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School Resources and Student Outcomes in Kentucky Public High Schools[1]

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This paper examines the effect of various input measures upon student outcomes within Kentucky public high schools from 2001 to 2004, using a pooled, cross-sectional time series research design with panel-corrected standard errors (PCSE). The results indicate mixed support for the proposition that school resources are related to desired school outcomes. Overall school spending seems to have no systematic impact. Schools that seem to perform well have few indigent students, many teachers with master's degrees, and fairly high numbers of volunteers. The authors offer some conjectures about the significance and meaning of these findings, especially in light of different findings in other extant research. It is likely that many of the differences in results are attributable to the choice of school-level measures rather than individual student-level indicators.

Key Words: Student outcomes, Kentucky, Education Policy

For most of the last forty years, education research has been characterized by a never-ending debate about the role of school inputs on student learning. While many practitioners in the field of public education have assumed as a matter of faith that more money, more teachers, more highly-credentialed personnel, better facilities, more access to technology would all lead to greater learning by students, the empirical research on the subject is mixed. Many researchers (most notably Eric Hanushek, 1986; 1989) have claimed that the level of resources used in schools is not nearly as important as the incentives affecting the way those resources are allocated. Other scholars, (e.g., Chubb and Moe, 1990) have claimed that constraints imposed on public schools are

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significantly more important in accomplishing learning goals than are levels of resources.

This paper will describe one effort to study the effect of school resources on student outcomes in one state, the Commonwealth of Kentucky. The paper begins with a brief review of the literature on the effect of resources on important student outcomes. The subsequent section reports on an analysis of the effect of school inputs on student performance in writing, arts and humanities, science, social studies, and mathematics in Kentucky public high schools. The final section discusses those findings and considers future research.

RESOURCES, PRODUCTION FUNCTIONS, AND SCHOOL OUTCOMES

One of the primary justifications for the increased federal role of public education in the United States was the belief that schools financed entirely by local and state tax sources would not be adequate to provide adequate, quality education to American children. To demonstrate the relationship between school resources, the federal government commissioned research by James C. Coleman in the 1960s that examined the impact that per pupil spending, class sizes, instructor certification, teacher salaries, and other input measures might have on student learning. Coleman's research was one of the most ambitious and extensive social science research projects ever conducted up to that time. The expectation was that Coleman's study would find a strong link between school resources and student performance in a number of academic areas. The establishment of such a finding would, it was believed, constitute a strong political justification for increased spending on school resources. The resulting report (Coleman, *et al.*, 1966) was much different from what its governmental sponsors expected to find. School resources did not appear to have much impact upon student learning. Characteristics of the students' families and those of their classmates seemed much more important in determining academic outcomes.

Coleman's research and that of other empirical researchers failed to settle the matter. The "Coleman Report" was attacked by some observers and ignored by others. A number of practitioners and some researchers continued to argue that input variables could have a dramatic, positive effect upon desired outcomes, such as higher graduation rates, lower dropout rates, and improved scores on standardized tests. For example, Clune (1994), Alexander and Slamon (2007), and Collins (2004), among others, contend that funding is often inadequate to provide sufficient resources to enable students to reach state educational standards and more general academic goals. Some scholars claim that differences in revenues between rich and poor school districts have led to huge disparities in expenditures, which in turn lead to differential student access to services and programs, some of which may affect the propensity of a student to do well in school or even to remain in school.

These arguments were accepted by many state courts in decisions regarding equity (or sometimes "adequacy") in public school finance. More resources for some, if not all school districts, were deemed to be necessary to accomplish the schools' mission. Such was the premise of a number of court decisions, including the holding of the Kentucky Supreme Court in *Rose v. Council for Better Education* (1989) [(790 S.W.2d 186, Ed. Law Rep. 1289) (Clune 1994)]. It was also the basis for a great deal of new litigation and programmatic change, including the Kentucky Education Reform Act of 1990, which provided for much more state funding for education as well as new forms of governance and new accountability mechanisms. Much of the new emphasis upon accountability included reliance upon student testing as a measure of student learning and, indirectly, of school performance.

The legal briefs advocating greater and more equitable school funding were premised on empirical arguments drawn from a basic production function theory of education outcomes. Production function theory contends that productivity is a function of a variety of input variables, such as labor, capital, and technology. In the case of education production functions, the usual variables examined are teacher/student ratios, teacher salaries, average class sizes, school percentage of certified teachers, and dollars spent per pupil. Nevertheless, the relationship between educational inputs and outcomes has never been fully understood even though determining the level of resources required to produce the desired level of achievement remains highly important to policymakers and a concerned public (see Hanushek, 2003; cf. Hedges, *et al.*, 1994). In fact, some summaries of empirical research as well as generalizations made in the popular press indicate that there is no consistent relationship between inputs and desired outcomes at all (see, e.g., Hanushek, 2003; Jacques and Brorsen, 2002; Tae Ho and Sock-Hwan, 2014; Haverluck, 2014; cf. Jimenez-Castellanos 2010; Jackson, Johnson, and Persico, 2014). This does not necessarily mean that resources do not matter. It may mean that the way resources are used matters more, and adequate incentives to make use of resources matters most of all. Other scholars (e.g., Chubb and Moe, 1990) contend that public schools operate in an environment of administrative and political constraint that prevents effective use of the resources that are available. Unless the constraints change, increases in resources may not have much effect.

In the research reported here, we examine some desired student outcomes from the public schools of one state, the Commonwealth of Kentucky. Single state studies suffer from some disadvantages, particularly regarding generalizability of results. However, the data from a single state should be relatively uniform in quality and consistent in the use of variable definitions. Other factors that could vary from state-to-state could be held constant in a single state sample, which may aid inferences about a few key variables.

DATA AND METHODS

The method of analysis that was used here was a pooled, cross-sectional time series analysis. The years of data used are 2001-2004 for all public high schools in Kentucky. This research examines various kinds of student outcomes, including standardized test scores that are used as part of the Commonwealth Accountability Testing System (CATS), which includes scores from the Kentucky Core Content Test and the Comprehensive Test of Basic Skills. The CATS scores examined here measure 11th grade student performance in writing, arts and humanities, science, social studies, and mathematics. The study only covers the years 2001-2004, since the subsequent years have missing data for most schools and the earlier years are not reported at all. The data are derived from the school and district report card data sets compiled by the Kentucky Department of Education (KDE). Per pupil expenditures, converted to constant dollar figures, are calculated using the KDE data set. Several other specific measures that represent school level inputs (normally requiring expenditures) are included, as well as some measures of teacher and school resources. These include pupil to teacher ratios, students-to-computer ratios, percentage of classrooms with connections to the Internet, percentage of teachers certified for the grade or subject that they teach, percentage of teachers having a major or minor in the subjects that they teach, percentage of teachers with a master's degree, average teacher experience (measured in years), and the per student parent-volunteer hours (number of hours donated divided by the school enrollment). The models also include school enrollment as a measure of school size, as well as the reported attendance rate (i.e., average daily attendance divided by enrollment). The district level measure for the percentage of students receiving a free or reduced price lunch is included as a measure of student socioeconomic status. The district level measure was included because the school level measure was not found. For the time series analysis we controlled for autocorrelation using the Wooldridge (2002) test, which is especially designed for panel data.

Overall, each of the models is statistically significant, with R^2 values ranging from .25 to .6. The models seem to do a better job explaining writing, science, and math scores than social sciences, and arts and humanities outcomes. While there is some variation across the models there is much agreement in the effect of certain variables, which should give us some more confidence in their effects on student outcomes.

Table 1: Eleventh Grade Outcomes, Kentucky 2001-2004

Variables	Coefficients (z-ratios)				
	Writing	Arts and Humanities	Science	Social Science	Mathematics
(Constant)	-57.128 (-2.21)	-170 (-2.96)	-101.89 (-3.06)	-152.812 (-3.58)	-147.246 (-3.07)
Per Pupil Spending ($1000)	.2 (.64)	.385 (.73)	-.687* (-2.32)	.13 (.36)	-.3 (-.79)
Student to Computer Ratio	.06* (2.32)	.078 (1.19)	.042 (1.14)	.093 (1.56)	.09* (2.83)
Percentage of Classrooms with Internet Access	.007 (.37)	.077* (2.34)	.018 (.8)	.036 (1.15)	.053 (1.93)
Pupil to Teacher Ratio	-.287 (-1)	-.696 (-1.16)	-.366 (1.27)	-.498 (-1.27)	-.366 (-1.02)
Percentage of Teachers Certified for Subject and Grade Level	.183 (1.38)	.375 (1.79)	.137 (1.27)	.297* (2.20)	.152 (1.05)
Percentage of Classes Taught by Teachers with a Major/Minor in the Subject Taught	-.007 (-.09)	-.172 (-1.41)	-.078 (-.93)	-.129 (-1.93)	-.034 (-.46)
Percentage of Teachers with Masters	.037 (1.18)	.132* (3.53)	.108 (.022)	.13* (3.96)	.129* (4.82)
Average Teaching Experience	.046 (.59)	-.158 (-1)	-.084 (.095)	.002 (.02)	.193 (1.47)
Per Student Volunteer Hours	.07 (1.71)	.168* (2.77)	.082* (2.04)	.167* (4.23)	.165* (4.62)
Free and Reduced Lunches	-.139* (-4.31)	-.219* (-3.59)	-.168* (-4.35)	-.171* (-3.89)	-.264* (-5.26)
School Enrollment	.0006 (.7)	.005* (2.87)	.002* (2.17)	.005* (4.06)	.006* (5.2)
Average Daily Attendance/Enrollment	1.15* (6.45)	2.286* (5.71)	1.792* (7.54)	2.166* (6.97)	2.105* (5.81)
p	.449	.338	.28	.311	.377
R^2	.578	.275	.542	.482	.587
Wald χ^2	535.41*	101.49*	702.08*	837.49*	189.39*
Number of Observations	895	895	895	895	895

*p<.05

What may be most notable are the variables that are not significantly related to the outcome measures. Overall per pupil spending has no significant effect upon most scores implying that what the money is spent for may be more important than how much in total is spent. Of course this does not mean there is no effect, but that we cannot be confident of an effect. In one instance, in the equation estimating student science scores, the impact of spending is negative and statistically significant. The variables dealing with teacher characteristics (aside from the percentage of teachers with a master's degree) do not have a clearly discernible effect. Possession of a master's degree appears to be important in affecting science, social studies, and mathematics scores, but not writing or arts and humanities. Characteristics that are much discussed by educators, such as student-to-teacher ratios and teacher experience, do not appear significantly related to these outcomes. The student-to-computer ratio, ironically, has a positive effect upon scores in writing and mathematics.

The coefficients for free and reduced price lunch are, as expected, negative and significant across all models. This is an aggregate measure, so we should not read this as students from poor backgrounds are not achieving, but rather that students in poor districts are not achieving. The attendance variable is positive and significant, suggesting that more attendance at school may increase student learning, at least in the areas examined here. Hours of volunteer work is significantly and positively significant on all scores except writing. In short, it appears that schools with few indigent students, a large proportion of students attending classes, and a good number of parents who are willing to volunteer are performing well.

CONCLUSION

Many of the findings from this research resemble results found by other researchers. The general absence of a consistent effect for school inputs is not surprising to scholars familiar with the empirical research on education production functions, although it may be a shock to the general public. The findings of inconsistent impacts for school inputs are at least somewhat different from those of an LRC research report (2006) that used largely the same data and similar model specifications. That is a puzzle that we cannot explain fully. However, the earlier LRC research did not include per pupil expenditure as an independent variable in either its individual student-level analyses or its school level analyses. Instead, the LRC report includes the input variables examined here without including the overall measure of funding.

The usually positive effect of teacher master's degrees found in this analysis is at odds with some recent research (e.g., Clotfelter, Ladd, and Vigdor, 2006; Goldhaber and Brewer, 1997), although many of those studies used individual students as the unit of analysis. In this study, which examines more

aggregated data at the school level, the results are different. No doubt more research using different samples and a longer time frame would be necessary to disentangle these relationships.

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