Why Johnny Can't Add and May Be Left Behind: The Case of Indiana 8th Graders

by

Dale Bremmer
Professor of Economics
Department of Humanities and Social Sciences
Rose-Hulman Institute of Technology

July 2008

Presented During Session #94A, "Assessing Measurement Techniques for Assurance of Learning"
The 83rd Annual Conference of the Western Economic Association International
Sheraton Waikiki, Honolulu, Hawaii
Tuesday, July 1, 2008, 8:15 a.m. – 10:00 a.m.

Why Johnny Can't Add and May Be Left Behind: The Case of Indiana 8th Graders

I. Introduction

The use of competency exams has long been a tenant of outcome-based or standards-based education reform. These exams attempt to measure student learning and the effectiveness of both public and private education while claiming to increase the accountability of schools and their teachers. The use of mandated competency exams has increased over the last two decades; but, their use came to the forefront when the "No Child Left Behind" Act was signed into federal law in January 2002. This law requires tests to be administered every year between the third and eighth grades and once during high school.

Using data from almost 300 Indiana public school corporations, this paper analyzes the factors affecting the performance of eighth graders on the mathematics portion of the competency exam known as the ISTEP (Indiana Statewide Testing for Educational Progress). Regression analysis is used to determine the various factors that affect the percentage of eighth graders that passed the standardized math exam that was given during September 2007.

The statistical results indicate the students' performance on the current exam is directly related to their previous performance on past exams in earlier grades. While the number of students passing the exam is directly related to the teacher's average salary and how much the school district spends per student, oddly enough, there is an inverse relationship between the percentage of students passing the exam and the average teacher's age or experience. The relationship between the pass rates on the exam and the percentage of male students was mixed. Socio-economic factors also affect student performance on the standardized math exam.

The percentage of eighth graders that pass the exam is inversely related to the percentage of minority students, the percentage of single parent families, the percentage of students entitled

to a subsidized school lunch and the percentage of adults without a high school education. The more importance families place on education, as measured by the percentage of high school seniors taking the SAT exam, the greater the number of eighth-grade students passing the ISTEP math exam. As the percentage of students in special education programs increase or as the number of suspensions and expulsions increase, the number of students passing the exam falls.

A brief review of the literature is in the second section of the paper following this introduction. The third section of the paper presents a simple theoretical model explaining the percentage of students passing the competency exam while the data, the expected signs of the regression estimates and model specifications are discussed in the fourth section of the paper. The statistical results are explained in the fifth section of the paper and concluding thoughts are in the paper's sixth and final section.

II. Literature Review

As the use of mandated competency exams has grown over time, the literature analyzing the determinants of the exams' pass rates has also grown. Greenwald, Hedges, and Laine (1996) find that student test scores are directly related to the inputs used in the educational process. Inputs affecting student performance on these exams include per-pupil expenditure, teacher ability, teacher education, teacher experience, the ratio of students to teachers and school size.

Student scores also depend on socio-economic factors and demographic variables. Grissmer, Flanagan, Kawata and Williamson (2000, p. 15) find "that attempts to explain the variance in test scores across populations of diverse groups of students shows that family and demographic variables explain the largest part of total explained variance." Statistically significant family characteristics affecting test scores include the level of parental education, family income and ethnicity. After controlling for the influence of other variables, family size,

family mobility, age of the mother when the student was born and whether the family had only a single parent living at home were also found to affect the pass rates on exams.

Using 2004 Indiana data at the school district level, Bremmer and Carlson (2005, 2006) analyze the factors that determine the percentage of eighth-grade middle students that pass the ISTEP math exam. Their research finds that the percentage of current eighth-grade students passing the exam is determined by past academic performance, as measured by the percentage of the school district's sixth-graders who passed both the math and English ISTEP exams two years earlier. Their regression results indicate that the test scores are directly related to teachers' salaries, the school district's expenditure per student, the students' attendance rate, the hours of instruction, and the percentage of the school district's high school graduates that pursue higher education. On the other hand, their empirical model indicates that the odds of passing the ISTEP eighth-grade math exam are inversely related to the teachers' average age, the percentage of minority students, the percentage of adults in the area who never attended high school, the percentage of single parent families and the percentage of special education students.

Using data from individual Indiana middle schools, Bremmer (2007) shows the percentage of eighth grade students passing the ISTEP math exam in October 2006 is directly related to the school's attendance ratio and the average teacher's salary. Private schools have higher pass rates than public schools, ceteris paribus. The regression results indicate the percentage of students passing the ISTEP math exam is inversely related to the teachers' average age, the percentage of minority students, the percentage of students receiving a free or reduced-cost lunch, and the percentage of the school's students enrolled in special education programs. There is no strong statistical evidence that smaller class sizes lead to a greater number of students passing the mandated exam. Finally, there is evidence of an inverse relationship between the

percentage of students passing the math exam and the percentage of male students, but the relationship is not statistically significant.

III. A Simple Theoretical Model

The percentage of students passing the state-mandated exam can be viewed as one of the many outputs of a school corporation's educational production function. Let p be the fraction of eighth-grade students that pass the math ISTEP exam. Assume p is function of three vectors, **x**, **y**, and **z**, or

$$p = f(\mathbf{x}, \mathbf{y}, \mathbf{z}) . \quad (1)$$

Vector **x** consists of school district variables such as the teacher-pupil ratio, expenditures per pupil, the average teacher's age, the average teacher's salary and the level of teacher effort expended. Vector **y** contains student-specific variables such as past educational attainment, student health, student attendance and the level of student effort applied to studying and test taking. Family and parental characteristics are captured by vector **z** and it contains variables such as measures of the extent of parental education, family income, the importance that families place on school attendance and educational success, and the level of effort that families expend on their students' education.

Some of the elements of these vectors are readily observable such as student attendance rates, the percentage of students qualifying for subsidized school lunches, and the average teacher's salary. There are elements of vectors **x**, **y**, and **z** are not readily observable and these would include the level of teacher, student and family effort expended in the educational process.

The public school district seeks the cost-minimizing level of resources that achieves a given percentage of students passing the standardized exam. There are other regulatory and political constraints. For example, student-teacher ratios cannot exceed the maximums allowed

by the state government and policy makers cannot provide such an inferior educational product that causes families to leave the district or voters to replace the school board.

IV. Model Specifications, Data, and Expected Signs of the Regression Estimates

Student performance on state-mandated, competency exams is a function of several inputs. Scores are affected by the students' academic aptitude, the socio-economic characteristics of the students' households, and the characteristics of the students' school district. This paper reports the results of three sets of regressions. In the first set of regressions, the dependent variable is the actual number of students of an Indiana middle school that passed the 8th grade ISTEP math exam in the fall of 2007. The dependent variable in the second set of regressions is the percentage of students that passed the exam. Since this limited dependent variable lies between 0 and 100, statistical techniques are used to control for this censored or truncated regression. In the third set of regressions, a logistic transformation is used where the dependent variable is the natural logarithm of the odds that students pass the math ISTEP exam.

Model specifications

The first set of regressions identifies those factors that affect the number of eighth-grade students that passed the math ISTEP exam in September 2007. If p_i is the percentage of eighth-grade students that passed the math ISTEP in school district i and N_i is the total number of eighth-grade students taking the ISTEP exam in school district i, then the total number of students passing the exam is p_iN_i. In specifying the regression model, the explanatory variables are elements from vectors **x**, **y**, and **z**, which contain selected characteristics of the school district, its students, and the students' families. The regression model is

$$p_iN_i = \alpha_0 + \sum_{j=1}^{m} \alpha_i x_i + \sum_{j=1}^{k} \beta_i y_i + \sum_{j=1}^{l} \delta_i z_i + \varepsilon_i \qquad (2)$$

where α_i, β_i and δ_i are the unknown parameters to be estimated by the regression and ε_i denotes the random error.

The second set of regression models deal with a limited dependent variable that lies between 0 and 100. The regression model becomes

$$p_i = \alpha_0 + \sum_{j=1}^{n} \alpha_i x_i + \sum_{j=1}^{p} \beta_i y_i + \sum_{j=1}^{q} \delta_i z_i + \mu_i \qquad (3)$$

where μ_i is the random disturbance term. The third set of regressions involve the logistic transformation and, letting υ_i denote the random error term, the specification of these regressions take the form

$$\ln\left(\frac{p_i}{1 - p_i}\right) = \alpha_0 + \sum_{j=1}^{r} \alpha_i x_i + \sum_{j=1}^{s} \beta_i y_i + \sum_{j=1}^{t} \delta_i z_i + \nu_i \quad . \qquad (4)$$

The independent variables in equations (2) – (4) need not be the same.

Data sources

Data on Indiana public school corporations is obtained from Indiana's Department of Education website.[1] After deleting missing variables, the set of regression models described in equations (2) – (4) have sample sizes of either 287 or 290 observations.

Table 1 lists the simple, bivariate correlation coefficient between the percentage of students passing the math ISTEP exam and 24 potential explanatory variables. Some of the results agree with intuition. More students will pass the eighth grade ISTEP math exam if more of the students passed the English and math ISTEP exam when they took it in the sixth grade. Variables that capture the importance of educational success to families - - the high school graduation rate, the percentage of high school seniors attending college the next year, the percentage of high school students taking the SAT exam and the average SAT score - - are

[1] See http://www.doe.state.in.us/htmls/education.html and http://www.doe.state.in.us/istep/welcome.html. The data is available upon request.

directly related to the pass rates on the ISTEP exam. Social economic variables perform as expected. The percentage of students passing the exam has an inverse relationship with the percentage of minority students, the percentage of families that are below poverty, the percentage of adults without a high school education, the percentage of families with only a single parent present, and the percentage of students that are entitled to a subsidized school lunch. As per capita income increases, pass rates increase. There is a weak, direct relationship between residential stability and pass rates on the exam as the simple correlation coefficient between the pass rate and the percentage of families living in the same house they lived in five years ago was 0.11.

However, some of the simple correlations are unexpected. The exam pass rate is inversely related to the average teacher's age, the average teacher's years of experience, the average teacher's salary and the expenditure per student. In addition, larger class sizes resulted in more, not less, students passing the standardized exam.

According to Table 1, as school attendance increases, the pass rate also increases; but the pass rate will fall as the percentage of special education students increases or as the number of suspensions and expulsions goes up. The percentage of students that pass the math ISTEP exam is inversely related to the percentage of students for whom English is their second language.

The expected signs of the regression coefficients

Table 2 lists the a priori or the expected signs of the regression coefficients. Three sets of regressions are estimated and each of the regressions has a dependent variable that is a monotonic function of the percentage of students that passed the math ISTEP exam. Therefore, each of these explanatory variables should have the same sign in any of the three sets of regressions.

Past academic achievement

Current student performance should be a function of past student learning and achievement. Therefore the percentage of 8th graders passing the math ISTEP exam in the fall of 2007 should be related to the percentage of 6th grade students that passed the math and English ISTEP exams in the fall of 2005. Because current performance on exams is directly related to past learning, each of the estimated coefficients associated with the first two explanatory variables listed in Table 2 should have a positive sign.

The average teacher's age, years of experience, salary and expenditures per student

Three explanatory variables are included to capture the quality of a school's teachers: the average age of the school district's teachers, the average years of experience of teachers in the school district, and the average salary of the school district's teachers. Regarding teacher longevity and its impact on student scores on standardized exams, there are several arguments. Both the average age and average years of experience serve as a proxy for the quantity of learning by doing that occurs while a teacher is in class. One argument is that the percentage of students passing the ISTEP exam would be greater the more experienced the teachers. Thus, the dependent variable should be directly related to the average teacher's age or experience.

On the other hand, experienced teachers (with tenure) may be more committed to teaching content and improving students' ability to learn, and they may resist teaching toward a standard exam. Exam pass rates may fall, but they may not be indicative of the ability of students to perform in the classroom in the future or in the workplace once they graduate. Unfortunately, the average years of experience and the average teacher's age may also capture the increased possibility of "teacher burn out" and lower exam pass rates reflect subpar teacher performance. In this case, the coefficients associated with the average age or the average years

of experience would be negative. Past research results by Bremmer and Carlson (2005, 2006) and Bremmer (2007) indicate that the regression coefficient associated with either of these variables is indeed negative. Clearly, average experience and average age are collinear and they should not be included in the same regression to avoid problems with multicollinearity.

School districts that attract and retain better teachers with higher salaries should have better performance in the classroom and students should score higher scores on the eighth-grade ISTEP math exam. Since higher average salaries attract superior teachers and the percentage of students passing the eighth-grade ISTEP math exam should increase, there should be a direct relationship between exam pass rates and the average teacher's salary. Given that labor is the largest cost that most school districts incur, the average salary of teachers serves as a proxy for expenditures per students. The more money that school districts spend per student, the more likely that standardized test scores will increase. Higher teacher salaries may also reflect higher per capita income and a school district with a higher tax base. Families in such areas would place increased importance on academic success and a direct relationship between average salary and pass rates is more likely to occur.

Again, average age, average experience and salaries are collinear, and past research by Bremmer and Carlson (2005, 2006) shows that care should be used in including combinations of these variables as explanatory variables in a regression. In addition, including both average teacher's salary and expenditures per student may introduce multicollinearity. Using data from previous years, Bremmer and Carlson (2005, 2006) show that when both average salaries and expenditures per student are included as explanatory variables, both of the coefficients are statistically significant and positive.

The percentage of the students that are minorities

Everything else held constant, there should be an inverse relationship between the percentage of students that passed the eighth-grade math ISTEP exam and the percentage of the school district's eighth graders that are minorities. There are several plausible theories for this inverse relationship. Some argue that standardized exams have a cultural bias against minority students and they score lower on the exams. Minority families bear the cost of past discrimination and past inequities in educational opportunities. Students from families with less educational backgrounds get less help at home, they receive less reinforcement at school, and their scores on standardized exams are lower. The percentage of minority students also serves as a proxy for the school's average family income. Lower income families have fewer educational opportunities. They live in areas with a smaller tax base and, consequently, their schools are of lower quality, resulting in lower scores on standardized exams.

The percentage of the students in special education

In Indiana, students enrolled in special education classes take the same state-mandated exam. Holding everything else constant, as reported in Table 2, if a school district has a larger percentage of eighth graders in special education, its pass rate on the mandated competency exam should be lower.

The percentage of students receiving a reduced-cost lunch

One of the explanatory variables that could be included in the three sets of regressions is the percentage of eighth graders that receive either a free or reduced-cost lunch. Like the percentage of minority students, the percentage of students receiving a subsidized lunch serves as a proxy for per capita income and it should be inversely related to the percentage of students that pass the ISTEP math exam. A higher percentage of students receiving reduced-cost lunches may

also capture students in poorer health with less nutrition and they will also score lower on the standardized exam.

The percentage of male students

Some claim that standardized exams have a built-in gender bias. To determine whether such a bias exists, the model specification could include the percentage of eighth graders taking the ISTEP math exam in a given school district that were male. The expected sign on the regression coefficient is not certain. Given the old mantra that "Boys are better at math," one may expect a direct relationship and a positive regression coefficient. However, given recent concerns about the rising percent of "bad boys" in middle school, an inverse relationship with a negative coefficient is also plausible.

The attendance ratio

The percentage of a school district's eight graders passing the ISTEP math exam should also be a function of the school's attendance rate. Higher attendance rates imply more frequent reinforcement of the material and higher scores on the standardized exams. This variable may also capture additional socio-economic characteristics. A higher attendance rate may reflect families that place relatively more emphasis on the educational experience and demand higher levels of student productivity, both in the classroom and on standardized exams. As reported in Table 2, the estimated coefficient associated with a school district's attendance rate should be positive.

The square miles in a school district

School districts with more square miles may reflect more rural areas with lower per capita income and a smaller pass rate on the standardized exam. It is also possible that districts consisting of a larger land mass experience diseconomies of scale in providing educational

quality and, once again, there should be an inverse relationship between the number of square miles in a district and the pass rate on the mandated competency exam.

Other variables measuring the importance families place on academic success

To capture the importance that families place on being success in school, two other variable were included: the percentage of high school seniors in the district that took the SAT exam and the number of suspension and expulsions that occurred per every 100 students in the district. Larger percentages of students taking the SAT exam reflect a population that places more importance on education and learning. This increased emphasis on education and the increased pressure to succeed will also be reflected in higher ISTEP pass rates by eighth graders. However, larger numbers of suspensions and expulsions capture student unhappiness with the educational product and predict a lower pass rate on the standardized exam.

Other socio-economic variables

The three sets of regressions to be estimated may also include two other variables to capture the particular socio-economic characteristics of a given school district. These variables measure the percentage of single parent families and the percentage of adults in the area that never attended high school. Again, these variables capture the per capita income of the area and the importance placed on learning and on performing well on standardized exams. Populations with less per capita income do not have educational opportunities of the same quality, therefore less student learning occurs and scores on the ISTEP exam should be lower. Thus, exam pass rates should be inversely related to these two explanatory variables.

Explanatory variables that capture the socio-economic conditions of the population - - the percentage of minority students, the percentage of single-parent families, the percentage of adults without a high school degree and the percentage of students receiving a subsidized school lunch -

- are likely to be collinear. If all of these explanatory variables were included in a regression, larger standard errors and reduced statistical significance of the estimated coefficients may occur.

V. Regression Results

The results from fourteen different regressions are reported in Tables 3 - 6. Each table is associated with a particular regression technique, a particular dependent variable, and a particular set of explanatory variables.

Discussion of the results in Table 3 and Table 4

The regressions in Tables 3 and 4 where estimated using ordinary least squares and the dependent variable was the total number of students that passed the math ISTEP exam in September 2007. In both tables, the columns labeled (1) and (3) include the average teacher's age and exclude the average teacher's years of experience while the columns labeled (2) and (4) do just the opposite: they include average teacher's years of experience as an explanatory variable and omit the average teacher's age. The regressions reported in Table 3 include the percentage of adult without a high school degree and the percentage of families with only a single parent as explanatory variables but they exclude the percentage of eighth graders who receive a subsidized lunch. Table 4 does the reverse, including the percentage of students receiving a free or reduced-cost meal and excluding the other two socio-economic variables.

As indicated in both Table 3 and Table 4, all eight of the regressions reject the null hypothesis of homoscedasticity using White's (1980) heteroscedasticity test and the standard errors reported in both tables have been corrected for heteroscedasticity using White's (1980) methodology. All the models reported in Tables 3 and 4 exhibit good fit with R^2s of 0.99 and high F statistics.

With few exceptions, the estimated coefficients have the correct signs and they are usually statistically significant at the one- or five-percent level. What key results can be taken from these tables? Past academic success in taking previous math exams is an important predictor in determining the number of students that pass the current exam. School districts that spend more dollars per student have higher pass rates on the math ISTEP exam. While controlling for expenditures per student, schools with older teachers or teachers with more experience have a smaller number of students that pass the standardized math exam. Another key conclusion is that socio-economic variables do matter. The estimated coefficients associated with the variables capturing these effects almost always had the anticipated sign and they were highly significant.

However, there are some minor exceptions. Similar to the results that Bremmer and Carlson (2205, 2006) obtained with data from a previous year, the percentage of students passing the English ISTEP exam in sixth grade are positive and significant in Table 3, although the coefficient of 0.34 reported in column (1) of Table 3 is marginally significant only at the ten percent level. However, in Table 4, the coefficient associated with the percentage of students passing the English ISTEP exam as sixth graders is positive in both columns (3) and (4), but they are also statistically insignificant. Referring to columns (1) and (2) of Table 4, the estimated coefficients associated with the percentage of seniors taking the SAT exam also have the anticipated positive sign, but they also are not statistically different from zero. While Table 3 provides weak statistical evidence that student bodies with more male students have more students that pass the math ISTEP exam in eighth grade, these coefficients are not statistically significant in columns (3) and (4) of Table 4.

Discussion of the results in Table 5

The four regressions reported in Table 5 were estimated by regression techniques that correct for a limited dependent variable that is censored or truncated. The dependent variable in these regressions is the percentage of eighth graders that passed the math ISTEP. These regression results agree with intuition and the estimated coefficients almost always have the correct anticipated sign that is verified with a one-tail t test. The only slope coefficient with the correct a priori sign but fails to pass the one-tail test regarding its anticipated sign is the estimated coefficient for the average teacher's salary reported in column (3) of Table 5. The results in Table 5 uniformly confirm the results obtained in Tables 3 and 4.

Discussion of the results in Table 6

Referring to the regression results reported in Table 6, the dependent variable was the natural log of the odds of passing the math ISTEP exam. The results are encouraging in that they once again tend to agree with intuition and statistically significant results. Like the results in Tables 3 and 4, the White heteroscedasticity test rejects the null hypothesis of a random error term with constant variance. Consequently, the standard errors listed in columns (1) and (2) of Table 6 have once again been corrected for heteroscedasticity using the methodology suggested by White (1980). There are some differences compared to the results in Tables 3 – 5.

Referring to column (1) in Table 6, both the estimated coefficients associated with the percentage of single parent families and the percentage of adults without a high school education have the correct, anticipated negative sign, however the estimated coefficient of -0.004 associated with the percentage of adults without a high school diploma fails to pass the muster of a standard one-tail t test. The estimated coefficient associated with the attendance rate in column (2) of Table 6 also fails to pass a similar one-tail test. Using 2004 data, Bremmer and Carlson

(2005, 2006) report regression results where the estimated coefficients associated with the attendance rate are always statistically significant. Likewise, the model specification of these previous studies always included both the average teacher's salary and the expenditure per student as explanatory variables. In those past studies, these variables always have estimated coefficients with the anticipated positive sign that easily pass a one-tail t test. However, in the current study of the 2007 data, inclusion of both of these variables resulted in disappointing outcomes where one of the slope coefficients would have a statistically insignificant sign that was counter to intuition. Likewise, while attendance rates have estimated coefficients that are marginally significant with the correct sign in Table 6, this result is not duplicated when attendance rates are included as an explanatory variable in the regressions reported in Tables 3 – 5.

VI. Concluding Comments

The regression results offer both good news and bad news. The good news is that school districts with higher average teacher salaries and greater expenditures per pupil have higher pass rates. So improved pass rates (and hopefully, the increased learning that they are supposed to measure) can come with increased resources. The bad news is that these additional funds will be difficult to raise during a time when state governments have competing priorities with limited tax funds and politicians who are elected on the promise of no new taxes.

But with the good news also comes some sobering facts. Socio-economic factors do affect the percentage of students who pass the mandated exams. If the gap in income differences across families continues to persist, relatively lower pass rates will also continue to persist. Wide gaps in the various socio-economic characteristics of a school's student body will generate a larger achievement gap and it is doubtful that the disadvantaged can achieve academic

proficiency as measured by a standardized exam. If states continue to rely on evidence from standardized exams as proof of accountability and academic success, the perverse, inverse relationship between years of teacher experience and the percentage of students passing the exam needs to be addressed. Maximizing society welfare requires equating the marginal social benefit and the marginal social cost. Setting a benefit-based goal such as 100 percent of the students passing a mandated competency exam ignores the cost of achieving such a goal. If some pollution is optimal, if some level of shoplifting is optimal, some students should probably fail a state-mandated competency exam.

References

Bremmer, Dale, "Determinants of Student Performance on State-Mandated Competency Exams: Evidence from Indiana Middle Schools." Working paper, Rose-Hulman Institute of Technology, 2007.

Bremmer, Dale and Patricia Carlson, "Determinants of Student Performance on Competency Exams: The Case of Indiana." Working paper, Rose-Hulman Institute of Technology, 2005.

Bremmer, Dale and Patricia Carlson, "An Assessment Framework for a Large-Scale, Web-Delivered Resource Project for Middle School Teachers of Math, Science, and Technology," ASEE Conference Proceedings, Emerging Trends in Engineering Education, Paper # 2006-1925, with P. A. Carlson, June 2006.

Greenwald, Rob, L.V. Hedges, and R. Laine, "The Effect of School Resources on Student Achievement," Review of Educational Research, 66(3), Fall 1996, 361-396.

Grissmer, David, Ann Flanagan, Jennifer Kawata, and Stephanie Williamson, Improving Student Achievement: What State NAEP Test Scores Tell Us, Santa Monica, California: RAND Corporation, 2000.

Grissmer, David, S. N. Kirby, M. Berends, and Stephanie Williamson, "Student Achievement and the Changing American Family." Santa Monica, California: RAND Corporation, MR-488-LE, 1994.

White, Halbert. "A Heteroscedasticity Consistent Covariance Matrix Estimator and a Direct Test of Heteroscedasticity," Econometrica, 48(4), May 1980, 817 – 838.

Table 1
Simple Correlation Coefficient with the Percentage of 8th Graders Passing the Math ISTEP Exam in 2007

Variable	Correlation Coefficient
Percentage of 6th Graders Passing the Math ISTEP Exam in '05	0.69031
Percentage of 6th Graders Passing the English ISTEP Exam in '05	0.69301
Average Teacher Age: '06-'07	-0.21367
Average Teacher Experience: '06-'07	-0.08543
Average Teacher Salary: '06-'07 (in $1000)	-0.00078
Expenditures/Student: '06-'07 (in $1000)	-0.36986
Student-Teacher Ratio: '06-'07	0.32131
Minority 8th Graders: '07-'08 (%)	-0.49868
8th Graders in Special Ed: '07-'08 (%)	-0.37832
8th Graders with Subsidized Lunches: '07-'08 (%)	-0.70055
Percentage of Male 8th Graders: '07-'08	-0.06513
Percentage of 8th Graders with English as a Second Language: '07-'08	-0.28325
Attendance Rate: '06-'07	0.37382
High School Graduation Rate: '05-'06	0.55711
College Attendance Rate: Class of '07	0.24182
Square Miles in School District	0.07314
Percentage of High School Seniors Taking SAT Exam: '06-'07	0.41622
Average SAT Score: '06-'07	0.54994
Suspensions/Expulsions per 100 Students: '06-'07	-0.57723
Adults with less than a High School Education (% - 2000 census)	-0.37217
Single Parent Families (% - 2000 census)	-0.64190
Families Below Poverty (% - 2000 census)	-0.59332
Per Capita Income (1999 – census)	0.39856
Same Residence in 2000 as in 1995 (% - 2000 census)	0.11462

Table 2
A Priori Expected Signs of the Regression Coefficients with a Dependent Variable that Measures the Number of 8th Graders Passing the Math ISTEP Exam

Variable	Expected Sign of Slope Coefficient
Percentage of 6th Graders Passing the Math ISTEP Exam in '05	+
Percentage of 6th Graders Passing the English ISTEP Exam in '05	+
Average Teacher Age: '06-'07	-
Average Teacher Experience: '06-'07	-
Average Teacher Salary: '06-'07 (in $1000)	+
Expenditures/Student: '06-'07 (in $1000)	+
Minority 8th Graders: '07-'08 (%)	-
8th Graders in Special Ed: '07-'08 (%)	-
8th Graders with Subsidized Lunches: '07-'08 (%)	-
Percentage of Male 8th Graders: '07-'08	?
Attendance Rate: '06-'07	+
Square Miles in School District	-
Percentage of High School Seniors Taking SAT Exam: '06-'07	+
Suspensions/Expulsions per 100 Students: '06-'07	-
Adults with less than a High School Education (% - 2000 census)	-
Single Parent Families (% - 2000 census)	-

TABLE 3
Regression Results
Dependent Variable: Number of 8th Grade Students Passing Math ISTEP in 2007

Independent Variables	(1)	(2)	(3)	(4)
Constant	**-7.88** (43.86)	**-46.06**‡‡‡ (26.65)	**-8.53** (43.06)	**-47.24**‡‡‡ (26.74)
Total Number of 8th Graders: '07-'08	**0.95*** (0.04)	**0.95*** (0.04)	**0.72*** (0.13)	**0.72*** (0.13)
6th Graders Passed English ISTEP: '05 (%)	**0.34***** (0.24)	**0.36***** (0.24)	**0.42**** (0.23)	**0.44**** (0.23)
6th Graders Passed Math ISTEP: '05 (%)	**0.47**** (0.20)	**0.47**** (0.19)	**0.38**** (0.19)	**0.38**** (0.18)
Average Teacher Age: '06-'07	**-1.51**** (0.82)		**-1.54**** (0.79)	
Average Teacher Experience: '06-'07		**-1.70**** (0.75)		**-1.74**** (0.72)
Expense/Student: '06-'07 (in $1000)	**2.51**** (1.17)	**2.30**** (1.15)	**2.42**** (1.19)	**2.21**** (1.17)
Minority 8th Graders: '07-'08	**-0.38*** (0.04)	**-0.38*** (0.04)	**-0.38*** (0.04)	**-0.38*** (0.04)
8th Graders in Special Ed: '07-'08	**-0.73*** (0.23)	**-0.73*** (0.23)	**-0.78*** (0.23)	**-0.78*** (0.23)
Adults without High School Diploma (%)	**-0.80*** (0.29)	**-0.83*** (0.29)	**-0.74*** (0.28)	**-0.78*** (0.28)
Single Parent Families (%)	**-0.65*** (0.22)	**-0.61*** (0.21)	**-0.62*** (0.21)	**-0.58*** (0.21)
Seniors Taking SAT Exam: '06-'07 (%)	**0.31**** (0.13)	**0.30**** (0.13)	**0.34**** (0.13)	**0.33*** (0.13)
Square Miles in District	**-0.04**** (0.02)	**-0.04**** (0.02)	**-0.03**** (0.02)	**-0.03**** (0.02)
Male 8th Graders: '07-'08			**0.45**‡‡‡ (0.24)	**0.46**‡‡‡ (0.24)
White Heteroscedasticity Tests	**253.50**††	**254.84**††	**255.15**††	**255.92**††
R^2	**0.99**	**0.99**	**0.99**	**0.99**
F Statistic	**2029.67**†	**2036.79**†	**1900.51**†	**1907.86**†
Number of observations	**287**	**287**	**287**	**287**

Standard errors are in parentheses. *, **, and *** indicate the coefficient is statistically different from zero and has the correct a priori sign at the 1, 5, or 10 percent level, respectively, using a 1-tail t test. ‡‡‡ indicates the null hypothesis that the coefficient is equal to zero is rejected at the 10 percent level using a two-tailed t test.
† indicates the null hypothesis that all the slope coefficients are simultaneous equal to zero is rejected using an F test at the 1 percent level. †† means the null hypothesis of homoscedasticity is rejected using a chi-squared test at the 1 percent level.

TABLE 4
Regression Results
Dependent Variable: Number of 8th Grade Students Passing Math ISTEP in 2007

Independent Variables	(1)	(2)	(3)	(4)
Constant	**-31.41** (34.40)	**-56.98**‡ (20.62)	**-29.81** (33.89)	**-56.29**‡ (21.30)
Total Number of 8th Graders: '07-'08	**1.01*** (0.03)	**1.01*** (0.03)	**0.83*** (0.14)	**0.83*** (0.14)
6th Graders Passed English ISTEP: '05 (%)			**0.05** (0.22)	**0.06** (0.21)
6th Graders Passed Math ISTEP: '05 (%)	**0.57*** (0.21)	**0.59*** (0.22)	**0.50*** (0.19)	**0.51*** (0.19)
Average Teacher Age: '06-'07	**-1.04***** (0.78)		**-1.07***** (0.75)	
Average Teacher Experience: '06-'07		**-1.21**** (0.68)		**-1.24**** (0.66)
Expense/Student: '06-'07 (in $1000)	**2.17**** (1.14)	**2.01**** (1.12)	**2.14**** (1.16)	**1.98**** (1.14)
Minority 8th Graders: '07-'08	**-0.31*** (0.06)	**-0.31*** (0.06)	**-0.31*** (0.06)	**-0.30*** (0.06)
8th Graders in Special Ed: '07-'08	**-0.54**** (0.21)	**-0.54**** (0.21)	**-0.59*** (0.22)	**-0.59*** (0.22)
Number of Subsidized Lunches: '07-'08	**-0.30*** (0.07)	**-0.30*** (0.07)	**-0.29*** (0.07)	**-0.29*** (0.07)
Seniors Taking SAT Exam: '06-'07 (%)	**0.15** (0.12)	**0.15** (0.13)	**0.18***** (0.13)	**0.17***** (0.13)
Square Miles in District	**-0.03**** (0.02)	**-0.03**** (0.02)	**-0.03**** (0.02)	**-0.03***** (0.02)
Male 8th Graders: '07-'08			**0.36** (0.26)	**0.37** (0.26)
White Heteroscedasticity Tests	**261.06**††	**261.02**††	**265.98**††	**265.80**††
R^2	**0.99**	**0.99**	**0.99**	**0.99**
F Statistic	**3102.84**†	**3111.03**†	**2570.46**†	**2577.97**†
Number of observations	**290**	**290**	**290**	**290**

Standard errors are in parentheses. *, **, and *** indicate the coefficient is statistically different from zero and has the correct a priori sign at the 1, 5, or 10 percent level, respectively, using a 1-tail t test. ‡ indicates the null hypothesis that the coefficient is equal to zero is rejected at the 1 percent level using a two-tailed t test.
† indicates the null hypothesis that all the slope coefficients are simultaneous equal to zero is rejected using an F test at the 1 percent level. †† means the null hypothesis of homoscedasticity is rejected using a chi-squared test at the 1 percent level.

TABLE 5
Censored or Truncated Regression Results
Dependent Variable: Percentage of 8th Grade Students Passing Math ISTEP in 2007

Independent Variables	(1)	(2)	(3)	(4)
Constant	**60.85**‡ (10.01)	**50.33**‡ (8.14)	**64.13**‡ (10.01)	**52.78**‡ (7.56)
6th Graders Passed English ISTEP: '05 (%)	**0.15**** (0.08)	**0.14**** (0.08)	**0.12***** (0.08)	**0.11**** (0.07)
6th Graders Passed Math ISTEP: '05 (%)	**0.29*** (0.06)	**0.29*** (0.06)	**0.29*** (0.06)	**0.29*** (0.06)
Average Teacher Age: '06-'07	**-0.37**** (0.18)		**-0.40**** (0.18)	
Average Teacher Experience: '06-'07		**-0.42**** (0.18)		**-0.43**** (0.19)
Average Teacher Salary: '06-'07 (in $1000)	**0.18***** (0.12)	**0.21***** (0.12)	**0.14** (0.11)	**0.17***** (0.12)
Minority 8th Graders: '07-'08 (%)	**-0.10*** (0.03)	**-0.11*** (0.03)	**-0.10*** (0.03)	**-0.11*** (0.03)
8th Graders in Special Ed: '07-'08 (%)	**-0.30*** (0.12)	**-0.31*** (0.12)	**-0.27**** (0.12)	**-0.28**** (0.13)
Number of Subsidized Lunches: '07-'08 (%)			**-0.15*** (0.04)	**-0.15*** (0.04)
Adults without High School Diploma (%)	**-0.13**** (0.06)	**-0.12**** (0.06)		
Single Parent Families (%)	**-0.18*** (0.06)	**-0.18*** (0.06)		
Seniors Taking SAT Exam: '06-'07 (%)	**0.05***** (0.03)	**0.06***** (0.03)	**0.06**** (0.03)	**0.06**** (0.03)
Suspensions/Expulsions: '07-'08	**-0.12*** (0.05)	**-0.13*** (0.05)	**-0.12**** (0.05)	**-0.12**** (0.05)
Log Likelihood	**-890.85**	**-890.39**	**-896.03**	**-890.39**
Number of observations	**290**	**290**	**290**	**290**

Standard errors are in parentheses. *, **, and *** indicate the coefficient is statistically different from zero and has the correct a priori sign at the 1, 5, or 10 percent level, respectively, using a 1-tail t test. ‡ indicates the null hypothesis that the coefficient is equal to zero is rejected at the 1 percent level using a two-tailed t test.

TABLE 6
Regression Results
Dependent Variable: Odds of 8th Grade Students Passing Math ISTEP in 2007 (in logs)

Independent Variables	(1)	(2)
Constant	**-3.656** (2.679)	**-2.100** (2.388)
6th Graders Passed English ISTEP: '05 (%)	**0.011*** (0.005)	**0.008***** (0.005)
6th Graders Passed Math ISTEP: '05 (%)	**0.017*** (0.004)	**0.017*** (0.004)
Average Teacher Age: '06-'07	**-0.020**** (0.011)	**-0.020**** (0.011)
Average Teacher Salary: '06-'07 (in $1000)	**0.012**** (0.007)	**0.011***** (0.007)
Attendance Rate: '06-'07 (%)	**0.036***** (0.027)	**0.023** (0.024)
Minority 8th Graders: '07-'08 (%)	**-0.003***** (0.002)	**-0.003***** (0.002)
8th Graders in Special Ed: '07-'08 (%)	**-0.016*** (0.006)	**-0.014**** (0.006)
Adults without High School Diploma (%)	**-0.004** (0.006)	
Single Parent Families (%)	**-0.011*** (0.004)	
Students with Reduced Cost Lunch: '07-'08 (%)		**-0.010*** (0.002)
Seniors Taking SAT Exam: '06-'07 (%)	**0.005**** (0.002)	**0.005**** (0.002)
Suspensions/Expulsions: '06-'07	**-0.007*** (0.003)	**-0.006**** (0.003)
White Heteroscedasticity Tests	**138.380††**	**87.639†††**
R^2	**0.623**	**0.638**
F Statistic	**41.28†**	**49.179†**
Number of observations	**287**	**290**

Standard errors are in parentheses. *, **, and *** indicate the coefficient is statistically different from zero and has the correct a priori sign at the 1, 5, or 10 percent level, respectively, using a 1-tail t test. † indicates the null hypothesis that all the slope coefficients are simultaneous equal to zero is rejected using an F test at the 1 percent level. †† and ††† mean the null hypothesis of homoscedasticity is rejected using a chi-squared test at the 1and 5 percent level, respectively.