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Can money diminish student performance disparities across regions?

Charles Jacques* **and B. Wade Brorsen***
American Express and Oklahoma State University

Abstract. Inequality in student performance is a major concern. This study examines the possibility of using increased public school expenditures to remove the disparities in students' achievement test scores between two distinct regions of Oklahoma. Results indicate that equality of outcome as measured by achievement test scores may be impossible to achieve using school district expenditures.

1. Introduction

Equity in public school finance among regions and communities has been an important issue for state policymakers and courts. Arguments have been made for educational equity using equality of opportunity across school districts. This is usually achieved by equalizing per student expenditures across school districts. Some have stated that funding adequacy, which usually means equality of outcome (Nakib and Herrington 1998, p. 361), should be the goal instead of equality of opportunity (Hirth 1996). Hirth suggests achieving equality in outcome by increasing school inputs (expenditures) in school districts whose students perform poorly on achievement tests. This strategy assumes that school expenditures and achievement test scores have a strong positive relationship. Hanushek (1991) argues that if schools are ineffective at translating resources into student achievement, equalizing expenditures will do little to achieve equity. He argues that finance reform that emphasizes the distribution of expenditure per student is almost certain to exacerbate existing problems of inefficiency in school operation. Cooper, Bloomfield, and Speakman (1997) say that school equity involves more than school district spending levels, and they

* Charles Jacques is an economist with American Express and B. Wade Brorsen is a regents professor in the Department of Agricultural Economics at Oklahoma State University. The authors wish to thank Dr. Larkin Warner for suggesting this research topic and Francisca G.C. Richter for research assistance.

recognize the need for effective teachers and offices in order to direct resources to the classroom. They conclude that more money in the classroom will lead to more learning and better test results. This study seeks to determine whether equality of outcome can be achieved between western and eastern Oklahoma by reallocating resources to eastern Oklahoma where students have lower achievement test scores.

Eastern Oklahoma historically has lagged western Oklahoma in literacy rates and educational attainment. Income disparity also has existed, with the east having significantly lower per capita income than the west. It has been suggested that the east-west economic disparity that exists today can be linked to the original settlement patterns of the state (Warner 1995b, p. 10).

Eastern Oklahoma was occupied by white settlers in the 1820s. A few years later Indian tribal groups, displaced by white settlers elsewhere, were relocated to this part of Oklahoma. This part of the state was designated Indian Territory. After the Civil War, however, the population was primarily white, tribal governments had weakened, and white immigration continued to increase from the south part of the country. Western Oklahoma was settled primarily by white persons from the north and Midwest of the United States. The western 37 counties of Oklahoma were originally Oklahoma Territory. This area was settled in large part by the land runs of 1889 and 1893. Differences of these two populations could be seen in issues such as land tenure, private ownership, the importance of establishing governmental institutions such as schools, and characteristics of the areas of origin (Warner 1995a). This has been described not as an east-west dichotomy, but as a north-south one, with persons from the northern United States settling in western Oklahoma (Hale 1982).

One reason for the economic disparity between Indian Territory and Oklahoma Territory at the time of statehood (1907) was the lack of governmental institutions, especially schools, in Indian Territory. Whites migrated into Indian Territory in spite of the fact that they had no political rights, no right to own land, and no access to formal schooling. Warner (1995a) suggests that these immigrants probably placed little value on education. Settlers of Oklahoma Territory set up communities, local governments, and schools immediately after the land runs. Public services were provided to the people of Oklahoma Territory by their political agencies. These original disparities could still be influencing student performance. Warner (1995b, p. 13) suggests, however, that regional disparities may be diluted over the years.

Evidence is emerging, however, that the east-west differential in economic well-being so dominant in Oklahoma's first century may be substantially ameliorated during the years to come and even may disappear. Population estimates for 1990-1994 reflect substantially greater economic opportunity in the east than in the west; 20 of the 39 counties in the former O.T. area lost population, while most of the nonmetropolitan population growth was in I.T. counties.

Research has shown that many of the factors affecting school achievement test scores are from outside the school. Family background is an important factor determining performance on achievement tests (Chubb and Moe 1990, pp. 105-111). Broomhall and Johnson (1994) find that students' values and beliefs influence their academic achievement. Deaton and McNamara (1984) suggest that not only socioeconomic background, but culture also determines the ability of pupils to use educational inputs. Because of the socioeconomic differences among the two Oklahoma regions, equating expenditures per student in Indian Territory counties and Oklahoma Territory counties is unlikely to remove the regional disparities in student performance.

The production function approach to educational output has been used with various measures of output and functional forms (Butler and Monk 1984; Hanushek 1986; Hanushek 1996; Hanushek 1997; Ferguson and Ladd 1996). Here a linear production function is used, with achievement test scores as the output and various socioeconomic, school, and expenditure variables as inputs. Hierarchical modeling and a correction for heteroskedasticity are used to improve the precision of the tests.

2. Data

Data for this research were obtained from the Oklahoma Department of Education (1996) for the 1994-1995 school year. Test scores by school district and grade were available for each school district for the school year 1994-1995. Subjects covered by the tests include reading, science, and math. Achievement test results were from a Criterion Referenced Test (CRT), which is unique to Oklahoma, and the Iowa Test of Basic Skills (ITBS). The ITBS is a norm-referenced test. It is not considered whether the tests are norm-referenced or criterion-referenced, as raw scores are used. The CRT is given to grades 5, 8, and 11. The ITBS is given to grades 3 and 7. All tests are weighted equally, although Blackburn and Newmark (1995) find that math scores alone are the best predictor of salary after graduation and thus math scores should perhaps be given a higher weight.

Problems arise when test scores are used as a measure of school performance:

- Tests scores are a one-shot measure of learning, are imperfect measures of knowledge, and fail to measure all areas of knowledge;
- Schools and teachers may adapt their procedures to teach to the test; and
- Test scores are due in part to schools, but also include student aptitude, social characteristics, and other causes (Chubb and Moe 1990, p. 198; Deaton and McNamara 1984).

Schools also teach social skills and a variety of other skills such as music and athletics that are not reflected in achievement test scores. Because special edu-

cation students usually do not take the tests, test scores do not measure how well schools are teaching these students. Also, CRTs do a poor job of measuring how well schools are teaching their most gifted students. It is important to recognize the limitations of using test scores as a proxy for school performance, such as their inability to measure student aptitude (Borland and Howser 1996). In spite of their limitations, however, test scores accurately measure student knowledge, and imparting knowledge is the primary goal of schools.

Cultural and socioeconomic background determine the ability of pupils to use educational inputs (Deaton and McNamara 1984). Student data include the number of students per gender and race by grade for each school district. Race data include black, Hispanic, Native American, and white. Parental data are derived from the 1990 census (United States Department of Education 1995) and are for parents with school age children. The parental data include proportion with at least a bachelor's degree, proportion with some college, proportion with a high school education, and proportion without a high school education. Other demographic data by school district are proportion of students obtaining a free or reduced-price lunch. The free lunch variable should reflect both family income and family size.

Proportion of special education students by school district is used because it is an important explanatory variable in per student costs and achievement test scores. Some schools are more restrictive than others about who they allow to take the tests. Schools can increase average tests scores by not letting their weaker students take the tests. We use the percentage of students enrolled in each grade who actually took the test to correct for differences due to this practice.

The range of school districts' average daily enrollment (ADM) for the Oklahoma school districts used in this research is from less than 50 students to about 7,000 students. ADM is used to calculate per student expenditures. Expenditures include variable costs to schools and do not include bond payments, trust payments, or contributions to sinking funds.

The definition of the counties in Oklahoma Territory and Indian Territory is the same as Warner (1995a, 1995b). To isolate cultural effects on the regions, the metropolitan counties of Tulsa and Oklahoma are eliminated from the analysis. In addition, the cities of Lawton, Norman, and Moore are eliminated. Norman and Moore are suburbs of Oklahoma City even though they are not in Oklahoma County. Lawton is the third largest city in Oklahoma, and many of its citizens are military personnel. The remaining data correspond to mainly rural regions in both territories.

Variable averages for each region are shown in Table 1. Indian Territory's achievement test scores are 2.2 points lower than Oklahoma Territory scores. This value is higher than the difference in average achievement test scores for

Table 1. School district per student averages for Oklahoma regions

Variable	Oklahoma Territory		Indian Territory	
	Mean	Sd. dev.	Mean	Sd. dev.
Average test score[a]	50.90	27.008	48.70	26.110
Parents wo/high school education	0.16	0.079	0.22	0.092
Parents w/high school education	0.39	0.098	0.39	0.096
Parents with some college	0.28	0.079	0.27	0.089
Parents with bachelor's degree	0.16	0.076	0.12	0.073
Parent's median income	27,851.00	5.859	24,709.00	6.549
Proportion male students	0.52	0.101	0.52	0.100
Proportion female students	0.48	0.101	0.48	0.100
Proportion Indian students	0.11	0.157	0.30	0.212
Proportion Hispanic students	0.05	0.085	0.01	0.028
Proportion white students	0.82	0.172	0.65	0.213
Proportion black students	0.02	0.044	0.04	0.108
Proportion free or reduced lunch	0.48	0.146	0.59	0.177
Proportion special education	0.12	0.033	0.13	0.044
Proportion taking tests	0.90	0.084	0.88	0.105
Average daily membership[b]	744.00	1093.400	716.00	858.329
Instructional expend./student[c]	3,345.00	753.112	3,186.00	585.347
Administrative expend./student[c]	1,760.00	0.514	1,701.00	0.453

Note: The means are unweighted averages of each district's proportion and therefore they will not match state averages

[a] These are average per student test scores, across all achievement tests

[b] Average daily school district student membership

[c] Expenditures per district divided by average daily membership

small versus large schools and urban versus rural schools.[1] Indian Territory also has less-educated parents with lower median incomes, more students receiving subsidized lunches, and more minority students. Average per student expenditures are also lower in Indian Territory.

3. Methods

The school quality function to be estimated has school district average achievement scores on standardized tests as the dependent variable and various socioeconomic and school factors as dependent variables. An intercept dummy variable is included to test for differences between the 40 Indian Territory counties and the rest of the state not reflected in the other variables. The data

[1] Small schools are considered those with ADM of at most 700. Large schools' average test score is 50.55 while small schools' average is 49.09. Schools in urban areas (which are not considered in the study) average 50.54 versus a 49.52 average test score in rural Oklahoma.

can be viewed as a panel with cross-sections of school districts observed 15 times each, at most.[2] A hierarchical linear model, which is a random effects model with adapted degrees of freedom, is used (Arminger et al. 1995, p. 531). This model allows recognizing a hierarchical structure in the data—classrooms are within school districts, so a common correlation among each test/grade combination within a school district is introduced. The model is estimated using PROC MIXED in SAS. There are many small school districts and few large school districts. Because of varying numbers of students in each school district, heteroskedastic disturbances are expected. Multiplicative heteroskedasticity is assumed, so variance is modeled as:

$$\sigma_i^2 = \exp(\gamma' z_i) \tag{1}$$

where z_i is a vector whose first element is one and the others are values for all the explanatory variables used in the quality function and the number of students taking the test. The index i represents each particular kind of test/grade/school district combination. Maximum likelihood estimation (MLE) is used to gain asymptotically efficient parameter estimates and valid hypothesis tests (Greene 1993, p. 567). The MLE is performed by iterating around the hierarchical linear model.

The following equation is estimated using maximum likelihood:

$$Y = \rho G + \beta S + \phi X + \epsilon \tag{2}$$

where Y is a vector of test scores for school districts and S is a matrix of student effects that vary by school district and grade. Student effects are proportions for each grade by race and gender and the percent of students taking the tests. Because the proportions by race and gender add to one, this procedure requires leaving two variables in the intercept (white and male students).

The socioeconomic effects matrix, X, varies only by school district. It includes the percent of students in special education, the percent of students receiving free or reduced-price lunches, instructional[3] and administrative expenditures per student, and four levels of education attainment of the parents. The proportion of parents without a high school education is left in the intercept.

G is a matrix of dummy variables for type of test (ITBS or CRT), kind of test (math, reading, or science), and grade level of the test (third and seventh for the ITBS and fifth, eighth, and eleventh for the CRT). The variable for CRT, grade 11, math test is left as part of the intercept. Equation (2) is estimated two

[2] Recall that data from five grades are used and within each grade three kinds of tests may be taken by the students. This gives a total of 15 observations, at most, for each school district.

[3] A quadratic term for instructional expenditures is included in the model. The estimated coefficient is negative, as expected, for both Indian and Oklahoma Territory (p-values are 0.61 and 0.22, respectively). Therefore test scores are assumed linear in the instructional expenditure variable.

ways. First, a dummy variable for Indian Territory is included. Second, it is estimated separately for Oklahoma and Indian Territories.

4. Results

The dummy variable for regional differences has a parameter value of -0.0067 and is significant only at the 0.9529 level. This indicates that lower achievement test scores in Indian Territory may be explained by variables already included in the model. If past differences in lifestyle still exist that influence student learning, these are reflected to some extent in parental education and socioeconomic characteristics immersed in the race variables.

Regression results for Oklahoma Territory and Indian Territory are shown in Table 2. All parental education variables for Oklahoma Territory are positive, statistically significant, and economically significant with larger parameter values than in Indian Territory. As seen in Table 1, Oklahoma Territory school districts average about four percent more parents with at least a bachelor's degree than do Indian Territory school districts. There are more highly educated parents, and educational effects of parents are clear in Oklahoma Territory. These variables are not as important in Indian Territory.

Table 1 shows that Indian Territory school districts have about two percent fewer students taking tests than does Oklahoma Territory. As shown in Table 2, the parameter values for proportion allowed to take tests are negative for both regions, with Indian Territory having more than twice the magnitude of Oklahoma Territory. This indicates that even though fewer students are allowed to take tests in Indian Territory schools than in Oklahoma Territory schools, allowing a greater percent to take tests has a much larger negative effect on test scores.

The estimated effect of free and reduced price lunches is negative for Indian Territory and surprisingly positive (although small) for Oklahoma Territory. Free and reduced price lunches can be used as a proxy for parental income. Effects of special education students are negative but insignificant in both regions, although these effects are much bigger in Indian Territory.

The gender variables for both regions show that females do not score significantly better or worse on achievement tests than do males. All minority parameters for Oklahoma Territory are negative, but only two are statistically significant at the five percent level. In Indian Territory, the minority parameters are also all negative but only one is significant at the five percent level.

Indian Territory school districts spend about $200 per student less than do Oklahoma Territory school districts. Parameter estimates show that additional monies spent for instruction in Oklahoma Territory have about half the effect of additional expenditures in Indian Territory (Table 2). Administrative expenditures do not contribute to student achievement in either region.

Table 2. Estimates of the effects of various factors on Oklahoma Public School achievement test scores by region

Variable	Oklahoma Territory		Indian Territory	
	Parameter estimated	p-value	Parameter estimated	p-value
Intercept	75.56	0.0001	77.96	0.0001
Grade 3 math[a]	-51.05	0.0001	-49.10	0.0001
Grade 3 reading[a]	-59.17	0.0001	-57.07	0.0001
Grade 3 science[a]	-58.44	0.0001	-56.55	0.0001
Grade 5 math[a]	-2.76	0.0001	-2.80	0.0001
Grade 5 reading[a]	5.47	0.0001	5.98	0.0001
Grade 7 math[a]	-50.84	0.0001	-49.32	0.0001
Grade 7 reading[a]	-53.71	0.0001	-52.39	0.0001
Grade 7 science[a]	-50.98	0.0001	-49.46	0.0001
Grade 8 math[a]	-0.75	0.0760	-0.70	0.0589
Grade 8 reading[a]	0.69	0.0578	1.22	0.0005
Grade 8 science[a]	-2.71	0.0001	-1.79	0.0001
Grade 11 reading[a]	-6.45	0.0001	-8.77	0.0001
Parents w/B. Degree	4.94	0.0002	0.34	0.7495
Parents w/some college	4.02	0.0062	0.28	0.7479
Parents w/high school	3.64	0.0087	-1.49	0.1157
Proportion females	-0.48	0.3812	0.02	0.9656
Proportion black students	-3.63	0.0158	-3.24	0.0001
Proportion Indian students	-2.12	0.0001	-0.25	0.4378
Proportion Hispanic students	-1.35	0.1591	-0.87	0.5016
Percent subsidized lunch	0.53	0.4235	-0.82	0.1225
Percent special education	-1.22	0.6330	-2.73	0.1101
Percent taking test	-2.27	0.0010	-3.87	0.0001
Administrative expenditures[b]	-0.19	0.4874	-0.10	0.6839
Instructional expenditures[b]	0.29	0.1258	0.55	0.0043

[a] These are intercept-shifting dummy variables

[b] These are average per student expenditures

Note: Parameter estimates are corrected for multiplicative heteroskedasticity

5. Policy implications

Equality of opportunity in terms of equal expenditures could be obtained with small changes in expenditures. The difference between the regions in 1995 was $240 per student. Increasing school expenditures in Indian Territory to the levels in Oklahoma Territory, however, would have a negligible effect on test scores. Our parameter estimates indicate that the effect of equalizing expenditures per student would increase average test scores in Indian Territory 0.13, well short of the 2.2 point difference. The results also suggest that efforts to equate school expenditures across districts in other states such as Kentucky (Goetz and Debertin 1991) may do little to equate test scores. Our findings indi-

cate that the effect of various demographics, such as parental education, on test scores is different across these two Oklahoma regions.

Some have indicated that equality of outcome should be the relevant goal (Ferguson and Ladd 1996). If Oklahoma Territory's expenditures were held constant and our parameter estimate for expenditures did not decrease as expenditures increased in Indian Territory (this heroically assumes away diminishing marginal returns to investment), it would take about an additional $4,000 per student in Indian Territory to equalize outcomes. With current expenditures of about $5000 per student, this would almost double current expenditures. This is not a viable option—the state already has budget problems and educational expenditures are already over half of the state's annual budget. Thus, equality of outcome cannot be practically achieved by reallocating money.

6. Conclusion

Significant differences are found in average achievement test scores between eastern Oklahoma and western Oklahoma. Because the difference in test scores between the regions is large, it is economically infeasible to achieve outcome equity by increasing spending in eastern Oklahoma. Most of the variables explaining the differences in test scores between the two regions are not under the schools' control.

Expenditures on instruction increased test scores while expenditures on administration did not. Thus, the results are consistent with recent research that shows that money does matter if it is carefully targeted toward instruction. While the effects of money are statistically significant, they are also small. This result is consistent with Hanushek's argument that the efficiency of schools must be improved before money can have much effect on outcome equity.

Educational equity and adequacy are important issues because they have a direct impact on the well-being of those in a community or area. Equality of opportunity as measured by expenditures could easily be achieved. This research indicates that policymakers should not expect equity in school financing to bring outcome equity, as measured by achievement test scores.

References

Arminger, G., C.C. Clogg, and M.E. Sobel, "Random Coefficient Models," in *Handbook of Statistical Modeling for the Social and Behavioral Sciences* (New York, NY: Plenum Press, 1995).

Blackburn, M.L., and D. Newmark, "Are OLS Estimates of the Return to Schooling Biased Downward? Another Look," *Review of Economics and Statistics,* 77 (May 1995), pp. 217-230.

Broomhall, David E., and Thomas G. Johnson, "Economic Factors that Influence Educational Performance in Rural Schools," *American Journal of Agricultural Economics*, 76 (August 1994), pp. 557-567.

Borland, M.V., and R.M. Howsen, "Competition, Expenditures and Student Performance in Mathematics: A Comment on Couch et al.," *Public Choice*, 87 (1996), pp. 395-400.

Butler, R.J., and D.H. Monk, "The Cost of Public Schooling in New York State: The Role of Scale and Efficiency," *The Journal of Human Resources*, 20 (Summer 1985), pp. 361-381.

Chubb, John E., and Terry M. Moe, *Politics, Markets, and America's Schools* (Washington, D.C.: The Brookings Institution, 1990), pp. 105-198.

Cooper, B.S., D.C. Bloomfield, and S.T. Speakman, "School-Site Finance and Urban Education Equity, New Legal Arguments, New Reform Opportunities," *Education and Urban Society*, 29, no. 2 (February 1997), pp. 162-181.

Deaton, Brady J., and Kevin T McNamara, "Education in a Changing Environment: Impact of Population and Economic Change on the Demand and Cost of Public Education in Rural America," *SRDC Synthesis-Bibliography Series No. 18* (Mississippi State, MS: Southern Rural Development Center, 1984).

Ferguson, Ronald F., and Helen F. Ladd, "How and Why Money Matters: An Analysis of Alabama Schools," *Holding Schools Accountable* (Washington, DC: The Brookings Institution, 1996), pp. 265-298.

Goetz, Stephan J., and David L. Debertin, "Rural Education and the 1990 Kentucky Educational Reform Act: Funding, Implementation, and Research Issues," *Agricultural Economics Research Report 54* (Lexington, KY, 1991).

Greene, William H., "Heteroskedasticity," in *Econometric Analysis*, Third Edition (Upper Saddle River, NJ: Prentice-Hall, 1993).

Hale, D., "The People of Oklahoma, Economics and Social Change," in Anne Hodges and H. Wayne Morgan (eds.), *Oklahoma, New Views of the Forty-Sixth State* (Norman, OK: The University of Oklahoma Press, 1982).

Hanushek, Eric A., "Assessing the Effects of School Resources on Student Performance: An Update," *Educational Evaluation and Policy Analysis*, 19, no. 2 (Summer 1997), pp. 141-164.

Hanushek, Eric A., "School Resources and Student Performance," *Does Money Matter?* Gary Burtless (ed.) (Washington, D.C: The Brookings Institution, 1996).

Hanushek, Eric A., "The Economics of Schooling: Production and Efficiency in Public Schools," *Journal of Economic Literature*, 24 (September 1986), pp. 1141-1177.

Hirth, M.A., "Systemic Reform, Equity, and School Finance Reform: Essential Policy Linkages," *Educational Policy*, 10, no. 4 (December 1996), pp. 468-479.

Nakib, Yasser, and Carolyn D. Herrington, "The Political Economy of K-12 Education Finance: The Context of a Fast Growing Large State," *Journal of Education Finance*, 23 (Winter 1998), pp. 351-373.

Oklahoma Department of Education, unpublished electronic data. (Oklahoma City, OK: Oklahoma Department of Education, 1996).

United States Department of Education, *1990 Census Data by School District* (Washington DC. National Center for Education Statistics, United States Department of Education, 1995) (CD ROM).

Warner, Larkin A., "An Overview of Oklahoma's Economic History, Part I," *Oklahoma Business Bulletin*, 63 (September 1995a), pp. 5-21.

Warner, Larkin A., "An Overview of Oklahoma's Economic History, Part II," *Oklahoma Business Bulletin,* 63 (December 1995b), pp. 5-13.