The Development of School Finance Formulas to Guarantee the Provision of Adequate Education to Low-Income Students

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Introduction

In a series of legal actions starting with the landmark ruling by the California Supreme Court in *Serrano v. Priest* (1971), state courts have grappled with the problem of inequities in the financing of schools. Spurred by these court decisions, a majority of state legislatures increased the level of state funding for education, and adopted formulas for the distribution of school aid which were designed to increase the equity in school finance.[1] In particular, some states attempted to equalize per pupil spending across school districts. Other states attempted to guarantee that property-poor school districts would be able to achieve a given level of spending per pupil as long as they levied a standard property tax rate. Still other states attempted to guarantee that all school districts that chose the same property tax rate would be able to spend the same amount of money per pupil regardless of district property wealth.

The focus of most of these attempts to reduce inequities in school finance has been on the distribution of dollars. The implicit (and sometimes explicit) assumption behind these efforts is that a more equal distribution of fiscal resources will lead to increased equity in educational opportunities and in educational outcomes. There continues to be a debate, however, about the strength of the relationship between spending on education and educational outcomes; some scholars, notably Eric Hanushek (1989, 1997), argue that no consistent relationship exists between spending and educational outcomes, while others (e.g., Hedges, Laine, and Greenwald, 1994) challenge Hanushek's conclusions.

Even if it can be shown conclusively that spending money on public education results in substantial improvements in student performance, it is important to recognize that there is not a one-to-one relationship between spending and educational outcomes. A comparison of two districts with equal spending per pupil reveals that educational performance may be lower in one of the districts if the costs of providing any given level of education are higher in that district, or if that district is more inefficient in its use of resources.

[1] For a discussion of alternative definitions of equity in school finance see Berne and Stiefel (1984) and Reschovsky (1994).

The *cost* of education can be defined as the minimum amount of money that a school district must spend in order to achieve a given educational outcome, such as reading at a third-grade level at the end of the third grade. Costs differ across school districts for reasons that are outside the control of local school boards, such as the number of children with "special needs" or factors that increase the amount of money needed to attract good teachers, such as the area cost-of-living. Although actual expenditures are influenced by the costs districts face, they also reflect choices made by local school boards concerning the type and amount of education they provide and the ways they choose to allocate and organize resources used in achieving their educational objectives. Thus, a school district with below-average costs could have above-average expenditures because it chooses to provide its students with the opportunity to take a particularly wide range of advanced courses, or because it is relatively inefficient in its use of resources.

The importance of costs in any discussion of equity in school finance is that as long as equity is defined in terms of equal educational outcomes, the achievement of equity will require higher spending in districts facing higher costs. Conversely, equal per pupil spending across districts will not result in equal educational outcomes as long as some districts face higher costs than other districts.

Over the past decade, a number of state courts have begun to recognize the important role cost differences play in the design of policies for achieving equity goals. The courts have realized that equal per pupil spending or equal tax effort do not guarantee equal educational outcomes. This has led them to address issues of student performance more directly, by recognizing that equality of education, however defined, cannot be achieved unless explicit account is taken of the higher costs that are generally associated with educating children who come from poor or otherwise disadvantaged backgrounds. As William Clune (1994) has argued, the courts are moving from a focus on equity in spending to one of educational adequacy, with adequacy defined in terms of minimum standards of student performance. The courts appear to be arguing that states are responsible for assuring that all school districts provide an adequate level of education. A prerequisite for designing a school finance system that is capable of achieving this goal is knowledge of how much it will cost each school district to provide an adequate education for its students.

In Kentucky, the court ruled that the state constitution required the state do more to raise the level of student achievement in poor school districts *(Rose v. Council for Better Education, Inc., 1989)*. In both New Jersey and Texas, state courts concluded that the state legislatures' responses to previous court cases had been inadequate, and further efforts must be made to allocate more resources to poor districts plagued by low student achievement. In a Massachusetts decision *(McDuffy v. Secretary of Education, 1993)*, the state's Supreme Court specified seven specific "capabilities" that an educated child must possess. In effect, the court ruled that the state must develop a system of school finance which guarantees that all children be provided with an adequate education, which is defined in terms of a specified set of skills.

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The establishment of a school financing system that guarantees all students an adequate education requires that we be able to measure the costs of providing an adequate education in each school district. The purpose of this paper is to estimate a cost function for K–12 education and, using data from the state of Wisconsin, demonstrate how these cost estimates can be integrated into state aid formulas in a way that is consistent with the achievement of educational adequacy.[2]

[2] For a detailed discussion of how costs can be integrated into aid formulas designed to achieve various educational equity goals, see Ladd and Yinger (1994).

We start with a brief discussion of the limited ways in which cost considerations have been included in school aid distribution formulas. We also review several previous efforts to develop cost measures. We then discuss the methodological approach used in estimating public education costs and describe the data used in the analysis. Our estimated cost functions are presented next, followed by a discussion of developing a cost index for school districts in Wisconsin based on our estimated cost function. We demonstrate that costs vary substantially among Wisconsin's 368 school districts.[3] Next, we develop a school aid formula designed to achieve education adequacy and then simulate the distribution of aid for the academic year 1997–98 using both this formula and a conventional foundation formula. In a number of states, cost factors are introduced into school aid formulas by "weighting" poor or disabled students more heavily than "regular" students. We then use our analysis of costs to define an appropriate weight for poor children. Finally, we summarize our results and draw some conclusions.

Accounting for Costs in the Distribution of Education Aid

State government grants financed about 45 percent of total spending on elementary and secondary education in 1993–94, the latest year for which we have data (National Center for Education Statistics, 1997). Most of these grants were distributed using foundation or guaranteed tax base formulas. Foundation formulas are designed to equalize per-pupil expenditures. Guaranteed tax base or district power equalizing formulas are intended to equalize the tax rates necessary to provide any given level of per pupil spending. In most states, neither of these formulas explicitly take into account inter-district differences in costs.

. . . equalization aid formulas generally do not include adjustments for cost differences . . .

Although equalization aid formulas generally do not include adjustments for cost differences, state governments do provide categorical aid to local districts for the education of certain disabled or "special-education" students. In fact, federal legislation, the *Individuals with Disabilities Education Act*, requires that school districts provide all children with physical, mental, or emotional disabilities with a public education "...in the least restrictive environment appropriate for their educational progress... (p. 346)" (Chaikind, Danielson, and Brauen, 1993). Although the federal government financed nearly $4 billion in special education grants in fiscal year 1997, these funds accounted for only a small portion of total expenditures by local school districts on special education programs.

Some states help to finance the education of these special-needs students by giving them a heavier weight in equalization aid formulas. For example, by assigning a weight of 2.3 to each "disabled" student attending public schools, the state signals that it believes that the per pupil cost of educating these students is 2.3 times the cost of providing education to "regular" students. A number of states also assign extra weight to students from economically disadvantaged families.

As described in detail by Chaikind, Danielson, and Brauen (1993), estimates of the cost of educating disabled and other "special education" students come primarily from a limited number of detailed surveys of special education programs in small samples of school districts.[4] These surveys provide a detailed accounting of the resources expended to educate special education students. It should be noted, however, that tabulating spending on special education is inherently difficult, particularly when some special education students

[3] We have excluded Norris from our analysis. Due to an historical anomaly, Norris is officially a K–12 school district, but it is in fact a private "school for wayward boys" with a 1996–97 enrollment of about 75 students and a per pupil property tax base that is less than three percent of the state average.

[4] The national expenditure survey discussed by Chaikind, Danielson, and Brauen (1993) samples 60 school districts around the country.

divide their time in school between regular classrooms and separate special education classes. Furthermore, as both federal and state special education grants are allocated on the basis of the number of students classified as eligible for special education and the spending on special education programs, school districts may have strong incentives both to declare as many students as possible eligible for special education and to attribute to special education as much general spending as possible.

Even if special education spending data are accurate, they do not necessarily provide full information on the costs of special education. Spending data tell us how much money districts allocate to special education, but provide no information on the services actually provided to special education students. Because some states excuse students in special education programs from taking standardized tests, it is particularly difficult to assess how effective schools are at educating special-education students. Unless an effort is made to account for differences across school districts in the level and quality of special education actually provided, the use of "weights" for special education pupils in school finance formulas may either over or under count the true costs of educating special education students.[5]

Even if special education spending data are accurate, they do not necessarily provide full information on the costs of special education.

Although most state aid formulas do not account in any systematic way for differences in costs, several cost indices have been developed that could be used in school finance formulas to adjust for differences in costs. One approach, followed by Walter McMahon (1991, 1994), has been to estimate cost-of-living indices for school districts. A second approach, primarily associated with Jay Chambers (1981, 1995), has been to estimate hedonic wage equations for teachers and use the results to compute a teacher salary index or, more broadly, a cost of education index for individual school districts.

Although both of these approaches provide valuable information about differences in the costs of providing education, they go only part of the way towards the goal of providing a comprehensive cost index that can be used in school aid formulas. By definition, the concept of costs links school district spending to school performance. For reasons outside the control of local school officials, districts with higher costs must spend more to provide any given level of educational services than districts with lower costs. The higher salaries that school districts in high cost-of-living areas have to pay to attract teachers is only one reason why costs may be high. For example, depending on the composition of their student bodies, some districts may have to provide special programs and hire additional employees in order to achieve the same educational outcomes that other districts can provide without special programs or extra employees. For this reason, cost-of-living indices provide an inadequate basis for making cost adjustments to school aid formulas. Furthermore, as pointed out by Chambers (1995), the extent to which an area's high cost of living reflects attributes of a given location that teachers find attractive, cost-of-living indices may overstate the true costs of hiring teachers in attractive locations.[6]

The teacher salary indices developed by Chambers provide a more direct measure of school district costs than cost-of-living indices. Chambers estimates hedonic wage equations in an attempt to isolate those factors outside the control of local school districts that require some districts to pay higher salaries than others in order to employ teachers with similar qualifications to carry out similar teaching assignments. In his re-

[5] Duncombe, Ruggiero, and Yinger (1995) provide evidence that school aid formulas in New York state that include "weighted pupils" are likely to under-adjust for cost differences, and in some cases may actually magnify, rather than reduce, the underlying cost differences among school districts.

[6] McMahon (1994) recognizes that cost-of-living indices will reflect locational amenities. He suggests, however, that *ad hoc* adjustments can be made to cost-of-living indices to adjust for the presence of amenities (and presumably, locational disamenities).

cent report to the National Center for Education Statistics, Chambers (1995) identifies as cost factors the racial and ethnic composition of the student body, land costs, pupil-teacher ratios, and a range of variables that influence the attractiveness of any given geographical area, such as weather conditions and crime rates. Using the coefficients of the cost factors, Chambers constructs two teacher salary indices, one that varies by county and the other by school district.

Although these indices provide useful information about costs, they almost certainly understate the contribution to costs of various school districts' characteristics. To develop a comprehensive measure of costs, one must not only account for differences across districts in the cost of hiring teachers of a given quality to carry out a given assignment, but one must also account for the fact that some districts will have to hire more teachers and incur more non-teacher expenditures (e.g., on textbooks, social workers) in order to achieve any specific educational goal.

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Economists generally define costs as the value of resources needed to produce any given level of output. The typical cost-of-living or cost-of-education index is designed to measure the dollar cost of purchasing a given set of inputs to be used in the production of education. While indices of this type provide useful information, they fail to provide a comprehensive measure of costs. In recent years there have been several attempts by economists to develop more comprehensive measures of costs. These studies have been motivated by a desire to develop a straightforward way to account for cost differences in state government grant formulas to local school districts. They include studies of school districts in Nebraska (Ratcliff, Riddle, and Yinger, 1990), in Arizona (Downes and Pogue, 1994), in New York (Duncombe, Ruggiero, and Yinger, 1996), and in Michigan (Courant, Gramlich, and Loeb, 1994).[7]

In each of these studies, the authors find that costs varied substantially among school districts. The studies identify a number of local school districts' characteristics that influence the cost of public education. For example, Ratcliff, Riddle, and Yinger found five factors that both influence costs and lie largely outside the control of local public officials: the number of handicapped students, the number of students that the school district is required to transport, secondary school students as a proportion of a district's total enrollment, and the size and type of school districts. Downes and Pogue show that school "maintenance and operations" costs per student in Arizona are related to the ethnic composition of the student body, the incidence of poverty, the proportion of students with limited English proficiency, and school size. Cost factors identified by Duncombe, Ruggiero, and Yinger include district size, the percentage of children living in poor families, the percentage living in female-headed households, the percentage of students with disabilities and the percentage with limited English proficiency.

The above-mentioned studies have followed one of two approaches in estimating the costs of public education. One approach is to estimate cost functions directly for public education. By definition a cost function provides a measure of the value of total resources necessary to produce any given level of output or performance. Thus, the use of this approach requires that one be able to develop measures of public school output. Difficulties in measuring public sector outputs have led some researchers to attempt to identify costs through the estimation of reduced-form public education expenditure functions. Although the estimation of an expenditure function does not require the use of educational output measures, it is likely to lead to underestimates of the impact of various cost factors on education spending. These underestimates are likely to occur because in a reduced-form regression it is impossible to separate

[7] Paralleling these studies of the costs of education, several recent studies have attempted to measure the costs associated with the provision of municipal government services. These include studies of local government in Massachusetts (Bradbury, et al., 1984), in Minnesota (Ladd, Reschovsky, and Yinger, 1992), and in Wisconsin (Green and Reschovsky, 1994).

the impact of cost factors on the demand for public education from their direct impact on costs. Downes and Pogue (1994) provide a detailed discussion of the strengths and weaknesses of each approach, and then proceed to estimate the costs of public education in Arizona using both approaches.

In this paper, we attempt to estimate cost functions directly for the provision of K–12 public education in Wisconsin. As we will explain in detail in the next section, we pursue a methodological approach that is very similar to that used by Duncombe, Ruggiero, and Yinger.

Methodology

Following Bradford, Malt, and Oates (1969) and Inman (1979), it is useful to think of public school output as a function of school resources, such as teachers and textbooks, the characteristics of the students, and the family and neighborhood environment in which the students live. This relationship is represented by equation (1), in which S_{it} represents an index of school output, X_{it} is a vector of direct school inputs, Z_{it} is a vector of student characteristics, and F_{it} is a vector of family and neighborhood characteristics. The subscript *i* refers to the school district and subscript *t* refers to the year.

Of critical importance in estimating an education cost function is the accurate measurement of school district output . . .

$$(1)\quad S_{it} = g(X_{it}, Z_{it}, F_{it})$$

To move from this education production function to a cost function, we must specify the relationship between school inputs and educational spending. Equation (2) indicates that per-pupil expenditures, E_{it}, are a function of school inputs, X_{it}, a vector of input prices, P_{it}, and ϵ_{it}, a vector of unobserved characteristics of the school district.

$$(2)\quad E_{it} = f(X_{it}, P_{it}, \epsilon_{it})$$

Since cost functions are defined as the spending necessary to provide any given level of output, we can formulate a cost function for public education by solving equation (1) for X_{it}, and then substituting X_{it} into equation (2). The results is represented by equation (3), in which u_{it} is a random error term.

$$(3)\quad E_{it} = h(S_{it}, P_{it}, Z_{it}, F_{it}, \epsilon_{it}, u_{it})$$

In the "Results" section, we present estimates of equation (3) using 1994–95 data for K–12 school districts in Wisconsin. In the remainder of this section, we discuss a number of methodological and data issues that must be addressed in order to carry out these estimates. Table 1 displays descriptive statistics of the variables we use in our analysis.

Of critical importance in estimating an education cost function is the accurate measurement of school district output, S_{it}. The vast literature on educational production function tends to focus on student cognitive achievement as measured by standardized test scores. A commonly used measure of school output or performance is average test scores from achievement tests administered to all students. It seems reasonable, however, to assume that most voters, including parents, judge the effectiveness of schools by their ability to generate annual improvements in test scores. Robert Meyer (1996) demonstrates that average test scores alone provide a highly flawed measure of school output. He points out that average achievement on a test administered to tenth grade students, for example, measures the average level of achievement prior to entering first grade, plus the average effects of school performance, and of family, neighborhood, and student characteristics on the growth of student achievement from the first through the tenth grade. It is thus likely that rather than providing a measure of the contribution of schools to the growth in student achievement, the tenth grade score primarily reflects the impact of family and neighborhood environment on student achievement.

Table 1.—Descriptive statistics

Variables	Mean	Standard deviation	Minimum value	Maximum value
Per-pupil expenditures, 1994–95	$6,327	$759	$4,690	$9,053
Tenth grade exam score, 1995–96	75.9	7.2	29	94
Eighth grade exam score, 1993–94	73.6	7.5	34	94
Number of advanced courses	17.9	19.2	3	227
Teacher salary index	1	0.1	0.8	1.3
Percent of students eligible for free and reduced-price lunch	23.1	13.4	0	79.8
Percent of students with disabilities	12.2	3	0.8	43.9
Percent of students with severe disabilities	0.2	0.2	0	1.1
Percent of students enrolled in high school	32.4	3.4	22.6	45.9
Student enrollment	2,192	5,676	109	97,555
Median income	$27,821	$7,184	$14,122	$56,859
Residential tax base/Total tax base	58.7	15.1	14.8	98.6
Tax price	0.6	0.3	0.2	1.5
Categorical state aid	$289.2	$126.2	$48.9	$772.3
Percent of households with children	35.3	4.9	18.6	54.5
Percent homeowners	75.6	7.1	44.7	90.8
Percent elderly	14.8	3.9	5.6	28.3
Percent with 4-year college degree	12.5	6.9	3.4	60.1

SOURCE: U.S. Bureau of the Census (with data from the 1990 Census of Population and Housing) and the Wisconsin Department of Public Instruction.

For a more accurate measure of school output (at least the portion of output measured by increases in cognitive skills), it is important to use a "value-added" measure of pupil achievement. By focusing on the changes in test scores over time, this type of school output or performance measure isolates the contribution of school resources to increases in student achievement as measured by scores on standardized achievement tests. Meyer points out that because student mobility among school districts tends to be quite high, the construction of value-added measures of school output should be based on tests of the same students at regular intervals, preferably annually.

Although we do not have annual data, we are able to construct a value-added measure of student achievement in Wisconsin schools using biannual test scores. In the 1993–94 academic year, Wisconsin began to require that all students take standardized exams during the eighth and tenth grades and that the test results be reported to the Wisconsin Department of Public Instruction. Thus, we can construct a value-added measure for students who were eighth graders in 1993–94 and tenth graders two years later, in 1995–96.

While standardized tests are targeted to specific knowledge about core subject areas (in Wisconsin, these are reading, mathematics, language, general science, and social studies), another measure of the quality of schools is the breadth of the course offerings. The education a child receives will be enriched if the child is exposed to a wide range of subjects above and beyond the core subject areas. One measure of richness of the course offerings is the number of advanced courses offered. Data on the number of advanced courses offered provide a measure of the opportunities available to students. Although no direct information on the actual number of students enrolled in these courses is available, the fact that few school districts can afford to continue to offer specialized courses unless the courses have reasonable enrollments, suggests that the use of data on the number of courses provides a good measure of the actual richness and diversity of the school curriculum benefiting students.[8]

In the vector of school input prices, salaries are a crucial component. Teacher salaries account for the largest share of school expenditures. In our estimate of an education cost function, we include only teacher salaries, excluding explicit treatment of other public school employees. It is important to recognize that teacher payrolls are determined both by factors under the control of local school boards, and factors that are largely outside of their control. In setting hiring policies, districts make decisions about the quality of teachers they will recruit and these decisions have obvious fiscal implications. For example, a district can limit its search for new teachers to those with advanced degrees, to those with high grade point averages, or to those with a certain number of courses in their teaching specialty. Teacher salary levels are generally determined through a process of negotiation with teacher unions, and school boards have a substantial impact on the outcome of these negotiations.

At the same time, the composition of the student body, working conditions within schools, and area cost of living play a potentially large role in determining the salary a school district must offer in order to attract teachers of any given quality. These factors will be reflected in student and district cost variables, to be described below.

In estimating the cost index, we would like a measure of teacher salaries that only reflects differences in salaries that are outside the control of local school districts. One possibility is to use the Chambers teacher cost index, discussed in the section on ”Accounting for Costs in the Distribution of Education Aid.” However, because we have access to detailed information on individual teacher characteristics, we chose to construct our own index of teacher salaries. To construct this index, we use data collected by Wisconsin’s Department of Public Instruction on the salary and fringes, education, and experience of every public school teacher in the state. We regress the log of the sum of salary and fringes for all full-time teachers on each teacher’s background characteristics (including years of teaching experience and highest degree earned) plus a dummy variable for each school district. The coefficients on the district dummies are then used as the values of the teacher salary index. That is, the teacher salary index represents differences in salaries across districts, holding teacher background constant.[9] As explained below, we treat the teacher salary index as endogenous when estimating the cost function.[10]

The vectors of student, family, and neighborhood characteristics, Z_{it} and F_{it}, are made up of several variables that we believe influence a district’s level of spending per pupil. First, enrollment and enrollment squared are included. The literature suggests that a U-shaped relationship exists between

[8] Another measure of school district output that could be included is the ability of the school system to prevent dropouts. Thus a school district will be more effective to the extent that it can minimize its dropout rate. Unfortunately, because enrollment numbers are collected only once each academic year, accurate estimates of dropout rates are difficult to calculate. A comprehensive list of school performance measures should include a measure of each district's success in educating students with mental, physical, and learning disabilities. These performance measures are particularly important as our test score data exclude the performance of most special education students. Unfortunately, Wisconsin does not compile comprehensive data on the performance of special education students.

[9] Although our construction of the teacher cost index is similar, in spirit, to the methods used by Chambers (1995), our index differs from Chambers index in several important ways. First, Chambers’ index numbers for Wisconsin are based on parameter estimates from a national sample while our index is based solely on Wisconsin data. As our objective is to analyze school costs within one state, it seems appropriate to use parameter estimates that are specific to the state. Moreover, we have data for the full population of Wisconsin public school teachers, rather than just a sample, increasing confidence in the estimates. Because we have data for the state population, our index is based on deviations of actual salary values from the average, rather than hedonic, predicted salaries. Because we use district dummies, our index also differs from Chambers in that it captures salary differentials that may be based on immeasurable factors. Chambers calculates cost differentials based on differences in measurable factors alone. If there are district-specific factors that affect salary differentials and that are left out of Chambers’ list of exogenous variables, then, relative to our index, his index will understate inter-district differentials.

[10] The endogeneity of the teacher salary index reflects the fact that while higher teacher salaries lead to higher per-pupil expenditures, decisions by school districts to raise spending are likely to result in higher teacher salaries.

per-pupil expenditure and district size (both measured in logs), reflecting diseconomies of scale associated with both very small and very large school districts. Next, we include a measure of economic disadvantage. The evidence from previous studies (cited earlier) indicates that there are higher costs associated with the education of children from low-income families. In our estimation procedure, we use the percentage of students who qualify for the federal government-financed free and reduced-price lunch program as a measure of the share of students coming from economically disadvantaged families. There is also substantial literature that documents the extra costs associated with educating students with various kinds of disabilities.[11] Therefore, we include two measures of disabled students. One is the percentage of students who are classified with any type of disability. The other is the percentage of students who are classified as autistic, deaf, or blind. Studies have shown that the education costs for students with these disabilities is far greater than the extra costs associated with educating students with other disabilities (Chaikind, Danielson, and Brauen, 1993).

To reflect the possibility that educating high school students requires more resources than educating elementary school students, we also include as a cost factor the proportion of a district's student body that is enrolled in high school.

The evidence from previous studies . . . indicates that there are higher costs associated with the education of children from low-income families.

The variable ϵ_{it} in equation (3) represents the unobserved factors in each school district that influence school district spending. One such factor that has received much attention is the "inefficiency" of a district; that is, the extent to which spending in a district is in excess of the amount necessary to obtain its chosen level of educational output. A number of recent papers have applied various methods of frontier analysis in an attempt to systematically measure this inefficiency for each district (Bessent and Bessent, 1990; Deller and Rudnicki, 1993; Duncombe, Ruggiero, and Yinger, 1996; McCarty and Yaisawarng, 1993; and Ruggiero, 1996). These authors have used these techniques to gauge the amount of inefficiency involved in the provision of public education.

Great care, however, must be taken before one interprets the results of such analysis as providing evidence about the inefficiency of public schools. This is because the standard measure of "inefficiency" that arises from applying frontier analysis captures the effect of all factors that lead spending to be higher than the minimum cost of providing any given mix of public school output. Thus higher spending in one school district that is attributable to the higher costs of educating an above-average share of economically disadvantaged students will, at least in part, be characterized as "inefficiency." As pointed out by Duncombe, Ruggiero, and Yinger (1996), the fact that these higher costs will be attributed in part to the efficiency measure and in part to the cost factors included in equation (3) means that the cost function estimates provide an underestimate of the full effects of the cost factors on education spending.

The correct interpretation of these efficiency measures also requires that we have adequately measured public school output. If our cost function fails to include a school output measure that is important to local residents, any expenditures attributable to achieving that object will be classified as due to inefficiency rather than to higher costs. For example, in many states students eligible for special education classes are not required (or allowed) to take standardized achievement tests. For this reason, if one school district devotes extra resources to bringing children enrolled in special education classes up to their grade level in reading, while another district

[11] A number of other studies have found that educating students who enter school with a limited knowledge of English results in higher costs. However, when we included the percentage of students enrolled in English as a Second Language programs in our cost functions, it was always statistically insignificant and had a negative sign. Thus, we do not include this variable in the estimates presented in this paper.

provides only limited resources to special education students, a standard frontier analysis is likely to characterize the first district as "inefficient" relative to the second district.

Because of these complexities, our analysis here does not include a measure of efficiency. Plans for future research include using both parametric and nonparametric frontier analysis techniques to estimate "efficiency" measures for inclusion in the estimated cost functions. Results from previous studies (particularly Duncombe, Ruggiero, and Yinger, 1996) suggest that the exclusion of an efficiency measure will not strongly affect the relative ranking of the estimated cost index, but will decrease variation and range.

Results

The cost function represented by equation (3) is estimated using two-stage least squares, with the school output variables and the teacher salary index treated as endogenous. Following much of the literature on education costs, the cost function is estimated in natural logs, the dependent variable being the natural log of total operating expenses per pupil during the 1994–95 school year.

We use three measures of education outcome: the district average battery score from the Tenth Grade Knowledge and Concepts Exam, administered in the fall of the 1995–96 academic year; the district average battery score from the Eighth Grade Knowledge and Concepts Exam, administered in 1993–94; and a count of the number of advanced courses offered by each school district during the 1994–95 school year (all in logs). The battery scores are themselves an average of the national percentile rank on multiple-choice exams in reading, math, language, science and social science. Because the exams are administered in October, the tenth-grade scores are actually reflections of knowledge acquired prior to the tenth grade; therefore, we use 1995–96 scores with 1994–95 spending data. The eighth-grade scores are included as a control for past achievement, thus isolating the relationship between spending and *growth* in achievement between the eighth and tenth grades.

. . . we model the demand for public education as a function of . . . residents' preferences for education, their incomes, the tax prices they face . . . , and the intergovernmental aid their school district receives.

As noted in equation (1), school output is, in part, a choice that reflects the "tastes" of the community. The decision about the mix and level of output is made in conjunction with the decision about how much to spend. We therefore treat the school output variables as endogenous. As instruments for these output measures, we draw upon a set of variables that are related to the demand for public education. Following a large literature on the determinants of local government spending, we model the demand for public education as a function of school district residents' preferences for education, their incomes, the tax prices they face for education spending, and the intergovernmental aid their school district receives. To the extent that the median voter model provides a reasonable explanation for school district spending decisions, it is appropriate to use median income and the tax price faced by the median voter as instruments. Since most state school aid in Wisconsin is distributed through a matching grant formula, we use the tax price implied by the aid formula. It should be noted that because Wisconsin distributes aid through a complex three-tier district power equalizing (DPE) formula, some districts, particularly those with modest property wealth and above average spending, may face a tax price that is greater than one because for every dollar of additional spending, the size of their grant is reduced. We also include categorical aid received by the district as another instrument. The ratio of the residential property tax base as a proportion of the total tax base serves as a rough measure of the district's ability to export the tax burden to commercial and industrial properties. Finally, we include as instruments several socioeconomic variables that may be related to the preferences for public education. These include the percentage of households with children, the percentage of household heads who are homeowners, the percentage of the population age 65 or older, and the percentage of adults who have earned a four-year college degree.

As instruments for the salary index variable, we include a set of variables that reflect differences in the cost of living in various parts of the state. Deller, Green, and Voss (1996) have divided Wisconsin's 72 counties into five cost-of-living groups based on median household incomes, median housing values and rents. As instruments, we use dummy variables reflecting the assignment of each school district to its appropriate cost-of-living group.

Over 50 of Wisconsin's K–12 school districts are very small, with fewer than 500 students. At the other extreme of the size distribution is Milwaukee with nearly 100,000 students; an enrollment that is four times greater than the next largest school district in the state (Madison). Fitting a regression in which every district is treated equally may mask the true relationship between per pupil spending and the covariates. To account for this, we weight the regressions by district membership.

Table 2 presents our estimates of a cost function for public education in Wisconsin for the 1994–95 academic year. The test scores have the expected signs; since eighth grade scores are a proxy for past levels of students' achievement, high scores mean that districts can spend less to achieve a given level of progress. The negative coefficient for the number of advanced courses is counter-intuitive; one would expect spending to be higher in districts offering a wide range of advanced courses. However, the negative coefficient may reflect, in part, economies of scale as the number of advanced courses offered is highly correlated with enrollment.

The cost variables generally have the expected signs and most are statistically significant. Our constructed salary index and proportion of students from poor families (as measured by the percentage eligible for participation in the free and reduced-price lunch program) are related to higher spending and are statistically significant; the percentage of students with disabilities (severe and otherwise) is also associated with higher costs though the coefficients of those variables are not statistically significant. Consistent with previous studies, we find a U-shaped relationship between spending per pupil and school district size. The estimated coefficients imply that average costs are lowest in districts with 5,694 students. In contrast to the results of other studies, we find a significantly negative relationship between per pupil education spending and the percentage of students who are in high school.

The Construction of a Cost Index

Estimating a cost function provides us with information about the contributions of various characteristics of school districts to the costs of education. To use this information in school aid formulas, we develop a cost index, which allows us to isolates the variation in school spending attributable to the exogenous cost factors, while holding constant variables that are under the control of the district. In the section "The Design of School Finance Formulas to Achieve Adequacy," this index is integrated into a foundation formula designed to ensure that each school district receives sufficient resources to provide an adequate education for its students.

Determining a level of educational output that is considered adequate for each state is obviously a public policy decision.

With a properly constructed cost index we can determine how much each school district must spend in order achieve any given level of educational outcome. Determining a level of educational output that is considered adequate for each state is obviously a public policy decision. One possibility is to define the standard of adequacy as the average level of current student performance within a state (Clune, 1995).

A cost index is constructed by using the results of our cost function estimation to predict hypothetical spending for each district. These predictions are then compared to actual spending in a district with average costs that provides average levels of educational output. Specifically, to determine each school district's hypothetical spending, we multiply the regression coefficients from our estimated cost function with the actual values of the cost fac-

Table 2.—Education cost function, 1994–95 Wisconsin's 368 K–12 school districts

Variable	Coefficient	t-statistic
Intercept	4.808*	4.508
Log of tenth grade exam score, 1995–96	2.796*	2.282
Log of eighth grade exam score, 1993–94	-1.650	1.573
Number of advanced courses	-0.002*	-2.065
Teacher salary index	1.583*	6.158
Percent of students eligible for free and reduced-price lunch	0.004*	3.078
Percent of students with disabilities	0.004	1.038
Percent of students with severe disabilities	0.131**	1.807
Percent of students enrolled in high school	-0.012*	-2.349
Log of student enrollment	-0.593*	-4.631
Square of log of student enrollment	0.034*	4.106
Sum of squared errors (SSE)	4.594	

* Indicates statistically significant at the 5 percent level.

** Indicates statistically significant at the 10 percent level.

SOURCE: Author's calculations based on the U.S. Bureau of the Census (with data from the 1990 Census of Population and Housing) and the Wisconsin Department of Public Instruction.

tors in each district and the state average values of the educational outcome values.[12] Thus, we set the number of advanced courses and tenth-grade score at the average for all Wisconsin districts. We should emphasize, however, that alternative standards of adequacy could be used in calculating cost indices. The use of different standards will not affect the relative ranking of districts, but will alter the absolute cost index numbers, and hence, will influence any distribution of state aid that is dependent on the cost index.

As discussed above, we use a value-added measure of student achievement in our cost function; that is, the coefficient on tenth-grade scores reflects the increase in spending associated with an increase in achievement, given an initial level of achievement in the eighth grade. Therefore, the expenditures necessary to reach an average level of tenth-grade achievement will depend on the level of student achievement in the eighth grade for that district. Lower eighth-grade achievement implies that it will be more costly to achieve average tenth-grade achievement. In the estimation of the cost function, eighth-grade achievement is treated as an endogenous variable because, like tenth-grade achievement, it is, in part, a choice of the district. In creating the cost index, we want to hold constant any variation in spending that is under the control of the district. Thus, to account for the endogeneity of the eighth-grade scores, we calculate the cost index using predicted eighth-grade scores, with the predictions based on the coefficient estimates from the first-stage regression, actual values of the cost factors, and state average values for the demand instruments. That is, a district's predicted eighth-grade score reflects the score expected from a district with average preferences and observed cost factors. Combined with the average tenth-grade score, the level of spending predicted by the cost function is the spending required to reach average tenth-grade achievement, given average preferences for education and observed cost factors.

Descriptive statistics for Wisconsin's cost index are presented in the first column of table 3. The data clearly show that costs vary tremendously across

[12] Since the salary index is treated as endogenous in the cost function estimation, a predicted salary, based on the first-stage regression, is used in constructing the cost index.

Table 3.—Distribution of education cost indices

	Cost index	Poverty-weighted index	Chambers teacher salary index
Mean	100.0	100.0	99.9
Median	88.8	98.6	99.0
Standard deviation	39.6	9.9	8.2
Range	411.3	58.4	48.4
Minimum	48.9	83.2	82.6
Maximum	460.2	141.6	131.0
Restricted range	73.4	24.9	20.9
Minimum at 10 percent	68.3	88.7	90.1
Maximum at 90 percent	141.7	113.6	110.9
Correlations:			
Cost index	1.000		
Poverty-weighted	0.810	1.000	
Chambers	-0.308	-0.362	1.000

SOURCE: Author's calculations based on the U.S. Bureau of the Census (with data from the 1990 Census of Population and Housing) and the Wisconsin Department of Public Instruction.

school district in Wisconsin. The district with the lowest costs could attain an average level of achievement by spending about half as much per pupil as the district with average costs. At the other extreme, the district with the highest costs must spend more than four and one-half times more than the average cost district to provide an average educational outcome for its students. The large range of the index reflects, in part, the values of the index in a few districts. Ignoring the 10 percent of districts with the lowest index values and the 10 percent of districts with the highest values substantially reduces the range of the cost index. The restricted range in table 3 shows that the district at the 10th percentile has costs that are 32 percent below average and the district at the 90th percentile has costs that are 42 percent above average.

Two school districts have cost indexes that are much higher than the indexes of any other district. Milwaukee's index is 460 and White Lake's is 352, while the district with the next highest index has a cost index of 238. The major reasons for Milwaukee's high cost index are its large size and its high concentration of economically disadvantaged students. With nearly 100,000 students, the district is 45 times the size of the average Wisconsin school district. Seventy-two percent of its students are eligible for free or reduced-price lunches, a proportion that is higher than all but one other Wisconsin school district. White Lake's cost index is high primarily because of its extremely small size (the entire school district has only 250 students) and its very high concentration of children from poor families.

Because our estimated cost functions include no measure of efficiency, it is possible that we are interpreting extra spending that is caused by inefficiencies on the part of school districts as higher costs. In their estimate of cost indexes for school districts in New York State, Duncombe, Ruggiero, and Yinger (1996) report that the maximum cost index declines from 356 to 240 when they replace a cost index calculated without a measure of efficiency with a cost index based on cost function estimates that include an endogenous measurement of efficiency. These New York State results suggests that the high cost indexes for Milwaukee and White Lake may reflect in part some degree of inefficiency on the part of these two local school districts. Duncombe, Ruggiero, and Yinger also report that the cost indexes measured with and without a control for efficiency are highly correlated, with a correlation coefficient equal to 0.94. This suggests that including a measure of efficiency may have relatively little impact on the rank ordering of districts in terms of costs.

The data in the second column of table 3 allow us to compare our cost index to an index that measures the concentration in each district of children from economically-disadvantaged families. We constructed this index by comparing the percentage of low-income students in each district to the average percentage of low-income students in the state. The third column of table 3 displays statistics describing the distribution of the teacher salary index developed by Jay Chambers (1995).

Recall that the Chambers teacher salary index only reflects factors outside school district control that require some districts to pay more or less for teachers with similar qualifications. Thus, while the Chambers index will reflect the higher salaries that school districts may have to pay to induce teachers to work in districts with high concentrations of poor children, these higher salaries are only one reason for the possibly high costs of educating poor children. For example, in order to overcome the educational disadvantages faced by many children from poor families, extra teachers may be needed to staff smaller class sizes and special remedial programs. By contrast, our cost index provides a comprehensive measure that reflects all the factors that lead to costs of achieving any educational outcome to be higher in some districts than in others. It is not surprising that our cost index shows larger variation (as measured by both the standard deviation and the range) than either of the other two indices.

Most members of the educational community use the term adequacy to refer to the achievement of minimum standards of educational performance or outcome.

Table 4 displays the distribution of the three indices across school districts characterized by size (in terms of enrollment), by property wealth per pupil, by urban-rural status, and by the concentration of students from poor families. The data clearly show the U-shaped relationship between district size and costs. They also indicate that costs tend to be high in rural districts, reflecting both small district size and relatively high concentrations of low-income students. Costs also tend to be higher in both the property-poor and the property-rich districts. Property-poor districts tend to be characterized by higher concentrations of students with disabilities and students from economically disadvantaged families. Higher costs in property-rich districts tend to reflect higher than average costs of living in those districts.

Table 4 illustrates quite clearly the differences between our cost index and the Chambers teacher salary index. The highest values of the Chambers index are found in Milwaukee and other urban school districts reflecting primarily the relatively high cost of living in these areas as compared to Wisconsin's rural areas. Average costs in the Milwaukee suburbs (listed as *Urban Fringe, Large City* in table 4) are 24 percent below the state average when measured using our index. At 17 percent above average, the Chambers index indicates that the Milwaukee suburbs have higher costs than any other area in Wisconsin. Also, in contrast to our cost index, the Chambers index tends to be highest in school districts with relatively few pupils from poor families.

Finally, because we are interested in the relationship between costs and achievement, table 5 shows the average index scores by performance on the tenth-grade exam. Using our cost index, or the poverty-weighted index, costs are higher in low-performing districts. This implies that even more resources will be needed to get students in these districts up to "adequate" levels of achievement.

The Design of School Finance Formulas to Achieve Adequacy

Most members of the educational community use the term adequacy to refer to the achievement of minimum standards of educational performance or outcome. Not surprisingly, disagreements arise concerning the level and composition of performance standards that should be considered as adequate. William Clune (1994), for example, defines true adequacy as the achievement of "...high minimum standards in low-income schools..." (p. 378). Although achieving agreement at a national level about the precise definition of high minimum standards may be impossible, individual state governments may be able to decide on a set of performance

Table 4.—Distribution of education indices, by school district characteristics

Social characteristics	Number of K–12 districts	Cost index	Poverty-weighted index	Chambers teacher salary index
District size (number of pupils)				
Less than 500	53	141.6	104.6	91.8
500–999	110	108.6	103.2	96.4
1,000–2,499	126	85.2	97.8	102.3
2,500–9,999	70	75.9	95.1	106.2
10,000–24,499	7	100.2	99.3	108.2
Milwaukee (97,555)	1	460.2	135.6	115.0
Equalized property values (EQV)/pupil				
Less than $125,000	54	117.9	107.0	95.6
125,000–174,999	108	103.2	102.0	97.3
175,000–249,999	127	90.2	97.6	100.3
250,000–399,999	55	96.8	96.9	106.2
400,000 or more	24	104.4	95.8	105.1
Urban/rural status				
Large city	1	460.2	135.6	115.0
Mid-size	18	91.9	99.4	104.7
Urban fringe, large city	20	76.3	91.4	117.2
Urban fringe, mid-size	14	75.8	92.2	104.4
Large town	3	68.4	91.9	99.3
Small town	96	82.7	97.3	100.8
Rural	216	110.9	102.6	97.2
Poverty concentration				
Less than 10 percent	55	72.3	87.8	106.7
10–19.9 percent	114	80.7	93.8	101.3
20–29.9 percent	101	95.4	101.1	98.0
30–39.9 percent	53	118.8	108.4	96.9
40 percent or more	45	170.9	118.7	96.0

SOURCE: Author's calculations based on the U.S. Bureau of the Census (with data from the 1990 Census of Population and Housing) and the Wisconsin Department of Public Instruction.

standards that they believe must be met to provide students with an adequate education.[13]

Foundation formulas used by the majority of states distribute grants so as to guarantee that each school district will be able to achieve a "foundation" level of per pupil spending as long as each district uses a state-determined "minimum" property tax rate. If costs were identical in all school districts, by defining the foundation level as the spending necessary to achieve the state-specified minimum performance level, the state could guarantee that each school district had sufficient resources necessary to provide an adequate level of education.

[13] The establishment of performance standards requires that decisions be made about precisely how a standard is defined. Is a standard achieved if all students meet it, or is it defined in terms of mean performance, or in terms of the percentage of students who perform above a given level?

Table 5.—Distribution of education indices, by student performance

	Number of K–12 districts	Cost index	Poverty-weighted index	Chambers teacher salary index
Tenth grade exam score decile				
1 (lowest)	37	132.8	107.6	97.5
2,3,4,5	147	102.6	101.8	98.7
6,7,8,9	147	92.4	98.1	99.9
10 (highest)	37	87.3	93.0	107.2

SOURCE: Author's calculations based on the U.S. Bureau of the Census (with data from the 1990 Census of Population and Housing) and the Wisconsin Department of Public Instruction.

The results presented in the previous section indicate that costs differ substantially among school districts. Thus, to guarantee the provision of adequate education, we need to develop a foundation formula in which each school district's foundation level of spending varies according to differences in costs and in which the average foundation level equals the dollar amount necessary to meet the performance standards associated with educational adequacy in districts with average costs.

A conventional foundation aid formula is presented in equation (4), where A_i equals foundation aid per pupil in district *i*, E^* is the foundation level of per pupil spending, t^* the mandated local property tax rate, and V_i the property value per pupil in school district *i*:

$$(4)\quad A_i = E^* - t^*V_i$$

Equation (4) will generate negative aid in districts with high per pupil property values. In practice, these districts are allocated zero aid, or, in some cases, a minimum per pupil grant. The first step in adapting the foundation formula so that it will guarantee that every district has sufficient resources to provide an adequate level of education is to determine a standard of educational performance that is considered adequate. Referring to this standard as S^*, we can define $\tilde{E}$ as the amount a school district with average costs must spend to obtain an adequate educational outcome, S^*. A foundation formula designed to guarantee that every school district has sufficient resources to provide S^* can be written as:

$$(5)\quad A_i = \tilde{E}c_i - t^*V_i$$

where c_i is the value of the cost index in school district *i*.[14]

To simulate the distribution of aid using this formula we have defined a standard of adequacy as the statewide average score on the tenth-grade Knowledge and Concepts Exam. $\tilde{E}$ is thus defined as the expenditure needed to achieve the average tenth-grade test performance in a district with average costs. The amount of aid allocated to district *i* using this cost-adjusted aid formula will be a function of the per pupil property wealth in *i* and the relative costs in district *i*. Lower average student performance on the eighth-grade tests (holding preferences constant) will lead to higher costs in district *i*, and hence to additional aid.

To provide a baseline upon which to judge the impact of using a cost-adjusted foundation formula, we first simulate the distribution of aid to Wisconsin's 368 K–12 districts using a conventional foundation formula. We have chosen $6,372 as the foundation level of per pupil spending, which is the amount needed to achieve the average tenth-grade test performance in a district with average costs.[15] To add some realism to the simulation, we adjust the required property tax rate (t*) so that the total

[14] See Ladd and Yinger (1994) for a detailed derivation of a cost-adjusted foundation formula.

[15] The state average expenditure per pupil was $6,084 in 1996–97.

amount of foundation aid distributed is equal to $3.03 billion, the actual amount of equalization aid allocated to K–12 districts in Wisconsin for the 1996–97 school year.[16]

In our second simulation, we allocate foundation aid using the $6,372 foundation level, the 11.8 mill tax rate, and the cost-adjusted foundation aid formula (equation 5). Before simulating the distribution of cost-adjusted foundation aid we adjusted downward the reported cost index for the nine school districts with the highest index values. In particular, we truncated the index at 200; that is, we make the (admittedly arbitrary) decision that no district could have costs that were more than twice the average. This adjustment reflects our view that very high-cost adjustments are not politically feasible and the fact that our index may overstate costs in some districts because it fails to account explicitly for school district inefficiencies.

Even if the state government is willing to reform its school finance system to account for cost differences among school districts and to provide funds to achieve educational adequacy, it may not be willing to devote additional state funds to this effort. To account for this possibility, we simulate a revenue-neutral cost-adjusted foundation formula. The foundation level is adjusted downward so that the total budgetary cost of foundation grants does not exceed the $3.03 billion budgetary cost of the non-cost-adjusted foundation formula. Revenue neutrality requires a lowering of the foundation level from $6,372 to $6,158, with a corresponding reduction in the standard of adequacy that can be financed.

Milwaukee receives the largest per-pupil grant; at $11,532 it is more than twice the largest grant distributed through the non-cost-adjusted formula.

The first column of data in table 6 summarizes the distribution of per pupil foundation aid using a foundation formula without cost adjustments. The average grant equals $3,900 per pupil and the largest grant is $5,404. In nine school districts, per pupil property tax bases are large enough to yield more revenue per pupil at the mandated tax rate than the $6,372 foundation level. These nine districts receive no foundation aid. Milwaukee's grant is equal to $4,635. Although this grant is greater than average, 97 other school districts in the state receive larger per pupil grants.

The second column of table 6 summarizes the distribution of cost-adjusted foundation aid. Because most of the state's largest school districts have above average costs, total cost-adjusted foundation aid totals $171 million more than non-cost-adjusted aid. As expected, the standard deviation of per pupil grants is higher ($2,388 compared to $1,133). Milwaukee receives the largest per pupil grant; at $11,532 it is more than twice the largest grant distributed through the non-cost-adjusted formula. As some relatively high-wealth districts have below-average costs, the number of school districts now getting zero aid increases from 9 to 18.

The data in the third column of table 6 shows that achieving revenue-neutrality results in a distribution of per pupil foundation grants with both a smaller mean and standard deviation. As expected, grants to school districts with relatively high costs are reduced. Milwaukee's grant allocation, for example, is reduced by over $400 per pupil. Since the foundation level is reduced in the revenue-neutral formula, 19 school districts receive zero aid under the revenue-neutral, cost-adjusted formula.

Table 7 provides additional information to allow us to compare a cost-adjusted and a non-cost-adjusted foundation formula. Both formulas use a foundation level that has been defined as the spending per pupil necessary to achieve an adequate educational outcome in districts with average costs. Thus, adjusting the foundation formula for cost differences will increase aid for districts with above-average costs and decrease aid for districts with below-average costs. For 130 of the 368 K–12 districts, using the cost-adjusted formula results in an

[16] The resulting property tax rate is 11.8 mills (1.18 percent).

Table 6.—Distribution of aid per pupil under alternative foundation formulas

	Conventional (no cost adjustment)	Cost-adjusted	Revenue-neutral cost-adjusted
Mean	$3,900	$3,824	$3,622
Median	4,170	3,517	3,328
Standard deviation	1,133	2,388	2,313
Range	5,404	11,532	11,103
Minimum	0	0	0
Maximum	5,404	11,532	11,103
Restricted range	2,606	6,118	5,984
Minimum at 10 percent	2,371	1,014	862
Maximum at 90 percent	4,977	7,132	6,846

SOURCE: Author's calculations based on the U.S. Bureau of the Census (with data from the 1990 Census of Population and Housing) and the Wisconsin Department of Public Instruction.

increase in per pupil aid. The top panel of table 7 illustrates that while per pupil aid remains substantially higher in low-property wealth as compared to high-property wealth districts, the largest percentage increases in aid go to high-wealth school districts. At the same time the largest percentage reductions in aid go the wealthiest districts. This pattern only serves to emphasize that the occurrence of high costs is not closely correlated with school district property wealth.

The data in the bottom panel of table 7 illustrate that the largest increases in aid resulting from using a cost-adjusted foundation formula benefit both small and large districts. While aid increases in over three-fourths of the smallest districts, in those small districts where aid does decline, the declines are generally quite small. The eight school districts with between 10,000 and 25,000 students are evenly split between those that gain and those that lose aid as a result of using a cost-adjusted formula.

The data in table 8 allows us to assess the impact of moving from a non-cost-adjusted to a revenue-neutral, cost-adjusted foundation formula. Because the cost-adjusted formula also has a lower foundation level (E*), 116 of the 368 school districts would receive an increase in aid. The lowering of the foundation level means that some school districts with above-average costs would face a reduction in foundation aid as the aid increases are concentrated among districts with the highest costs. The general pattern of changes in aid across districts characterized by both per pupil property wealth and district size is similar to that displayed in table 7, however, the average increases in aid are smaller and the average reductions in aid are larger.

Poverty Weights in School Aid Formulas

The use of a cost index as part of a state aid formula allows states to simultaneously account for all the factors that lead to cost differences among school districts. Although there are advantages to a comprehensive treatment of cost differences, a number of states have taken a partial approach by replacing actual student enrollment with a weighted student count. In this approach, the weights are designed to reflect the higher costs associated with educating particular groups of students. While these weights are most commonly used for pupils with mental or physical disabilities, roughly one-fourth of all states use some kind of weight to allocate extra funding for either or both low-income and low-achieving students. These weights, which reflect the extra costs associated with low-income students, range in value from 0.15 (Vermont) to 0.625 (Illinois), with most states falling somewhere around 0.25 (Odden and Picus, 1992).

Table 7.—Distribution of state aid under a conventional foundation formula and a cost-adjusted foundation formula

By district equalized property values (EQV)/pupil

		Districts with increased aid					**Districts with decreased aid**				
EQV/pupil	Number of K–12 districts	Number with increased aid	Aid/pupil no cost adjustment	Aid/pupil with cost adjustment	Dollar change	Percent change	Number with decreased aid	Aid/pupil no cost adjustment	Aid/pupil with cost adjustment	Dollar change	Percent change
Less than $125,000	54	36	$5,088.41	$7,084.30	$1,995.89	39%	18	$5,021.72	$4,288.66	($733.05)	-15%
125,000–174,999	108	45	4,617.37	6,154.46	1,537.09	33%	63	4,574.06	3,545.89	(1,028.17)	-22%
175,000–249,999	127	32	3,884.50	5,783.59	1,899.09	49%	95	3,899.47	2,425.85	(1,473.61)	-38%
250,000–399,999	55	11	2,673.37	6,481.00	3,807.63	142%	44	2,832.26	1,346.06	(1,486.20)	-52%
400,000 or more	24	6	598.11	4,558.05	3,959.93	662%	18	744.81	80.21	(664.60)	-89%
Total	**368**	**130**	**$4,217.42**	**$6,274.61**	**$2,057.20**	**49%**	**238**	**$3,727.03**	**$2,486.19**	**($1,240.83)**	**-33%**

By district size

		Districts with increased aid					**Districts with decreased aid**				
EQV/pupil	Number of K–12 districts	Number with increased aid	Aid/pupil no cost adjustment	Aid/pupil with cost adjustment	Dollar change	Percent change	Number with decreased aid	Aid/pupil no cost adjustment	Aid/pupil with cost adjustment	Dollar change	Percent change
Less than 500	53	43	$4,218.18	$7,200.02	$2,981.84	71%	10	$2,456.12	$2,235.60	($220.52)	-9%
500–999	110	55	4,173.97	6,036.93	1,862.96	45%	55	4,251.18	3,444.07	(807.11)	-19%
1,000–2,499	126	24	4,425.63	5,414.75	989.13	22%	102	3,808.35	2,427.82	(1,380.53)	-36%
2,500–9,999	70	3	4,421.06	5,087.97	666.91	15%	67	3,380.70	1,837.55	(1,543.15)	-46%
10,000–24,999	8	4	3,300.27	4,460.79	1,160.51	35%	4	3,424.42	2,295.18	(1,129.24)	-33%
Milwaukee	1	1	4,634.97	11,007.12	6,372.15	137%	0	—	—	—	—
Total	**368**	**130**	**$4,217.42**	**$6,274.61**	**$2,057.20**	**49%**	**238**	**$3,727.03**	**$2,486.19**	**($1,240.83)**	**-33%**

— Not applicable.

SOURCE: Author's calculations based on the U.S. Bureau of the Census (with data from the 1990 Census of Population and Housing) and the Wisconsin Department of Public Instruction.

Table 8.—Distribution of state aid under a conventional foundation formula and a revenue-neutral cost-adjusted foundation formula

By district equalized property values (EQV)/pupil

		Districts with increased aid					**Districts with decreased aid**				
EQV/pupil	Number of K–12 districts	Number with increased aid	Aid/pupil no cost adjustment	Aid/pupil with cost adjustment	Dollar change	Percent change	Number with decreased aid	Aid/pupil no cost adjustment	Aid/pupil with cost adjustment	Dollar change	Percent change
Less than $125,000	54	33	$5,098.13	$6,984.01	$1,885.88	37%	21	$5,015.98	$4,201.29	($814.70)	-16%
125,000–174,999	108	38	4,632.11	6,158.14	1,526.03	33%	70	4,570.39	3,472.33	(1,098.06)	-24%
175,000–249,999	127	29	3,899.08	5,701.51	1,802.43	46%	98	3,894.69	2,302.65	(1,592.04)	-41%
250,000–399,999	55	11	2,673.37	6,138.99	3,465.61	130%	44	2,832.26	1,192.03	(1,640.24)	-58%
400,000 or more	24	5	717.74	5,052.91	4,335.18	604%	19	705.61	47.79	(657.82)	-93%
Total	**368**	**116**	**$4,226.96**	**$6,229.47**	**$2,002.51**	**47%**	**252**	**$3,749.88**	**$2,421.85**	**($1,328.02)**	**-35%**

By district size

		Districts with increased aid					**Districts with decreased aid**				
EQV/pupil	Number of K–12 districts	Number with increased aid	Aid/pupil no cost adjustment	Aid/pupil with cost adjustment	Dollar change	Percent change	Number with decreased aid	Aid/pupil no cost adjustment	Aid/pupil with cost adjustment	Dollar change	Percent change
Less than 500	53	42	$4,214.58	$6,948.03	$2,733.46	65%	11	$2,630.05	$2,291.00	($339.05)	-13%
500–999	110	48	4,212.27	6,046.99	1,834.72	44%	62	4,212.81	3,324.61	(888.20)	-21%
1,000–2,499	126	18	4,445.95	5,476.77	1,030.82	23%	108	3,839.26	2,376.79	(1,462.46)	-38%
2,500–9,999	70	3	4,421.06	4,851.47	430.41	10%	67	3,380.70	1,698.66	(1,682.04)	-50%
10,000–24,999	8	4	3,300.27	4,207.70	907.43	27%	4	3,424.42	2,119.03	(1,305.39)	-38%
Milwaukee	1	1	4,634.97	10,578.94	5,943.97	128%	0	—	—	—	—
Total	**368**	**116**	**$4,226.96**	**$6,229.47**	**$2,002.51**	**47%**	**252**	**$3,749.88**	**$2,421.85**	**($1,328.02)**	**-35%**

— Not applicable.

SOURCE: Author's calculations based on the U.S. Bureau of the Census (with data from the 1990 Census of Population and Housing) and the Wisconsin Department of Public Instruction.

As far as we can determine, the process of determining the weights assigned to low-income children often reflect political considerations rather than estimates of the true costs of educating children from economically disadvantaged families.

Although we believe that it is preferable to use a comprehensive index of costs, using weights for specific populations of students is still an improvement over state aid formulas that do not make any attempt to account for cost differences. In this section, we use our estimated cost functions to calculate a weight based on the extra costs associated with educating children from poor families. If poverty weights are going to be used in state aid formulas, in our view it is preferable that the magnitude of the weights reflect as accurately as possible the extra costs associated with educating poor children.

The use of a poverty weight implies that the first poor pupil in a school district contributes the same amount to extra costs as the 500th poor pupil. It appears more reasonable to assume that the first few poor students contribute little to extra costs, while after a threshold proportion of poor students, costs begin to rise as the number of poor students increases. By estimating equation (3) for different subgroups of districts defined by their percentage of students from economically disadvantaged families, we find support for this hypothesis. The data suggest that the threshold above which additional poor children lead to higher costs is at the eighth percentile on the distribution of the percentage of students eligible for the free and reduced-price lunch program.

. . . determining the weights assigned to low-income children often reflect political considerations rather than estimates of the true costs of educating children from economically disadvantaged families.

To create a poverty weight, we used the results of our estimation of equation (3) to predict total expenditures in each district. For each district, we then set the percentage of students from poor families equal to the threshold level and recalculated predicted expenditures. This latter prediction tells us the cost of educating a regular mix of students. The difference between the two predictions, divided by the number of poor students in each district in excess of the threshold level provides a measure of the additional costs in each district associated with educating students from poor families. A district-specific poverty weight is determined by dividing this measure by the cost for each regular (non-poor) student.[17] The results of these calculations indicate that both the mean and median weight equals 1.59, with the individual district weights distributed very tightly around the mean value.

A poverty weight of 1.59 indicates that to achieve any given level of educational outcome costs two and a half times as much money as required to educate a regular student. The fact that our poverty weight is considerably larger than the largest poverty weight used by those states that include such weights in their equalization aid formulas, suggests that these other states underestimate the true costs of educating poor children.

Although our poverty weight for Wisconsin is high relative to weights used in state aid formulas, it is much closer to William Clune's (1994) estimate of the additional "cost" of educating students in high-poverty schools. Clune argues that these extra costs are about $5,000 per poor pupil. As the national average spending in these schools was also about $5,000, Clune's estimate implies a poverty weight of about 1.0. Using current spending data, Clune's estimate of the per pupil cost of educating poor children would be closer to $6,000. Although Clune admits that his cost estimate is more of an educated guess than a precise calculation, it is more or less consistent with our results that are based on a complex statistical estimate of the costs of education.[18]

[17] School districts with few poor children are assigned a poverty weight of zero.

[18] In Wisconsin, the average spending per pupil for regular students is $5,082. Thus, using a poverty weight of 1.59, the average district would require an additional $8,080 for each poor student.

Conclusions

There appears to be a growing public awareness that the receipt of a high-quality education is the key to economic success, and at the same time a realization that the education received by a substantial number of students in the United States, especially in large cities, is not of high enough quality to prepare them for well-paying jobs. Although these failures of the U.S. system of public education have been well documented, a heated public debate is raging over how to improve public education.

A number of scholars have argued that improving the performance of public education requires, as a necessary though not sufficient step, reform of the financing of public schools. While most efforts over the past several decades to reform school financing have focused on equalizing the resources available for education, in recent years reformers have attempted to link financing to the actual educational performance of students. A relatively new goal of school finance reformers is the achievement of educational adequacy which is defined in terms of a minimum acceptable level of educational performance for all students, including those who come from economically disadvantaged families.

The key to linking educational outcomes to school financing is the integration of cost considerations into school financing formulas. Costs are defined as the minimum amount of money that a school district must spend in order to achieve a given educational outcome. In this paper, we estimated a cost function for elementary and secondary public education using data from Wisconsin school districts. We used the results of our estimate to construct a cost index. We then integrated the cost index into a foundation formula designed to guarantee that each school district would have sufficient resources available to achieve educational adequacy, which we defined in this paper as state average performance on a comprehensive achievement examination taken by tenth-grade students. We concluded that the State of Wisconsin could finance adequacy by increasing state aid to local school districts by approximately 6 percent, with aid distributed using a cost-adjusted foundation formula.

It is important to emphasize that providing school districts with enough resources to achieve educational adequacy does not in itself guarantee that students will be provided with an adequate education. Additional financial resources must be accompanied with strict accountability standards. States will need to develop financial incentives or penalties, plus other administrative mechanisms, to assure that local school districts actually improve educational outcomes and meet their goals of educational adequacy. If local school districts fail to meet these standards of performance, state governments may have to assume direct administrative control over local districts.

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