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ABSTRACT

For years people have assumed there is an unquestionable connection between school funding and student achievement. A study of Alabama students in grades 4 and 8 attempted to unearth the truth about the widely held assumption that the more money spent on a school the higher the student achievement will be. The study only examined funds that are spent directly on students, not on teacher salaries. The measurement of student achievement was done through the Stanford Achievement Test. School system averages were taken from 128 schools. Results of the study show a relationship between school funding and student achievement, but the relationship is not a simple linear one, but rather an ogive-shaped curve. Thus, as the ogive-shaped curve illustrates, until funding is increased to a high level, the increases will have relatively little impact on student achievement. Additionally, when the amount of money spent on teaching higher order skills is increased, the relationship between school funding and student achievement will become closer. (KDP)

Educational Funding and Student Achievement:

You Be the Judge

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Educational Funding and Student Achievement:

You Be the Judge

Is there a relationship between how we fund education and the achievement of our students? The world has acted as if this is a universal truth for many years. However, in recent years challenges to this conventional wisdom have been made by various groups and organizations. In many states courts have had to decide whether funding was a determinate of a quality education and some "expert" testimony has proclaimed there is no relationship between many educational inputs, including funding, and the output of student achievement. If there is no relationship between funding and achievement, then one might expect voter backlash at attempts to raise property taxes or any other attempts to provide additional funds for education. If, on the other hand, the achievement of our students is in some way related to the level of funding provided to education, then maybe the public can be convinced to provide the needed funds to education. This study examined the relationship between student achievement at grades 4 and 8 and the level of educational funding in Alabama.

Background

One of the issues noted in a review of research conducted in this area was the fact that many investigations assumed, and therefore only looked for, a linear relationship between funding and achievement (Hanushek, 1989). From a purely

logical point of view it seems reasonable to assume something other than a simple linear relationship. If one begins with the premise that if money makes a difference and there is a linear relationship, then more money should continue to increase achievement. The fact is that the measurement and definition of achievement in school settings puts a limit on achievement. Thus, if we know that the achievement must stop at some predetermined point, then more money can only hold that level of achievement. This implies at least some degree of nonlinearity in the relationship. At the other extreme, if one assumes no money is being provided (for textbooks, materials, etc.) then it again seems reasonable to assume that the average achievement would be very low. Providing additional but insufficient funds (from $0 to $1 to $5) may not change the measured achievement. Only when the funds reach a certain level (enough to maybe buy a book or some instructional materials) would the expectation hold that achievement ought to begin to improve.

This then leads to the hypothesis that the actual relationship between funding and achievement is more an ogive shaped curve. Figure 1 illustrates this hypothesized relationship showing that, until funding is increased to some threshold level, the increases have little additional impact. However, once that threshold level is reached, increases in achievement accelerate as the funding

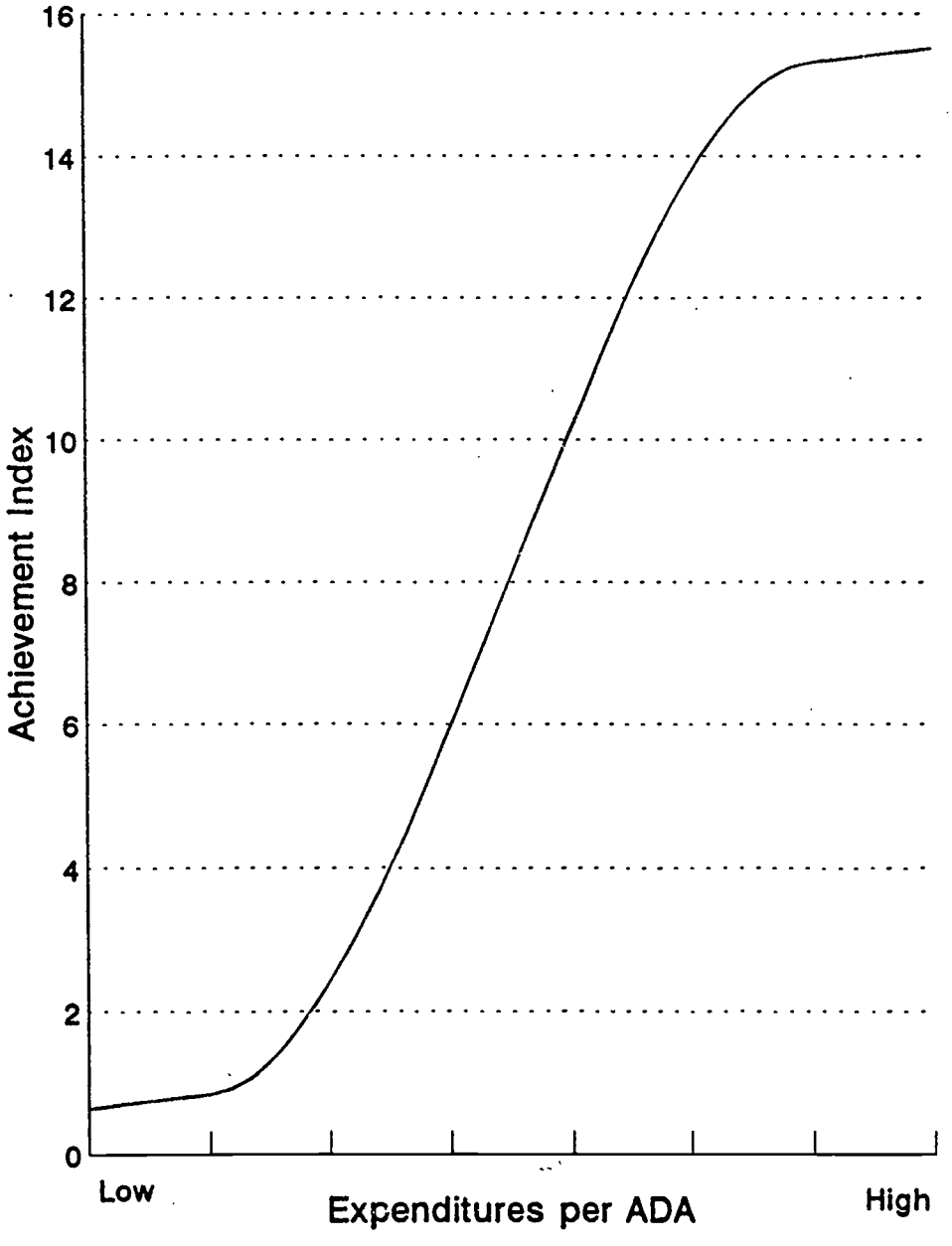

Figure 1.
Hypothesized relationship between achievement and expenditures per ADA

increases. The threshold effect also occurs at the upper end of the curve. A point is ultimately reached where providing more money has little, if any, effect on achievement. Attempts to describe this curve using a linear equation would quite naturally fail to show a significant relationship.

Method

In this study the relationship between instructional expenditures and student achievement was investigated. Instructional expenditures were selected as the input variable to control for differences that may be paid to teachers that are not reflective of quality. Economists refer to this condition as compensating differentials. It is based on the assumption that certain areas or positions are inherently more or less attractive than others. To obtain persons for those positions may require more or less pay for personnel. To use teacher salaries or to include it in a measure of educational inputs may confound the relationship between funding and achievement. By example, a poor, rural school system may be required to pay higher salaries to fill instructional vacancies, even though the educational system is behind more affluent suburban schools. This, the requirement to pay higher salaries, may reduce the actual money available to the instructional program. If a simple relationship between salaries and achievement is calculated, it may turn out to be near zero or even negative. This does not really reflect the relationship between tne two. This study assumed that the

provision of funds (materials and supplies) that directly impact the student, regardless of school desirability, is a more appropriate measure of educational funding.

The measure of student achievement used in this study was the average Normal Curve Equivalent (NCE) from the Stanford Achievement Test, Eighth Edition, given to all students in grades 4 and 8 as part of the statewide testing program. For analyses, all data were aggregated to the school system level, yielding a data set containing 128 school system averages for instructional expenditures and student achievement.

Since each school system has a differing number of students, the instructional expenditures were adjusted by dividing them by the average daily attendance (ADA) in the school system. In this way the expenditures were comparable across the 128 school systems. The achievement data available from the Stanford Achievement Test were Total Reading scores, Total Mathematics Scores, Total Language scores, and the Basic Battery scores for grades 4 and 8.

The relationship between these variables was investigated by regressing student achievement on instructional expenditures. There were, therefore, eight separate regression equations generated in this study. Since it was hypothesized that there would be a curvilinear relationship between funding and achievement, squared and cubed terms were included in these analyses. If the research

hypothesis was tenable, then it would be expected to find significant relationships between the achievement variables and the squared and/or cubed terms.

Results

The primary analysis consisted of regressing the achievement variables on the instructional expenditures per average daily attendance from the square and cube of these values for the 128 school systems in Alabama. The mean and standard deviation for each of these variables are included in Table 1.

Table 1

Descriptive Statistics for Expenditure and Achievement Variables (n = 128)

Variable	Mean	SD
Expenditure/ADA	33.65	10.80
Expenditure/ADA Squared	1,247.96	931.57
Expenditure/ADA Cubed	51,583.14	74,129.81
SAT Basic Battery, Grade 4	47.73	6.53
SAT Reading, Grade 4	45.72	6.45
SAT Math, Grade 4	49.54	6.74
SAT Language, Grade 4	48.94	6.14
SAT Basic Battery, Grade 8	46.78	7.35
SAT Reading, Grade 8	45.39	7.45
SAT Math, Grade 8	48.87	7.63
SAT Language, Grade 8	48.93	6.66

The regression analysis was applied separately for the SAT Basic Battery, Reading Total, Mathematics Total, and Language Total NCE scores for both grades 4 and 8. Thus, eight regression analyses were run.

Before the regression equations were run, a correlation matrix was computed to examine the linear relationship between achievement and instructional expenditures per ADA. The results of this analysis are presented in Table 2. All 24 correlation coefficients were significant.

Table 2

Correlation Coefficients Between Achievement and Expenditure Variables (n = 128)

Achievement Variable	Grade	Expenditure Variable		
		Expenditure per ADA	Squared	Cubed
Reading	4	.21*	.25**	.28**
Math	4	.26**	.27**	.27**
Language	4	.21*	.24**	.26**
Basic Battery	4	.24**	.27**	.29**
Reading	8	.18*	.21*	.23*
Math	8	.26**	.28**	.29**
Language	8	.21*	.24**	.25**
Basic Battery	8	.23**	.26**	.27**

* $p < .05$ ** $p < .01$

Eighteen of them were significant at the .01 level. They ranged from .18 to .29, with most of them being in the .23 to .27 range. All but one of the relationships between expenditure per ADA cubed and achievement were significant at the .01 level. Thus, the squared and cubed expenditures per ADA were included in the regression analyses.

Table 3 presents the final R^2 for each model as well as the values for the full model and each of the expenditure per ADA terms. All eight regression models

Table 3

Multiple R^2 and the p-values of Model and Terms in Regression Analysis (n = 128)

Dependent Variable	R^2	p-values for:			
		Full Model	Expen-diture per ADA	Squared Expen-diture	Cubed Expen-diture
Reading, Grade 4	.09	.008	.455	.543	.727
Math, Grade 4	.07	.021	.919	.928	.833
Language, Grade 4	.07	.031	.859	.921	.927
Basic Battery, Grade 4	.09	.010	.710	.764	.923
Reading, Grade 8	.07	.036	.250	.193	.398
Math, Grade 8	.09	.010	.389	.389	.475
Language, Grade 8	.07	.028	.381	.415	.526
Basic Battery, Grade 8	.08	.014	.289	.310	.404

were significant at the .05 level or better. The multiple R^2s ranged from .07 to .09. These values were generally about .03 higher than if only the instructional expenditures per ADA term was used in the model without its squared and cubed terms. Further, the mean-squared error was reduced in 7 of the 8 cases by adding the squared and cubed terms. However, even though a better model was obtained in each case by adding the squared and cubed terms, their coefficients were not significant by themselves. In summary, expenditures per ADA accounted for between 7% and 9% of the achievement variance on the Stanford Achievement Tests in grades 4 and 8 when a curvilinear relationship is assumed.

Discussion

The results of this study support a relationship between achievement and instructional expenditures per ADA. While this result supports conventional wisdom, it is in conflict with recent writings of Hanushek (1989) and others. Our results support the more recent conclusions of Hedges, Laine, and Greenwald (in press) that bring Hanushek's views into question. The present findings provide additional empirical support for the position taken by Hedges et al.

At first glance, the 7% to 9% of the achievement variance accounted for by instructional expenditures per ADA in this study might seem modest. However, taken in the context of the full range of expenditure per ADA throughout the United States and the theory suggested by Figure 1, these results are impressive.

Another way of estimating the true meaning of the results obtained in this study is to look at the range of Total Expenditures in the United States. The National Center for Education Statistics (1992) reported a range of total expenditures from $2,567 (Utah) to $8,025 (Alaska), with Alabama's expenditures reported at $2,879. Given that Alabama is at the bottom of the scale in total expenditures, one could expect that the positive benefits of additional funding, assuming the positive, curvilinear relationship, might not be evident in the data from Alabama. Under this hypothesis, the slope of the curve has not yet begun to accelerate (see region marked A in Figure 2). We would expect that if the study were replicated at the mid-range of the expenditure variable, the relationship would be stronger as the slope of the curve increases (see the region marked B in Figure 2). It is not reasonable to expect to measure the full extent of the relationship (particularly a curvilinear relationship) with a restricted sample of the expenditure variable.

In addition, we have taken only one measure of achievement into account. While the Stanford Achievement Test is a fine standardized instrument, it measures only one aspect of student learning. Measuring achievement more fully would require the use of instruments that go beyond multiple-choice formats. Procedures that research suggests promote higher-order learning such as manipulative and other hands-on techniques are also the most expensive. It would then follow that,

once the money is available to implement the teaching of these higher-order skills, the relationship between learning and instructional expenditures should further increase.

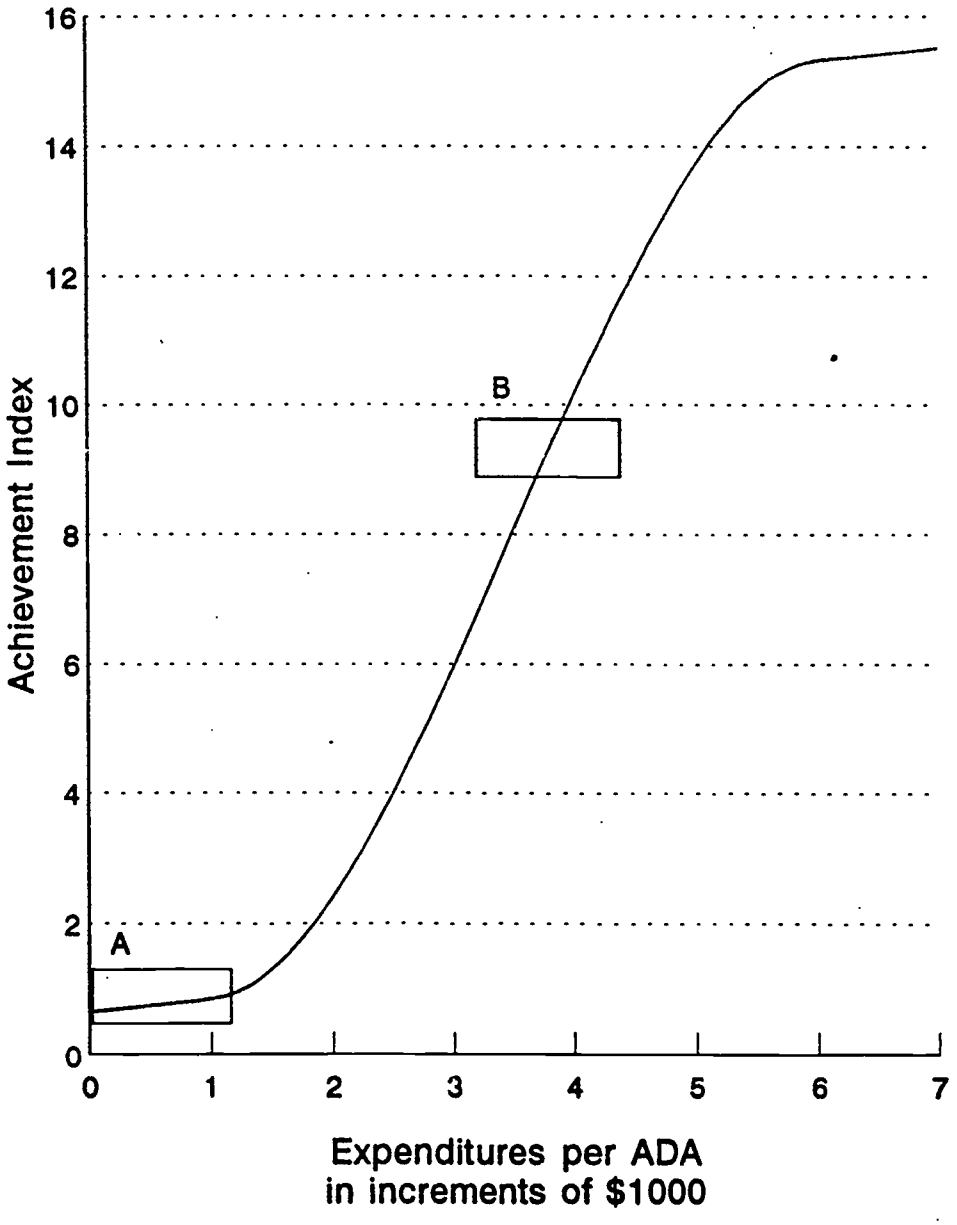

Figure 2.
Hypothesized relationship between achievement and expenditures per ADA showing extreme and middle regions.

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