JOURNAL OF EDUCATION FINANCE
29 (SUMMER 2003), 137–156

Financing Adequate Education in Rural Settings

BY JENNIFER IMAZEKI AND ANDREW RESCHOVSKY

INTRODUCTION

In recent years there has been a growing public awareness of serious problems associated with the financing of public schools in rural areas. These problems have taken on an added sense of urgency since passage of new federal education legislation known as the No Child Left Behind Act of 2001 (20 USC 6301). The act mandates annual testing of all students in Grades 3 through 8 and requires that schools make annual progress in meeting performance goals for all students and for separate groups of students characterized by race, ethnicity, poverty, disability, and limited English proficiency (LEP).

Although students in many rural schools perform at high levels, data from the 1998 and 2000 National Assessment of Education Progress (NAEP) mathematics, reading, and writing exams indicate that students at the fourth-, eighth-, and 12th-grade levels in rural schools perform less well than students in suburban schools, although better than the average student in a central city school (National Center for Education Statistics 2003). These national data hide a great deal of variation among the states, including the fact that student performance in rural schools in a number of Southern states is exceptionally weak.

The problems of financing rural schools vary substantially across states, but most states face, to one degree or another, a similar set of issues. For many rural districts, a central issue is that they will have to spend substantial amounts of money per student in order to meet state and/or federal student performance standards. If we assume that state-imposed standards define what has, in the language of the courts, been called an "adequate" education, we can refer to the amount of money necessary to achieve educational adequacy as the "cost" of education. Costs generally are determined by a set of factors over which school district officials have little or no control.

Jennifer Imazeki is Assistant Professor of Economics, San Diego State University. Andrew Reschovsky is Professor of Agricultural and Applied Economics in the Robert M. LaFollette School of Public Affairs, University of Wisconsin-Madison.

Among the most important factors contributing to high costs in rural districts is their small size—a reflection of the low populations of the communities they serve. Providing education, whether public or private, involves substantial fixed costs, both in terms of physical capital and human resources. Rural school districts, therefore, must spend more money per pupil to provide a basic education than most larger, non-urban school districts.

Exacerbating the problem is that, in many states, a high proportion of rural residents have low incomes and relatively low levels of education. There is ample evidence that the burden on schools to meet state- and federally imposed student performance standards is greater when many of their students come from poor and poorly educated families. Students from economically or educationally disadvantaged families require extra attention and resources if they are expected to overcome the disadvantages of their environments.

The pressure on rural districts to augment their spending is increased even more when their student bodies include individuals with limited proficiency in English or a physical or mental disability. Although all school districts spend more money on special education students, the financial burden on rural districts can be particularly severe because they are less able to spread the cost of specialized instructors and equipment over multiple students.

Many teachers are attracted to the small size, pleasant environment, and relatively low cost of living that characterize many rural school districts. While these characteristics may make hiring teachers easier and cheaper for some rural school districts, the isolated and poverty-stricken nature of other rural districts makes attracting qualified teachers difficult unless they are willing to pay a substantial salary premium. The reality for most of these districts is that they struggle to find teachers and often must make do with a less-than-well-qualified instructional staff.

The heavy reliance on the property tax by school districts in many states further exacerbates the problem of funding rural schools. Falling rural populations and weak markets in agricultural land in many areas limit the amount of property tax revenue many districts are able to raise. In many places, low incomes lead to unwillingness on the part of many district residents to raise school property taxes to meet rising costs.

State governments certainly are not oblivious to the fiscal problems facing rural school districts. In fiscal year (FY) 2000, state governments provided nearly half of all school district revenues in the form of state aid to local districts. Although succinctly summarizing 50 state school finance systems is hard, most states allocate larger amounts of aid per student to districts with relatively low per-student property tax bases. Many states also allocate additional aid to districts whose student enrollment comprises larger concentrations of "high cost" students, including individuals eligible for special education programs, individuals from poor families, and those with LEP. In addition, some states make special efforts to target state aid to rural districts by including factors in their school-aid formulas that consider sparsity, school isolation, and small enrollments.

Despite these efforts, some observers suggest that many states are not doing enough to assist their rural districts. Some point to the low academic performance of students in many rural districts or to the low levels of per-pupil spending as evidence of state government neglect. Others argue that state-aid formulas either take no account or inadequate account of various factors, including district size, difficulty in recruiting teachers, and declining enrollment, all of which have a negative impact on the ability of rural school districts to provide high-quality education.

These issues lead us to the policy question that motivates this paper: Should we address the fiscal problems of rural school districts with a set of policies targeted to rural districts, or should we design policies to help all districts not providing students with an adequate education achieve educational adequacy?

To begin answering this question, we believe it is important to first ask if there is something fundamentally different about how education is produced in rural districts versus suburban and urban districts. If the process of educating children is in some measurable way different in rural districts, then it seems reasonable to argue that a different set of public policies is appropriate for funding education in rural settings.

In this paper, we employ a statistical approach to determine the relationship between per-pupil education expenditures, student performance, and various characteristics of school districts and students. Specifically, we use data from Texas and Wisconsin to estimate cost functions for K–12 public education in these two states. Once we have estimated cost functions for all K–12 school districts in each state, we use various statistical methods to explore whether different cost functions explain the relationship between per-pupil spending, student performance, and various student and district characteristics in rural and non-rural school districts.

In the next section, we briefly describe the school finance systems in Texas and Wisconsin and explore the differences between rural and non-rural districts in school spending and district characteristics. In the following section, we explain how we estimated educational cost functions and describe the statistical methods and variables that enter into our analysis. The next section starts with a discussion of the results of our cost-function estimates for K–12 school districts in Texas and Wisconsin. We then explore whether the structure of the cost-function relationships is different in rural versus non-rural districts. We conclude the paper with a discussion of the factors that explain differences in the cost of education in rural school districts.

School Finance in Texas and Wisconsin

Data from the 2000 census indicate that Wisconsin is a relatively rural state, with 31.7% of its population classified as rural, compared with the national average of 21%. Because much of its vast rural area is thinly populated, only 17.5% of Texans are classified as rural residents. Given its large population, however, Texas leads the nation in the number of people in rural areas (Beeson and Strange 2003).

With respect to rural school funding, the finance systems in Texas and Wisconsin provide an interesting contrast. As we shall describe below, the formulas used to allocate state financial aid to school districts in Texas include a number of factors explicitly targeted to rural districts. For example, not only is extra money allocated to all small and midsized districts, but small districts that cover a large physical area also receive additional funds. Texas uses pupil weights to allocate additional state aid for poor students, students with disabilities, and students eligible for bilingual education programs. Although Wisconsin also allocates some categorical aid for these student groups, its generous school finance system provides no special allocation for rural or small school districts.

The Texas School Finance System

The Texas school finance system distributes aid to districts under three tiers of funding. Tier I is based on a traditional foundation formula that guarantees a base level of funding to all districts levying a minimum property tax rate of $0.86 per $100 of assessed valuation. In 2001–02, the base funding level, called the "basic allotment," was $2537 per pupil in average daily attendance (ADA). This allotment, however, is adjusted in several ways. Districts with fewer than 1600 and fewer than 5000 students receive the small and midsize district adjustments, respectively. Districts with low enrollments that cover more than 300 square miles qualify for the "sparsity adjustment." Finally, the state applies a cost-of-education index, which is designed to reflect cost variations due to such factors as cost of living and concentration of low-income students. Each of these adjustments increases the basic allotment for individual districts.

A district's Tier I total guaranteed level of revenue also is adjusted through the use of pupil weights for students in special education, compensatory education, bilingual education, career and technology (vocational) education, gifted and talented education, and the public education grant program. Once the basic allotment and ADA have been adjusted, a district's Tier I guaranteed funding level is the adjustment allotment multiplied by weighted ADA, plus a transportation allotment based on the number of students and bus route miles.[1]

1. In 2001–02, all school districts also received an additional $250-per-student grant as part of their Tier 1 aid.

For districts that choose to levy a tax rate higher than $0.86, Tier 2 provides additional equalization funds based on a guaranteed-tax-base formula. For the 2001–02 school year, districts are guaranteed $25.81 per weighted ADA for each penny increase in the tax rate over $0.86, up to a maximum tax rate of $1.50. It should be noted that under Tier 2, districts with property wealth greater than $258,100 are able to generate more revenue than lower-wealth districts with the same tax effort. To further equalize revenues and increase fiscal neutrality, the Texas system requires that districts with property wealth greater than $300,000 per weighted ADA reduce their wealth to that level. In most cases, purchasing attendance credits from the state or paying for the cost of educating students in other districts accomplishes this "recapture" (Texas Association of School Boards 1996; Imazeki and Reschovsky n.d.).

THE WISCONSIN SCHOOL FINANCE SYSTEM

Nearly 90% of state aid in Wisconsin is distributed to school districts using a complex equalization aid formula (Reschovsky 2002). The remaining aid is distributed through a large number of categorical aid programs, the largest of which provides funding for special education. Since the mid-1990s, the state has committed to provide, on average, two-thirds of school district revenues (excluding federal revenues).[2] At the same time, all school districts face a revenue limit that places a fixed dollar limit on the amount by which school district revenue per pupil can increase from one year to the next. For 2002–03 the limit is approximately $230. As the limit is nominal, it allows smaller-than-average annual percentage spending increases in high-spending rural districts.

For most school districts in Wisconsin, equalization aid is allocated using a complex two-part formula.[3] The first part is a foundation formula. For the 2001–02 school year, the foundation level for K–12 districts was equal to $6848 per pupil, and the required property tax rate equal to 6.972 mills. The second part is a percentage equalization formula applied to school district spending in excess of $6848. For all school districts with equalized property values per pupil below the state average ($325,154 for the 2001–02 school year), the state pays a portion of each dollar of spending per pupil above $6848. Thus, a school district with a per-pupil property value that is 25% below the state average would receive additional state aid (above the amount allocated through the founda-

---

2. To help solve a large FY 2004 budget deficit, the state reduced its funding commitment to school districts. During the 2003–05 biennium, it will provide somewhat less than two-thirds of school district revenues.

3. The formula can be written as:

A_i = (\$6848 - 6.972 mills * EQV_i) + [{1 - (EQV_i/\$325,154)}*(SC_i -\$6848)], where A_i is the per-pupil equalization aid allocated to school district I; EQV_i is its per-pupil equalized property tax base; and SC_i is its per-pupil spending (shared cost) in the previous year.

tion formula) equal to 25 cents for each dollar of spending (in the previous year) in excess of $6848.

While the second part of the formula subsidizes additional spending for school districts with per-pupil property wealth below the state average, it penalizes additional spending by school districts that have per-pupil property values above the state average.[4] Thus, a school district with a per-pupil property tax base 50% above the state average would have its aid reduced by 50 cents for each dollar per-pupil spending (in the previous year) exceeded $6848.

The legislative objective of the second part of the formula is to encourage increased spending by low-property-wealth districts and discourage spending by high-property-wealth districts. Perhaps surprisingly, 46 out of the 164 rural (non-metropolitan) school districts in Wisconsin have above-average per-pupil property values and, thus, are penalized for extra spending, even though the "high" spending is in many cases attributable to high costs related to the district's small size and heavy concentrations of students from poor families. In most cases, these school districts' above-average per-pupil property values are due to the presence of vacation property.

A Comparison of Rural and Non-Rural Districts in Texas and Wisconsin

Table 1 provides some descriptive data for Texas and Wisconsin K–12 school districts, which are placed in one of five locational categories: central cities of metropolitan areas; suburban school districts (defined as all non-central-city districts located within metropolitan areas and in jurisdictions with populations of 2500); districts located outside metropolitan areas but in places with populations of at least 2500; rural districts located outside metropolitan areas; and districts designated as rural but located within metropolitan areas.

In the cost functions we estimate in the next section of the paper, we define rural school districts as those rural school districts outside metropolitan areas. In the introduction, we suggested that the problems plaguing many rural districts include their small size, high levels of per-pupil spending, and high concentrations of students from poor families. The data in Table 1 indicate that in both Texas and Wisconsin, substantial differences exist between rural districts inside metropolitan areas and those outside metropolitan areas. Non-metropolitan-area rural districts are much smaller, spend more per pupil, and have much higher concentrations of poor students than rural districts in metropolitan areas. In fact, aside from their smaller-than-average size, rural districts within metropolitan areas look quite similar to the typical suburban school district.

4. A very small number of high-wealth K–12 districts (with per-pupil property values in excess of $904,000) receive aid allocations through another formula.

TABLE 1
DESCRIPTION OF SCHOOL DISTRICTS IN TEXAS AND WISCONSIN BY CENTRAL CITY, SUBURBAN, AND RURAL LOCATION, 2000–01

TEXAS

School District Location	Expenditure per Student (Total)	Expenditure per Student (Excl. Transportation)	Number of School Districts	Percent of All Students	Average School District Enrollment	Average Composite TAAS Pass Rate	Percent of Students from Poor Families
Central city	$6616	$6465	83	43.5%	20,782	87.6	61.6%
Suburban ring of metro. areas	6629	6460	199	34.6%	6896	92.6	35.0%
Places over 2500 outside of metro. areas	6449	6269	191	10.0%	2076	90.5	54.5%
Rural, outside of metro. areas	7489	7267	418	5.3%	504	89.2	50.5%
Rural, within metro. areas	6767	6545	146	6.5%	1761	91.5	36.5%
Average/Total	6660	6492	1037	100.0%	3820	90.0	49.4%

WISCONSIN*

School District Location	Expenditure per Student (Total)	Expenditure per Student (Excl. Transportation)	Number of School Districts	Percent of All Students	Average School District Enrollment	Average Composite TAAS Pass Rate	Percent of Students from Poor Families
Central city	$8550	$8180	16	34.6%	18,160	64.9	41.2%
Suburban ring of metro. areas	7938	7633	70	25.8%	3099	77.6	11.0%
Places over 2500 outside of metro. areas	7711	7362	70	18.3%	2195	73.0	21.4%
Rural, outside of metro. areas	8055	7586	164	14.7%	756	72.4	25.9%
Rural, within metro. areas	7714	7279	48	6.6%	1153	74.8	12.6%
Average/Total	8111	7742	368	100.0%	2284	71.4	25.6%

* The data in this table are only for K–12 districts. Approximately 96 % of Wisconsin's public school students attend school in K–12 districts.

The data in Table 1 also indicate that, consistent with national data, student performance on standardized tests in non-metropolitan rural school districts is lower than the average student in suburban districts but substantially higher than the average in central-city districts. The first two columns of data in Table 1 display per-pupil spending with and without transportation expenditures. Although transportation spending in both states is a larger share of rural school district spending, the rural–urban differences are very small.

Estimating Cost Functions for K–12 Education

Using data on per-pupil school expenditures, student performance, and various school district characteristics, we estimate separate cost functions for K–12 public education in Texas and Wisconsin. A cost function quantifies the relationship between the minimum amount of money necessary to achieve various educational performance goals and the economic, educational, and social characteristics of a school district and its student body, as well as the prices it must pay for *inputs* used to provide education.[5]

As pointed out by Duncombe and Yinger, estimating cost functions provides a practical way to identify and quantify the factors that influence the cost of education, where the *output* of school districts can be measured using multiple measures of student performance (Duncombe and Yinger 1999). Although student performance can be measured in various ways, most states rely on standardized exams to measure how effectively a school district improves the academic performance of its students. Robert Meyer provides a strong argument for using a value-added approach in order to isolate the contribution of school resources to increases in student achievement (Meyer 1996). Thus, as our measure of school district output in Texas, we used the average passing rate on the Texas Assessment of Academic Skills (TAAS) in 2000–01, controlling for the average passing rates of the same cohort of students in the previous year.[6] For the Texas cost-function estimate, we also

5. In algebraic terms, a cost function can be represented by the following equation: $E_{it} = h(S_{it}, P_{it}, Z_{it}, F_{it}, e\ it, uit)$, where per-pupil expenditures, E_{it}, are specified as a function of public school outputs; S_{it} a vector of input prices; P_{it} the characteristics of the student body; Z_{it} the family and neighborhood environment in which the students live; F_{it} a vector of unobserved characteristics of the school district, e_{it}, and a random error term uit. For a fuller discussion of educational cost-function estimation, see Reschovsky and Imazeki (2003).

6. The TAAS is administered to all students in Grades 3 through 8 and 10, in reading and math, during the spring of each year. The measure used here is a composite across subjects and across Grades 4–8 and 10 in 2000–01. To capture the same cohort of students, the lagged score is a composite across Grades 3–7 in 1999–2000 and Grade 8 in 1998–9 (to match the 10th-graders in 2000–01). We note that test scores in two academic years will represent the same cohort of students to the extent that interdistrict student mobility is relatively low. A recent study of elementary school students in Texas by Hanushek, Kain, and Rivkin found that roughly 86% of fourth through seventh graders remain in the same district from one year to the next (Hanushek, Kain, and Rivkin 2001).

include student performance on the College Board exams as a measure of the quality of student preparation for higher education.[7] In Wisconsin, we used the average 10th grade district score on the Wisconsin Knowledge and Concept Exams (WKCE) in 2000–01, controlling for the eighth-grade scores in 1998–99.[8]

In estimating cost functions, we must take into account that these educational output variables and per-pupil expenditures are determined simultaneously. In other words, while local school board decisions to raise student performance level are expected to have direct implications for spending levels, decisions concerning per-student spending are likely to influence student performance. To deal with this simultaneity, cost functions are estimated using two-stage least squares. As instruments for the endogenous school output variables, we drew on a set of variables related to the demand for public education. Following a long literature search on the determinants of local government spending, we modeled the demand for public education as a function of 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, using the median income and tax price faced by the median voter as instruments is appropriate.[9]

In the Wisconsin cost function, we also included as an instrument the categorical aid each district receives. Finally, we included as instruments several socioeconomic variables that may be related to preferences for public education, including the percentage of households with children, the percentage of household heads that are homeowners, and the percentage of adults who have earned a four-year college degree.

Teachers are the single most important factor in the production of education, and, not surprisingly, teacher salaries account for the largest share of school expenditures. In our estimation of education cost functions, we included only teacher salaries and excluded explicit treatment of other public school employees. It is important

7. We use the percent of students who take either the SAT or ACT and score at or above 1110 or 24, respectively. Using performance on these exams as a measure of school quality can be problematic, however, because students decide whether to take the exam. Only students with a particular interest in continuing on to college will choose to take these exams—presumably the 'best' students, so their scores may reflect their own abilities and motivation rather than any influence of the school. By treating these scores as endogenous, we are able to control for this self-selection. As an instrument, we include the percent of students who take either exam.

8. The WKCE is administered to students in Grades 4, 8, and 10, in reading, math, language, science, and social studies during the spring of each year. The measures used here are composites across subjects for the 10th- and eighth-grade exams.

9. We use the tax price implied by the aid formula in the cost functions for both states.

to recognize that teacher payrolls are determined both by factors under the control of local school boards and factors that largely are outside of their control. In setting hiring policies, districts make decisions about the quality of teachers they recruit, and teacher salary levels generally are determined through a process of negotiation between unions and school boards. As our goal is to isolate factors that contribute to higher levels of education spending but are outside the control of local school districts, we use teacher cost indexes that reflect salary differences exogenous to school district decisions. In Texas, we used an existing cost index developed by Jay Chambers.[10] For Wisconsin, we developed a teacher salary index that only reflects differences in salaries due to factors outside local control by using detailed information on the characteristics of individual teachers in the state.[11]

Previous research suggested several student and school district characteristics that have a direct impact on costs. First, considerable evidence shows that there are higher costs associated with educating children from low-income families. To measure the number of children from economically disadvantaged families, we used the percentage of students who qualify for the federal government-financed Free and Reduced Price Lunch program or other public assistance. Second, a substantial literature exists that documents the extra costs associated with educating students with various kinds of disabilities and those who enter the schools with limited knowledge of English. Therefore, we included the percentage of students who were identified as having LEP and two measures of disabilities—the percentage of students classified as having any type of disability and the percentage of students classified as autistic, deaf, or deaf/blind. Third, to reflect the possibility that more resources may be needed to provide a high school education, as compared to an elementary school education, we also included the proportion of each school district's student body enrolled in high school. Finally, to reflect potential diseconomies of scale associated with both

10. The construction of Chambers' index relied on a large national sample of teachers. Using 1990–1 data from the National Center for Education Statistics' *Schools and Staffing Survey* (SASS), he estimated hedonic wage equations for teachers. He used the coefficients on factors outside the control of school districts (e.g., racial composition of the student body, local climate, crime rates, etc.) to construct a teacher salary index for each district in the country (Chambers 1995).

11. To construct our Wisconsin teacher salary index, we used data collected by Wisconsin's Department of Public Instruction on the salary, education, and experience of every public school teacher in the state. We regressed the log of the salary for all full-time teachers on each teacher's background characteristics (including race, gender, years of teaching experience, and highest degree earned) plus a dummy variable for each school district. The coefficients on the district dummies were 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.

small and large school districts, we included each district's enrollment and enrollment squared.[12]

Summary statistics for all variables are shown in Table 2. It should be noted that in each state, the sample of districts used in the cost-function estimation is slightly smaller than the full sample of K–12 districts due to missing data. Specifically, we were forced to exclude 98 of the 973 K–12 school districts in Texas because of missing test data. Excluded districts tended to be somewhat smaller, poorer, and higher spending than the 875 districts that remained in our sample, and the large majority of them (71) were non-metropolitan rural. This may affect our results and we are working on ways to retain these districts in our sample.

Cost Function Results

The first two columns of Table 3 show our estimates of a cost function for public education in Texas.[13] The test scores have the expected signs; since lagged scores are a proxy for past levels of student achievement, high scores mean that districts can spend less to achieve a given level of educational progress. The cost variables generally have the expected signs and most are statistically significant. In particular, the percentage of students eligible for free and reduced-price lunches is positive and statistically significant. Consistent with previous studies, we found a U-shaped relationship between per-pupil spending and school district size; with our estimates, the bottom of the U is at roughly 12,735 students. In contrast to the results of some other studies, we found that costs seem to be *lower* when a district serves more LEP or severely disabled students. These puzzling results perhaps could be explained by economies of scale—there certainly are fixed costs associated with having specialized programs for these students, and having more students in these programs could mean lower average costs. When a quadratic term for LEP students is included, some evidence exists that the relationship is U-shaped; the coefficient on the quadratic term is positive, though not highly statistically significant. In the case of severely disabled students, more than a third of districts do not have any such students at all. When we included a dummy variable for simply having any severely disabled students, the coefficient on this variable is positive and statistically significant. Thus, these students do increase district spending relative to districts that do not have any such students. However, if a district has severely disabled students, then having more such students can reduce costs.[14]

12. In Texas, we also included dummy variables for Dallas and Houston.

13. We weighted all regressions by district enrollment.

14. These results are available from the authors.

TABLE 2
Descriptive Statistics

	Texas		Wisconsin	
Variable	Mean	Standard Deviation	Mean	Standard Deviation
Per-pupil expenditures, 2000–01 (excludes transportation)	$6925	$1298	$7646	$792
Exam score, 2000–01 (a)	92.3	4.8	73.7	5.3
Lagged exam score (b)	89.1	6.0	70.4	5.7
Percent of students taking College Board exams	21.2	11.5	—	—
Teacher salary index	84.0	9.2	95.3	6.6
Percent of students eligible for free and reduced-price lunches and other public assistance	46.7	18.8	21.6	12.9
Percent of students with disabilities	14.1	3.7	14.3	2.8
Percent of students with severe disabilities	0.21	0.23	4.12	23.13
Percent of students with LEP	6.9	9.4	1.0	2.4
Percent of students enrolled in high school	29.7	3.5	34.0	3.4
Student enrollment	4473.8	12,462.1	2299.4	5798.5
Tax price	0.5	0.3	0.9	0.4
Percent of households with children	36.4	7.4	33.0	4.7
Percent homeowners	76.1	9.4	77.5	8.0
Median income	$36,463	$11,471	$43,819	$9940
Categorical aid	$370	$219	$370	$219
Percent of students taking college entrance exams	62.3	15.6	—	—
Number of K–12 districts	875		364	

(a) Texas: Composite score on 2000–01 TAAS exams;
Wisconsin: 2000–01 10th grade WKCE exam.

(b) Texas: Composite score on 1999–2000 and 1998–99 (8th grade) TAAS exams;
Wisconsin: 1998–99 8th grade WKCE exam.

TABLE 3
TEXAS EDUCATION COST FUNCTION, 2000–01
875 K–12 SCHOOL DISTRICTS

Variable	Coefficient	t-statistic	Coefficient	t-statistic
Intercept	-2.53*	-0.95	-0.09	-0.04
Log of composite exam score, 2000–01	9.19*	4.6	7.77*	4.64
Log of lagged composite exam score, 1998–2000	-6.6*	-4.54	-5.68*	-4.56
Percent passing College Board exams	0.98*	5.61	0.87*	5.81
Teacher salary index	0.004*	4.41	0.004*	4.93
Percent of students eligible for free and reduced-price lunches	0.57*	5.84	0.49*	5.74
Percent of students with disabilities	-0.08	-0.29	-0.096	-0.38
Percent of students with severe disabilities	-10.75*	-2.56	-9.97*	-2.61
Percent of students with LEP	-0.17**	-1.9	-0.23*	-2.61
Percent of students enrolled in high school	-0.37	-1.31	-0.6*	-2.24
Log of student enrollment	-0.28*	-5.12	-0.29*	-4.6
Square of log of student enrollment	0.015*	5.04	0.015*	4.54
Indicator for Dallas or Houston	-0.26*	-4.65	-0.245*	-4.54
Rural dummy			-8.65	-0.55
Rural * Log of composite exam score			0.28	0.04
Rural * Log of lagged exam score			1.75	0.47
Rural * Percent passing College Boards exams			-1.07	-0.53
Rural * Teacher salary index			-0.003	-0.34
Rural * Percent of students eligible for free and reduced price lunches			-0.16	-0.35
Rural * Percent of students with disabilities			-0.012	-0.02
Rural * Percent of students with severe disabilities			10.94	0.92
Rural * Percent of students with LEP			1.04**	1.75
Rural * Percent of students enrolled in high school			2.03	1.63
Rural * Log of student enrollment			-0.21	-0.45
Rural * Square of log of student enrollment			0.017	0.48
SSE	8.265		8.265	

* Indicates statistically significant at the 5% level.

** Indicates statistically significant at the 10% level.

Columns 1 and 2 of Table 4 present the cost-function results for public education in Wisconsin. The results are quite similar to those for Texas. The test scores, teacher salary index, and percent of economically disadvantaged students all have the expected signs and are statistically significant. As in Texas, we found a U-shaped relationship between per-pupil spending and district size. The estimated coefficients imply that average costs are lowest in school districts with 5308 students. We also found that, in Wisconsin, costs seem to be lower in districts with a larger proportion of students enrolled in high school.

Are Cost Functions Different for Rural Districts?

The two cost functions discussed in the previous section were estimated using nearly all K–12 districts in each state. As a result of this specification, the relationship between spending, student performance, and cost factors is constrained to be the same for all districts within each state. This implicit assumption may not be appropriate if differences in these cost relationships exist among districts in rural, suburban, and urban locations. For example, Brasington suggests that teacher quality may be more important for performance in rural schools than in urban schools (Brasington 2002). If this is true, teacher salaries (which affect the quality of teachers a district can attract) could have a different impact on costs in rural versus non-rural districts. To explore whether rural districts have a fundamentally different cost structure than non-rural districts, we interacted each of the independent variables with a dummy variable for rural districts and re-estimated the cost functions. The results are shown in the last two columns of Tables 3 and 4 for Texas and Wisconsin, respectively.

Examining the Texas results first, an F-test to determine whether the interacted cost variables, as a group, are statistically equal to zero is rejected.[15] This implies that rural and non-rural districts do not have identical cost structures. However, the individual coefficients on most of the interacted cost variables are not significantly different from zero, suggesting that these relationships essentially are the same for rural and non-rural districts. One exception is the interaction term for percentage of LEP students, which is positive and statistically significant at the 10% level. As noted earlier, the coefficient for this variable in the pooled sample was negative, somewhat counter to expectations. It is possible that because of the small size of most rural districts, the fixed costs of a specialized program

15. The test on the group of interactions on the lagged composite score, the teacher salary index, the percent of students eligible for free or reduced-price lunches, enrollment, enrollment-squared, percent of students with disabilities and severe disabilities, percent of students with LEP, and percent of high school students has an F value of 2.6 with 9 and 850 degrees of freedom.

TABLE 4
WISCONSIN EDUCATION COST FUNCTION, 2000–01
364 K–12 SCHOOL DISTRICTS

Variable	Coefficient	t-statistic	Coefficient	t-statistic
Intercept	3.63*	4.27	4.55*	6.87
Log of 10th grade exam score, 2000–01	3.26*	5.75	2.63*	5.29
Log of 8th grade exam score, 1998–99	-1.81*	-4.61	-1.34*	-3.68
Teacher salary index	0.33*	2.41	0.4*	3.36
Percent of students eligible for free and reduced-price lunches	0.38*	3.81	0.31*	3.17
Percent of students with disabilities	0.98*	3.06	1.14*	3.61
Percent of students with severe disabilities	0.040	0.8	-0.27	-0.47
Percent of students with LEP	-0.23	-0.91	-0.14	-0.7
Percent of students enrolled in high school	-0.007*	-2.13	-0.01*	-2.31
Log of student enrollment	-0.33*	-4.07	-0.39*	-4.17
Square of log of student enrollment	0.02*	3.94	0.02*	4.19
Rural dummy			8.89*	2.39
Rural * Log of 10th grade exam score			-3.33*	-2.52
Rural * Log of 8th grade exam score			1.54*	2.01
Rural * Teacher salary index			-0.31	-0.9
Rural * Percent of students eligible for free and reduced-price lunches			-0.23	-1.0
Rural * Percent of students with disabilities			-0.29	-0.42
Rural * Percent of students with severe disabilities			0.28	0.48
Rural * Percent of students with LEP			-0.06	-0.06
Rural * Percent of students enrolled in high school			0.01**	1.87
Rural * Log of student enrollment			-0.34	-0.58
Rural * Square of log of student enrollment			0.03	0.61
SSE	3.213		3.213	

* Indicates statistically significant at the 5% level.

** Indicates statistically significant at the 10% level.

like LEP may be higher. Another possibility is that native speakers in urban areas are able to flee public schools if too many students are immigrants, thus reducing their willingness to support higher spending (and taxes) for schools. In rural school districts, the supply of private schools is very limited, so support for spending remains high, and more money is devoted to LEP programs.

In contrast to Texas, an F-test on the interacted variables in Wisconsin cannot be rejected.[16] As in Texas, the coefficients on most of the individual interacted cost variables are not statistically significantly different from zero. One notable exception in Wisconsin is that the intercept is much larger in rural than non-rural districts. It also is interesting to note that the interaction terms for the test scores, both current and lagged, are significant and, if taken at face value, suggest that test score performance is inversely related to spending in rural districts. This is a puzzling result that we continue to explore.

The Cost of Rural Education

Overall, it appears that the cost structure of rural districts is, in most respects, the same as that of non-rural districts. However, this does not necessarily imply that the level of costs is the same in rural and non-rural districts. Rural districts are more likely to have small enrollments and large proportions of economically disadvantaged students; factors our results show clearly increase costs. The cost-function analysis simply indicates that, holding performance and all else equal, the effect of a given cost factor on spending is the same in rural and non-rural districts. To illustrate this point, we used the cost-function estimation results to build a cost index for each state. These indexes summarize all the information about costs into a single number for each district. By holding the output measures constant at some chosen level and allowing the cost factors to vary across districts, we can predict the level of spending required for each district to achieve the chosen output level. For example, if we assume that policymakers define the minimum standard for an accountability system as the current average level of student performance, then a cost index can be constructed that will indicate how much a particular district must spend, relative to the district with average costs, in order for its students to meet the performance standard.

Using the cost-function estimates from Table 3 and setting the performance standard equal to the average achievement on the TAAS

16. The test on the group of interactions on the eighth-grade score, the teacher salary index, the percent of students eligible for free or reduced-price lunches, enrollment, enrollment-squared, percent of students with disabilities and severe disabilities, percent of students with LEP, and percent of high school students has an F-value of 0.87 with 9 and 342 degrees of freedom.

TABLE 5
COST INDEX VALUES IN TEXAS AND WISCONSIN
BY CENTRAL CITY, SUBURBAN, AND RURAL LOCATION, 2001-02

	Texas	Wisconsin
School District Location	Average Cost Index	Average Cost Index
Central city	96.9	104.1
Suburban ring of metro. areas	94.1	92.0
Places over 2500 outside of metro. areas	98.9	96.4
Rural, outside of metro. areas	106.5	105.0
Rural, within metro. areas	95.8	98.7

* Indices are normed so that a district with average costs has a cost index value of 100.

and ACT exams, the Texas district with average costs (i.e., each of the cost factors set equal to its mean) had to spend $6925 per pupil (in 2000–01) to achieve the performance standard. For any given school district, the product of this average spending level and its cost index (divided by 100) will indicate the minimum amount the district must spend in order to meet the performance goal. Thus, for example, a district whose cost index is 125 will need to spend $8656 ($6925 x 1.25) to reach the same performance standard. The cost-function estimates in Table 4 show that, in Wisconsin, the district with average costs must spend $7597 per pupil to achieve the performance standard of average achievement on the 10th-grade WKCE exam.

Table 5 shows the average cost index values for central city, suburban, and rural districts. In both states, rural districts outside metropolitan areas clearly have the highest average costs. This is driven largely by the much smaller enrollments and higher proportion of poor students generally found in these districts. It also should be noted that, although the difference in average costs across location categories seems relatively small, a wide variation in costs exists among school districts in each state. In Texas, the district with costs at the 90th percentile has a cost index value of 117.6, compared to 85.3 in the district at the 10th percentile, representing costs that are 38% higher. In Wisconsin, the restricted range is slightly smaller than in Texas, but with cost index values of 114.3 and 90.1 for the 90th and 10th percentiles, respectively, this still represents a gap of 26%.

Conclusion

As states and individual school districts work to comply with the new federal guidelines for testing and accountability, it is important that schools are given the resources necessary to meet the requirements. There has been a growing concern that the enforcement of stricter student performance standards will place particularly heavy burdens on rural school districts. These concerns raise the question of what state policymakers can do to best assist rural districts in meeting the new standards. We have argued elsewhere that state educational aid should account explicitly for differences in costs across districts (Reschovsky and Imazeki 2003, 263–290). In this paper, we have explored whether fundamental differences exist in the cost structures of rural and non-rural districts that might justify a separate set of school financing policies for rural and non-rural districts. Using cost-function analysis and data from Texas and Wisconsin, we found that the differences in the relationship between cost factors and student performance in rural and non-rural districts are minimal. That is, the relationships between per-pupil spending, student performance, and district and student characteristics are quite similar in rural and non-rural districts. We emphasize, however, that although our results seem to be statistically robust, further statistical analysis of the cost structure of education in rural and non-rural areas clearly is warranted.

It also is important to point out that our conclusion about similar cost structures in rural and non-rural settings does not imply that the level of costs is the same in rural and non-rural districts. As we have tried to demonstrate, small district size, high poverty rates, and the burden of special-needs students all result in particularly high costs in many rural districts. Thus, well-designed policies to address cost differences across all districts almost certainly would help rural districts, without the need for separate school-financing policies targeting rural school districts. However, this does not necessarily mean that providing adequate education in rural areas will not require rural-specific educational policies. Within metropolitan areas, for example, school district consolidation may be an appropriate policy to address the high costs associated with small district size. However, consolidating small districts in rural areas generally is an inappropriate policy because it would require that some students travel great distances to attend school. This suggests that, in rural areas, cost-saving alternatives to consolidation, such as the use of distance education or the sharing of teachers of specialized subjects among several districts, may be appropriate rural-specific policies to address the high costs of education associated with small school district size.

References

Beeson, Elizabeth, and Marty Strange. February 2003. *Why Rural Matters, 2003: The Continuing Need for Every State to Take Action on Rural Education.* Washington, D.C.: The Rural School and Community Trust.

Brasington, David M. 2002. "Differences in the Production of Education Across Regions and Urban and Rural Areas." *Regional Studies* 36 (2): 137–145.

Chambers, Jay. 1995. *Public School Teacher Cost Differences Across the United States: Analysis/Methodology Report* (NCES 95–758). Washington, D.C.: National Center for Education Statistics, U.S. Department of Education.

Duncombe, William, and John Yinger. 1999. Performance Standards and Educational Cost Indexes: You Can't Have One Without the Other. In *Equity and Adequacy in Education Finance; Issues and Perspectives,* eds. Helen F. Ladd, Rosemary Chalk, and Janet S. Hansen, 260–297. Washington, D.C.: National Academy Press.

Hanushek, Eric A., John F. Kain, and Steven G. Rivkin. 2001. Disruption versus tiebot improvement: The costs and benefits of switching schools. *NBER Working Paper 8479.* Cambridge, Mass.: National Bureau of Economic Research.

Imazeki, Jennifer, and Andrew Reschovsky. Forthcoming 2004. School finance reform in Texas: A never ending story? In *Helping Children Left Behind: State Aid and the Pursuit of Educational Equity*, ed. John Yinger. Cambridge, Mass.: MIT Press.

Meyer, Robert H. 1996. Value-added indicators of school performance. In *Improving the Performance of America's School,* eds. Eric A. Hanushek and Dale W. Jorgeson, 197–223. Washington, D.C.: National Academy Press.

National Center for Education Statistics. 1998, 2000. *Navigating Resources for Rural Schools: Student Assessment.* Available at http://nces.ed.gov/surveys/ruraled/Assessment.asp; Accessed on March 20, 2003.

Reschovsky, Andrew. 2002. *Wisconsin's School Finance: A Policy Primer.* Madison, Wis.: Robert M. La Follette School of Public Affairs.

Reschovsky, Andrew, and Jennifer Imazeki. 2003. "Let No Child Be Left Behind: Determining the Cost of Improved Student Performance." *Public Finance Review* 31 (May): 263–290.

Texas Association of School Boards. 1996. *The Basics of Texas Public School Finance.* 6th ed. Austin: Texas Association of School Boards.