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Variation in State Education Policies and Effects on Student Performance

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Abstract

There have been few systematic studies of the effects that education policies adopted at the state level have on the quality of schooling within the state. This article, building on a framework developed by Eric Hanushek and Lori Taylor, measures the effects of state policies—in particular, the effects of state teacher certification requirements on SAT performance across states. In an examination of SAT data from 1972 to 1990, the results suggest that students in states with a master's degree requirement for teacher certification had lower SAT scores than students in states without a master's requirement. The empirical model accounts for inputs such as family background and other school factors typically used in education production functions.

INTRODUCTION

In a recent article, Hanushek and Taylor [1990] present a paradox in the existing literature on economics and schooling. Numerous education reports and reform efforts focus attention on state educational policies and make recommendations about changes in state policies. Yet there is a dearth of systematic evidence on the effectiveness of state policies in improving educational outcomes. There has been little empirical testing of whether policies adopted at the state level have any effect on the performance of students in schools within a state. In their article, Hanushek and Taylor provide a foundation for estimating the effects of state educational policies on student performance, but do not examine particular state policies.

Many studies have examined the effects of school and family on school performance. For example, Hanushek [1986] surveys 147 studies of education production functions. The inputs into the production of education typically include expenditures per pupil, pupil–teacher ratios, or teacher characteristics, and the output is some measure of student performance. Some production function studies have examined individual student variations in performance, while others have measured differences between schools or school districts. Virtually the only studies that have looked at state effects have been those attempting to measure trends in achievement scores [Congressional Budget Office, 1986; 1987; Dynarski, 1987]. These studies, however, have

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generally not controlled for the broad range of inputs typical of the production function literature. None of the studies has explicitly examined policies adopted at the state level and their potential effects on student achievement.

A related set of studies has focused not on school achievement per se, but on the effects of schooling on subsequent labor market outcomes.[1] Altonji [1988, 1989] examines the effects of the high school curriculum and both personal and community characteristics on wages and the rate of return to education, using data from the National Longitudinal Survey of the High School Class of 1972. Card and Krueger [1992] use data from the 1970 and 1980 censuses to estimate rates of return to education, by state, for men born between 1920 and 1949. Differences in rates of return across states and cohorts are in part explained by differences in pupil–teacher ratios, school term lengths, and characteristics of teachers.

Building on the framework developed by Hanushek and Taylor [1990], we incorporate state policy variables into our empirical analysis. While we include the inputs traditionally used in estimating education production functions, such as family and school characteristics, our main focus is on policy variables that differ at the state level. These policy variables can be viewed as mandatory inputs from the perspective of the schools. It is important to examine policy-driven inputs separately from those voluntarily chosen by the schools because, as we argue in the next section, their effects on student output may differ significantly.

In recent years, states have implemented various reforms in education policy, involving student or teacher testing, curriculum policies, and funding policies. For the most part, the recent implementation of these policies prohibits any systematic testing of their effects. One requirement, however, has been in place across states for a longer time:teacher certification. Because of its relatively long history and its variance both across states and over time, we examine the effect of state teacher certification requirements on SAT performance across the states from 1972 to 1990.

EXPECTED EFFECTS OF STATE POLICIES

Education has long remained under the jurisdiction of state and local governments; until recently, there has been very little involvement at the federal level. The result has been great diversity across states in the rules and regulations that govern schooling. The states' rules apply to a broad range of issues, including curriculum requirements, textbook selection, classroom size, expenditure levels, and tenure procedures; sometimes state rules may even specify the brands of equipment that can be purchased by local school districts.

While diversity characterizes the 50 states' education policies, almost all states have certain policies in common. For example, states generally prohibit persons without a teaching certificate from teaching in the public schools. Teacher certification minimally requires graduating from an approved program in education offered by an accredited college or university. Some states

[1] A partial list of these studies includes the seminal work of Becker [1964] and Mincer [1974], along with more recent studies by Altonji [1988, 1989, 1991], Angrist and Krueger [1990], Becker [1991], Berger [1988], and Card and Krueger [1992].

go further and require not only a bachelor's degree but a master's degree as well. Some states have required a master's degree for secondary certification, while others have required the degree for either elementary or secondary certification. For example, in 1960 only 8 states required a master's degree for certification to teach at either the elementary or secondary levels. By 1972, 13 of the states required a master's degree for elementary certification, while 14 required it for secondary certification. Between 1972 and 1984, 4 states dropped the master's requirement at the elementary and secondary levels, while 4 states added the requirement at the secondary level, and 3 states added the requirement at the elementary level. States have continued to eliminate and add this requirement, so that in 1990, 11 states had a master's requirement for certification at either the elementary or secondary level. Often the master's degree is not required for initial certification, but must be completed for continued certification after a specified period of time.

State policies regulating teacher certification have important ramifications for who will teach in the public schools, as well as for the measured effects of teacher training on educational output. By affecting the pool of teachers, certification policies can influence teacher quality and ultimately the quality of educational output. The effect of certification policies on schooling outcomes, however, has not been systematically examined.

Past studies that have examined teacher training effects on school output implicitly have assumed that training has differed across individuals, within and across schools, because teachers (and schools) have voluntarily chosen different education levels. Teachers who choose more education have been assumed to do so because of the increased knowledge it imparts; thus, enhanced returns to the teacher and the teacher's students are expected.

But consider the effects of a state requirement that teachers must have a master's degree to be certified. Because of the requirement, teachers will choose to pursue the degree not necessarily because they have a demand for increased knowledge or skills, but because it is a prerequisite to keeping their position.

There are different possible supply responses to this policy-driven demand. One possibility is that suppliers respond to some underlying demand for increased educational quality and provide a product that increases the knowledge of the teacher. Under these circumstances, the master's requirement would positively influence educational output.

An alternative supply response, however, would lead to either no effects on output or even negative effects. To illustrate the different possibilities, suppose the suppliers of the master's degree education respond to teachers who do not demand increased knowledge but merely demand certification. Under this scenario, the master's degree requires time inputs on the part of the elementary and secondary teacher, but does not result in real increased knowledge or skills that would affect a teacher's classroom performance. The result is no change in the quality of educational output.

In fact, this scenario could result in a decline in quality of schooling produced. If the master's degree is mere certification, it could have the effect of causing individuals with high opportunity costs to self-select out of the teaching profession entirely, because it raises the costs of pursuing a career in education without offering the reward of enhanced human capital. Under this scenario, the master's degree requirement serves primarily as a barrier to entry to the teaching profession that reduces both the quality of the pool of teachers and student achievement.[2]

Conceptually, we conclude that the master's requirement may increase the quality of teachers and subsequent school output, may decrease the quality, or may have no effect at all. Ideally, we could test whether the master's requirement significantly affects teacher ability and school output. Lack of data by state prevents a test of the relationship between teacher quality and the certification requirement. Data at the national level and from individual universities do suggest that persons attracted to the teaching profession have lower standardized test scores than persons going into other fields, and some evidence suggests that the gap has widened over time.[3] We devote the remainder of this article to exploring the empirical question of whether there is a significant relationship between the master's degree requirement and school output.

ACHIEVEMENT MEASURES

A first step in testing for an empirical relationship between teacher training requirements and quality of school output is some discussion of a measure of output quality or student achievement. Achievement is influenced by many factors outside the school environment, but many developed abilities—such as reading, writing, critical reasoning, analyzing, and learning certain facts—are generally considered academic-related skills. Measures of these skills necessarily reflect the influence of both home and student background, as well as that attributable to school.

There are many ways achievement might be measured. Grade point averages, for example, reveal information about a student's performance relative to others in that school. Grade point average, however, cannot be used for comparisons between schools or states, because of subjective biases and variations in grading policies within individual schools.[4] Standardized exams, while imperfect, avoid these subjectivities and enable comparisons across a broader base, such as across states.

[2] Similar arguments have been made for other state requirements, such as compulsory attendance laws for students. Compulsory attendance laws may increase time in school, and if the benefits of the additional time are greater than the costs, those students who would have dropped out are better off. Edwards [1978] finds that overall, compulsory schooling laws are not effective at increasing teenage enrollment rates. On the other hand, Angrist and Krueger [1990] find that compulsory attendance laws are effective at increasing attendance and increase the earnings of those who are compelled to attend for a longer period. However, they do not examine the costs of compulsory schooling laws, either to the individual student or to others. Compulsory schooling laws have external effects in that requiring the poorest quality students to stay in school detracts from teachers' efforts to improve the quality of teaching for the other, better students.

[3] Studies of student performance on SAT, ACT, and GRE exams, by major, consistently find students majoring in education scoring below those of other disciplines. ACT scores for college-bound seniors, for example, show that education majors' scores fell relative to the average graduate throughout the 1970s. Scores on the SAT reveal the same pattern. In 1973, the mean SAT score for an education major was 54 points below that of other intended majors. In 1982, the difference was 80 points [Schlechty and Vance, 1983]. A National Longitudinal Study sample of college seniors in 1976 found that education majors ranked 14th out of 16 fields on SAT verbal scores and 15th out of 16 in math scores [Weaver, 1983, 1978].

[4] See the Congressional Budget Office [1986] study for a fuller discussion of the advantages and disadvantages of subjective versus standardized exam results.

Many standardized exams exist and are given to limited cohorts; some, such as the Iowa Test of Educational Development, are specifically designed as broad-based achievement measures. Other more commonly known exams, such as the Scholastic Aptitude Test (SAT), serve as proxies for achievement measures. As discussed by Bishop [1989], there is fairly strong evidence for their validity as proxies. Among other things, school attendance raises scores on these "aptitude" tests [Lorge, 1945; Husen, 1951; Department of Labor, 1970]; trends in aptitude and achievement tests tend to be parallel [Congressional Budget Office, 1986]; and there are strong correlations between broad achievement tests and verbal and mathematical aptitude tests such as the SAT.[5]

Beyond objective empirical evidence relating SAT scores and achievement, SATs are also important because of their visibility and public perception. Chubb and Moe [1990, pp. 7–8] argue that the decline in SAT scores from the mid-1960s to the 1980s has been the "single most important symbol" of widespread dissatisfaction with the American public school system. The concern over declining SATs is based on real effects. Bishop [1989], for example, finds evidence that falling achievement, reflected through SAT scores, was a significant factor in explaining decreases in productivity growth in the U.S. during the 1980s and 1990s. In summary, given evidence that SAT scores proxy school achievement, that the public perceives SATs as an indicator of quality, and that SATs have been shown to be related to real changes in productivity, we choose SAT scores as our empirical measure of school quality or student achievement.

EMPIRICAL MODEL AND DATA

Hanushek and Taylor [1990] posit a model of individual student performance in which achievement is determined by the level of current and past family and school resources, individual-specific unobservables, and a random component that varies over individuals and time. We adopt a similar model, in which the average achievement in a given state for a given year is determined by current and past school variables, including state policy variables, current and past family variables, and various other control variables to take into account location effects, year effects, and possible nonrandom test participation or selection bias. More explicitly, our model of average student achievement by state and year can be written

$$\text{Achieve} = b_1\text{School} + b_2\text{Family} + b_3\text{Location} + b_4\text{Year} + b_5\text{Partic} + e$$

Our measure of achievement is the average SAT score in a given state during 1972, 1978, 1984, and 1990. Thus, there is variation in achievement both across states and over time. Current and past values of the School and Family variables are incorporated into the model by computing averages over the previous 12 years. For explaining 1990 SAT scores, for example, averages of 1990, 1984, and 1978 values of the School and Family variables are computed and included in the model. Similarly, for 1972 SAT scores,

[5] Bishop [1989] discusses this issue in great detail. As he notes (footnote 1), the College Board recognizes that aptitude scores are influenced by educational background in describing the SAT as a measure of "developed verbal and mathematical reasoning abilities" [1987, p. 3].

1972, 1966, and 1960 values were used to compute averages of the School and Family variables.[6]

As a test for robustness, we also estimated the model using first differences and different weighting schemes for past values of the independent variables (e.g., geometrically declining weights). Because the results are qualitatively unchanged across specification, we present only the results from the model above. The definitions and means of all the variables used in the estimation are given in Table 1. The Appendix presents descriptive statistics for major variables by individual state.

Several school and state policy variables are included in the model. Most important is our measure of teacher certification. We construct a variable (MASTER) that equals 1 in any given year if a state requires a master's degree for elementary or secondary teacher certification, either for initial certification or within a specified period of time after certification. As with the other variables, MASTER is averaged over a 12-year period, thus providing information on whether the requirement was in effect in all three (the current period, six years ago, 12 years ago) sample years (MASTER = 1), two (MASTER = 0.67) or one (MASTER = 0.33) sample years, or none of the sample years (MASTER = 0). We also include per-pupil expenditures (PEXP), average teacher salaries (SALARY), and pupil-teacher ratios (PTR), which Hanushek [1986] shows have been estimated to have conflicting effects on achievement in the literature. ADMEXP is the percentage of total expenditures devoted to administrative rather than classroom activities. We expect that the greater expenditures for administrative purposes, other things being equal, the lower student achievement. LOCAL is the proportion of total tax revenues raised from local sources and is commonly used as a measure of the role of the local government [Eberts and Gronberg, 1990]. The greater the local revenues, the more local control. This in turn may lead to higher quality schools and greater student achievement. DISTRICT is the number of school districts in the state per pupil, which Martinez-Vasquez and Seaman [1985] argue measures the extent of schooling choice. MINORITY measures the proportion of minority teachers in the state. Finally, PRIVATE is the proportion of pupils enrolled in private schools in the state. Given the work of Long and Toma [1988] on the choice of public versus private schools, and that of Coleman and Hoffer [1987] and Coleman, Hoffer, and Kilgore [1982] on differences in achievement by private and public school students, it is important to control for differences in the proportion of students attending private schools.

Family background is likely to be an important determinant of student achievement. Families with high incomes and parents with high levels of education are likely to provide more resources for the education of their children, with the result being higher test scores. Thus, we include measures of the per-capita income (PCI) and median years of schooling (MSCHOOL) in

[6] The only exceptions to this are one variable (MINORITY) available only for 1980 and variables such as median schooling (MSCHOOL) that are available only for census years. Thus, the MINORITY variable available only in 1980 provides no variation over time. The variables available only in census years are assigned to our sample years in the following way: 1960—1960 census; 1966—average of 1960 and 1970 censuses; 1972—1970 census; 1978—1980 census; 1984—1980 census; 1990—1990 census. These variables were then averaged over the previous 12 years (current year, 6 years ago, 12 years ago) using the assigned values before being included in the regression models.

Table 1. Variable definitions and means.

Variable name	Mean (Standard deviation)	Description and source of data
SATVM	954.8 (68.6)	Mean SAT score—verbal and mathematical; *State SAT scores* 1972–1990. Admissions Testing Program, The College Board
SATV	456.7 (33.8)	Mean SAT score—verbal; *State SAT scores.*
SATM	498.1 (35.8)	Mean SAT score—verbal; *State SAT scores.*
MASTER	0.262	Binary variable that equals 1 if a state requires a master's degree for elementary or high school teacher certification; 0 otherwise. Roger Goddard, *Teacher Certification Requirements: All Fifty States* and C. Emily Teistritzer, *The Condition of Teaching.*
PEXP	3236.6 (1123.3)	Per pupil expenditures (elementary and secondary public schools); *Digest of Education Statistics* and *Statistics of State School Systems.* National Center for Education Statistics. (1990 dollars)
PTR	18.37 (2.72)	Pupil–teacher ratio in public schools; *Digest of Education Statistics* and *Statistics of State School Systems.*
SALARY	30,034 (4847.1)	Average annual salary of public school teachers; *Digest of Education Statistics* and *Statistics of State School Systems.* (1990 dollars)
ADMEXP	0.048 (0.014)	Total administrative expenditures as a proportion of all expenditures; *Digest of Education Statistics* and *Statistics of State School Systems.*
LOCAL	0.463 (0.169)	The proportion of total revenues from local sources; *Digest of Education Statistics* and *Statistics of State School Systems.*
DISTRICT	0.808 (1.325)	Total number of school districts per pupil × 1,000; *Digest of Education Statistics* and *Statistics of State School Systems.*
MINORITY	0.114 (0.108)	The proportion of minority teachers; C. Emily Teistritzer, *The Condition of Teaching.* The Carnegie Foundation for the Advancement of Teaching.
PRIVATE	0.099 (0.052)	The proportion of pupils enrolled in private schools (1984 data are not available; 1980 are used); *Digest of Education Statistics* and *Statistics of Nonpublic Schools.*
PCI	14,336 (2803)	Per capita income; *Statistical Abstract of the U.S.* (1990 dollars)
MSCHOOL	12.06 (0.660)	Median years of schooling for the population 25 years and older; *Digest of Education Statistics* and *U.S. Census of Population.*
NONWHITE	0.131 (0.117)	Proportion of the population that is nonwhite; *U.S. Bureau of Census Current Population Reports* and *U.S. Census of Population.*
FAMILY	3.09 (.192)	Number of persons per family; *U.S. Census of Population.*
METRO	0.583 (0.245)	Proportion of the population residing in metropolitan areas; *U.S. Statistical Abstract.*

Table 1. (*Continued*)

Variable name	Mean (Standard deviation)	Description and source of data
ACT	0.560	Binary variable that equals 1 if most college-bound students in state take the ACT exam and equals 0 otherwise; U.S. Department of Education, *State Education Statistics.*
LOG (P)	−1.64 (1.00)	Log of proportion of high school graduates (public and private) who take the SAT exam; *State SAT Scores* and *Digest of Education Statistics.*
YR90	0.250	Binary variable that equals 1 if year equals 1990; 0 otherwise.
YR84	0.250	Binary variable that equals 1 if year equals 1984; 0 otherwise.
YR78	0.250	Binary variable that equals 1 if year equals 1978; 0 otherwise.
YR72	0.250	Binary variable that equals 1 if year equals 1972; 0 otherwise.
NEWENG	0.120	Binary variable that equals 1 if state is a New England state—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, or Connecticut; 0 otherwise.
ATLANTIC	0.060	Binary variable that equals 1 if state is a Middle Atlantic state—New York, New Jersey, or Pennsylvania; 0 otherwise.
ENCENT	0.100	Binary variable that equals 1 if state is an East North Central state—Ohio, Indiana, Illinois, Michigan, or Wisconsin; 0 otherwise.
WNCENT	0.140	Binary variable that equals 1 if state is a West North Central state—Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, or Kansas; 0 otherwise.
SOUTHATL	0.160	Binary variable that equals 1 if state is a South Atlantic state—Delaware, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, or Florida; 0 otherwise.
ESCENT	0.080	Binary variable that equals 1 if state is an East South Central state—Kentucky, Tennessee, Alabama, or Mississippi; 0 otherwise.
WSCENT	0.080	Binary variable that equals 1 if state is a West South Central state—Arkansas, Louisiana, Oklahoma, or Texas; 0 otherwise.
MOUNTAIN	0.160	Binary variable that equals 1 if state is a Mountain state—Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, or Nevada; 0 otherwise.
PACIFIC	0.100	Binary variable that equals 1 if state is a Pacific state—California, Oregon, Washington, Alaska, or Hawaii; 0 otherwise.

the model. We also include the proportion of the population that is nonwhite (NONWHITE) and average family size (FAMILY) to control for differences in economic opportunities across states.

The model includes variables for eight of nine detailed census regions to allow for regional time-invariant fixed effects on SAT scores. A location variable, METRO, measures the proportion of the population residing in metropolitan areas. Variations in SAT scores over time are captured with three-year indicator variables, one each for 1990, 1984, and 1978. Finally, we account for nonrandom test participation or selection bias using two variables. One is a transformation of the proportion of high school graduates who take the SAT in 1990, 1984, 1978, or 1972. As pointed out by Hanushek and Taylor [1990], this proportion differs widely across states. We follow Dynarski [1987] in constructing a measure to control for this variation. Our other participation variable is an indicator that shows whether most of the college-bound students in the state take the ACT exam.

The use of SAT scores and aggregate state data poses a number of problems, as pointed out by Hanushek and Taylor [1990]. We have taken steps to address each of these problems in our empirical model. The first problem they point to is that family data are often missing from the analysis. Our model includes a set of family variables controlling for income, schooling, and family size and race. The second problem is that typically, aggregate studies do not include time-varying school inputs. Our model includes state policy, school, and family variables that incorporate variation over the previous 12 years. Thus, the entire time period for which the SAT test takers were in school is taken into account. The third problem pointed out by Hanushek and Taylor is that there is typically measurement error in school inputs. Their specific example is that SAT scores include both students from public and private schools, and that public school information may not be relevant for private school students. In order to account for this problem, we include a variable measuring the proportion of students in private schools over the 12 years prior to the SAT data. Lastly, Hanushek and Taylor point out that nonrandom test taking is a potential problem, given the wide variation in test participation rates across states. We control for this type of selection bias, employing the same method as Dynarski [1987]. Hanushek and Taylor state that the Dynarski method is preferable to the alternative of directly adjusting SAT scores based on demographic information.

RESULTS

Table 2 presents regression results using three alternative SAT measures: SATVM, SATV, and SATM. The models are estimated using SAT data for the 50 states for the years 1972, 1978, 1984, and 1990.[7] SATVM is the combined verbal and math SAT average score by state for the years 1972, 1978, 1984, and 1990. SATV is the average verbal score by state and year, and SATM is the average math score.

The most important result for this study is that states with a master's degree requirement for certification have significantly lower SAT scores. This

[7] Private school data have not been reported since 1980. For 1984 and 1990, we calculated private enrollments by assuming the ratio of private to public enrollments was equal to that in 1980. Also, the latest administrative expenditure data are for 1989 rather than 1990.

Table 2. Regression estimates explaining state SAT scores, 1972, 1978, 1984, and 1990 (*t*-statistics are in parentheses).

	SATVM	SATV	SATM
School and state policy variables			
MASTER	−14.22	−8.32	−5.90
	(2.68)	(2.94)	(2.08)
PEXP	−0.012	−0.0062	−0.0061
	(7.02)	(1.91)	(1.87)
PTR	−6.60	−2.97	−3.62
	(4.44)	(3.76)	(4.55)
SALARY	0.00065	0.00051	0.00014
	(0.540)	(.788)	(.224)
ADMEXP	−193.61	−51.55	−142.06
	(1.41)	(.703)	(1.93)
LOCAL	10.01	4.81	5.21
	(0.614)	(0.553)	(0.596)
DISTRICT	−3.10	−2.05	−1.06
	(1.79)	(2.22)	(1.14)
MINORITY	−87.99	−30.09	−57.90
	(2.19)	(1.41)	(2.70)
PRIVATE	239.52	99.28	140.24
	(4.52)	(3.51)	(4.94)
Family variables			
PCI	0.0029	0.0013	0.0015
	(1.34)	(1.18)	(1.32)
MSCHOOL	22.48	10.73	11.75
	(4.34)	(3.88)	(4.23)
FAMILY	1.82	4.38	−2.56
	(0.116)	(0.524)	(0.304)
NONWHITE	−71.50	−65.95	−5.55
	(1.98)	(3.42)	(0.286)
Selection, location, and time variables			
METRO	−0.557	−2.45	1.89
	(0.043)	(0.353)	(0.271)
ACT	−3.03	1.42	−4.45
	(0.319)	(0.282)	(0.876)
LOG(P)	−58.74	−26.85	−31.89
	(13.82)	(11.85)	(14.0)
YR90	−48.04	−30.10	−17.94
	(3.73)	(4.38)	(2.60)
YR84	−55.22	−31.85	−23.37
	(5.71)	(6.18)	(4.51)
YR78	−54.23	−30.65	−23.58
	(8.75)	(9.28)	(7.10)
NEWENG	−27.64	−10.67	−16.97
	(2.54)	(1.84)	(2.91)
ATLANTIC	−27.78	−11.11	−16.67
	(2.58)	(1.93)	(2.88)
ENCENT	−15.64	−10.89	−4.75
	(1.39)	(1.81)	(0.784)
WNCENT	−2.44	−1.88	−0.558
	(0.198)	(0.287)	(0.085)
SOUTHATL	−7.20	−0.598	−6.60
	(0.774)	(0.121)	(1.32)

Table 2. (*Continued*)

	SATVM	SATV	SATM
ESCENT	2.62	4.46	−1.83
	(0.180)	(0.572)	(0.234)
WSCENT	3.67	5.76	2.09
	(0.288)	(0.847)	(0.306)
MOUNTAIN	10.16	3.94	6.22
	(0.832)	(0.005)	(0.951)
CONSTANT	736.10	342.03	394.07
	(9.13)	(7.95)	(9.12)
R^2	0.924	0.911	0.920
n	200	200	200

is the case for both the total score and the individual verbal and math components. The presence of a master's degree requirement lowers SAT scores by over 14 points, with approximately 8 points of the decrease on the verbal exam and almost 6 points on math scores. While one argument for the existence of master's degree requirements may be to increase the quality of teachers and thus the level of student performance, the evidence suggests that the reverse is true. Students' performance decreases with the presence of a master's degree certification requirement, suggesting that the requirement has the opposite effect from that purportedly intended.

Several other school and state policy variables have significant effects on SAT scores. Our estimates show that states spending more per pupil (PEXP) have significantly lower SAT scores than states with higher pupil–teacher ratios (PTR), or with a higher percentage of minority teachers (MINORITY). Teacher salaries (SALARY) are insignificantly related to SAT scores. We do find that states with a higher percentage of students enrolled in private schools during the 12 years prior to the observed SAT scores have significantly better student performance. Each percentage point increase in private school enrollment is associated with a 2.4-point increase in SAT scores.

The family variables included in the model perform mostly as expected. States with higher median schooling levels (MSCHOOL) have significantly higher SAT scores. Each year added to the median schooling level raises SAT scores by over 22 points. Average family size (FAMILY) does not significantly affect the level of SAT scores. While not significant, per-capita income (PCI) is positively related to SAT scores. States with a higher percentage of nonwhites (NONWHITE) in the population have lower overall and verbal SAT scores on average.

We also include a set of selection, location, and time variables in our empirical model. The percentage of a state's population in metropolitan areas is not significantly related to SAT scores. The significant and negative coefficients on the New England and Atlantic regional indicator variables suggest that states in these regions have lower SAT scores than states in the omitted Pacific region, after controlling for other influences. The variables corresponding to the years 1978 (YR78), 1984 (YR84), and 1990 (YR90) all have negative and significant coefficients. The fact that the YR90 and YR84 coefficients are smaller in absolute value than the YR78 coefficient reflects the upturn in SAT scores in the early 1980s.

Finally, we have also controlled for selection bias using a variable similar to the one used by Dynarski [1987]. Our P variable is the log of the proportion of high school graduates who take the SAT exam by state and year. As the proportion of graduates who take the SAT exam increases, the average score in the state significantly decreases. This variable controls for differences in participation probabilities across states and over time, an important source of selection bias. Following Dynarski [1987], we tried different functional forms for the P variable, such as a quadratic and a logistic transformation, as well as including the variable linearly. The logarithmic transformation provided the best fit of the data. Once we control for differences in test participation across states and over time, SAT scores are not significantly different in states in which students primarily take the ACT exam.

As discussed earlier, the negative finding on the MASTER variable is not sensitive to the functional form of the model.[8] We also estimated the model with different combinations of independent variables and different samples of data, for example, over more limited time periods, and for each of the individual years. Qualitatively similar results to those reported in Table 2 were found.

CONCLUDING COMMENTS

Many studies examining education production functions have concluded that increased expenditures do not result in higher quality output for schools. The evidence suggests that the answer to declining educational achievement is not increasing dollars for schools. This article reaches a similar conclusion about teacher certification requirements. Our results suggest that requiring a master's degree for teacher certification does not increase the quality of teacher inputs; instead it actually decreases the performance of students when measured by SAT scores.

These findings represent a first effort to measure the effect of teacher training rules on student achievement. Although the data set in this article covered a time span from 1972 to 1990, it included only four years of measured achievement. Future research should examine data covering different years and, ideally, should look at individual students across different states with various teacher training requirements. The finding of a negative relationship between teacher training requirements and student achievement should serve as an impetus for increased attention to this issue by both academics and policymakers.

[8] We also estimated 2SLS models that treated the policy variables, MASTER and PEXP, as endogenous. The model was identified by including SAT scores from the previous period (six years ago) in the MASTER and PEXP reduced form equations, along with variables measuring National Education Association (NEA) dues, NEA membership per capita, and NEA expenditures per capita. Because of the lack of state-by-state SAT data prior to 1972, estimates could be made only for the period from 1978 through 1990. The results for the PEXP and MASTER variables were: PEXP parameter estimate, −0.300; *t*-value −5.67; MASTER parameter estimate, −70.8; *t*-value, −5.56. Thus, both the PEXP and MASTER parameter estimates increased in magnitude and significance when moving to the 2SLS estimation.

APPENDIX: VARIABLE MEANS BY STATE, 1972–1990

State	SATVM	MASTER	PEXP	PTR	MSCHOOL	PRIV
Alabama	930	0.750	7364	21.71	11.34	0.065
Alaska	934	0.000	6316	17.17	12.68	0.146
Arizona	995	0.083	2821	19.73	12.52	0.069
Arkansas	994	0.167	2290	19.54	11.20	0.034
California	912	0.000	3531	22.00	12.63	0.094
Colorado	988	0.833	3385	18.59	12.68	0.067
Connecticut	914	0.000	4117	16.00	12.25	0.148
Delaware	915	0.000	3812	17.93	12.18	0.160
Florida	901	0.833	2957	18.22	12.16	0.096
Georgia	830	0.667	2474	20.53	11.13	0.050
Hawaii	885	0.000	3359	19.04	12.52	0.157
Idaho	995	1.000	2454	19.03	12.36	0.036
Illinois	983	0.000	3372	18.99	12.12	0.168
Indiana	877	0.917	2891	19.86	12.11	0.092
Iowa	1088	1.000	3369	16.81	12.23	0.110
Kansas	1048	0.000	3148	16.42	12.35	0.078
Kentucky	990	0.917	2358	17.56	10.89	0.099
Louisiana	970	0.000	2755	19.57	11.32	0.158
Maine	901	0.083	2908	18.21	12.17	0.092
Maryland	910	0.000	3656	18.26	12.28	0.130
Massachusetts	906	0.000	3872	16.19	12.47	0.152
Michigan	966	0.000	3685	21.17	12.15	0.117
Minnesota	1036	0.000	3683	17.93	12.23	0.127
Mississippi	937	0.833	2210	20.19	11.28	0.084
Missouri	986	0.000	2745	18.42	11.88	0.128
Montana	1031	0.000	3502	15.06	12.34	0.072
Nebraska	1012	0.083	3307	15.45	12.30	0.135
Nevada	945	0.667	3019	20.16	12.42	0.037
New Hampshire	941	0.250	3047	17.60	12.41	0.148
New Jersey	888	0.000	4428	15.80	12.13	0.164
New Mexico	1011	0.833	2888	19.37	12.27	0.066
New York	908	0.250	4992	16.60	12.14	0.185
North Carolina	833	0.000	2555	20.33	11.24	0.034
North Dakota	1069	0.000	3216	16.06	11.98	0.097
Ohio	959	0.000	3061	19.47	12.12	0.128
Oklahoma	1009	0.000	2745	18.44	12.12	0.028
Oregon	918	0.083	3756	17.81	12.57	0.060
Pennsylvania	898	0.000	3764	18.36	12.02	0.190
Rhode Island	896	0.083	3752	16.93	11.75	0.190
South Carolina	811	0.083	2432	19.89	11.14	0.056
South Dakota	1072	0.000	2859	15.98	12.12	0.090
Tennessee	999	0.000	2346	21.06	11.23	0.059
Texas	886	0.917	2814	18.12	11.87	0.051
Utah	1059	0.000	2452	22.40	12.72	0.018
Vermont	912	0.000	3637	14.24	12.24	0.112
Virginia	900	0.750	2920	18.08	11.87	0.063
Washington	978	0.083	3547	19.98	12.63	0.068
West Virginia	962	0.000	2760	19.22	11.23	0.033
Wisconsin	1022	0.000	3562	17.61	12.12	0.184
Wyoming	1028	0.917	3934	15.61	12.47	0.032

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