Funding For Success: The Cost of Delivering a Quality Education In Maine's Small Rural Secondary Schools

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ABSTRACT

Larger schools may benefit from economies of scale, but the geographic makeup of Maine requires the existence of small rural schools in isolated or sparsely populated areas. The study focused on both the issue of size and geographic isolation. School, community, and student characteristics were used in a regression analysis to identify the enrollment threshold at which per-pupil expenditures rise to the point where an amount that might be adequate in a larger school would be inadequate in a smaller school. The results of this analysis suggest that schools with fewer than 600 students spend more per pupil relative to estimated costs with an adequacy model, and schools with fewer than 100 students spend the most relative to estimated costs. Road miles were used to determine how far students may be expected to travel to their high schools.

In 1997 Maine developed *Learning Results*, a set of educational standards that each student is expected to achieve. Each school district in the state is responsible for ensuring that every child in the district graduates having met these standards, and in 2002 a new model for school funding was written into law to provide the financial means to achieve this goal. This funding model is called *Essential Programs and Services* (EPS) and was designed to provide each school with the financial resources to ensure all students meet the *Learning Results*, regardless of where they live.

Economic theory suggests that larger schools benefit from economies of scale should operate at lower per-pupil costs. Theoretically, small schools will operate at a higher cost per pupil due to necessary fixed expenditures (building, teacher, principal) and a small number of students. In some predominantly urban states, efforts are made to ensure schools don't become too large. The reality in Maine is that small schools are often not a matter of choice, but a matter of necessity due to the fact that it is a predominantly rural state with many communities located in sparsely populated areas. If higher per-pupil costs exist in small, rural districts, such districts either need to spend the resources necessary to continue to provide their students with a quality education, or be content with curriculum limitations (Monk as cited in Verstegen, 1991). If schools do not have the financial means to choose the former, students may receive inadequate educations due to their residential circumstances.

The EPS funding model is a census model that provides funds based on a district's resident enrollment and does not, by design, take into account any potential relationship between size and per-pupil cost. If such a relationship exists, the potential exists to build adjustments into the formula to provide small schools with supplemental funds to help offset the higher per-pupil costs associated with low enrollment. Determining whether such a relationship exists is imperative, given the projected dramatic decrease in enrollment in Maine's schools over the next 10 years. Recent estimates by the Maine Planning office project a decrease of 12.5% in school-age enrollment throughout the state between October 1, 2004 and October 1, 2013. Four individual counties alone are estimated to experience declines in resident enrollment of over 20%. (Maine Department of Education, 2004). The average projected enrollment decline for schools with fewer than 300 students is approximately 20%, indicating that small schools are going to be among the hardest hit by low enrollments.

This research was designed to examine the relationship between size and per-pupil cost, and to explore the concept of geographic isolation as it pertains to Maine's secondary schools. It is expected that this information could be used in two ways: 1) to aid in determining whether a funding adjustment for small schools is necessary, and 2) to provide information to be used in identifying Maine's geographically isolated secondary schools. This analysis only pertains to secondary schools due to the lack of readily available school-level data for elementary schools in Maine. All, but one, districts in Maine operate a single high school, allowing for secondary school-level analysis to be conducted.[1] It is expected that similar methodology could be used for an analysis of elementary schools when school-level expenditure data are made available.

Studies of School Size and Cost

Swanson (1988), in a review of the literature on the relationships between size, achievement and cost, found there to be little agreement on optimal school size. All but one of the cost-function studies reviewed by Andrews, Duncombe, and Yinger (2002) were conducted at the district, rather than school level. However, they acknowledged the existence of production-function studies that had been conducted at the school level. Although these studies reveal inconsistent results, they do suggest evidence that elementary schools with enrollments between 300 and 500, and secondary schools with between 600 and 900 students may be an optimal size.

The school-level cost function study reviewed by Andrews et al. (2002), was a study of a sample of public Maine elementary schools intended to

[1] Staffing expenditures were allocated by the percentage of district staff in each school; operation and maintenance and system administration were allocated by the percentage of district pupils in each school.

compare estimates of economies of size under the assumption of managerial efficiency (the traditional assumption) and managerial inefficiency. A comparison of two models used for estimating the cost function (ordinary least squares and frontier regression) suggested evidence of managerial inefficiencies in the schools studied. The study revealed economies of size under the assumption of managerial efficiency, but not under an assumption of managerial inefficiency (Deller & Rudnicki, 1992). Bowles and Bosworth (2002) conducted a school-level study using Wyoming school-level expenditure data, and found that a 10% increase in school size decreased cost per student by approximately 2%.

Bickel, Howley, Williams, and Glascock (2001) used regression analysis to examine the relationships between size, achievement, and cost in a sample of Texas high schools. Using expenditures per pupil as the dependent variable, a statistically significant and negative relationship between size (natural log) and per-pupil cost was found, indicating higher per-pupil expenditures in small schools.

The review of the literature did not identify many studies of the relationships between size and cost at the school level, as the majority of such studies have been conducted at the district level. The lack of availability of school-level expenditure data in most states has been a significant barrier in conducting such a level of analysis.

Funding Adjustments for Small Schools

Supplemental funds to offset higher per-pupil costs are usually provided to small schools that qualify based on low enrollment alone, or both low enrollment and geographic isolation. Using strictly enrollment provides additional support to all small schools. Using both enrollment and geographic isolation is based on the belief that a state should only offset the higher per-pupil costs of small schools for which there are no feasible options (Bass & Verstegen, 1992).

Information regarding small school adjustments in other states was collected from the publication, Public School Finance Programs of the United States and Canada, 1999 – 1998 (2001). Adjustments in other states were examined for enrollment thresholds and geographic isolation definitions. Fourteen states include an adjustment in their school finance formulas that provide additional funds to districts based on small school size. The majority of states include separate elementary and secondary enrollment thresholds; only three states have one threshold that applies to all schools. There is considerable variation in the enrollment thresholds used for the adjustments. The secondary enrollment thresholds range from 35 to 970. The majority (six of the 10), however, are between 300 and 599.

Five of the 14 states with small school adjustments also include “necessary” or “geographically isolated” criteria that a school must meet to receive an adjustment. Four states use the criteria to determine the level of adjustment schools will receive. The three primary methods used are the distance between a high school and the nearest high school, the distance an individual student has to travel, and the maximum time a student is permitted to be on the bus.

Bass and Verstegen (1992) recommend that states consider a number of factors when determining an adjustment. First, states need to identify the educational resources that should be provided to all students, and determine whether the costs of such resources are higher in small schools. They then need to establish whether geographic isolation should be a consideration in either qualifying schools for a funding adjustment and/or determining the level of such an adjustment.

Using the EPS funding model as the measure of the educational resources that should be provided in each school in Maine, the remaining portion of this study is aimed at providing policymakers information to address the latter two considerations in the deliberation of a small school funding adjustment for Maine’s secondary schools.

Sources of Data

The sample includes Maine's 118 100% publicly funded secondary schools. Maine operates an additional 11 high schools that are 60% or more publicly funded and provide public education for students in districts without a high school. Funds from these schools come from tuition, rather than a direct allocation from state and local funds, therefore these schools were excluded from the analysis. The source of median household income was the 2000 United States Census. The geographic data was provided by the Maine State Geographic Information Systems Department. The projected enrollment data was provided by the Maine State Planning Office, and is from their 2000 projections. MEA data was compiled from the Maine Educational Assessment. All remaining data were provided by the Maine State Department of Education.

Methodology for Size Analysis

The first part of this study examines whether there are apparent enrollment thresholds where per-pupil costs rise as a result of low enrollment. First, a comparison was made between what schools are actually spending and what they are estimated to spend under EPS. This was calculated by subtracting the EPS per-pupil estimate from actual per-pupil expenditures. This figure represents a school's per-pupil expenditures relative to the estimated per-pupil EPS cost. Multiple regression was used to determine whether this difference is related to school size, holding student and community characteristics constant.

The EPS funding model includes recommended staff-student ratios, per pupil amounts for supplies and equipment, specialized services, (professional development, student assessment, technology, instructional leadership support, co-curricular and extra-curricular student learning), and district services. Additional dollars are also provided for specialized populations that have been determined to increase costs, such as students in early grades, students with limited English proficiency, and disadvantaged students (defined as students eligible for free or reduced lunch) (Maine State Board of Education, 1999).

For the purpose of this analysis, operating costs excluded the cost of special education, vocational education, transportation, major capital outlays, and debt service. Special education, vocational education, and transportation are excluded from this analysis because they have not yet been formally built into the EPS funding model.

The dependent variable used in the regression analysis was the difference between the actual per-pupil expenditures and the estimated per-pupil cost under EPS. The estimated cost under EPS was available for the 2003 – 2004 school year. Using 2001 – 2002 data, an estimated per-pupil cost using the EPS model was calculated. The dollar amounts were then adjusted to 2003 - 2004 dollars using the actual inflation factor of 1.4% for the first year, and the CPI annual inflation rate of 2.5% for the second year. For comparison purposes, actual per-pupil expenditures from 2001 – 2002 were adjusted to the comparable year using the same inflation factors. Table 1 displays the mean per-pupil expenditures, EPS per-pupil estimates and differences by enrollment increments of 100 students.

Table 1. Difference Between Actual Expenditures and Estimated Cost

	Number of High Schools	Actual Per-Pupil Expenditures		Estimated Per-Pupil EPS Cost		Actual - EPS	
		M	SD	M	SD	M	SD
1000 or more students	13	$5,798	$692	$6,413	$335	-$615	$577
900 - 999	5	$5,867	$562	$6,245	$192	-$378	$551
800 - 899	7	$6,151	$789	$6,282	$181	-$131	$772
700 - 799	9	$5,871	$324	$6,127	$168	-$256	$394
600 - 699	9	$6,193	$775	$6,096	$196	$98	$810
500 - 599	10	$6,659	$1,286	$6,071	$204	$587	$1,242
400 - 499	8	$7,060	$956	$6,311	$213	$749	$956
300 - 399	19	$6,713	$827	$6,035	$248	$678	$811
200 - 299	15	$7,032	$999	$6,110	$303	$923	$923
100 - 199	15	$7,085	$832	$6,097	$587	$989	$1,089
Fewer than 100 students	8	$10,486	$3,191	$5,952	$330	$4,534	$3,382

School size was entered into the model as a series of indicator variables using the enrollment groupings from Table 1. Sloan and McIntire (2004) used this method in a recent study of Maine school district size. To identify enrollment breaks, these were coded as inequalities. In essence they are not mutually exclusive groups, but represent schools at or below each enrollment grouping. This allows for the use of t-tests on the coefficients to identify potential enrollment breaks. Enrollment groups are combined if corresponding indicator variables are absent from the model.

Characteristics indicating a community's ability to pay for education and education tax effort were included as potential independent variables. Median household income (as reported by the Census 2000) and per-pupil valuation were used to control for a community's ability to pay for a public education. The per-pupil valuation of a district is defined as the annual state property valuation for each community divided by the number of public school students. Per pupil valuation and median household income are both factors in determining a community's ability to raise local funds for education (Gravelle & Silvernail, 2004). The mills raised for education in 2001 – 2002 was included to capture a community's tax effort toward education.

Three-year average Maine Educational Assessment (MEA) composite scores were included to control for the student achievement of the school. The school years included were 1999 – 2000, 2000 – 2001, and 2001 – 2002. The six content areas included in the composite score are: math, reading, writing, science, social studies, and arts and humanities. Including a measure of output is necessary in this analysis to control for the potential that some schools may be spending less per pupil at the expense of student achievement.

Three factors used in the EPS funding model were included as independent variables. The EPS model allocates additional funds for the added costs of educating students identified as Limited English Proficiency (LEP), and economically disadvantaged students (eligible for free or reduced lunch). The model provides 30% - 60% more funds for an LEP student, and 15% more for an at-risk student. The 2001 – 2002 proportions of students with each of these characteristics were included as independent variables. The third variable was a teacher salary cost index used to adjust for labor cost differences among geographic regions. Although it is expected that these three characteristics impact per-pupil costs, this impact may differ from district to district. Including them as potential variables in the model adds a control for this differential.

Size Analysis Results

A stepwise multiple regression analysis was conducted. The appendix includes the descriptive statistics for each variable considered in the regression model. The regression yielded five significant variables related to the difference between per-pupil expenditures and per-pupil EPS cost, and an R-squared of .70. The mean of the continuous independent variables in the equation were set to zero. This method was used by Sloan and McIntire (2004) in their analysis of Maine school district size, and permits a straightforward interpretation of the coefficients. Each coefficient can be interpreted as the expected change in the difference between actual expenditures and EPS costs with one unit change of the independent variable, assuming the state average in the continuous variables. Table 2 displays the results of the regression.

Table 2. Multiple Regression Results

Dependent Variable: Per-Pupil Operating Expenditures - Per-Pupil EPS Cost			
Independent Variables	**Unstandardized Coefficient**	**Standardized Coefficient**	**Significance**
Constant	$72		0.636
Enrollment fewer than 600	$689	0.20	0.001
Enrollment fewer than 100	$2,083	0.32	0.000
Per-Pupil Valuation Index	$1,034	0.68	0.000
Mills Raised for Education	$251	0.35	0.000
Salary Cost Index	-$5,874	-0.22	0.000
Adjusted R^2 = .70			

Two enrollment variables proved significant in the model. The analysis indicates that, all else being equal, schools with fewer than 600 students are spending more than the estimated EPS per-pupil cost. The difference between actual expenditures and EPS cost is highest for schools with fewer than 100 students. Assuming a state average in all other variables, and comparing to schools with 600 or more students, the actual per-pupil expenses relative to per-pupil cost is approximately $689 more for schools with 100 – 599 students, and $2,155 for schools with fewer than 100 students. The value of the constant term suggests that schools with 600 or more students, assuming the state average in the other variables, may be equal to the EPS estimate.

The significant and positive signs on per-pupil valuation and mills raised for education suggest that the fiscal ability and educational tax effort of a community both positively impact spending on K – 12 education. The MEA composite variable did not prove to be a significant variable in predicting per-pupil expenditures relative to the estimated EPS per-pupil cost. These are notable findings as they suggest that, although districts that have more fiscal resources available may be spending more per pupil on secondary education, schools with less are not impacted to an extent that the achievement level of their students is lessened.

Geographic Isolation

The second part of the study examines where schools are located relative to other schools to provide information that could be used to identify geographically isolated schools. The concept of geographic isolation as related to schools is unique to each state. Geographic, political, and historical factors all contribute to the policy decisions made in this area. Distance and driving time are the two most frequently used criteria in other states to qualify a school as isolated. This qualification is usually used to identify schools eligible for an adjustment or determine the amount of adjustment necessary.

Methodology for Geographic Isolation Analysis

The first step in examining how to define this in Maine may be to identify how far or long students are currently traveling to attend their high school. Ideally, data on where each individual student lives relative to his/her high school can be used for this purpose. However, such data are not readily available in the state of Maine. For the purpose of this study, the approximate road miles between a high school and the furthest point in its district were used to determine the furthest distance students are potentially traveling to attend their high school. (Road miles consider geographic barriers to transportation.) This can then be used as a comparison point to determine how far high school students should be expected to travel if their high school was not in operation. Of the 118 public secondary schools in Maine, distance data was not available for eight schools. It should be noted that this distance does not consider the distance a student may have to travel if they are tuitioned to a school outside of their district.

Geographic Isolation Analysis Results

An analysis of this mileage data suggests that the distance a student may have to travel is partly dependent on the organizational structure of the school administrative unit where they reside. Four major organizational structures exist in Maine. School Administrative Districts, Community School Districts, and Unions of Towns all are combinations of two or more municipalities that pool their educational resources in varying ways. Cities or Towns with Individual Supervision are single municipalities that educate all grades in that city or town. An analysis of variance revealed that the maximum distance students are potentially traveling to attend a high school in a City or Town with Individual Supervision is significantly different than that of a high school that is part of a School Administrative District or Union ($p < .01$). Table 3 displays the average distance between the furthest point in a district and the and the high school for the three enrollment ranges that appeared in the regression model.

Table 3. Road Miles Between High Schools and Furthest Point in District by District Type

	School Administrative Districts		City/Towns with Individual Supervision		Unions of Towns		Community School Districts		State
Size Range	**Schools**	**M**	**Schools**	**M**	**Schools**	**M**	**Schools**	**M**	**Average**
600 or more	21	17.9	18	11.6	1	22.0	2	10.1	**14.9**
100 - 599	31	19.1	16	10.2	9	23.3	7	13.9	**16.9**
Fewer than 100	3	8.9	1	11.1	1	34.9			**14.5**
Total	55	18.1	35	10.9	11	24.2	9	13.1	**16.0**

Distance data was not available for 8 schools.

For the purpose of this study, the statewide average maximum distance a student is potentially traveling to attend high school in a different town was used as the maximum distance a student should be expected to travel. This distance is eighteen miles.

Two steps were taken to determine the potential distance a student would have to travel to the nearest high school if the current high school was not in operation. First, road miles were used to determine the nearest public or semi-public high school that publicly educated students might attend. The second step was to calculate the distance between the furthest point in the district and that high school. This distance was chosen over using simply the distance between a high school and its nearest high school due to the wide geographic area of many Maine districts. Two issues that must be noted with using this methodology: 1) the nearest high school chosen was the school closest to the current high school for that district. There may be another high school closer to students that live in the furthermost areas of the district. 2) This does not consider actual travel time or transportation issues due to inclement weather or poor road conditions.

Using this information, a potential definition of "geographic isolation" may be based on two criteria. The nearest high school must be more than 18 miles from the furthest point in the district, or a school is located on an island. The first criterion indicates that schools are necessary in areas where, in the absence of the existing school, students may have to travel a significantly longer distance to attend school. Islands have natural geographic barriers that require the operation of schools to educate the small number of children living in these areas.

Schools were analyzed to identify how many would qualify as isolated using these criteria. School-level enrollment projections were used to determine how many schools would fall into each of these categories in 2015, assuming the current number and location of high schools. Table 4 displays the number and percentage of schools that would be considered geographically isolated under this definition by the enrollment ranges suggested in the regression analysis.

Table 4. Current and Projected Number of Schools "Geographically Isolated" High Schools

Size Range	Current			Projected in 2015		
	Total High Schools	Isolated High Schools	Percent of Schools	Total High Schools	Isolated High Schools	Percent of Schools
600 or more	43	19	44%	39	16	41%
100 - 599	67	40	60%	62	36	58%
Fewer than 100	8	7	88%	17	14	82%

Distance data was not available for 11 schools.

Table 5 displays the average distance a student may have to travel to attend the 66 schools that are currently categorized as geographically isolated according to the definition in this study. The potential distance students would have to travel to attend high school, in the absence of their current school is significantly greater. The increase in the average potential distance students may travel is the greatest for schools with fewer than 100 students.

Table 5. Average Distances for "Geographically Isolated" High Schools

Size Range	Average Maximum Distance to Current High School		Average Maximum Distance to Next Nearest High School	
	M	SD	M	SD
600 or more	19.9	10.9	26.4	8.1
100 - 599	21.5	8.3	29.4	8.8
Fewer than 100	15.4	13.1	44.5	15.0

Discussion

All students have the right to an adequate education, and Maine's EPS funding model was developed to ensure each district has the means to achieve this. The results of this analysis suggest that schools with fewer than 600 students spend more per pupil relative to EPS than schools with more than 600 students. Schools with fewer than 100 students spend the most relative to EPS. The conclusion should not be drawn, however, that only schools with fewer than 100 students should be considered for supplemental funding because they appear to spend the most per pupil. Schools between 100 and 599 should also be examined to determine whether the smaller schools within that enrollment range are operating at a relative higher cost than the larger schools.

If small schools must operate at a higher per-pupil cost to provide their students an adequate education, and communities do not have the resources to raise these funds locally, students across the state will not receive equitable educational opportunities. A differential must be made, however, between necessarily existent small schools, and small schools that are small by choice. The expected decline in enrollments coupled with the financial climate in Maine indicates that efforts to increase efficiency in K – 12 education must be made. A recent study by the Task Force on Increasing Efficiency and Equity in the Use of K – 12 Educational Resources (2004), which was charged with examining this issue, included regionalization of services and potential consolidation of districts among its recommendations.

There may be potential for small, isolated schools to achieve cost savings through the regionalization of some services. Consolidation, however, may not be a possibility for the necessarily existent schools that must operate due to their geographic location, and lack of alternative options for students. The method for identifying geographically isolated schools used in this analysis is intended to identify such schools. As seen in Table 4, the geographic isolation analysis identified 47 schools with fewer than 600 students that are geographically isolated according to the definition in this study. Over half of the schools with 100 – 599 students and all but one of the schools with fewer than 100 students are considered isolated. By the year 2015, 17 high schools are projected to have fewer than 100 students, and the majority of these schools do not have high schools within a reasonable distance.

This method of identification has its limitations, however. It does not consider specific travel time that may differ depending on varying road conditions in different geographic areas and/or time of the year.

Considerations related to the impact of long or rough bus rides on student achievement, and the impacts on students' school or home experiences are also potential areas of concern. Current research on these impacts on rural students is necessary to appropriately address these concerns for the citizens of Maine.

This study provided information to be used in the deliberation of whether a small school adjustment is necessary for high schools and how schools might qualify to receive such funds. Further research is necessary to determine the exact level of such an adjustment and whether schools will receive varying amounts dependent on their size or location. The level of supplemental small school funds in other states is typically determined through either a flat amount distributed to all schools that qualify or on a sliding scale where the smallest schools receive the largest amount. A funding adjustment may also need to involve an appeals process, particularly for schools that may qualify on size or geographic isolation but not both. There may be schools or groups of schools that do not qualify on both enrollment and isolation with unique circumstances that result in higher per-pupil costs.

The development of an appropriate policy for ensuring an adequate education for students in small isolated schools is crucial as Maine moves toward a more equitable funding formula. Decisions regarding related funding adjustments may significantly impact the students in such schools, and must be made in such a way as to remain consistent with the underlying goal to provide all children an equal opportunity to achieve *Maine's Learning Results*.

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APPENDIX

Table A-1. District Characteristics by Enrollment Group

Enrollment Group	Enrollment	Local Mills Raised for Education	Per Pupil Valuation Index	Median Household Income Index	Regional Cost Adjustment
1000 or more	1211	11.80	1.00	1.10	1.03
900 - 999	941	11.65	0.90	0.95	1.00
800 - 899	842	12.90	1.07	1.30	1.04
700 - 799	757	12.73	0.79	1.12	1.00
600 - 699	668	12.31	1.38	1.22	0.99
500 - 599	557	12.99	1.25	1.24	1.00
400 - 499	450	13.56	1.11	1.23	1.02
300 - 399	346	12.01	1.08	0.98	0.96
200 - 299	255	12.22	0.99	0.90	0.94
100 - 199	142	13.10	0.76	0.83	0.93
Fewer than 100	59	10.60	2.97	0.89	0.97

Table A-2. Student Characteristics by Enrollment Group

	MEA Composite Score	Percentage of LEP Students	Percentage of Free/Reduced Lunch Students
1000 or more	532	3.38%	35.05%
900 - 999	531	0.58%	40.17%
800 - 899	532	0.46%	22.41%
700 - 799	531	0.41%	32.63%
600 - 699	533	0.13%	26.03%
500 - 599	532	0.30%	31.80%
400 - 499	532	0.23%	28.84%
300 - 399	531	0.18%	41.11%
200 - 299	530	1.73%	47.40%
100 - 199	529	5.73%	49.10%
Fewer than 100	531	2.37%	47.19%