average outcomes (i.e., fall below the horizontal dashed line). In contrast, schools that spend more than the model deems necessary to reach this target outcome standard (i.e., those to the right of the vertical dashed line) tend to have outcomes that exceed the statewide average (i.e., appear above the horizontal dashed line).

The panel on the right side of the exhibit shows the relationship between the funding gap and the outcome gap when the outcome target standard is set to one standard deviation above the statewide average. Raising the outcome standard also raises the expected costs to achieve that goal and thus increases funding gaps to achieve that standard. As such, far more schools fall in the lower left quadrant – spending less than needed to achieve the higher standard and falling below that outcome standard. Only a few schools are in the upper right, spending enough or more than needed to meet or exceed the outcome standard and performing above that goal.

**Exhibit 18. Funding Gaps by Outcome Gaps for Statewide Average and Statewide Average +1 Standard Deviation Target Outcome Standards, School Year 2022–23**

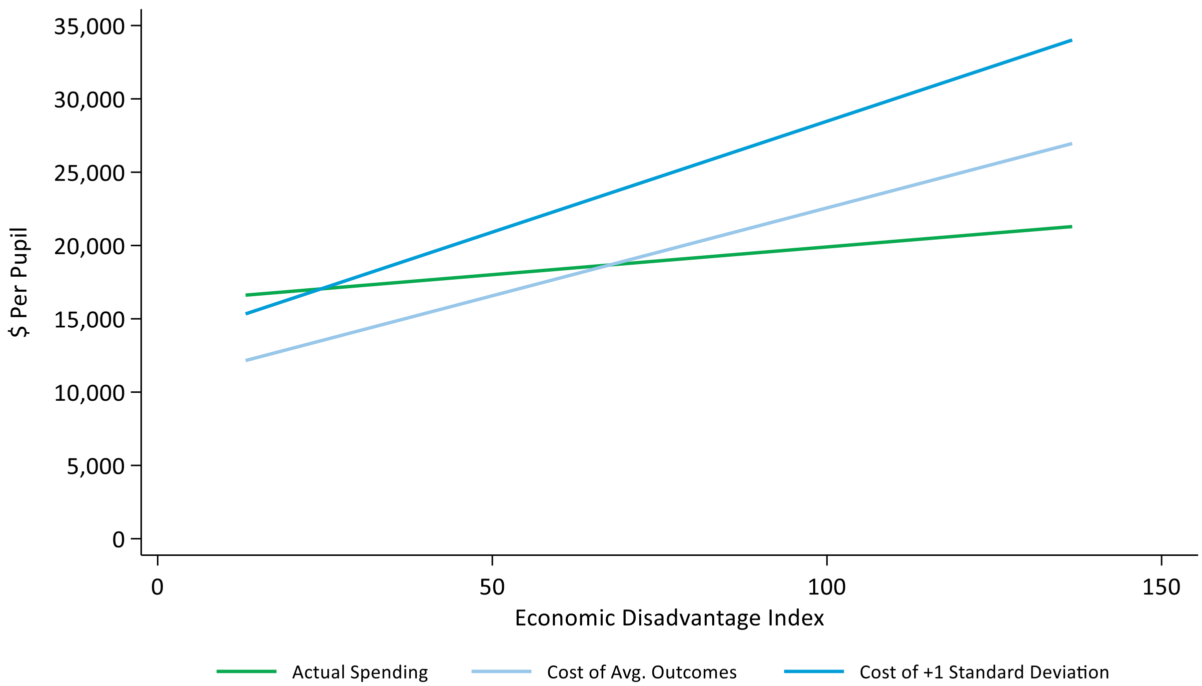



*Note.* Plotted points are weighted by student enrollment so that larger circles indicate greater total enrollment in each school. The outcome gap represents the difference between the outcome target and actual outcomes. The funding gap represents the difference between projected costs per pupil to meet the outcome target and actual expenditures per pupil.

*Source.* Calculations based on data from the ODE; Baker et al., 2024; NCES, n.d.-a; NCES, n.d.-b; U.S. Census Bureau, 2021.

Exhibit 19 shows how the relationships in 2022–23 between EDI and both the cost model projections to meet (a) the statewide average outcome standard and (b) statewide average plus one standard deviation target outcome standard differ from the EDI relationship with actual spending. In the exhibit, average cost projections and current spending across different levels of student economic disadvantage are represented by their linear trends. Current spending ranges from just above $16,000 for low-needs schools to just over $21,000 on average for high-needs schools. In contrast, providing an equal opportunity for all public K-12 students in Oregon to achieve current state average outcomes would require spending that increases far more dramatically as student economic needs increase at the school level, with costs ranging from approximately $12,000 per pupil at the low end to nearly $27,000 per pupil at the high end. Raising the standard to one standard deviation over statewide average outcomes increases those costs by approximately $3,000 per pupil for the lowest-needs schools and by approximately $7,000 more in the highest-needs schools. We provide more specific estimates in our weights analysis that follows.

**Exhibit 19. Actual Spending and Projected Adequate Costs and School-Level Economic Disadvantage Index Values, School Year 2022–23**

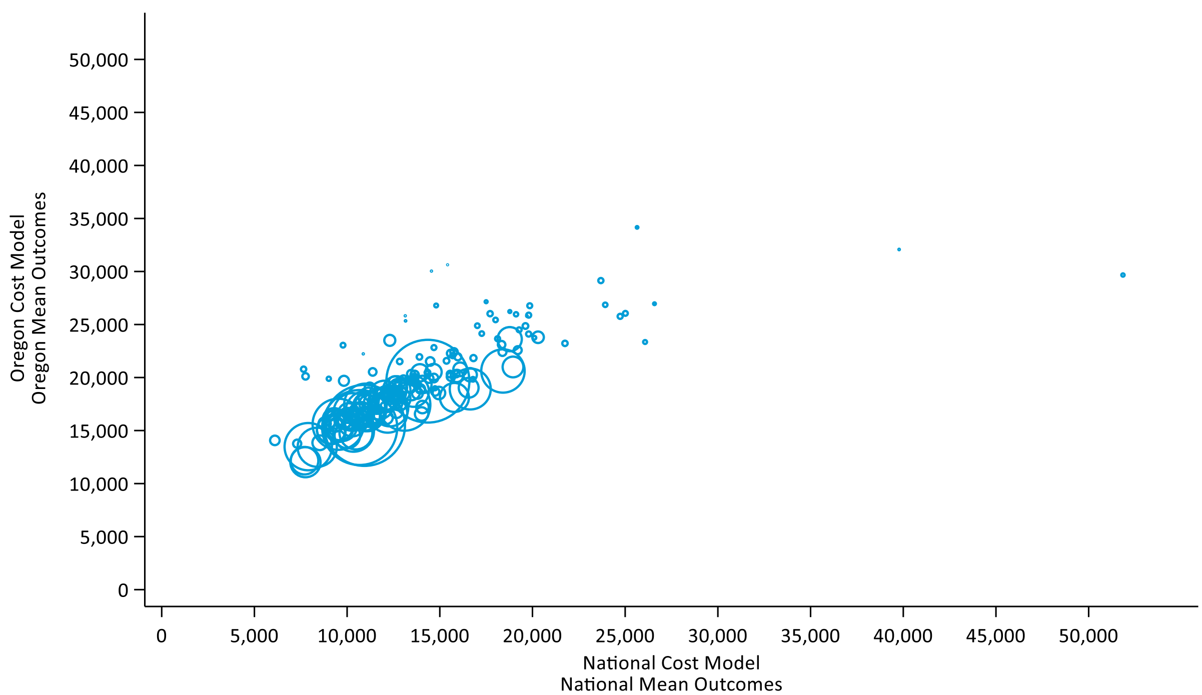



*Source.* Calculations based on data from the ODE; Baker et al., 2024; NCES, n.d.-a; NCES, n.d.-b; U.S. Census Bureau, 2021.

## Comparing Oregon and National/Regional Cost Models

As additional validation of our Oregon school-level cost model, we compare our estimates to those from our National Education Cost Model which has appeared in several peer-reviewed publications and working papers (Baker, 2024; Baker et al., 2021; Weber & Baker, 2023). The national education cost model uses a variety of federal source data, including spending data from the NCES's fiscal survey (F33), which reports a somewhat lower current operating expenditure figure for Oregon school districts. All data in the national model are reported at the district level and outcome measures include only standardized assessments of reading and math between Grades 3–8. Still, we find that the cost predictions from our Oregon school-level model aggregated to the district level, which were derived using state-provided data, correlate at 0.89 with cost predictions from the national model. When we estimate a regional version of our national model (Oregon, Washington, Idaho, California) the correlation with the district-level costs projected for Oregon drops slightly to 0.87. Exhibit 20 below shows the relationship between our Oregon school-level cost model, rolled up to district cost estimates, and the national education cost model. We interpret the similarity in these cost estimates as a point of validation for Oregon school-level cost model.

**Exhibit 20. Relationship Between National Cost Model Estimates and Oregon Model Estimates**




*Note.* Plotted points are weighted by student enrollment so that larger circles indicate greater total enrollment in each school.

*Source.* Calculations based on data from the ODE; Baker et al., 2024; NCES, n.d.-a; NCES, n.d.-b; U.S. Census Bureau, 2021.

## 4. Estimating the Weights Model

Finally, we translate our cost estimates into a funding formula. Here, we estimate our weights models which can then be used to simulate a pupil weighted school funding formula that the state might consider. The goal is to develop a formula for calculating the state and local revenue to be delivered to local public-school districts such that they can provide all children with equal opportunity to achieve the outcome goal. Meeting this goal requires two preliminary steps:

- First, our cost model described above produced estimates of school-level costs to achieve the outcome goal. However, districts are the entities that raise local revenues and receive state aid. As such, we aggregate our school-level cost estimates for each local public school district to generate estimates at the district level.
- Second, the spending figures upon which our cost estimates are based include expenditures from federal funds. However, the focus of our analysis is to inform the adequate level and equitable distribution of that funding over which the state has influence. Therefore, we must remove federal funds from our cost estimates to isolate only those costs that would be supported by state and local funding. Because federal funding was elevated in recent years due to COVID-19 relief, and because those funds will no longer flow in the coming years, we base our federal funding estimates, which we subtract from our district cost estimates of the average pre-COVID (2017–18 to 2019–20) federal revenues per pupil.

After aggregating the school-level per-pupil cost estimates to the district level and subtracting per-pupil federal revenues, we then run an additional weights regression model in which the updated district-level predicted per-pupil cost is regressed on a subset of the covariates included in the more elaborate cost function model.

Exhibit 21 below presents our weights model where the estimated weights represent cost multipliers and can be interpreted individually as student weights. For example, the weight of 5.27 for children with low-cost disabilities estimated in the model for the high target outcome standard (statewide average plus one standard deviation) suggests that each such student costs 5.27 times (or 526% more than) the base per-pupil cost. While the weights can be interpreted as student-level cost adjustments, in reality the raw estimates represent the additional cost associated with a district where 100% of the enrollment are in the student group being considered (e.g., students with low-cost disabilities).

In practice, to arrive at a measure of additional cost corresponding to a given weight the raw estimates must first be combined with district share of students in the group and then projected against the base cost amount. Specifically, because each student need category generally applies to a fraction of students being served in the district, in order to calculate a target per-pupil funding amount from the estimates the raw weights must be adjusted downward according to the fraction of students in each category. These weights, once adjusted to the fraction of students in each district, are termed *effective weights*.

## Calculating Effective Weights and Applying the Weights Model Results

To calculate the effective weight for a school or district in which some proportion of students is represented in each category, the weight is exponentiated according to the student proportion as follows:

$$Effective\ Weight = Weight^{Characteristic\ Value}$$

Exponentiating by the proportion of students (or index value) for which a weight applies appropriately discounts the weight. At the extremes, a proportion of one means that the full weight is applied (so that the effective weight simply equals the raw weight), and a proportion of zero discounts the weight to a value of one.

### Exhibit 21. Regression Model Estimates of Raw Pupil Cost Weights and Base Funding

| DV = District cost per pupil—pre-COVID- federal funding per pupil | State average | Statewide average + 1 standard deviation |
|---|---|---|
| **Student needs** | | |
| EDI | 1.422 | 1.452 |
| % Students with low-cost disabilities | 5.289 | 5.269 |
| % Students with middle- and high-cost disabilities | 6.173 | 6.145 |
| % EL | 1.709 | 1.682 |
| **School and district factors** | | |
| Grade range distribution | | |
| % in grades K–8 | (Reference) | |
| % grades 9 to 12 | 1.061 | 1.057 |
| District enrollment | | |
| Under 100 | 1.833 | 1.837 |
| 101 to 300 | 1.434 | 1.430 |
| 301 to 600 | 1.217 | 1.216 |
| 601 to 1,200 | 1.111 | 1.110 |
| >1,200 | (Reference) | |
| Time (Base year = 2025) | 1.068 | 1.066 |
| Constant (Base cost in 2025) | 11,648.98 | 14,643.47 |
| Number of observations | 1,599 | 1,599 |

*Note*. Figures are exponentiated coefficients from Poisson regression. The reference group is a district serving students in grades K-8 with enrollment greater than 1,200. All percentage variables range from 0–1. All measures are calculated or reported at the district level. All variables are statistically significant at the .01 level.
*Source*. The ODE; Baker et al., 2024; NCES n.d. -a.

As an example, using the raw EL weight from the second model calibrated to the higher target outcome standard (statewide average + 1 standard deviation), in a hypothetical district where 10% of students are EL the effective weight would be:

$$Effective\ Weight = 1.682^{0.10} = 1.053$$

meaning that this district would cost 5.3% more per pupil than a district with otherwise similar characteristics but with no EL students. As shown below, effective weights must be calculated for each model factor, which can then be used to compute the projected amount of funding necessary to cover the cost of providing an adequate education in each district.

In Exhibit 22, we report summary statistics (averages and standard deviations) for the district characteristics included in our weights model for school year 2022–23. In Exhibit 23, we apply the average values to illustrate the calculation of effective weights from the results of our model calibrated to the high target outcome adequacy standard of one standard deviation above the statewide average outcome level. The average district has an EDI score of 65.8% with enrollment percentages of students who are low-cost SWD, middle- or high-cost equal, and EL equal to 7.7%, 7.7%, and 10.6% respectively. Further, 32.9% of the students in the average district are enrolled in Grades 9–12 and it enrolls over 1,200 students. Finally, we will predict the adequate cost for the 2022–23 school year, which is three years prior to the weights model base year of 2025 (where year equals 0) meaning the value of this model factor will be set to -3.

### Exhibit 22. Summary Statistics for District Characteristics in Weights Model, School Year 2022–23

| Model factor | Average/<br>Share of districts | Standard deviation |
|---|---|---|
| **Student Needs** | **Average** | |
| EDI | 65.8% | 16.6 |
| % students with low-cost disabilities | 7.7% | 1.7 |
| % students with middle- and high-cost disabilities | 7.7% | 1.5 |
| % EL | 10.6% | 8.1 |
| **Grade range distribution** | | |
| % 9 to 12 | 32.9% | 3.4 |
| **District enrollment** | **Share of Districts** | |
| Under 100 | 4.5% | - |
| 101 to 300 | 17.6% | - |
| 301 to 600 | 13.6% | - |
| 601 to 1,200 | 18.8% | - |
| >1,200 | 45.5% | - |
| Number of observations | 176 | |

*Note.* Statewide averages are weighted by district enrollment. Percentages indicate the share of districts in Oregon belonging to each enrollment category.
*Source.* The ODE.

Exhibit 23 demonstrates how “effective weights” are calculated for a school district and used to determine an *overall needs index*. The estimated raw weights shown in Exhibit 23 are the funding weights (reported in Exhibit 21) derived from cost estimates for providing funding to give each district an equal opportunity to achieve a district-level outcome factor score one standard deviation above the 2022-23 statewide mean.

In this example, we use a hypothetical district with the statewide average characteristics and an enrollment of more than 1,200 students, as summarized in Exhibit 22. These values are displayed in the third column of Exhibit 23. We use the estimated raw weights and the characteristics values to calculate *effective weights* in the fourth column of Exhibit 23. As noted above, the effective weight is calculated via the following formula:

$$Effective\ Weight = Weight^{Characteristic\ Value}$$

So, in this example, the effective weight for EDI is calculated as:

$$Effective\ Weight = 1.452^{.658} = 1.278$$

Performing this calculation for each of the model factors generates effective weights for each student-need category or district characteristic.[9] Finally, to calculate the overall needs index, we multiply all the effective weights together, producing a value of 1.485. This number indicates that a district with this level of student need and with these characteristics would require 48.5% more funding per pupil than the base per-pupil funding amount. By multiplying the overall needs index by the base per-pupil funding of $14,643, we show that this hypothetical district is projected to require $21,748 per pupil from state and local sources to meet the costs of achieving the outcome target.

Applying this same methodology to every school district in Oregon, using actual levels of student need and district characteristics, would yield district-specific cost estimates for raising the outcome factor score to one standard deviation above the statewide mean in 2022-23. Based on our analyses, we recommend adopting the base per-pupil funding amount *and* the funding distribution formula outlined in Exhibit 23. This funding model would give all school districts in Oregon an equal opportunity to reach outcome factor scores one standard deviation above the statewide average, which represents a reasonable adequacy target for the state.

[9] Exhibit 23 displays student needs and grade range distribution as percentages. In our weights model, these variables are stored as proportions, ranging from 0-1. Therefore, when calculating effective weights, the listed percentages must be divided by 100.

**Exhibit 23. Application of Weights for +1 Standard Deviation Outcomes to a Hypothetical District**

| Model factor | Estimated raw weight | Characteristic value (enrollment percentage/ enrollment group indicator/ year) | Effective weight |
|---|---|---|---|
| **Student needs** | | | |
| EDI | 1.452 | 65.8% | 1.278 |
| % students with low-cost disabilities | 5.269 | 7.72% | 1.137 |
| % students with middle- and high-cost disabilities | 6.145 | 7.71% | 1.150 |
| % EL | 1.682 | 10.6% | 1.057 |
| **Grade range distribution** | | | |
| % Grades 9–12 | 1.057 | 32.9% | 1.018 |
| **Enrollment group** | | | |
| Under 100 | 1.837 | 0 | 1.000 |
| 101 to 300 | 1.430 | 0 | 1.000 |
| 301 to 600 | 1.216 | 0 | 1.000 |
| 601 to 1,200 | 1.110 | 0 | 1.000 |
| Time (Base year = 2025) | 1.066 | -3.00 | 0.826 |
| Base per-pupil amount | 14,643.47 | | |
| | **Overall needs index (multiplied effective weights)** | | 1.485 |
| ***District per-pupil funding =*** | ***$14,643*** | ***x 1.485 =*** | ***$21,746*** |

*Note.* Estimated weights are taken from the model calibrated to the high target outcome standard (Statewide Average + 1 Standard Deviation) reported in Exhibit 21. Effective weights are calculated by raising the estimated weight to the power of the model factor value. The combined needs index is the product of all effective weights. The district formula per-pupil funding estimate is calculated by multiplying base funding by the combined needs index. The final calculation indicates that a district with average located in a district with enrollment greater than 1,200 would require $21,745.55per pupil in funding to address the cost adequately of educating all students to achieve one standard deviation above statewide average outcomes.
*Source.* Calculations based on data from the ODE; Baker et al., 2024; NCES, n.d.-a.

# 5. Supplementary Analyses

## The Role of Capital Funding

In this section, we explore the sensitivity of the cost model and subsequent weights model to the inclusion of capital financing and debt service expenditures in our spending measure. Specifically, we add district-level spending on capital and debt back into our total spending per-pupil figure and re-estimate our cost model. Exhibit 24 shows that the subsequent cost model yields generally logical results but fails some statistical tests.[10]

Overall, the coefficients on the outcome factor and student needs factors are smaller than in previous cost models. That is, including capital spending reduces the sensitivity of spending to student needs and outcomes, as there is more variation added to our spending measure that is not associated with either of these model factors. This difference makes sense given that capital spending can be quite "lumpy" both across districts and over time (i.e., significant capital investments often only occur sporadically in and across districts). There is also a larger share of spending in our spending figures that do not vary across schools within districts because capital spending is reported at the district level.

To better understand the sensitivity of the estimated weights and base funding to the inclusion of capital spending we next re-estimate our weights models and display the results in Exhibit 25. As a reminder, the weights model makes use of predictions from the cost model (this time estimated with capital spending included), subtracts pre-COVID federal aid from the cost model predictions, and uses these adequate cost figures sans federal aid as the dependent variable in a model that uses a more limited subset of the factors used in the cost model. We estimate the weights model using cost model predictions that have been calibrated to the statewide average outcome standard. Using the new cost model that accounts for capital spending we find that the estimated raw weights on student needs are smaller than before, as the cost model was less sensitive to those needs. But, as one might expect, the base per-pupil cost when capital is included increases quite substantially from $11,649 to $20,722.

We do not necessarily believe, however, that spending on bond principal and interest should be funded through the general aid program given that needs and costs (outside of our cost model) will vary substantially across settings. And it is worth reiterating that the results produced when capital funding is included fail tests statistical validity and show weak relationships between funding and student need. Therefore, these findings should not be used to develop a funding

[10] Specifically, in the new model the test for overidentification (Hansen J) fails indicating that the instrumental variables used in the model are not valid.

model for capital spending. That said, we do believe in a strong state role in ensuring equitable access to quality facilities for all children to provide the programs and services covered by the general aid formula. Also notable is the fact that modernized facilities with newer mechanical systems can often operate more efficiently, drawing less funding into maintenance and operations from general funds and leaving more for programs and services.

### Exhibit 24. Cost Model Estimates including Capital Spending

| DV = (ln) School total spending per pupil with district overhead and capital outlay | Coefficient | Standard error |
|---|---|---|
| Outcome factor score | 0.097* | 0.050 |
| **Student needs** | | |
| EDI | 0.161* | 0.089 |
| % students with low-cost disabilities | 0.766*** | 0.235 |
| % students with middle- and high-cost disabilities | 0.869*** | 0.269 |
| % EL (school) | 0.240*** | 0.054 |
| **School and district characteristics** | | |
| % in Grades 9–12 | 0.055*** | 0.010 |
| District enrollment | | |
| Under 100 | 0.538*** | 0.071 |
| 101 to 300 | 0.315*** | 0.029 |
| 301 to 600 | 0.154*** | 0.025 |
| 601 to 1,200 | 0.045** | 0.018 |
| (ln)Population density | 0.004 | 0.004 |
| CWIFT centered on Oregon minimum | 0.447*** | 0.109 |
| **Efficiency measures** | | |
| Herfindahl index | -0.034 | 0.447 |
| Ratio of median housing values to labor market avg. | -0.113*** | 0.035 |
| Total assessed value per pupil (in) | 0.173*** | 0.021 |
| % NAV that is personal property | -0.317** | 0.158 |
| GINI index (census income) | 0.284 | 0.221 |
| Time (base year = 2025) | 0.057*** | 0.002 |
| Constant | 7.411*** | 0.313 |
| Number of observations | 8,836 | |
| $R^2$ | 0.538 | |
| Partial F | 28.35 | |
| Hansen J (*p*-value) | 0.0035 | |

Note. *$p < .1$. **$p < .05$. ***$p < .01$. Estimates are weighted by total school enrollment. Standard errors for the model are robust, clustered at the district level. All percentage variables range from 0–1. Coefficients for categorical variables are interpretable relative to the reported (Omitted) group. (District) and (School) represent the level at which the variable is reported in our data.

*Source.* The ODE; Baker et al., 2024; NCES, n.d.-a; NCES, n.d.-b; U.S. Census Bureau, 2021.

**Exhibit 25. Regression Model Estimates of Raw Pupil Cost Weights and Base Funding Using Cost Model Estimates That Include Capital Spending**

| DV = District cost per pupil—pre-COVID- federal funding per pupil | Coefficient | Standard error |
|---|---|---|
| **Student needs** | | |
| EDI | 0.954 | 0.001 |
| % Students with low-cost disabilities | 1.975 | 0.010 |
| % Students with middle- and high-cost disabilities | 2.423 | 0.023 |
| % EL | 1.665 | 0.005 |
| **School and district factors** | | |
| Grade range distribution | | |
| % in grades K–8 | (Reference) | |
| % in Grades 9–12 | 1.047 | 0.002 |
| Under 100 | 1.656 | 0.001 |
| 101 to 300 | 1.370 | 0.001 |
| 301 to 600 | 1.164 | 0.001 |
| 601 to 1,200 | 1.042 | 0.001 |
| >1,200 | (Reference) | |
| Time (Base year = 2025) | 1.067 | 0.000 |
| Constant (Base cost in 2025) | 20,722.470 | 29.050 |
| Number of observations | 1,599 | |

*Note.* All percentage variables range from 0–1. All measures are calculated or reported at the district level. All variables are statistically significant at the .01 level.
*Source.* The ODE; Baker et al., 2024; NCES, n.d.-a.

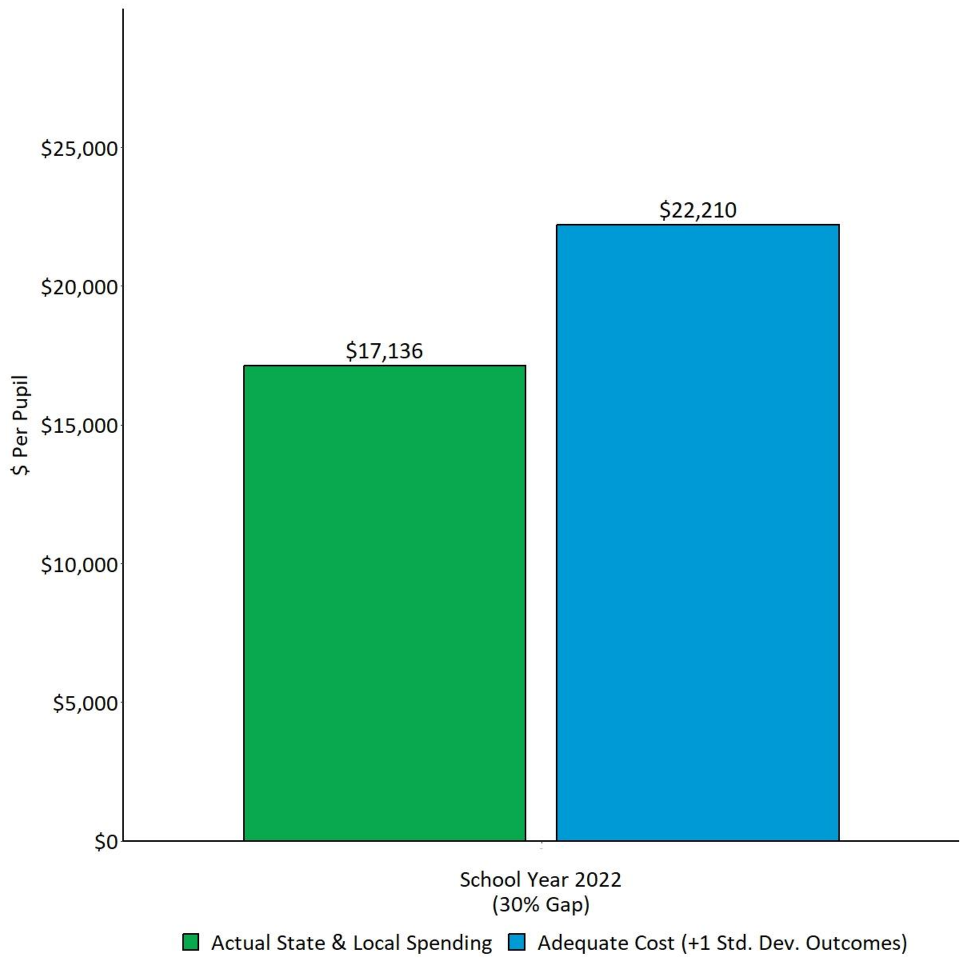
## Comparing Cost Model Estimates to Actual Funding and the QEM

Our final analysis is to contextualize the level of funding recommended by the weights models, which excludes federal funding, against actual expenditures in Oregon from state and local sources, and to compare our cost estimates to those generated by the QEM. In this section we report the estimated adequate cost associated with the outcome target standard of raising student achievement to one standard deviation above the statewide average.[11] These cost predictions are generated by applying the coefficients from the weights model to actual data on student demographics and district characteristics for every school district in the state.

Exhibit 26 reports the statewide projected adequate cost per pupil and actual state and local expenditure per pupil in the 2022–23 school year. Our model indicates that an additional $5,074 in spending per student is required for the state to meet the projected costs of adequacy. This represents a 30% increase in per-pupil spending from state and local sources.

[11] As noted previously, we believe an outcome target which raises statewide achievement by one standard deviation is the more appropriate measure for assessing an adequate education.

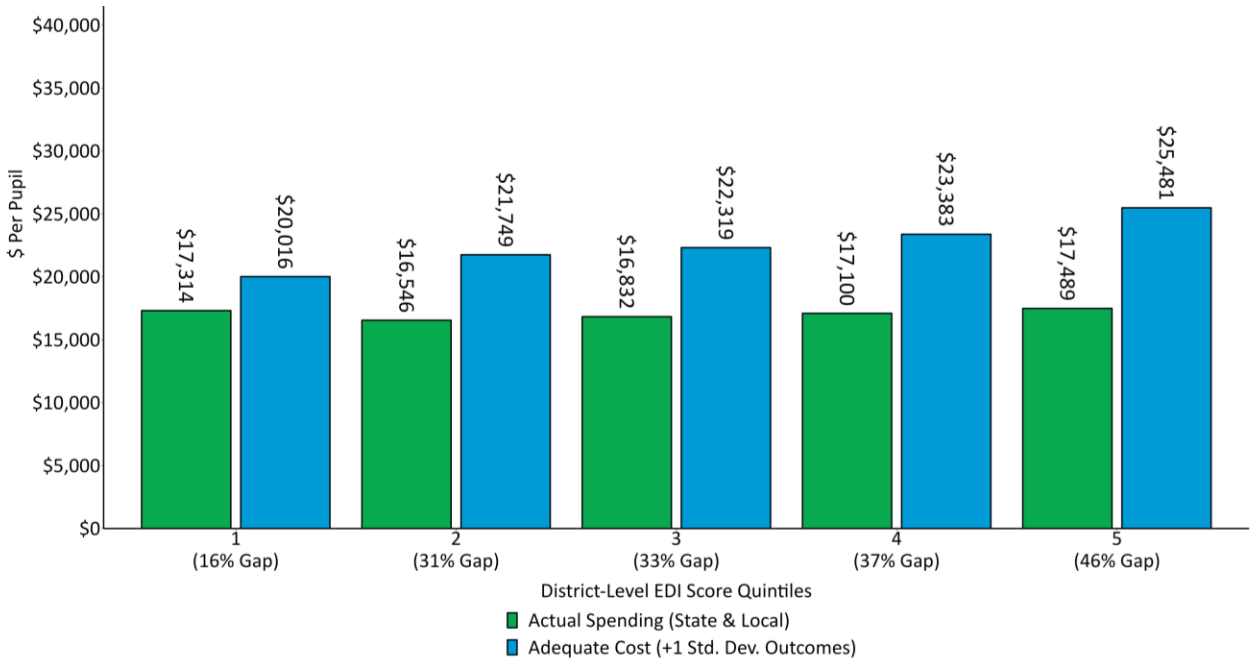
**Exhibit 26. Comparison of Actual State and Local Spending Per Pupil and Adequate Spending Per Pupil in Oregon, School Year 2022–23**




*Note.* Actual spending is defined as current per-pupil spending from state and local sources reported in Oregon that removes non-current expenditures (capital expenditures, debt services, and internal service funds). Adequate cost is the projected per-pupil funding required to raise all students to one standard deviation above the statewide average outcome factor score. The cost projections omit federal funding and non-current expenditures. Gap is calculated as: (1- (*Adequate Cost Per Pupil*/*Actual Spending Per Pupil*).
*Source.* Calculations based on data from ODE; Baker et al., 2024; NCES n.d. -a.

In Exhibit 27, we further break out average actual spending and projected adequate spending per-pupil by EDI score quintiles. Average EDI scores increase with the quintile number, with districts in the first quintile have the lowest levels of economic need in Oregon, while districts in the fifth quintile have the highest levels of economic need.[12] Projected costs to reach adequacy also increase as the level of need increases in each quintile. The gap between projected adequate cost per pupil and current expenditure per pupil is substantial in each quintile. However, these differences are greatest in districts with the highest EDI scores. For example, districts in the first quintile of EDI are projected on average to need $2,702 per pupil in additional funding to meet the adequacy target. In contrast, the average district in the fifth quintile of EDI requires $7,992 per pupil more to meet the same target. The differences across quintiles highlight the importance of both increasing funding to adequate levels and ensuring that funding is distributed equitably, so that schools and districts serving students with greater needs have the resources necessary to meet the same outcome standard.

**Exhibit 27. Comparing Actual State and Local Spending Per-Pupil and Adequate Spending Estimates Per-Pupil Across EDI Quintiles, School Year 2022–23**




*Note.* Actual spending is defined as current per-pupil spending from state and local sources reported in Oregon that removes non-current expenditures (capital expenditures, debt services, and internal service funds). Adequate cost is the projected per-pupil funding required to raise all students to one standard deviation above the statewide average outcome factor score. The cost projections omit federal funding and non-current expenditures. Gap is calculated as: (1- (*Per Pupil Adequate Cost*/*Per Pupil Actual Spending*).
*Source.* Calculations based on data from ODE; Baker et al., 2024; NCES n.d. -a.

[12] EDI scores can be interpreted similarly to economic disadvantage rate with larger values indicating greater economic need. The average EDI score within each quintile are as follows: Quintile 1 = 49; Quintile 2 = 63; Quintile 2 = 69; Quintile 4 = 76; Quintile 5 = 92.

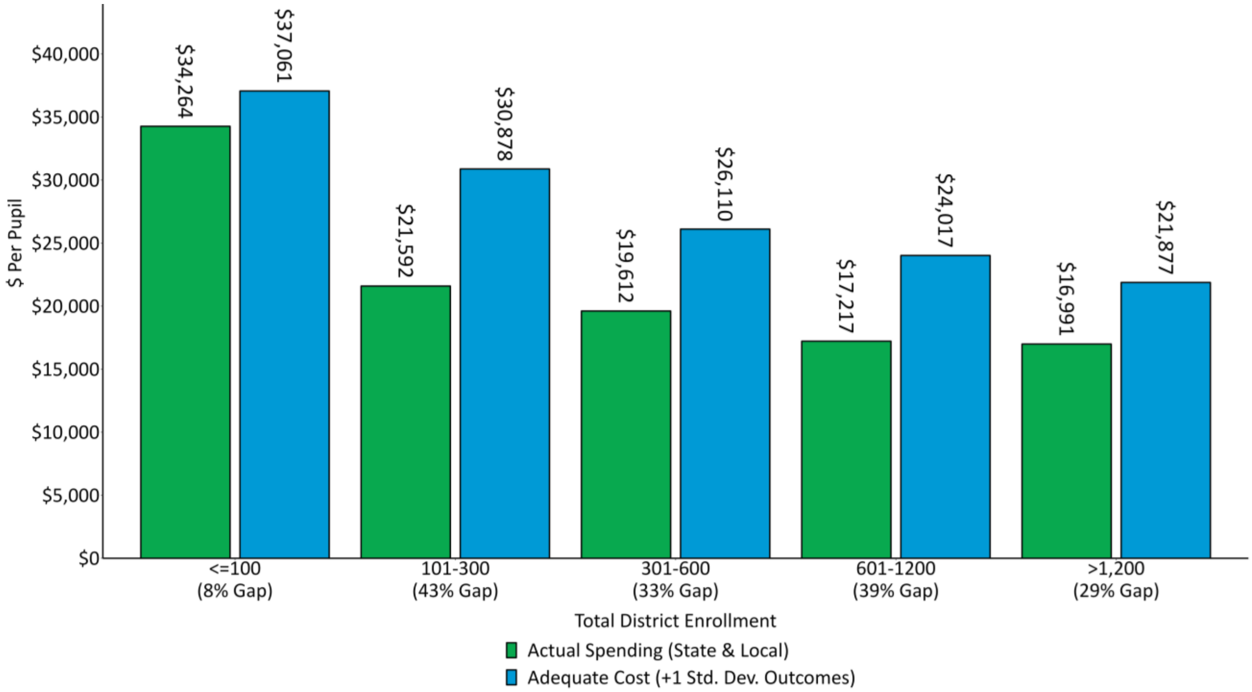
In Exhibit 28, we display the average actual spending and adequate costs for districts according to enrollment size categories.[13] Adequate costs per pupil are substantially higher in smaller school districts, with a $15,184 difference between districts with enrollments below 100 and above 1,200. This reflects the diseconomies of scale that low enrollment districts typically face when meeting the high fixed costs of operating a school district. Actual expenditures per pupil also reflect diseconomies of scale, with spending being greater in smaller school districts. While there are gaps between actual expenditures and adequate costs per pupil in every size category, the gaps are greatest for districts with enrollments of 101-300, 301-600, and 601-1,200. For these districts, the gaps between actual spending and adequate costs range from $6,498 to $9,286 per pupil. Districts with over 1,200 hundred students have an estimated average adequacy gap of $4,886 per pupil. This number is quite notable, as this category is both the plurality of the district enrollment categories (45.5%) and because over 90% of total student enrollment in Oregon is attributed to districts with enrollments over 1,200.

We now turn to comparing our cost estimates to those generated by the Quality Education Commission's (QEC) QEM. Direct comparisons between cost estimates are complicated by the fact that our cost model and the QEM make different assumptions about what funding is included or excluded in their analysis and what outcome goals are being used in estimating the cost of providing an adequate education. The QEM generates a total statewide cost estimate for achieving the target goal of 90% graduation rates statewide. This statewide total is then reduced by all projected non-State School Fund revenues and reported as the amount of State School Fund revenues needed in a budget biennium to offer an adequate education to all students. The QEM also notably does not offer recommendations on a particular formula that should be used to ensure the adequate amount of funding is appropriately (equitably) distributed to ensure equal educational opportunity.

In contrast, our cost function approach: (a) assumes that all educational state and local funding included in our per-pupil spending figures will be delivered through a formula that is based on our weights model; (b) provides these estimates for each school year; and (c) is built to estimate costs based on a more inclusive outcome factor that accounts for academic achievement in ELA and math, chronic absenteeism, and graduation rates.

[13] The distribution of school districts across enrollment size categories is as follows: 4.5% of districts have enrollments below 100; 17.6% have enrollments between 101 and 300; 13.6% have enrollments between 301 and 600; 18.8% have enrollments between 601 and 1,200; and 45.5% of districts have enrollments above 1,200.

**Exhibit 28. Comparing Actual State and Local Spending Per-Pupil and Adequate Spending Estimates Per-Pupil Across District Size Categories, School Year 2022–23**




*Note.* Actual spending is defined as current per-pupil spending from state and local sources reported in Oregon that removes non-current expenditures (capital expenditures, debt services, and internal service funds). Adequate cost is the projected per-pupil funding required to raise all students to one standard deviation above the statewide average outcome factor score. The cost projections omit federal funding and non-current expenditures. Gap is calculated as: (1- (*Per Pupil Adequate Cost*/*Per Pupil Actual Spending*).
*Source.* Calculations based on data from ODE; Baker et al., 2024; NCES n.d. -a.

Despite these differences, the QEM and our cost models offer estimates of the *additional* funding that is deemed necessary to reach specific adequate outcomes (QEC, 2024).[14] In Exhibit 29, we report two estimates of the additional funding required to adequately educate all students in Oregon: (1) the difference between our estimated total cost of all students reaching statewide average outcomes and our calculation of total actual expenditures from state and local sources in Oregon and (2) the QEM estimates of the funding gap between current spending and adequacy.

[14] The QEC reports funding gaps for each budget biennium on page 61 of their 2024 report. To translate biennium funding gaps into school year funding gaps, we simply divide the biennium gap by two and assign that value as the constant gap for both school years within the biennium. To calculate our total statewide differences between funding and actual spending, we multiplied our projected per-pupil estimates for each school district by district total enrollment and totaled these district costs to generate a statewide projected cost for adequacy across both outcome goals. We then multiplied our calculated current expenditures per pupil in each district, totaled it, and took the difference between our projected costs and actual expenditures in each school year from 2014-15 to 2022–23. This was done for both target outcome standards that we modeled.

Exhibit 29 shows that our projections for the additional funding required to meet the cost of achieving a one standard deviation increase in the statewide average outcome factor score is substantially larger than the QEM estimate of additional funding needed to achieve adequacy for the 2022–23 school year. This is unsurprising given that our cost model has a wider array of target outcome standard than the QEM. However, in the most recent QEM reports, covering school years 2023–24 through 2026–27, the estimated gaps between current spending and adequate spending have been notably larger. This is due to the QEC updating numerous cost and resource assumptions in their 2022 report, which carried over to their 2024 report. The QEM estimated that the funding gap would be $1.514 billion in the 2023-24 and 2024-25 school years and $1.126 billion per school year in 2025-26 and 2026-27. These figures are somewhat closer to our estimates for the 2022–23 school year of $2.803 billion. Regardless, while the level of funding across these models may differ, both align with the notion that additional resources are required to provide equal and adequate educational opportunity for all students in Oregon.[15]

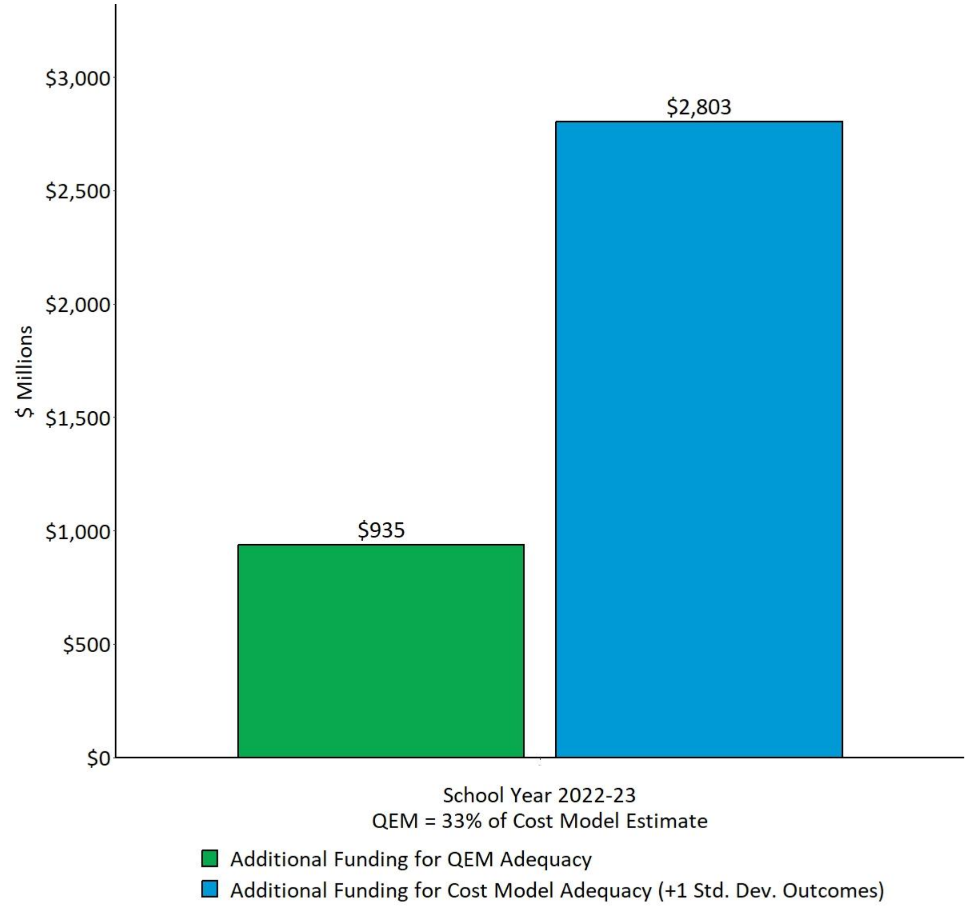
## 6. Conclusion

This report provides a comprehensive analysis of the cost of providing an adequate education to all students in Oregon, using a cost function approach and leveraging data from the 2014–15 to 2022–23 school years. The findings have several important implications for understanding and promoting equitable funding policies that provide an adequate educational opportunity for all students.

First, we investigated the relationship between student outcomes, student need, and district contexts, finding that the shares of SWD or EL students, along with our EDI measure, are negatively associated with academic outcomes at the school level. The share of SWD students and EDI scores are also positively associated with total spending and spending from state and local sources. This does not, however, mean that funding is sufficiently differentiated to meet the costs of providing an adequate education for these students. Furthermore, there is not a clear association between EL rates and funding from state and local sources.

[15] See AIR's Task 3 Report (Brooks & Levin, 2025) for a detailed comparison of the cost function approach used in this report and the professional judgement panel approach used by the QEC in the QEM. The Task 3 report also provides a summary of the methods of the QEM and offers a series of recommendations for how the methodology of the QEM can be improved to better align with best practices for estimating the cost of an adequate education when using a professional judgement approach.

**Exhibit 29. Comparison of Additional Funding Required to Meet Statewide Adequacy Standards Estimated by the AIR Cost Model and QEM, School Year 2022–23**




*Note*. The QEM estimates for the difference between (biennial) current funding and adequate cost were divided by two to generate an annual funding gap for the 2022–23 school year. Additional funding for meeting AIR cost model adequacy is calculated by multiplying per-pupil adequate costs and actual state and local expenditures per pupil, respectively, by the total fall enrollment reported by ODE for the 2022-23 school year (552,380) and subtracting the subsequent total actual spending from total adequate costs.
*Source*. Calculations based on data from the ODE; QEC, 2024 p.61; Baker et al., 2024; NCES n.d. -a.

Next, our cost model estimates indicate that costs are higher in schools with higher EDI scores and those serving more EL students and SWD. Economies of scale are evident, with smaller districts having higher per-pupil costs as well. Our cost model analysis resulted in an estimated base per-pupil funding amount of $11,649 to provide an equal opportunity for all students to reach statewide average outcomes and $14,643 to achieve outcomes that are one standard deviation above the statewide average. Further, our analysis produced a series of multiplicative weights to adjust the base funding amount per pupil according to various measures of student need, such as the share of a district that is EL or has a low-, middle-, or high-cost disability, and district contexts, such as district enrollment and the proportion of district enrollment in Grades

9-12. These results provide a firm basis for an empirical cost-based funding formula capable of generating district funding allocations that will support an adequate education for all students.

Lastly, we provided two supplemental analyses. First, we found that accounting for capital expenditure in the cost model raises base per-pupil cost estimates by approximately $9,000 per pupil. However, this increase in the base per-pupil cost in the weights model that includes capital spending coincided with much smaller student needs weights and failed important statistical validity tests. Considering these findings, we recommend that the state should have a role in ensuring districts can equally build and maintain school facilities. However, capital funding should be considered outside of the primary state mechanism for appropriating funding to support operations (current expenditures).

Second, the findings of our cost model analysis suggested that providing an adequate education to all students in Oregon, defined as all students achieving at a level equivalent to a one standard deviation increase in the statewide average outcome factor score, would have required an additional $5,074 per pupil more than was spent from state and local funding in the 2022–23 school year. When comparing actual spending per-pupil to the estimated costs of adequate education across EDI score quintiles, we found that substantial investments would be necessary across all quintiles to provide an adequate education (defined as generating outcomes that are one standard deviation above the statewide average), but the required increase in funding was largest for the highest need districts. This highlights the importance of both increasing overall funding and adopting our recommended funding formula, which would equitably distribute funding to meet the costs of an adequate education across districts with varying characteristics and levels of student need. Finally, we also found that our cost model estimates directionally align with the estimates produced by the Quality Education Commission QEM. However, differences in the target education outcomes that each costing-out method adopts significantly limits the direct comparability of these estimates. We nonetheless cautiously view this as a point of validation for both approaches.

High-quality education holds transformative potential for children of all backgrounds. However, our findings suggest that not every student in Oregon attends schools that are granted the resources necessary to ensure that they have an equal educational opportunity. The inequitable associations we have identified between student needs and academic outcomes, and the difference between current spending and estimated adequate costs, especially for districts with high levels of need, represent an opportunity to improve the adequacy and equity of the current funding mechanism. Our analysis findings indicate that Oregon does not currently fund its K-12 education system at a level that is sufficient to meet an adequacy target of having all districts achieve one standard deviation above current statewide outcomes. The results also suggest that the distribution of funding is not progressive enough with regards to student needs and other district characteristics. We strongly recommend Oregon consider the levels of funding suggested by the base per-pupil cost and funding weights for student needs and district characteristics outlined in Exhibit 21 and further explained in Exhibit 23, to better meet the costs of adequately educating all students.

In a world of necessarily scarce resources, implementing the funding structure outlined in this report, even gradually, may seem daunting. However, each and every one of Oregon's students deserves a high-quality education that enables them to pursue fulfilling and gainful future lives, regardless of their needs or where they attend school. The analyses and recommendations provided in this study can be used by Oregon's leaders and policymakers to create a more equitable and adequate education funding system in service to all of Oregon's K-12 students.

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# Appendix A. Detailed Road Map to the Analyses

The goal of a state school finance system is to deliver the funding necessary for each district and school to provide students with the educational programs and services needed to achieve common outcome goals. Embedded in this aim are two key principles. The first is educational equity, which is achieved when all children have equal opportunity to achieve common outcome goals. This requires that students with greater educational needs also receive greater educational funding. The second goal is educational adequacy, which is achieved when outcome goals are sufficient for those children to become productive, self-determined, and civically engaged adults. Combining the two, the aim of this cost function analysis is to generate estimates of the costs that will provide all students in Oregon with an equal opportunity to achieve adequate outcomes and subsequently determine a funding formula that would appropriately distribute funding across districts to meet those costs.

To estimate the educational costs associated with achieving both equitable and adequate education for all students, we employ an analysis in two steps, each of which contains two sub-steps. They are:

Step 1. Analyzing current Oregon data

- 1a. assessing the relationships between student needs and schooling contexts and educational outcomes
- 1b. estimating the relationships between student needs and schooling contexts and school funding/spending

Step 2. Projecting an adequate school funding system for Oregon

- 2a. developing a school-level cost model for projecting the cost of adequate education
- 2b. translating the school-level cost model into a district-level weighted funding formula

In the remainder of this appendix, we outline the importance of each in estimating the cost of an adequate education for all students in Oregon.

## Step 1a. Assessing the Relationship Between Student Needs and Schooling Contexts and Educational Outcomes

In Oregon and many other states in the U.S., educational outcomes vary widely, according to levels of student need, the environments in which children are raised, and the settings in which they are schooled. They also continue to vary widely due to the failures of states to enact education funding and other policies that promote equal opportunity for an adequate education.

Step 1a of our process, outlined in Exhibit A.1, is to identify the “risk” factors, or what we more commonly refer to in education finance policy analysis as “need” factors, that are associated with inequality in educational outcomes.[16] The goal in Step 1a is to identify the measures of student educational need (shown as the yellow circle) and other contexts (shown as the blue circle) that are most strongly associated with educational outcomes (in the green circle). These measures include student needs, such as the percentages of students who are ELs, SWD, or economically disadvantaged students being served in a school or district, and other contextual factors, such as the number of students enrolled.

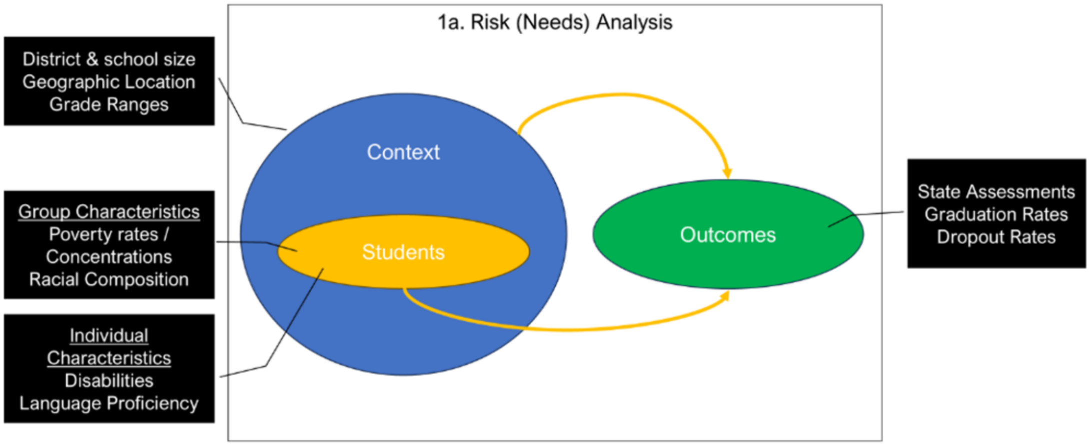
There is consistent evidence that economically disadvantaged students require additional resources to achieve at levels equivalent to their more affluent peers. However, economic disadvantage may be measured in several different ways. At the school level, one could use the share of students qualified for free or reduced priced lunches under the National School Lunch Program. At the district level, one could use census-reported child poverty rates for families of children between the ages of 5 and 17 who live in the geographic school district and attend a public school (U.S. Census Bureau, 2021). Economic disadvantage can also be measured by the income-to-poverty ratio of families living in the neighborhoods surrounding individual schools (NCES, n.d. -b). Determining which of these measures best captures the (negative) relationship between economic disadvantage and student outcomes is essential for developing a cost model that addresses this disparity.

Other constraints that guide our selection of measures in our analysis are that:

- The data must be available and have been consistently measured for at least five or more years.
- The data must be uniformly and consistently reported by a vetted and reliable source across the institutions included in our analyses, ideally at the school level but at the very least, at the district level.
- It must be possible to translate the data into a school finance policy/formula, which typically requires that data be publicly available.

[16] These outcomes, such as standardized test scores, chronic absenteeism rates, and graduation rates, are widely available educational measures that are reasonable predictors of important longer-term aims of an adequate education, such as higher educational attainment and better economic outcomes in adulthood.

**Exhibit A.1. Conceptual Model for Step 1a. Risk (Needs) Analysis**



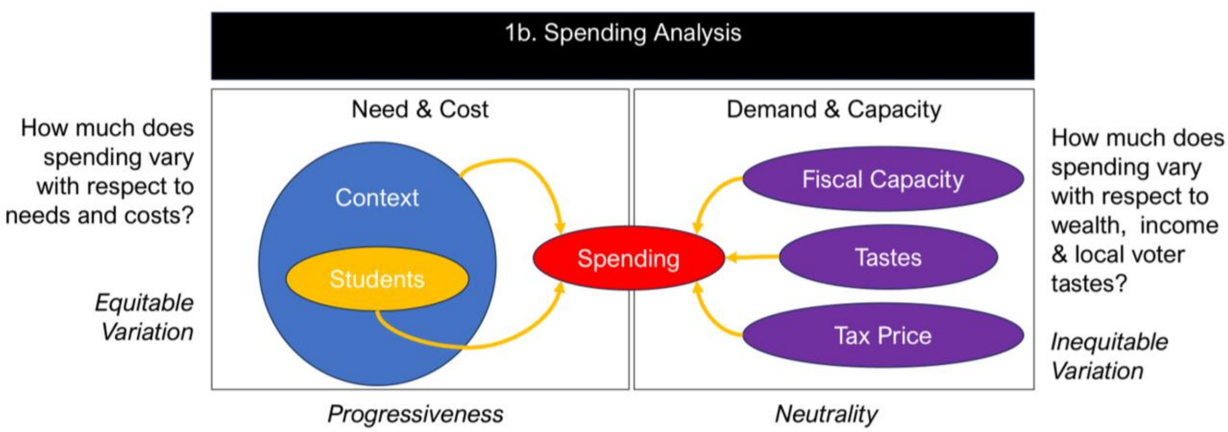

## Step 1b. Estimating the Relationship Between Student Needs and Schooling Contexts and School Funding/Spending

In Step 1b, shown in Exhibit A.2, we evaluate the current distributions of spending across schools and districts with respect to the student, school, and district characteristics associated with worse educational outcomes that were identified in Step 1a. Disrupting the relationship between these characteristics and education outcomes requires additional resources that afford more intensive programs and services. The first portion of Step 1b, shown on the left side of Exhibit 3, evaluates the relationship between student characteristics and school and district contexts, and school spending and revenues. A school funding system in which funding or spending is higher in schools or districts with greater needs would be considered progressive and one in which funding or spending is lower in schools or districts with greater needs would be considered regressive.

Step 1b also includes a more traditional school finance *wealth neutrality* analysis, shown on the right side of Exhibit 3. This analysis estimates the extent to which the spending choices and characteristics of local communities and public school districts drive school and district spending differences. Literature on local public finance suggests that the demand for local public goods and services — measured by choices on how much to spend on public goods and services — is influenced by the income and preferences of the median voter and the price of taxes paid to raise an additional dollar of revenue (Corcoran & Evans, 2010; Gramlich & Rubinfeld, 1982; Holcombe, 1980). Communities with higher-income families may choose to spend more because they can. Communities with larger shares of adults and parents with higher education may have a greater preference to spend on schools, whereas communities with larger shares of elderly citizens without school-aged children may prefer to spend less on schools (Fletcher & Kenny, 2008). Communities in which larger shares of the taxable property wealth lie in high-value commercial or industrial properties may have an easier time raising an additional dollar in revenue (because less of it falls on the median voter/homeowner). A well-designed state school finance formula should mitigate these inequalities in fiscal capacity and taste, meaning that there should not be an association between these factors and school spending across Oregon.

The right side of Step 1b serves a secondary purpose in identifying factors that may predict spending variation that is not associated with outcomes — or *inefficiencies*, per se. Importantly, this should not necessarily be construed as *waste.* Rather, some communities with high income and low tax prices may choose to spend on additional programs and services (more elaborate arts programs, electives, boutique sports such as fencing, lacrosse, squash, etc.) that the community desires but may have a less direct impact on the outcome measures used in our models. We will revisit this in Step 2. The purpose of Step 1b is to reveal the current patterns of Oregon's educational funding levels and funding equity. This allows us to compare the current state of funding and outcome in Oregon to what it would require to adequately fund all students, which we calculate in our cost function model in Step 2a.

**Exhibit A.2. Conceptual Model for Step 1b. Spending Analysis**




## Step 2a. Developing a School-Level Cost Function Model for Projecting the Cost of Adequate Education

Step 2 takes us from characterizing current relationships between student and district (or school) characteristics, outcomes, and spending to estimating a model of what a cost-based adequate funding model would look like in Oregon. In Step 2a, shown in Exhibit 4, we develop a cost function model to determine the costs associated with achieving a given level of educational outcomes for all children and across all settings. In our models, we predict adequate costs based on real world variation in school-level expenditures that contain variation associated with the educational outcomes of interest which we classify as true costs *and* variation on other community preferences and institutional choices, outcomes, and student characteristics. To appropriately estimate the costs associated with achieving adequate levels of educational outcomes for all students, we must disentangle spending associated with our outcomes of interest (the blue and yellow circles in Exhibit A.3.) from the spending variation due to preference and choice (the purple circle in Exhibit A.3.)

To do this, we first include our student need (risk) factors and other district characteristics such as economies of scale, population sparsity, and regional variation in competitive wages (the blue and yellow bubbles in Exhibit A.3). These measures are considered true "cost factors" in that they are (1) factors outside the control of local schools or districts and (2) characteristics that affect costs (i.e., the spending needed to achieve the desired outcomes).

We then include factors that might affect spending choices not directly associated with the measured outcomes (the efficiency factors in the purple bubble in Exhibit A.3.). Measured school outcomes, such as test scores, attendance, or graduation rates, do not encompass the full scope of the purpose or aims of public schooling. However, as a cost function is constrained to predicting measures that are readily quantified and publicly available, we must predict costs while netting out local preferences on spending and other possible determinants of inefficiency, including competition density and local public monitoring (Duncombe et al., 1997; Grosskopf et al., 2014). This step is a critical feature of the cost model and one that is lacking in other commonly used methods of estimating the cost of an adequate education, such as the education production function.

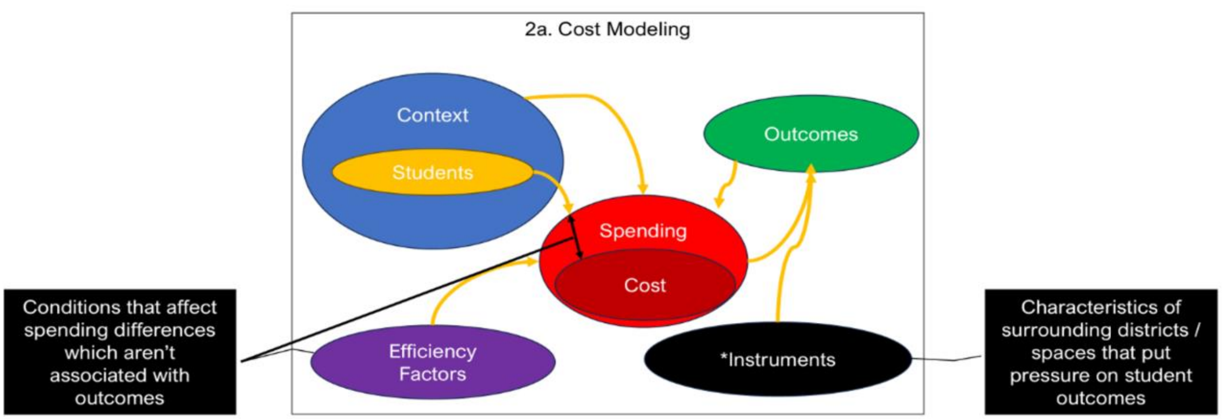
In turn, we identified a set of factors to be used as indirect efficiency measures that predict additional spending variation, above and beyond spending variation associated with outcomes. These include a Herfindahl Index (sum of squared school shares of districtwide enrollment), the ratio of median housing values to labor market averages, total assessed property value per pupil, the district-level percentage of net assessed value that is personal property, and the GINI index (a measure of county level wealth inequality that details the extent to which total household incomes are equally distributed within counties [more equality] or are concentrated among a smaller share of the overall population [less equality]).[17] Our predicted costs using the estimated cost function set these efficiency factors to the statewide averages so that our projections of the spending associated with achieving target outcome levels can be understood as being for a district of average wealth, income, taste, tax prices, and other efficiency pressures.

[17] The efficiency controls were derived from data obtained from the ODE, NCES, and Census.

Another complication in cost modeling, wherein spending per student is the dependent measure, is that spending and outcomes exist in a potentially circular relationship, indicated by arrows between the green and blue circles in Exhibit A.3. It is simultaneously true that (a) spending affects the outcomes *and* (b) outcome goals affect spending choices. This circular relationship is problematic, as ideally there would be a one-way relationship, with the dependent measure (spending) varying due to variation in the independent variables (educational outcomes,) but not the other way around. This can bias the estimated relationship between outcomes and spending. Fortunately, we can employ a statistical technique known as an *instrumental variables* or *two-stage least squares* approach, which corrects for bias in our estimates due to the circular relationship between spending and outcomes. As shown in the bottom right of Exhibit 4, it does so by using *instruments* (the black circle in Exhibit A.3) that are related to outcomes *only through their relationship to costs*.

We follow the standard statistical guidance for implementing instrumental variables, which have been developed and refined in academic research for decades (Duncombe & Yinger, 1997; 1998; 2006; Gronberg et al., 2017; Imazeki & Reschovsky, 2006; Taylor et al., 2018). Specifically, our cost function model uses a set of conceptually relevant and statistically appropriate exogenous "instruments" to use in our first stage regressions as predictors of school-level outcomes, based on characteristics of surrounding schools and districts. These include the average outcome factor index of the nearest 10 schools outside of the observed district, and the median household income of other districts in the same labor market space (NCES, n.d. – b).

### Exhibit A.3. Conceptual Model for Step 2a. Cost Modeling



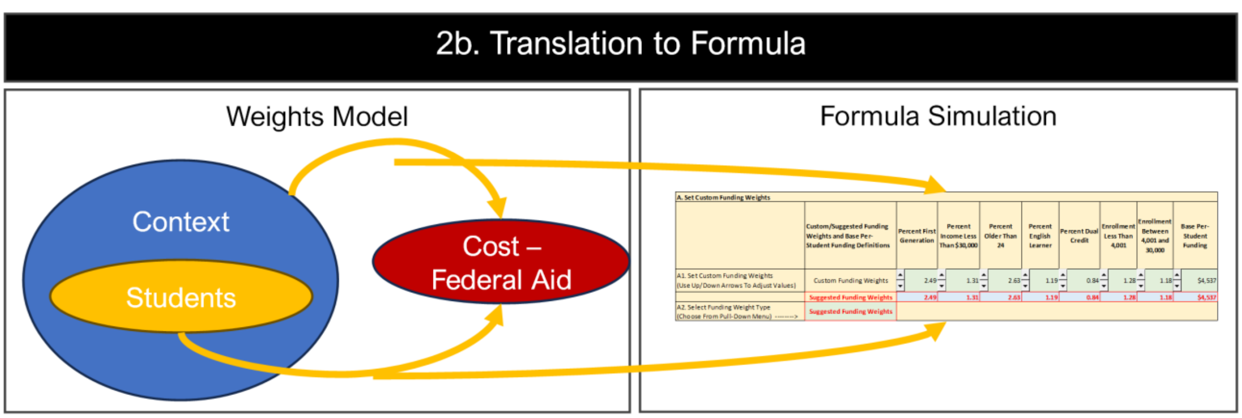
## Step 2b. Translating the School-Level Cost Model into a District-Level Weighted Funding Formula

As noted above, the cost function is a complex statistical model that identifies, at average levels of efficiency, the relationship between spending and outcomes, and it can be used to predict the spending needed to achieve a given level of outcomes (at average efficiency) for each school or district in Oregon based on the children they serve and their geographic and economic context. In Step 2b, we translate the complex cost function model results into relevant, usable pupil-based weighted funding models (Exhibit A.4).

The cost predictions from Step 2a include spending from state and local sources and from federal sources. Because state funding formulas only distribute funding from local and state sources, we start by subtracting the typical rates of federal funding (i.e., federal funding levels prior to the influx of funding following the onset of the COVID-19 pandemic) from the cost targets. Next, we identify a set of student needs and district contexts that are associated with increased education costs. We run a statistical model to estimate the weights (or multipliers), that when applied to a base-per-pupil funding amount, would appropriately differentiate funding levels according to the unique levels of student needs and district contexts in order to provide equal opportunity for all districts to achieve the target level of student outcomes.

Using the funding adjustment weights and base funding from our weights models, we further construct a simulation in which the weights and base funding amount are applied to each district to generate a funding allocation target from state and local resources.

**Exhibit A.4. Conceptual Model for Step 2b. Translation to Formula**



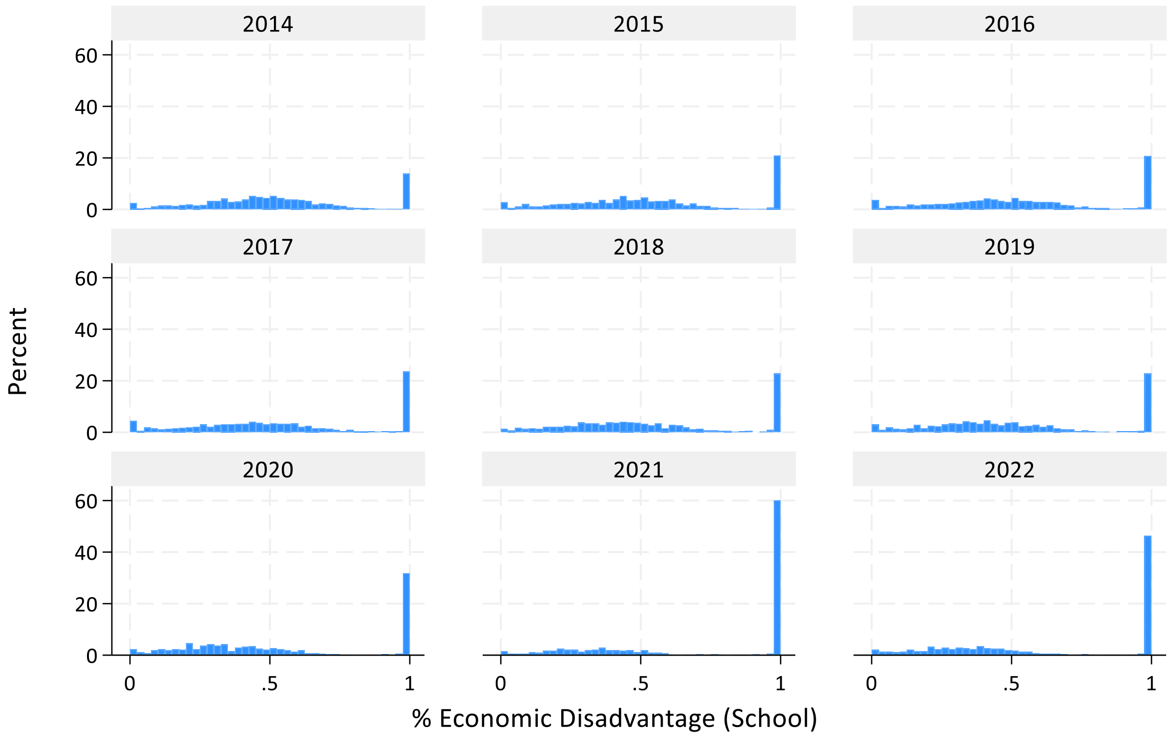
# Appendix B. Explaining the Economic Disadvantage Index

In this appendix we provide a brief explanation of our construction of an EDI for the State of Oregon. Plausible measures for use as an indicator of economic disadvantage include the following:

- School-reported shares of children who qualify for subsidized lunch under the National School Lunch Program (whose family income falls below the 185% income threshold for poverty)
  - *Source.* The ODE
- Share of children between the ages of five and 17 residing in each district who are from families that fall below the income threshold for poverty (100% threshold)
  - *Source.* U.S. Census Bureau, 2021
- Ratio of income to poverty income threshold (income-to-poverty ratio) for families of children residing in spaces geographically surrounding each school
  - *Source.* The NCES, n.d.-b

As discussed and presented in the body of this report, existing school-level data on shares of children who qualify for subsidized lunches are unevenly distributed across Oregon schools. We also believe that due to increased use of the Community Eligibility Provision, reported rates of children qualified for free or reduced-priced lunches do not accurately represent child poverty variation across schools, especially for the range between 60% and 100%. Exhibit B.1 shows that over the past decade as more schools have exercised the Community Eligibility Provision option, the number of schools reported as having 100% of children qualified for subsidized lunches has increased. Also, far fewer schools are reported as having between 60% and 100% of children who qualify. It is quite likely that there exists meaningful variation in the extent of child economic disadvantage across these schools, which is masked by identical reported of 100% qualification on this measure.

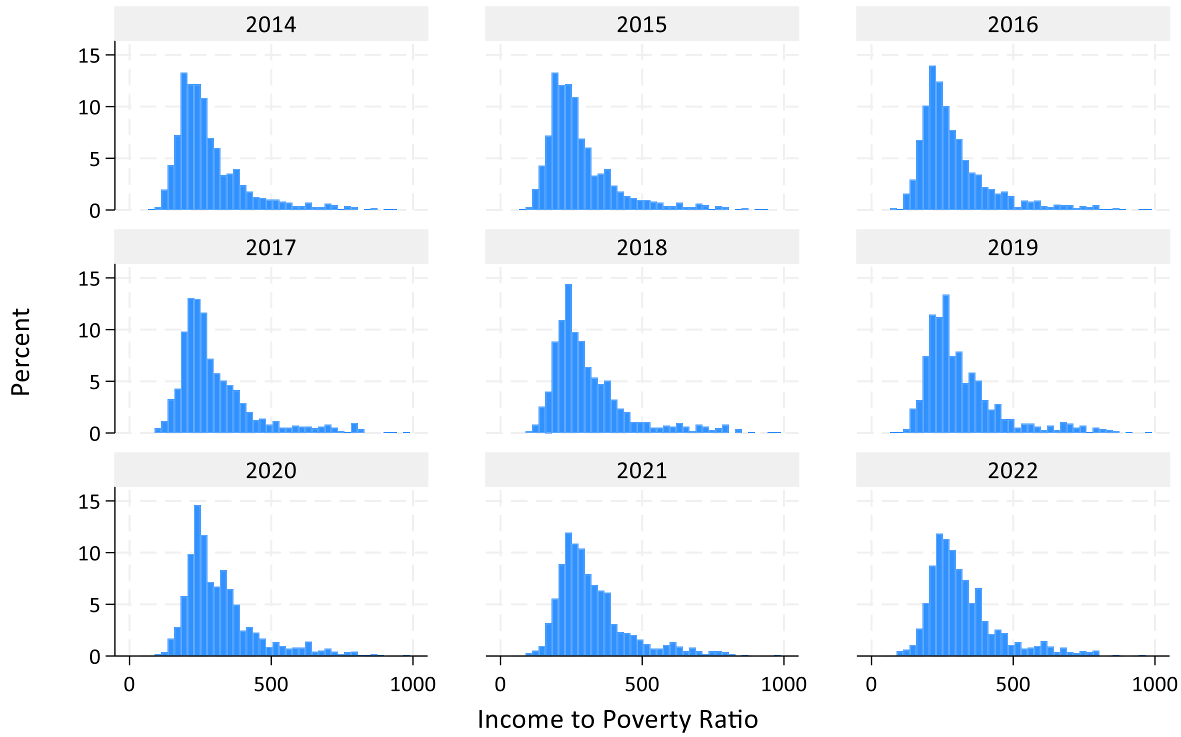
**Exhibit B.1. Distribution of School-Level Economic Disadvantage Rates, School Years 2014–15 to 2022–23**




*Note*. Each graph reports an academic year (2014 = 2014–15 school year).
*Source*. The ODE.

The income-to-poverty ratio provided by the NCES (n.d.-b) suggests that a typical distribution of economic advantage/disadvantage exists. Where this index has a value of 100, families in neighborhoods around the school have income levels, on average, at the poverty level. Most families have much higher income than this. We can see from Exhibit B.2 that many schools are surrounded by neighborhoods that have more than five times the income level of poverty income (Index >= 500). The average appears to be somewhere between 200 and 300. This measure is not compromised by the Community Eligibility Provision but also may not perfectly capture school enrollment characteristics if significant differences between where students live versus where they attend school exist.

**Exhibit B.2. Distribution of School-Level Income-to-Poverty Ratio, School Years 2014–15 to 2022–23**




*Note.* Each graph reports an academic year (2014 = 2014–15 school year).
*Source*. The NCES (n.d. -b).

In our main report, we test the relationship between reported subsidized lunch rates and student outcomes, and between the income-to-poverty ratio and student outcomes, finding that the income-to-poverty ratio has a slightly stronger correlation with our outcome measure than the free/reduced lunch rate.

We go on to test two alternatives, which we create by estimating regression models and generating predicted values of free/reduced lunch rates, referring to those predicted values as an Economic Disadvantage Index. Exhibit B.3 shows our two regression models. In the first, we predict reported economic disadvantage rates using (a) district census poverty rates and (b) regional variation in competitive wages. Note that we include the wage index because poverty thresholds (for subsidized lunches or the census) are not adjusted for the income that might be required from one location to another to have a comparable quality of life. Academic publications by the authors have shown the importance of adjusting poverty measures for competitive wage variation (Baker et al., 2013). The second model includes school-level racial composition—specifically the percentage of Hispanic and Black enrollments. This model explains substantially more variation in existing subsidized lunch rates than the first model (0.47 compared to 0.39). More importantly, the second model creates a student need index that is much more highly correlated with student outcomes (0.65 compared to 0.54). As such, we choose the student need index generated by Model 2 here for our cost modeling.

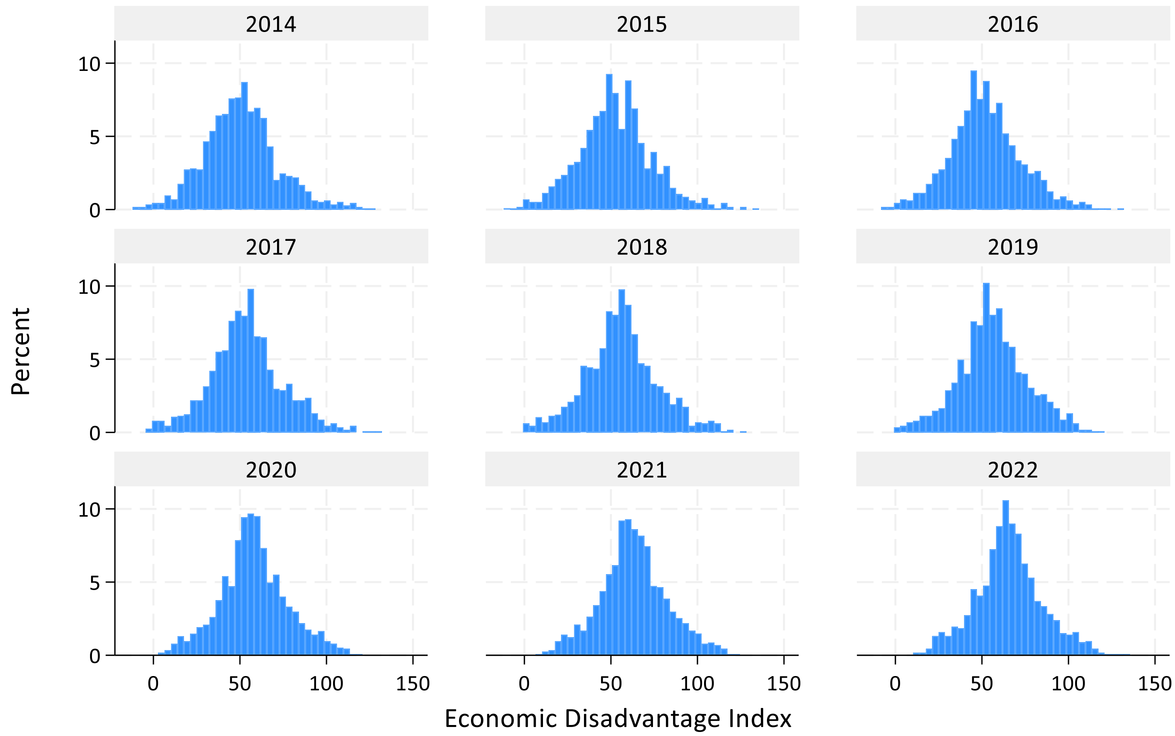
### Exhibit B.3. Regression Models of Economic Disadvantage

| DV = % economic disadvantage | Level | Source | Model 1 | | Model 2 | |
|---|---|---|---|---|---|---|
| | | | **Coefficient** | **Standard Error** | **Coefficient** | **Standard Error** |
| Income-to-poverty ratio | School | NCES / EDGE | -0.001*** | 0.000 | -0.000*** | 0.000 |
| Census poverty rate 5 to 17-year-olds | District | Census / SAIPE | 1.781*** | 0.058 | 1.306*** | 0.053 |
| CWIFT | District | NCES / EDGE | 0.575*** | 0.051 | -0.589*** | 0.052 |
| % Black enrollment | School | ODE | | | 1.318*** | 0.059 |
| % Hispanic enrollment | School | ODE | | | 0.663*** | 0.014 |
| Time | | | 0.039*** | 0.001 | 0.029*** | 0.001 |
| Constant | | | 0.290*** | 0.050 | 1.113*** | 0.050 |
| Number of observations | | | 10,272 | | 10,272 | |
| $R^2$ | | | 0.339 | | 0.471 | |

*Note.* *** *p* < .01. ** *p* < .05. * *p* < .1.
*Source*. Census Small Area Income Poverty Estimates, National Center for Education Statistics Education Demographic and Geographic Estimates (EDGE) and Comparable Wage Index for Teachers (CWIFT) data, ODE supplied student enrollment data.

Exhibit B.4 shows that the EDI generated by Model 2 is relatively normally distributed and does not suffer the overtime distortion created by community eligibility, even though the model is based on predicting variation in reported subsidized lunch rates.

### Exhibit B.4. Economic Disadvantage Index (Model 2)




*Note.* Each graph reports an academic year (2014 = 2014–15 school year).
*Source.* Census Small Area Income Poverty Estimates, National Center for Education Statistics Education Demographic and Geographic Estimates (EDGE) and Comparable Wage Index for Teachers (CWIFT) data, ODE supplied student enrollment data.

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