The Costs of Operating Small Schools in Oregon

Final Report to the Interim Legislative Committees on Education

Prepare by:
Oregon Department of Education
School Finance, Data, and Analysis Office

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Executive Summary

Senate Bill 519 of 2001 required the Department of Education to:

> "…conduct a study on the relationship between the size of Oregon's small school districts and the cost and need for programs. Based on the study, the department shall develop recommendations about small school districts."

Senate Bill 519 also created the Small School District Supplemental Fund, to be used to make grants to small districts (enrollment of 8,500 or less) with small high schools (enrollment of 350 or less). This focus not just on small districts, but on small schools, and specifically small ***high*** schools, suggests that the interests of the legislature were broader than simply on the size of districts, but on the size of schools as well.

To meet the legislature's charge, the study had four primary objectives:

- To develop an understanding of the resource needs of small districts and schools;
- To distinguish between the effects of small ***district*** size and small ***school*** size;
- To evaluate the effectiveness of Oregon's Small School Correction; and
- To develop recommendations to improve the efficiency of small districts and schools.

In evaluating Oregon's small districts and schools, we used a three-part approach:

- We conducted interviews with superintendents, principals, and business managers of small districts and schools.
- We developed small school prototypes to estimate small school resource needs.
- We estimated a cost function to determine the relationship between size and per student costs.

Key Findings

- School size has a dramatic affect on per student costs for Oregon high schools, with costs per student rising rapidly as sizes fall below about 300 students. For high schools, school size and district size are highly correlated, so it is difficult to discern their independent effects. The costs that increase the most at smaller sizes are predominately school-based costs, however, so the primary effects appear to be related to school size, with a smaller role played by district size.

- School size has a dramatic affect on per student costs for elementary schools also, with costs rising rapidly at sizes below about 100 students. For elementary schools, the independent effect of district size leads to significantly higher costs for the smallest districts—those serving fewer than about 2,000 students (about 14% of all students in the state). Costs then flatten out, and then rise gradually as district size increases.

- Oregon's Small School Correction does a fairly good job of compensating for the higher operating costs of small high schools, but for small elementary schools it appears to give relatively more resources to small schools than cost function estimates indicate is warranted, particularly for the smallest schools.

- For high schools, while the Small School Correction appears to compensate for the effects of small school size, it is not enough to compensate districts for the higher transportation costs faced by small, remote schools. As a result, the 30% share of reimbursable transportation costs that must be paid by school districts, as well as the entire un-reimbursable amount, drains resources from the classroom to a greater extent than it does for larger districts.

- For elementary schools, because the Small School Correction tends to over-compensate districts for the higher costs associated with small size, some of that compensation might be considered payment for higher transportation costs faced by those districts due to remoteness.

- It is possible to reduce the per-student operating costs by forming fewer, but larger, schools in Oregon's sparsely populated areas. There is, however, a tradeoff between the lower operating costs that are possible with larger schools and other factors that are important to families and communities—in particular, the amount of time students must spend traveling to and from school and the community identity and cohesion that local schools often create.

Recommendations

- Develop strategies, with the cooperation of Education Service Districts, to increase the efficiency of operating small schools.

- Refine the Small School Correction so it more closely compensates for actual differences in costs related to school size.

- Develop an independent adjustment for the higher transportation costs faced by remote schools. Because the effects of remoteness are likely to affect operating costs in a fundamentally different way than the effects of smallness, the two adjustments should be done separately.

- Work with the Quality Education Commission to incorporate estimates for schools of different sizes into the Quality Education Model.

- Develop an ongoing process to evaluate and modify, if necessary, the State School Fund formula student weights and cost factors.

Introduction

Senate Bill 519, passed by the 2001 Oregon Legislature, created the Small School District Supplemental Fund to provide additional resources to small school districts with small high schools. The legislature appropriated $9.0 million dollars for the 2001-03 biennium to be used for grants to districts based on high school enrollment and on the districts' financial needs.

In addition to the creation of this grant program, Senate Bill 519 required the Department of Education to "…conduct a study of the relationship between the size of Oregon's small school districts and the cost of and need for programs. Based on the study, the department shall develop recommendations about small school districts." (Senate Bill 519, Section 6 (1), amending ORS 327.013).

This document reports the results of the Department of Education's evaluation of small schools and school districts.

Objectives of the Study

In keeping with the charge of the legislature, this study has four primary objectives:

- To develop an understanding of the resource needs of Oregon's small districts and schools and how they differ from those of larger districts and schools;
- To distinguish between the effects of small *district* size and small *school* size on overall education costs;
- To evaluate how well Oregon's small school correction compensates for the higher costs of operating small schools; and
- To develop recommendations related to small schools and districts in Oregon.

Study Approach

To meet these objectives, the Department used three distinct but complementary approaches to evaluating small school and district resource needs. First, the Department conducted informal interviews and discussions with superintendents, principals, and business managers of small school districts to better understand the resource needs and staffing constraints they face. Many of these discussions took place at the Oregon Small Schools Summit held in March of 2002.

The second approach was the development of small school prototype models similar to those used in Oregon's Quality Education Model. The prototype school approach involves specifying the resources, at a detailed level, needed to operate an effective school. Then, by specifying the cost of each type of resource (e.g., teachers,

administrators, support staff, textbooks, energy, supplies, building maintenance), we are able to estimate the total cost of operating an effective school. By developing prototype schools of different sizes, it is possible to evaluate how and why schools of different sizes cost different amounts to operate.

The third approach to evaluating the costs of districts and schools is to develop a formal cost function that estimates the effect on school operating costs of various student and school attributes, including district and school size. This approach, using detailed school and district level data, estimates the relationship between school spending and student performance, controlling for various student, school, and community characteristics. One advantage of the cost function approach is that, unlike the other two approaches described above, it explicitly accounts for the level of student performance when it estimates the costs of operating schools with varying characteristics, such as different sizes. Another advantage is that it is able to provide estimates for a broad range of school sizes.

By utilizing all three approaches described above we are able to provide a relatively thorough and detailed description of resource needs of small districts and schools in Oregon compared to their larger counterparts. Based on these findings, we evaluate how well the Small School Correction currently used in Oregon's distribution formula performs in directing the appropriate level of resources to Oregon's small schools. We also look at how transportation costs vary for schools of different sizes.

Finally, we suggest some potential opportunities for small schools to reduce their costs without compromising the quality of education they are able to provide their students, and we provide recommendations for policymakers based on our findings.

Section 1: Background on Small Schools

Relative Benefits of Small v. Large Schools

There exists a large literature on the effects of school size on student outcomes and, more recently, on how the cost of running schools varies with school size.[1] In most studies of school size, researchers hypothesis certain benefits of large size along with certain other benefits of small size. Finding the "optimal" size school is, therefore, an exercise in weighing the advantages and disadvantages of big versus small.

The benefits of largeness are based primarily on the economic concept of economies of scale:

- Fixed costs can be spread over a larger number of students as school size increases, reducing costs per student.
- A broader range of more specialized courses can be offered, and specialization results in higher student achievement.
- A broader range of extracurricular activities can be offered.
- Certain activities, such as purchasing supplies and services, can be done more efficiently as size increases.

The benefits hypothesized for smaller schools, in contrast, are based less on economic arguments and more on the benefits of an improved learning environment and better student behavior, which in turn result in higher student performance.

- Better attendance rates.
- Lower dropout rates.
- Fewer discipline problems.
- Opportunities for a larger share of students to participate in extra-curricular activities.
- More meaningful adult connections for students.
- A safer school environment.

Most recent studies have concluded that the costs savings from larger school sizes have not materialized, primarily because administrative costs tend to increase as school sizes increase, eating up much of the costs savings. At the other end of the spectrum, the benefits of smallness diminish below a certain level, with costs per student rising dramatically as class sizes in small schools inevitably fall. As a result of these findings, a number of researchers have estimated that the optimal high school size is between 500 and 1,000 students[2], with optimal sizes for elementary and middle schools being somewhat smaller than that.

[1] For a fairly comprehensive review of the literature, see Kathleen Cotton, "School Size, School Climate, and Student Performance", Northwest Regional Educational Laboratory, May 1996, updated January 2002.

[2] For example, see Valerie E. Lee and Julia B. Smith, "High School Size: Which Works Best and for Whom?" Education Evaluation and Policy Analysis, Fall 1997, vol. 19, no. 3, pp. 205-227.

Numbers of Small Districts and Schools in Oregon

Oregon has a lot of small school districts, and within those districts, a lot of small schools. For the 2000-01 school year, Oregon had 198 school districts, 74 of which had fewer than 500 students and 107 of which had fewer than 1,000 students. On the other end of the spectrum, only 11 districts had more than 10,000 students, and just three had more than 20,000. Table 1 shows a distribution of Oregon districts by enrollment size. While more than half of the districts had fewer than 1,000 students, those districts represent just 7 percent of total students. Table 2 shows school sizes.

Table 1: Oregon School Districts by Size, 2000-01

October 1 Enrollment Category	Number	Percentage
100 or Fewer	32	16.2%
101 to 200	7	3.5%
201 to 300	15	7.6%
301 to 500	20	10.1%
501 to 1,000	33	16.7%
1,001 to 1,500	15	7.6%
1,501 to 2,000	10	5.1%
2,001 to 5,000	37	18.7%
5,001 to 10,000	18	9.1%
10,000 to 20,000	8	4.0%
20,001 to 50,000	2	1.0%
Greather than 50,000	1	0.5%
Total	198	100.0%

Table 2: Oregon Schools by Type and Size, 2000-01

October 1	Elementary Schools		Middle Schools		High Schools		Combined Schools	
Enrollment Category	Number	Percent	Number	Percent	Number	Percent	Number	Percent
25 or Fewer	20	2.7%	0	0.0%	0	0.0%	1	3.1%
26 to 50	8	1.1%	0	0.0%	2	1.0%	1	3.1%
51 to 75	15	2.0%	0	0.0%	3	1.5%	5	15.6%
76 to 100	16	2.2%	0	0.0%	6	3.0%	5	15.6%
101 to 150	63	8.5%	4	2.0%	12	6.1%	4	12.5%
151 to 200	40	5.4%	9	4.5%	9	4.6%	5	15.6%
201 to 250	53	7.2%	15	7.5%	12	6.1%	4	12.5%
251 to 300	70	9.5%	6	3.0%	14	7.1%	3	9.4%
301 to 350	77	10.4%	10	5.0%	10	5.1%	1	3.1%
351 to 500	217	29.3%	45	22.5%	18	9.1%	2	6.3%
501 to 750	156	21.1%	68	34.0%	20	10.2%	1	3.1%
751 to 1,000	5	0.7%	35	17.5%	19	9.6%	0	0.0%
1,001 to 1,500	0	0.0%	8	4.0%	37	18.8%	0	0.0%
1,501 to 2,000	0	0.0%	0	0.0%	30	15.2%	0	0.0%
Greater than 2,000	0	0.0%	0	0.0%	5	2.5%	0	0.0%
Total	740	100.0%	200	100.0%	197	100.0%	32	100.0%

With few exceptions, small schools are found in small districts. Of the 32 high schools in Oregon with fewer than 200 students, all but 3 are in districts with fewer than 500 students. A similar pattern can be found for middle and elementary schools.

Small schools also tend to be concentrated in the rural areas of Oregon. Table 3 shows average school sizes by county. Rural counties, particularly those in the eastern and southern parts of the state, have the smallest schools. The largest schools in Oregon, in contrast, are found in the urbanized areas of the Willamette Valley.

Table 3: Average School Size by County, 2000-01

	Average October 1 Enrollment			
County	Elementary Schools	Middle Schools	High Schools	Combined Schools
BAKER	173	372	432	86
BENTON	246	453	684	na
CLACKAMAS	409	554	1,104	na
CLATSOP	292	474	452	168
COLUMBIA	284	344	609	538
COOS	268	414	536	na
CROOK	296	746	970	na
CURRY	259	525	331	na
DESCHUTES	447	608	1,011	18
DOUGLAS	309	408	392	148
GILLIAM	114	na	63	na
GRANT	164	131	305	106
HARNEY	80	214	207	na
HOOD RIVER	332	421	1,059	199
JACKSON	386	677	1,149	205
JEFFERSON	264	580	473	32
JOSEPHINE	340	547	907	na
KLAMATH	305	444	645	454
LAKE	112	229	355	176
LANE	292	504	805	142
LINCOLN	288	372	515	142
LINN	254	382	709	na
MALHEUR	204	361	318	82
MARION	360	626	1,060	na
MORROW	359	365	327	155
MULTNOMAH	431	623	1,376	na
POLK	251	706	661	319
SHERMAN	113	na	138	na
TILLAMOOK	265	240	478	na
UMATILLA	338	435	535	144
UNION	238	399	344	243
WALLOWA	144	na	159	na
WASCO	254	344	402	251
WASHINGTON	509	816	1,466	na
WHEELER	61	na	37	79
YAMHILL	389	445	690	na

The concentration of small schools in the rural, sparsely populated areas of the state suggests that the key factors determining school size are related primarily to geography:

- Because transportation is expensive in terms of financial costs and (perhaps more importantly) in terms of student travel time, a large number of small schools results in lower transportation costs than would a smaller number of larger schools.

- Because schools often are a critical element in the social cohesion of small communities, a large number of small schools tend to emerge in sparsely populated areas characterized by large numbers of relatively small communities.

School Resource Use

The forces described above have resulted in a large number of small schools in the more sparsely populated areas of Oregon, and those small schools might be expected to have different resource needs than larger schools. More specifically, because many of the costs of running schools are fixed (i.e., they don't vary significantly with changes in enrollment), small schools would be expected to have higher per student costs than larger schools.

To gain an understanding of how school costs vary with size, we first focus on the primary input into the education process—teachers. Table 4 shows the student teacher ratio of Oregon schools by school size. For all three types of schools—elementary, middle, and high—student/teacher ratios tend to decline as school size drops.

Table 4: Student/Teacher Ratios by School Type and Size, 2000-01

School Enrollment	Elementary Schools	Middle Schools	High Schools	Combined Schools
25 or Fewer	8.6	na	na	16.0
26 to 50	12.1	na	6.1	14.5
51 to 75	17.0	na	10.3	8.9
76 to 100	16.8	na	10.7	9.6
101 to 150	17.8	17.6	12.4	11.0
151 to 200	17.5	17.7	14.5	12.8
201 to 250	19.2	17.8	14.9	13.6
251 to 300	18.6	19.1	17.4	14.5
301 to 350	19.1	19.2	15.9	22.0
351 to 500	19.8	18.8	19.2	16.3
501 to 750	21.1	19.7	18.8	19.6
751 to 1,000	21.0	20.2	19.5	na
1,001 to 1,500	na	21.5	21.5	na
1,501 to 2,000	na	na	22.1	na
Greater than 2,000	na	na	22.6	na

Because teachers are the predominant input into the education process, the fact that student/teacher ratios decline as schools get smaller suggests that school expenditures per student will be higher for smaller schools. Table 5 shows per-student operating expenditures per student by school size. As expected, expenditures per student increase as school size falls. At very small sizes, spending per student is often two or three times the level found in larger schools.

Table 5: Non-Transportation Operating Expenditures per Student
By School Type and Size, 2000-01

School Enrollment	Elementary Schools	Middle Schools	High Schools	Combined Schools
25 or Fewer	$10,763	na	na	$12,903
26 to 50	$10,522	na	$15,577	$6,320
51 to 75	$8,564	na	$11,092	$11,408
76 to 100	$7,524	na	$12,292	$13,149
101 to 150	$7,192	$6,980	$9,866	$11,643
151 to 200	$7,293	$6,876	$9,001	$9,659
201 to 250	$6,981	$6,958	$7,588	$8,853
251 to 300	$6,671	$6,714	$7,585	$8,713
301 to 350	$6,651	$6,669	$7,845	$6,113
351 to 500	$6,282	$6,914	$7,278	$7,995
501 to 750	$6,055	$6,670	$7,027	$7,147
751 to 1,000	$5,862	$6,527	$6,930	na
1,001 to 1,500	na	$6,071	$6,971	na
1,501 to 2,000	na	na	$6,599	na
Greater than 2,000	na	na	$6,335	na
Total	$6,372	$6,671	$6,945	$9,070

* Includes district-level expenditures and the value of ESD services allocated to schools.

But lower student/teacher ratios (i.e., more teachers per student) are not the only source of higher per-student spending for smaller schools. As Table 6 shows, small high schools tend to spend more per student in most spending categories. This suggests that, at least below a certain size, many school costs have a fixed component that is spread over fewer students in smaller schools, thus driving up per-student expenditures.

Table 6: Operating Expenditures by Category and School Size
for Oregon High Schools, 2000-01

	Per Student Operating Expenditures				
School Enrollment	Instruction	Operations & Maintenance	Transport-tation	Administration	Other Support
25 or Fewer	na	na	na	na	na
26 to 50	$9,443	$1,737	$1,556	$968	$6,024
51 to 75	$7,488	$1,407	$874	$1,384	$5,457
76 to 100	$6,216	$1,286	$633	$1,102	$5,401
101 to 150	$6,164	$1,660	$558	$1,251	$4,379
151 to 200	$5,338	$887	$458	$941	$3,402
201 to 250	$4,773	$861	$395	$929	$3,351
251 to 300	$4,586	$903	$419	$907	$3,286
301 to 350	$4,926	$851	$444	$957	$3,335
351 to 500	$4,307	$806	$427	$893	$3,186
501 to 750	$4,196	$731	$353	$698	$2,915
751 to 1,000	$4,356	$761	$381	$759	$3,163
1,001 to 1,500	$4,373	$718	$315	$755	$3,093
1,501 to 2,000	$4,036	$560	$307	$629	$2,764
Greater than 2,000	$4,257	$556	$299	$580	$2,491

A Focus on Small High Schools

This background information on the number and resource use of small schools sets the stage for a more detailed evaluation of how the cost structure of schools varies with school size. In the sections that follow, we focus on Oregon high schools in evaluating the factors that influence the costs of running small schools relative to larger ones. In later sections we look at small elementary schools.

Section 2: The Cost Structure of Oregon High Schools

The expenditure data presented in the preceding tables hint at a relationship between school size and school costs, but relying solely on expenditure information to evaluate costs is inadequate and can be misleading. In most public sector activities such as education, revenues drive expenditures: governments and school districts typically spend all the resources they receive. Defining costs in terms of expenditures is, therefore, equivalent to defining costs in terms of revenues. Such a definition leads to the circular and erroneous conclusion that increases in revenue cause costs to rise and, conversely, revenue reductions cause costs to fall.

Expenditures are not Costs

The critical flaw in defining education costs solely in terms of expenditures is that such an approach does not take into account educational output—it doesn't consider what we are getting for our educational dollar. Economists and most private sector businesses define costs as the minimum amount that must be spent ***in order to produce a given level of output***. In order to evaluate how costs vary among schools we need to take into account not just the amount schools are spending, but the schools' output as well. Educational output can be defined in a number of different ways, but in a system such as Oregon's where the state's education goals are defined in terms of student outcomes, some measure of student performance is the logical choice for an output measure.

In evaluating the level of spending required to achieve a given level of output in schools of difference sizes, we use two distinct approaches. The first is a prototype school approach similar to that used by Oregon's Quality Education Model. Using this approach, analysts are able to build a prototype school of a given size, then determine, based on available data and professional judgment, the level of resources (teachers, administrators, support staff, textbooks, supplies, etc.) that is needed to run that school effectively and achieve a given level of student performance. That resource level can then be "costed out" to determine the total amount it would cost to run such a school. The prototype school approach, while using detailed spending data for schools, relies on the professional judgment of educators to establish resource needs and to determine what level of student performance can be expected from that level of resources.

The second approach, known as an education cost function, uses statistical methods to estimate the relationship between school spending and student performance, taking into account a series of other student and school characteristics (such as district and school size) that can affect education costs. It has the advantage that it uses both spending and student performance data from actual schools, so it relies less on professional judgment in establishing the link between spending and performance.

Because neither of these approaches is perfect, and because each has its strengths and weaknesses, it makes sense use both so that the results can be compared. In the following sections we present descriptions and results of both methods, but first we

discuss the operational environment faced by Oregon's small high schools that distinguish them from larger schools in the state.

Operational Environment of Small High Schools

The environments in which small schools operate in Oregon are much different than those of larger schools. The related characteristics of low population density and isolation found in much of the eastern and southern parts of the state have resulted in a system of geographically dispersed small schools typically serving one community and the rural areas surrounding that community. Because the communities in eastern and southern Oregon often are far apart, so are the schools.

Small schools have a number of characteristics that set them apart from larger schools. In relation to school operating expenditures, small schools tend to spend more per student in most spending categories (Table 6, above). Below we discuss some of the areas where expenditures differ most dramatically, the most important of which involves the related issues of staffing levels and the range of courses that a school is able to offer.

Staffing Levels and Range of Course Offerings

As was shown earlier (Table 4), small schools tend to have smaller student teacher ratios (i.e., fewer students for each teacher) than larger schools. This occurs because, in order to offer even the basic range of core academic courses—math, English, science, and social studies, second language, art—student scheduling constraints result in smaller class sizes, and therefore the need for proportionally more teachers, than in larger schools. When electives are added, class sizes become even smaller, driving staffing needs up further.

The result is that, in small schools, teachers are much more like a fixed cost than they are in larger schools. As an example, consider two high schools, one that has 100 students and the other that has 2,000, and assume that both schools lose five percent of their students. In the small school that is just 5 students, and it would be difficult for the school to reduce their teaching staff in response to the enrollment decline without having a significant impact on the remaining students. In the larger school, in contrast, the five percent decline means a loss of 100 students, and that school would have a much greater ability to reduce teaching staff without impacting the remaining students.

As schools offer a broader range of elective courses, this fixed-cost nature of the teaching staff for small schools becomes even more pronounced because a broader range of course offerings requires additional teachers with certification or experience in the added subject areas. As enrollment declines, those teachers can be retained, driving up costs per student, or the added course offerings would have to be dropped.

The preceding discussion illustrates one of the key constraints faced by small schools: there is a tradeoff between the breadth of courses a school can offer and per-student

costs. As a school offers a wider variety of electives, staffs grow, class sizes decline, and per-student costs rise.

Transportation Costs

Arguably the other most important cost-related difference between small and large schools is the higher per-student transportation costs that small schools face due to their isolation and the sparsely populated areas they serve. In terms of financial costs and (perhaps more importantly) in terms of the larger amount of student time spent traveling to and from school, transportation costs for small, isolated schools are much higher than for larger schools in more densely populated areas.

The issue of transportation costs also involves an important tradeoff in relation to small schools. One approach to reducing the costs of operating small schools is to consolidate two or more schools into a larger one. Due primarily to more effective use of teachers and other staff and to the economies of scale that can be achieved in certain other functions (e.g., operations and maintenance, discussed below), the operating costs (excluding transportation costs) of the larger, consolidated school, would be lower. It is almost certain, however, that transportation costs would rise because many, if not most, students would have to travel further to and from school.

The consolidation of small schools into larger ones often has a further cost that sometimes is overlooked by policymakers. Schools, particularly high schools, often represent a large part of the social life of small communities and provide a community cohesiveness that isn't provided by any other institution. In school consolidations at least one community must lose it's school, and the loss of community cohesion and identity that is lost with it often cannot be replaced.

Operation and Maintenance Costs

The costs of operating and maintaining school buildings are substantial, with expenditures averaging nearly $600 per student in 2000-01. Because of economies of scale, the per-student cost of operating and maintaining school buildings and other physical facilities is usually considerably higher for small schools than for larger ones. For high schools serving fewer than 100 students, for example, expenditures per student exceeded $1,200 in 2000-01.

In order to capture the differences in operating environment that lead to higher per-student costs for small schools, we compare, as discussed earlier, two different methods for estimating the costs of small high schools: a prototype school approach and a cost function approach.

A Small High School Prototype for Oregon

Prototype schools, sometimes called "representative" schools, are examples of what a typical school with given characteristics looks like. Prototype schools are typically built

in order to analyze some aspect of the schooling process, such as staffing requirements, administrative resource needs, or overall school funding levels. In building a prototype school, the analyst specifies the level of various resources required to operate the school at some chosen level of effectiveness or student performance. The resources include all of the inputs required to run a school: teachers, administrators, support staff, counselors, librarians, textbooks, supplies, copying, energy, building maintenance, curriculum development, business services, etc. Once the quantities of each these resources are specified, prices required to purchase them are applied in order to estimate the total cost of running the prototype school.

In constructing a small high school prototype, we attempted to take into account all of the aspects of the operating environment faced by small high schools described above. To the extent that that environment differs from the one faced by larger schools, the small school prototype will differ in the level of resources, and perhaps their prices, from the prototype for the larger schools.

Table 7 shows a summary of the components of the small high school prototype constructed for this study. Full details of the prototype are included in Appendix A. The small high school prototype presented here has 120 students. For comparison purposes, the table also includes information for the 1,000-student high school from the Quality Education Model. Estimates for both prototypes are based on actual spending levels for the 2000-01 school year. The differences between the two prototypes provide one measure of how the operational environments differ for schools of different sizes.

Table 7: Prototype High School Estimated Costs per Student, 2000-01

	High School of 120 Students		High School of 1,000 Students	
Model Element	Total Expenditures	Expenditures per Student	Total Expenditures	Expenditures per Student
Core Instructional Staff	$566,388	$4,720	$3,398,182	$3,398
Instructional Support Staff	$140,670	$1,172	$674,370	$674
School Administration	$85,685	$714	$352,429	$352
Computer Hardware and Software	$9,500	$79	$51,750	$52
Supplies, Books, and Materials	$36,960	$308	$191,000	$191
Extra-curricular Activities	$39,180	$327	$275,480	$275
Professional Development	$11,037	$92	$50,058	$50
Student Transportation	$69,000	$575	$317,000	$317
Other Building Support	$153,480	$1,279	$940,000	$940
District Administrative Support	$63,000	$525	$224,000	$224
ESD Support to Districts	$28,320	$236	$236,000	$236
ESD Administration	$6,000	$50	$50,000	$50
Total	$1,209,220	$10,077	$6,760,270	$6,760

The estimates in Table 7 show that a high school of 120 students is estimated to cost roughly 50% more to operate than a high school of 1,000 students ***to achieve the same level of student performance***.

As the table shows, the smaller school costs more to operate in nearly all cost categories, with the biggest dollar differences in the costs of core instructional staff (i.e. teachers). Because small schools must employ a proportionally larger number of teachers than a large school in order to offer an equivalent breadth of course offerings, per-student costs rise dramatically as school sizes fall.

An Education Cost Function for Oregon High Schools

Costs are defined as the minimum expenditures required to produce a given level of output. In the case of schools, therefore, it is critical that in evaluating the costs of operating schools with different characteristics (such as size) that account be taken of educational output. It is erroneous, for example, to conclude that a school spending $5,000 per student costs less to operate than a school spending $6,000 per student if the output of the first school (measured, say, in terms of student achievement) is much lower than the output of the second school. Any evaluation of educational costs that relies on school expenditures without taking into account student performance is, therefore, seriously flawed.

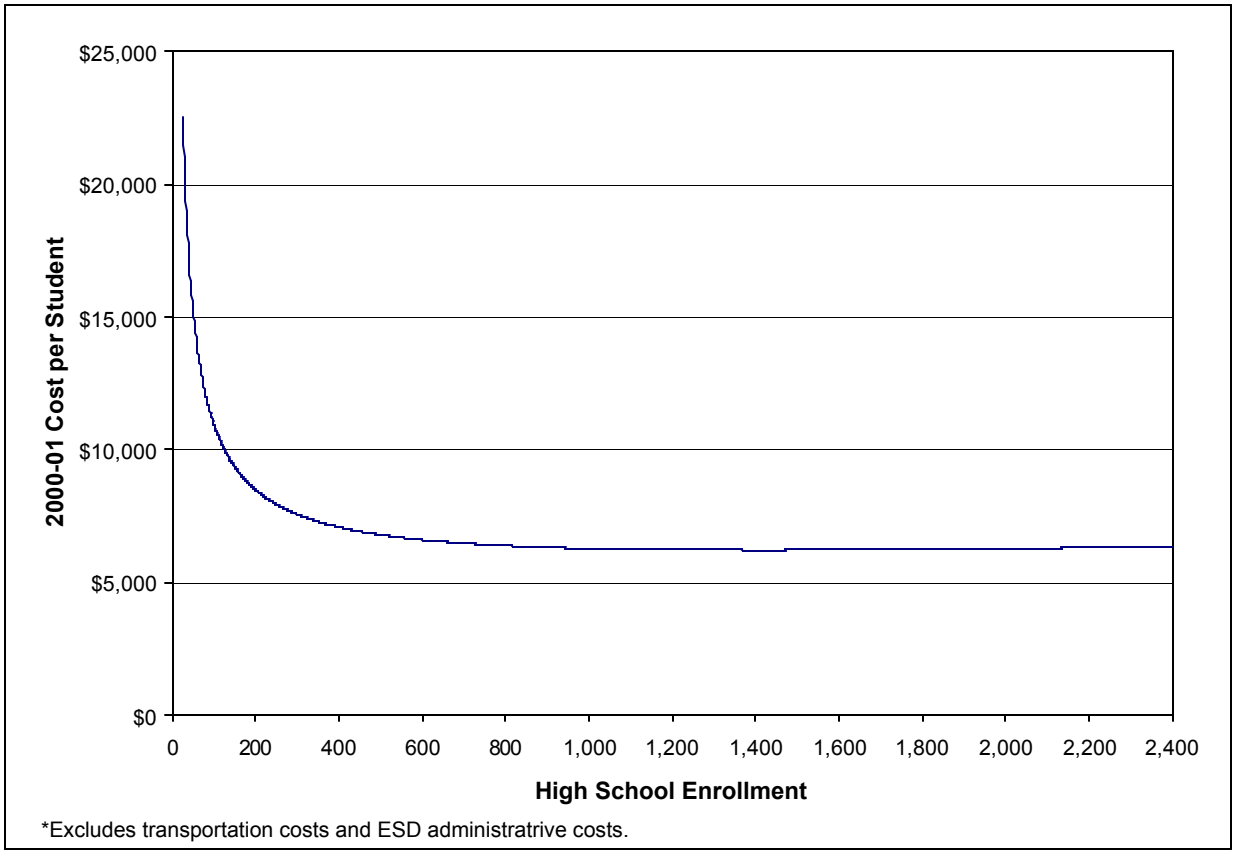
An education cost function is designed to estimate how much a school or district must spend to obtain a given level of output. Educational output can be defined in a number of different ways, but in a system such as Oregon's where the state's education goals are defined in terms of student performance, it seems logical to define educational output also in terms of student performance. It is the inclusion of a measure of student performance that is the critical distinction between the concept of costs and simpler, and flawed, measures that are based solely on expenditures.

In estimating a cost function, we use a statistical procedure known as multiple linear regression to isolate the independent effects of a number of factors that influence educational costs. For the purposes of this study, we are interested in evaluating how costs vary with differences in school and district size, and regression analysis will allow us to isolate those effects.

Unfortunately, school size and district size are highly correlated for Oregon high schools, so it is not possible to determine, with complete certainty, which has the biggest effect. A number of factors indicate, however, that school size is the key factor affecting per student costs, with district size playing a smaller role. First, the largest cost in every school district is for licensed staff, which is almost exclusively school based. Second, other primary cost categories, such as instructional support and operations and maintenance, are also predominately school-based. And finally, the cost function results, despite the high correlation between school and district size, show that the effect of district size is not statistically different from zero, while the effect of school size is. For these reasons, we dropped the district size variables from the cost function equation and focused on school size. (For a detailed description of the cost function results, see Appendix B).

Figure 1 shows, based on the estimation of a cost function for Oregon high schools, how operating costs per student vary with school size. At sizes above about 300 students, costs per student do not vary much as school sizes get larger. At sizes below 300, however, costs per student rise dramatically as schools get smaller. One policy implication of this finding is that districts should avoid operating high schools of less than 300 students if at all possible. In practical terms, because of sparse population and high transportation costs, districts often have little choice about school size. **A key finding of our analysis is that there is a tradeoff between school size and other important costs faced by schools and communities, primarily transportation costs (both financial costs and student travel time) and the community identity and cohesion that often are centered in schools.** Increasing the size of high schools through school consolidations involves closing schools in some communities and busing those students longer distances. This involves greater financial costs for transportation, more student time spent traveling, and lost community identity and cohesion in the community suffering the school closure.

Figure 1: High School Cost Per Student by School Size*



*Excludes transportation costs and ESD administratrive costs.

Comparing the Results of the Two Approaches

Table 8 shows the results of the two different approaches for the high school of 120 students, and it also includes estimates for a high school with enrollment of 1,000 from both the cost function and the 1,000-student high school prototype from the Quality Education Model. The estimates from the cost function approach are close to those using the prototype approach: 7 percent higher for the high school of 120 students and 2 percent lower for the high school of 1,000 students. In general, the two approaches yield quite similar results and indicating the costs for a high school of 120 students are 50-60% higher than those for a school of 1,000 students.

Table 8: Comparison of Prototype School and Cost Function Estimates Of High School Non-Transportation Costs per Student, 2000-01*

School Enrollment	Prototype School	Cost Function	Percent Difference
120 Students	$9,452	$10,138	7.3%
1,000 Students	$6,393	$6,284	-1.7%

* Includes ESD support but excludes ESD administrative costs.

One advantage the cost function has over the prototype school approach is that the cost function can provide estimates of the cost of operating schools over a broad range of sizes, while the prototype approach requires constructing a separate prototype school for each different school size.

Taken together, the two approaches can provide a useful tool in evaluating the resource needs and costs of running schools of different sizes. The prototype school provides detailed estimates of the quantities and costs of each input needed to run a school (teachers, administrators, supplies, etc.). And the cost function, because it can estimate the cost of operating a school of any size, can be used to determine how much costs change as school sizes change.

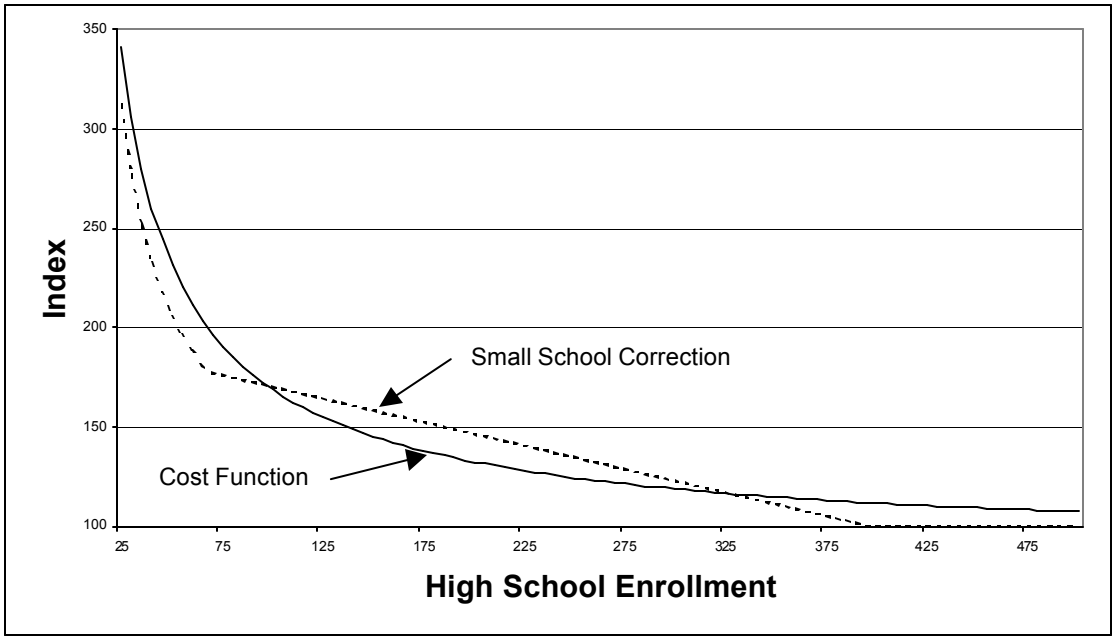
Section 3: Is Oregon's Small School Correction Working?

Oregon distributes state and local school revenue to school districts using a formula that allocates money based on a per weighted student basis. As part of the formula, small and remote elementary and high schools receive added student weights. In general, the smaller the school (measured by average daily attendance) and the more remote the school (measured by distance from the nearest school offering the same grades), the more added weights, and therefore more revenue, the district receives.

For elementary schools, the added weights are phased out at school sizes of 224 and above, and for high schools, the added weights are phased out at sizes of 350 and above. The distance factor limits the added weights to elementary schools that are more than 8 miles away from the nearest school, with the factor increasing to it's maximum value of 1.0 for schools 12 or more miles away. For high schools, the distance factor limits the added weights to schools that are more than 10 miles away from the nearest school, but that factor is being phased out so that all small high schools with fewer than 350 students will receive added weights starting in the 2005-06 school year.

Figure 2 shows a comparison of the small high school correction (assuming full phase-out of the distance factor) and the results of the high school cost function described in Section 2. Both are expressed as indices having a value of 100 at a school size of 1,000, the high school size used in the Quality Education model and a size where per student costs are close to their minimum.

Figure 2: Indices of High School Costs by School Size
School Size of 1,000 = 100



The graph shows that, in general, the small school correction results in per-student resources that are fairly close to the relative costs estimated by the cost function. In other words, the small school correction does a pretty good job at adjusting for the cost variations that result from variations in high school size.

It is important to note that the cost function approach excludes transportation costs, as does the approach used to calculate the small school correction. To the extent that transportation costs per student vary with school size, the Small School Correction probably does not fully compensate small high schools and districts (particularly the smallest ones) for their higher transportation costs. We turn to that issue in the next section.

Section 4: How Do Transportation Costs Vary with School Size?

Because of the remoteness of many of Oregon's small schools, and the sparse populations they serve, we would expect that per student transportation expenditures would be higher—perhaps considerably higher—than for schools that are located in more densely-populated and less isolated areas of the state. Table 9 shows the average transportation expenditure per student for districts of different sizes. It would be preferable to have school level expenditures, but few school districts collect transportation expenditures at the school level. But because most small schools are in small districts, the distribution of transportation expenditures for districts should approximate fairly well the distribution for high schools.

Table 9: Transportation Expenditures per Student
by District Size, 2000-01

District Enrollment	Total Enrollment	Transportation Expenditures	Expend. per Student
100 or Fewer	1,420	$1,959,949	$1,380
101 to 200	1,107	$868,434	$784
201 to 300	3,358	$2,053,081	$611
301 to 500	7,753	$3,922,891	$506
501 to 1,000	25,343	$11,107,423	$438
1,001 to 1,500	17,983	$6,739,262	$375
1,501 to 2,000	18,219	$6,172,624	$339
2,001 to 5,000	116,204	$39,669,346	$341
5,001 to 10,000	119,826	$38,978,860	$325
10,000 to 20,000	111,058	$35,907,597	$323
20,001 to 50,000	68,708	$19,356,057	$282
Greather than 50,000	53,096	$15,046,779	$283
Total	544,075	$181,782,305	$334

As expected, transportation costs per student decline consistently as size increases, and the differences in costs per student for different district sizes are quite large. Transportation costs per student in the districts of 100 or fewer students are nearly 5 times as much as those in the largest district.

Despite the 70% reimbursement by the state for qualifying transportation expenditures, transportation costs can have a disproportionate burden on districts if the share of total expenses represented by transportation varies significantly by size or if the share of expenditures that do not qualify for reimbursement varies by size. Table 10 shows both reimbursable and non-reimbursable transportation expenditures as a share of total operating expenditures for districts of different sizes. Smaller districts spend a larger share of their resources on transportation than do larger districts, with the smallest districts spending more than twice as much as the largest districts. Because only 70% of these reimbursable expenditures are actually paid for by the state, the 30% share paid by the districts represents a larger burden for small districts than for large. This means that smaller districts must use resources for transportation that otherwise could go into instructional activities to a larger extent than do larger districts. The higher

percentage of **non-**reimbursable expenditures that small districts experience exacerbates this problem.

Table 10: Transportation as a Share of Total Expenditures By District Size, 2000-01

School Enrollment	Reimbursable Expenditures: 70% State Share	Reimbursable Expenditures: 30% District Share	Non-Reimbursable Expenditures
100 or Fewer	6.02%	2.58%	1.32%
101 to 200	3.96%	1.70%	1.09%
201 to 300	3.99%	1.71%	1.07%
301 to 500	3.86%	1.65%	0.66%
501 to 1,000	3.86%	1.66%	0.57%
1,001 to 1,500	3.47%	1.49%	0.48%
1,501 to 2,000	3.28%	1.41%	0.40%
2,001 to 5,000	3.24%	1.39%	0.29%
5,001 to 10,000	3.33%	1.43%	0.13%
10,000 to 20,000	3.15%	1.35%	0.10%
20,001 to 50,000	2.77%	1.19%	0.08%
Greater than 50,000	2.42%	1.04%	0.03%

Based on the evaluations of the small school correction and the level of transportation spending by districts and high schools of difference sizes, we make the following conclusions:

- The small school correction does a fairly good job at adjusting for the *non-transportation* cost differences between high schools of different sizes. Some minor adjustments are needed to make it more closely follow the variation in costs across schools of different sizes.

- Transportation costs for small districts (where most small schools are located) are much higher than they are for larger districts. As a result, small districts must use relatively more resources for transportation that otherwise could be used for instructional programs than do larger districts.

Section 5: Opportunities for Reducing Small High School Costs

While small schools appear to spend more per student on most functions than do larger schools, the greatest cost differences are in licensed staff salaries. It follows that the greatest potential for cost savings in small schools may lie in using staff and other resources more efficiently to reduce the number of licensed staff required to serve a given number of students. In discussions with superintendents, principals, and district business managers, they identified the following areas of potential costs savings. The first group focuses on cutting costs by reducing the number of teachers. The second group looks at costs savings in areas outside the classroom.

Reducing the Number of Teachers

- **More efficient use of teacher aides:** this may reduce the number of teachers needed or result in more effective teaching with the ones a school has.
- **Greater use of distance learning:** by providing the opportunity for students to take internet-based or V-Tel courses, schools may be able to reduce their teaching staffs by eliminating some classroom-based courses, particularly higher-level courses that may have only a few students. Alternatively, schools may be able to offer a broader curriculum with the same number of teachers.
- **Greater use of opportunities at community colleges for advanced courses:** as with distance learning, by utilizing community college courses for students requiring higher-level courses, high schools may be able to reduce the number of teachers or offer a broader range of courses with their existing staffs.
- **Increased use of integrated thematic teaching methods that can reduce teacher/student ratios:** where teachers can teach multiple subjects in an integrated-thematic approach, fewer teachers may be needed.
- **Teacher sharing with other schools:** where schools are not too far apart, schools may be able to share teachers.
- **Teaching specialized subjects every other year instead of every year, allowing a broader curriculum with a given number of teachers teachers:** this would allow all students an opportunity to take specialized courses since each course could be offered twice in the four years a student is in high school.

Reducing Costs Outside the Classroom

- **4-day school week:** a number of schools currently are using a 4-day week to reduce costs and eliminate a travel day for students and staff. The cost savings appear to be relatively small and are limited primarily to lower building maintenance and energy costs.

- **Cooperative arrangements with other districts:** With the help of ESDs, small districts and schools may be able to increase efficiency and reduce costs in areas such as supply and textbook purchasing, technology, professional development, and other areas where economies of scale are present.

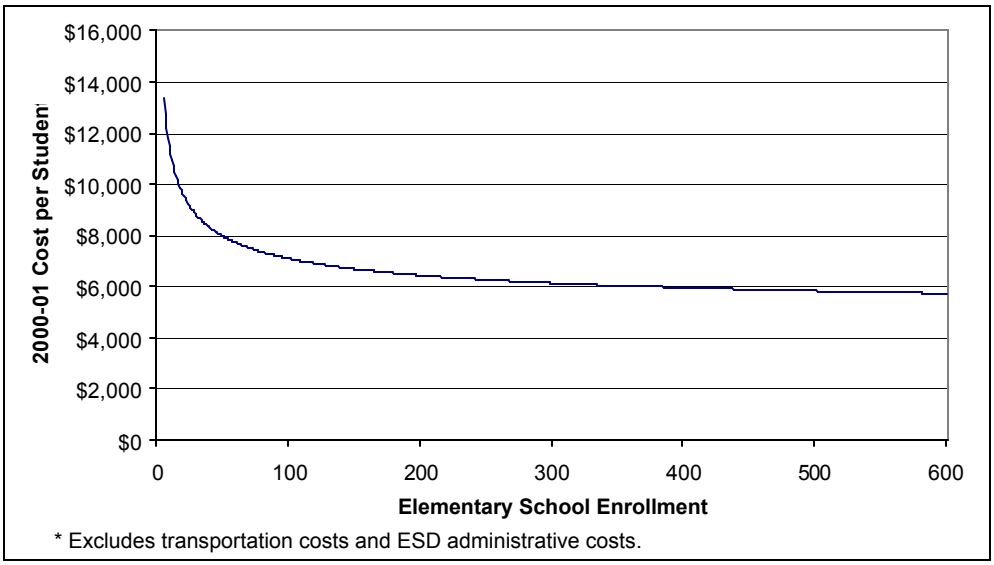
Section 6: Evaluation of Elementary Schools

Our analysis so far has focused on high schools, but Oregon also has a significant number of small elementary schools. We do not do a separate analysis of middle schools because most small districts in Oregon do not operate free-standing middle schools: the middle school grades are typically combined with other grades to form K-8 schools, 7-12 schools, or K-12 schools.

In addition to building the small high school prototype discussed earlier, we also built a small elementary school prototype serving 84 students and a small 7-12 school prototype serving 180 students (the detailed prototype tables for these are shown along with the small high school prototype in Appendix A). Using the prototypes, we estimate that operating an elementary school of 84 students would cost $8,047 per student (excluding transportation costs and ESD administrative costs), about 47 percent higher than the 340-student elementary school in the Quality Education Model. Similarly, a 7-12 school of 180 students is estimated to cost $7,549 per student, 20 percent higher than the 500-student middle school in the Quality Education Model (all cost estimates use data from 2000-01).

In addition to the prototypes for the small elementary and 7-12 schools, we estimated a cost function for elementary schools using the percentage of students meeting standards on the 3rd and 5th grade math and reading benchmark tests as our measure of student performance. The graph below shows the relationship between operating costs and elementary school size based on the 5th grade math equation (the reading equation yields similar results). For a school with 84 students, the cost function estimates per student costs of $7,289, about 9 percent lower than the estimate from the prototype school approach.

Figure 3: Elementary School Costs per Student by School Size*

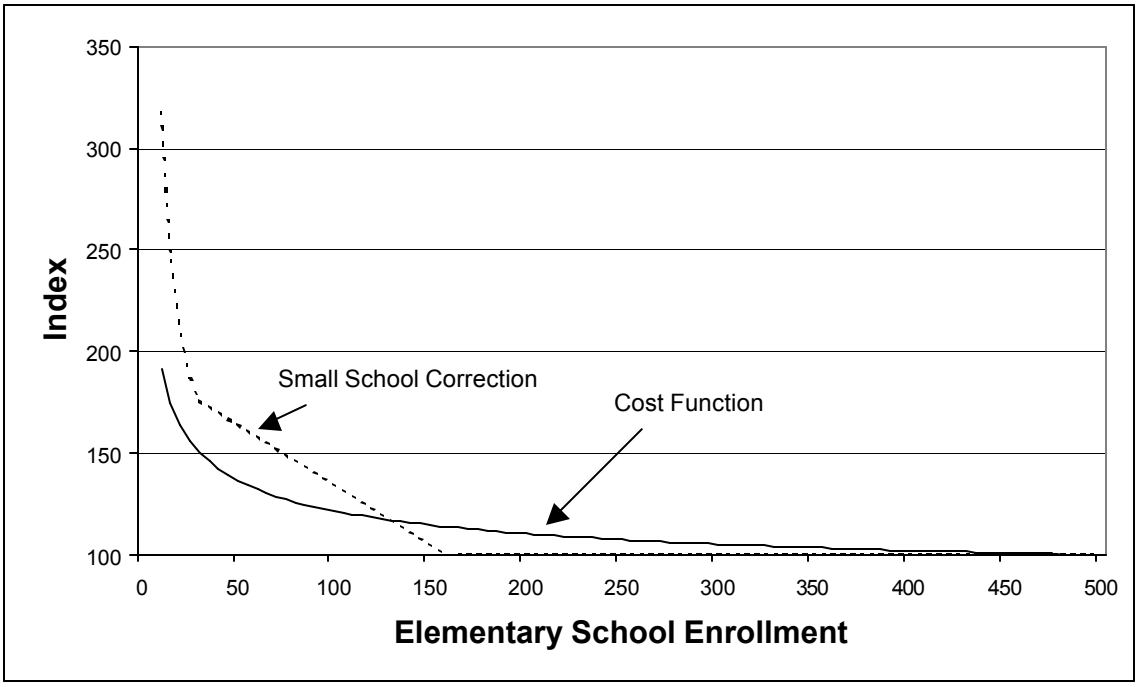


* Excludes transportation costs and ESD administrative costs.

As with high schools, the costs per student are dramatically higher at smaller elementary school sizes. For elementary schools, costs per student fall steadily as school size increases, flattening out at about 200 to 300 students.

For elementary schools, like for high schools, we compare the results of the cost function estimation to the level of resources available to schools qualifying for the Small School Correction. The results for high schools, shown above in Figure 2, indicate the Small School Correction does a pretty good job of adjusting for the higher costs of small high schools. For elementary schools, however, the Small School Correction is higher than the cost function for nearly all school sizes, giving relatively more resources to districts with small schools than the cost function results indicate is warranted, particularly for the smallest schools. This higher compensation to districts with small elementary schools could be considered, however, payment of the higher transportation costs faced by districts with small schools.

Figure 4: Indices of Elementary School Costs by School Size
School Size of 500 = 100

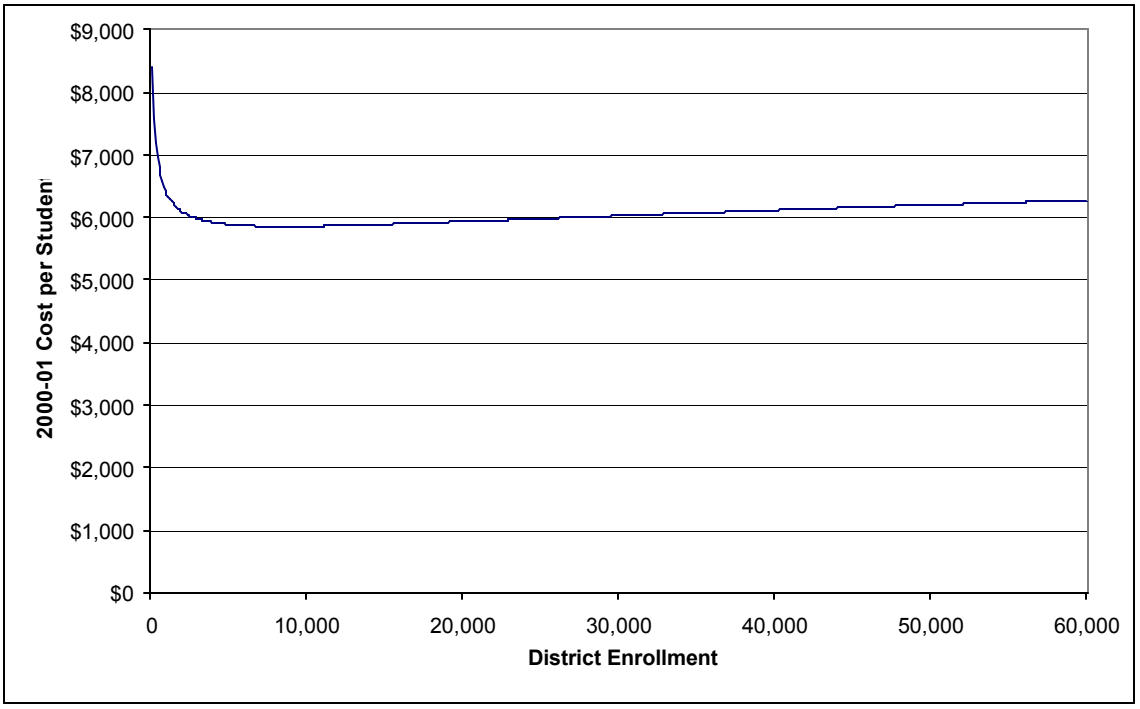


District Size

Unlike for high schools, where district size did not appear to have a statistically significant independent effect on the per student costs, for elementary schools district size does affect costs. Figure 5 shows the relationship between district size and per student costs as estimated by the cost function, holding all variables other than district size constant. Costs fall dramatically as district size increases to about 2,000 students.

The decline in costs then flattens out, climbing slightly at larger district sizes. In Oregon, about 14% of all students attend districts with fewer than 2,000 students.

Figure 5: Elementary School Costs per Student by District Size, 2000-01



The two approaches used in this study to estimate school costs—the prototype school approach and the cost function approach—yield similar results for elementary schools just as they did for high schools. This consistency will allow analysts to use the small elementary school prototype to evaluate detailed resource needs for schools of that size--84 students in the elementary prototype. Analysts can then use the cost function to estimate how per student costs change as school sizes differ from the size for which the prototype was built.

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