

**Paying Teachers for Advanced Degrees:  
Evidence on Student Performance from Georgia**  
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## **Paying Teachers for Advanced Degrees: Evidence on Student Performance from Georgia**

ABSTRACT: Georgia offers salary incentives for K-12 educators to obtain post-baccalaureate degrees, intending to improve student performance. In this paper, we evaluate the empirical relationship between advanced degrees earned by teachers and student pass rates on the state high school graduation test. More advanced degrees do not significantly improve pass rates. We conclude the Devil is in the details. It is well known that educational performance is the product of the interaction of many factors, particularly family and socio-economic variables. Previous literature also draws only a weak relationship between teacher quality and salary incentives. Thus, Georgia's experience suggests it is difficult to design effective policy that conditions on indirect incentives to perform. Certain policies may fail because they are ill-conceived, or because interest group pressures interfere in their planning or execution. But sometimes policies fail because there is simply a limit to government's ability to solve problems.

# **Paying Teachers for Advanced Degrees: Evidence on Student Performance from Georgia**

## **Introduction**

In nearly any comparison of educational performance, Georgia regularly scores poorly relative to other states. Publication of such findings is, as expected, followed by public officials announcing the need to improve public education in the state. State officials in Georgia had a promising idea: give K-12 teachers a monetary incentive to increase their formal academic qualifications. The reasoning behind the policy is that better qualified teachers will produce higher quality educational services; teachers acquiring more formal education will enhance their ability to stimulate and motivate their students.<sup>1</sup> In turn, higher quality education should reveal itself as improved performance on common measures of educational outcomes, thereby addressing the perceived public policy concern. Despite Georgia's laudable adherence to a basic economics principle—people respond to incentives—we expect this policy will not a noticeable impact on student achievement.

This study evaluates the relationship between advanced degrees for teachers and student performance on the Georgia High School Graduation Test (GHS GT). Using data over the period 1998 to 2002 for nearly all of Georgia's independent school districts, we model GHS GT pass rates as a function of educational, demographic, and socio-economic conditions.<sup>2</sup> Our estimates indicate that GHS GT pass rates do not improve as more teachers earn more advanced degrees. According to the data examined in this paper, Georgia's policy is an expensive yet ineffective instrument for leaving no child behind.

This result may be unsurprising to some. The relationship between the formal qualifications of teachers and student achievement is too tenuous and too poorly understood.

Although this policy is likely to be politically popular, for it to be effective, it must be true that (a) the state's incentives are sufficient for a significant number of teachers to improve their qualifications, (b) a teacher's professional effectiveness improves with a teacher's formal qualifications, and (c) the increase in teacher effectiveness is not inframarginal; it is large enough to overcome the effect of other influences on student achievement. In terms of influencing student achievement salary incentives are, at best, indirect effects.

Nevertheless, our "non-result" highlights an important issue in determining and executing public policy. Georgia has acknowledged that people respond systematically to incentives, and has attempted to find a workable set of incentives to achieve a desired end. Georgia's government has attempted to borrow the mechanisms of the market to achieve a desired effect. Conventional economic thinking would assess this policy as "smart" and likely to be more effective than other policies which ignore human motivations. However, this example shows the serious difficulties a non-market organization has in creating *de novo* incentives that induce a particular behavior—to achieve a particular result—at non-inframarginal levels.

Georgia's expensive failure exemplifies a Hayekian knowledge problem (which one could also discuss as Alchian's question of economic adoption) often found in markets for essentially private services that have become politicized. In a functioning market, rewards flow to the proven performers. If the market for educational services were more competitive, we would expect rewards to flow to schools and teachers whose methods prove more effective. Should these methods be reproducible, their adoption would spread through the market. If earning an advanced degree enhances teacher competitiveness, teachers would seek advanced degrees. Otherwise, teachers would not seek advanced degrees, to very little and there would be little wasted expense on additional teacher education. However, as the state has become the

overwhelmingly dominant provider of educational services, such informational flows and adoptive mechanisms have been severed. To improve outcomes, the state must try to replicate market incentives, and must try to accurately relate incentives to outcomes. In this instance, Georgia has selected a plausible incentive, but applied the incentive in a difficult situation. Georgia's policy provides sufficient incentive to motivate teachers to acquire more advanced degrees, but the policy fails because having more teachers with advanced degrees does not seem to lead to improved educational outcomes.

In the next section we discuss the GHSGT. The initial pass rate on this exam is our measure of school-system average educational outcome. We then discuss what various groups and organizations within Georgia's government desire as educational outcomes, and discuss the economic importance of incentives. In the following section we outline our data and hypothesis. Subsequently, we discuss our empirical model and the results from our estimates. The final section concludes.

### **Georgia High School Graduation Tests (GHSGT)**

Since 1991, Georgia law has required high schools to administer curriculum-based assessments in grade 11 for graduation purposes. Accordingly, the state's Department of Education (DOE), with input from the state's educators, developed and administers the tests. The tests are based on the standards specified in the state's Quality Core Curriculum as established by the State Board of Education and revised in November 1997.<sup>3</sup> In addition to meeting the mandates of state law, since 2004 the state has used the language arts and math tests to measure Adequate Yearly Progress (AYP) for federal No Child Left Behind reporting purposes.<sup>4</sup>

Students entering ninth grade after July 1, 1991, must pass the English language arts, mathematics and writing tests as part of the requirements to graduate from high school. Passing the social studies test is a graduation requirement for students who entered ninth grade after July 1, 1994 (i.e., the graduating class of 1997). Students in the graduating class of 1998 were also required to pass the science test. These requirements apply to all students, regardless of the type of diploma or diploma seal they seek.<sup>5</sup>

Eleventh-grade students have their first opportunity to pass the graduation tests with the fall administration of the writing subtest. The first administration of the English language arts, mathematics, social studies and science subtests occurs in the spring of the junior year. The data reported for the high school graduation tests are based on scores of 11<sup>th</sup> grade regular program students and represent the percentage of test takers passing the indicated section of the test on the first administration.<sup>6</sup> The DOE also reports the percent of test takers passing all of the subtests given on first administration in the spring. Having discussed the relevant institutional details, we now turn to the policy's stated objectives.

### **What Does the State Government Seek To Maximize?**

In repeated instances, the state legislature has issued instructions to the state's executive-branch offices to pursue policies consistent with increasing the academic achievement of the state's students. For example, in addition to the requirement that students pass the GHSGTs to graduate,

“The Governor's Office of Student Achievement (GOSA)... was established July 1, 2000, by Georgia Code... to improve student achievement... in Georgia. GOSA is committed to partnering with Georgia DOE in their mission to “lead the nation in improving student achievement.” Both No Child Left Behind and Georgia's A Plus Education Reform Act are built upon the principles of accountability and results; ... [and] quality teachers in every classroom....”<sup>7</sup>

Similarly, the state’s DOE superintendent publicly states her vision as, “We will lead the nation in improving student achievement.” To help achieve the stated vision, the Superintendent set a goal to recruit, train, and retain educators, in order to “ensure a highly qualified teacher for every classroom.” Consistent with both the vision and the goal of highly qualified teachers, the superintendent also states a goal of high-school improvement. In this goal, the superintendent wishes to “significantly improve Georgia’s SAT scores.”<sup>8</sup> Thus emerges the state’s policy of encouraging more formal education for the state’s teachers.

The stated objectives of the major players—the legislature, the governor’s office, and the DOE—seem to be in alignment. The objectives are to meet No Child Left Behind’s standards of AYP, increase the number of high school graduates, and increase the state’s SAT scores. Furthermore, there appears to be a consensus that one way to improve student achievement is to improve teachers’ formal qualifications.

Neither GOSA nor the DOE Superintendent specifically refers to the GHSGT. However, for empirical reasons, the GHSGT pass rates offer many advantages over examining school district average SAT scores. First, the percentage of students who take the SAT varies widely from one Georgia school district to the next. Furthermore, those students most likely to take the SAT will be those most interested in higher education. Presumably, one reason these students self-select to take the SAT is because they believe themselves capable of college-level schoolwork. Therefore, focusing on SAT scores is equivalent to “skimming the cream” of the students’ distribution. Furthermore, in those school districts which compel most students to take the SAT, there is little consequence if an uninterested student chooses to under perform her true ability. Taking these considerations together, we believe the SAT will be biased, while the GHSGT will not be. In order to graduate, each student must take the GHSGT. Students

uninterested in graduating have already had the opportunity to drop out prior to taking the GHSGT. Furthermore, failing the GHSGT carries a significant penalty, motivating students to try hard. Accordingly, we believe the school district pass rates for the GHSGT form a very appealing measure of system-average student achievement.

### **Improving Achievement by Improving Teacher Qualifications: Incentives Matter**

One of the most fundamental lessons in economics is that incentives matter, i.e., that people's behavior will change based on the costs and benefits. For most people, the opportunity to increase one's salary provides compelling motivation. As discussed, the consensus of Georgia's policymakers—whether correct or incorrect—is that more formally qualified teachers are more effective teachers. Georgia's goals of increasing student performance through increasing teacher qualifications, then, if the state were to take fundamental economics seriously, it should pay more as teachers increase their qualifications, *ceteris paribus*.

Accordingly, the state provides teachers with salary increments based on their years of creditable service *and* on the highest degree obtained. Most teaching positions in the state require a minimum of a bachelor's degree. However, a salary boost occurs when a teacher earns a master's degree, and occurs again with an education specialist's degree, and occurs again with a doctorate (Ph.D. or Ed.D.). The state salary schedule for administrators and teachers is organized into seven tiers, corresponding to the academic preparation of individual teachers. The tier establishes a base-line for salary. The base-line is then adjusted by years of creditable service. Therefore, a teacher may increase her salary along two margins. She may increase salary by: (a) earning years of creditable service—advancing within a tier, and/or (b) attaining a more advanced degree—shifting to a new tier. The salary policy that has emerged from the

political budgeting process gives teachers the monetary incentive to earn advanced degrees. However, the salary policy does not necessarily give teachers any specific incentive to improve student performance.

### **Data, Hypotheses and Empirical Treatment**

Each of Georgia's 159 counties has a single independent school district (often comprising numerous high schools). In addition, there are 21 city school districts within the various counties (11 are fiscally independent of the county system). The data from some sources are available on the county level, while other data is available on the school *system* level. The smallest common unit of observation is the county, which is identical to the school system in all but 21 instances. For the empirical analyses, we incorporated data for city school districts into their respective county totals. Additionally, we discarded six of Georgia's counties, Chattahoochee, Clay, Schley, Taliaferro, Quitman, and Webster, because their school districts lack a high school, and therefore lack educational data on graduates. Thus, our data set consists of 153 Georgia counties from 1998 through 2002. Our sources are the U.S. Census, Georgia Public Education Report Card, Georgia Office of Educational Accountability, Georgia Department of Education, and various editions of the Georgia County Guide.<sup>9</sup> In Table 1 we present variable names and definitions, and in Table 2 are summary statistics.

The variable *Pass Rate* equals the proportion of students passing the GHS GT on first attempt. *Pass Rate* is our general measure for educational achievement, and represents the dependent variable in our estimates.<sup>10</sup> As discussed above, the GSHGT pass rate is a superior measure of achievement compared to SAT or ACT scores, graduation rates, or other measures of school quality, because every Georgia high school student takes the exam. Therefore, there is no

“skimming the cream” bias (as with SAT scores) and no complications associated with cross-state comparisons. Furthermore, the test has genuine, meaningful consequences: failure to pass means failure to graduate. Also, because the test is administered by the state, district-level variations, i.e. grading strictness, grade inflation, etc., are minimized. *A priori*, one might expect that an average student should pass the GHS GT regardless of her instructors, and, ideally, empirical work should focus on pass-rate gains by the marginal students. However, the Georgia Department of Education reports the school system average pass rate, without additional comment. In any event, the mean pass rate for first-time test takers in our sample is only 62 percent, which seems to indicate that even “average” students may find the GHS GT challenging.

For purposes of this paper, we measure a school district’s teacher qualifications with the variable *Advanced Degree*, the school district percentage of K-12 teachers possessing better-than-Bachelor’s credentials.<sup>11</sup> Given the policymakers’ stated objectives, *Advanced Degree* should exert positive and significant influence on GHS GT pass rates. Suppose that there is a causal link and direct correlation between teacher qualifications and educational quality, and further assume that we adequately capture these concepts with our variables. Applying the basic economic result that people respond systematically to incentives, Georgia’s salary bonus for advanced degrees would motivate more teachers to seek such degrees. If the state appropriately selects the salary bonus amount, the state’s aggregate teacher qualifications improve, and the state’s educational quality increases.

However, *a priori*, we anticipate an insignificant coefficient on *Advanced Degree*. This is not because we find fault with the chain of reasoning, i.e. that better educated teachers are better teachers, and the people respond systematically to incentives. Rather, we question whether an indirect policy intervention on the “supply side” of the educational market will have

a significant effect. Educational outcomes are a complicated product of the interaction of many factors, and, furthermore, family and socio-economic variables seem to predominate.<sup>12</sup>

Regarding educational outcomes, whether a child's teacher has a Master's degree seems likely to be swamped by the education level, income, and demographic characteristics of the child's family. Furthermore, recent research shows that the relationship between education spending and educational quality is empirically ambiguous,<sup>13</sup> and that there is only a weak relationship between teacher salaries and teacher quality.<sup>14</sup> Recent research also indicates that teacher experience has a greater impact on teacher quality than does teacher education.<sup>15</sup>

Moreover, the state faces a challenge in appropriately setting the salary incentive. In public policy, the old saw about the devil and details seems true so frequently. Assuming the correlation between teacher credential and educational quality holds true (and the evidence for this proposition is murky<sup>16</sup>), if the state sets the bonus too low, too few teachers will increase their credentials for the policy to have a noticeable effect. Finally, there is issue of "noise" in our data. The data available is school district average GHSGT pass rates, and the percentages of K-12 teachers possessing better-than-Bachelor's credentials. Using our data sources, we cannot separate out the number of Master's qualified high school teachers, for example, nor follow a particular teacher's students. It seems unlikely that a contemporaneous increase in early childhood Master's-qualified teachers would increase the pass GHSGT pass rate for high school juniors. In short, our data compel us to estimate only the sort of "primitive models" criticized by Hanushek.<sup>17</sup> Collectively, these reasons lead us to expect an insignificant empirical result for *Advanced Degree*.

To achieve a well-specified model, we control for a number of educational and demographic variables, including the student to teacher ratio, number of students, population

density, district total revenue per FTE student, district median income per capita, and Caucasian (non-Latino) percentage of students. A large literature exists regarding average class size. The underlying, and perhaps naïve, reasoning is that students will perform better in smaller groups featuring more frequent direct interactions with the teacher. Although the empirical evidence is mixed<sup>18</sup>, the variable is commonly used. We include the number of students and the district's population density to account for economies of scale and scope, as well as any increased extra-curricular opportunities which may exist in larger, more urbanized school districts. We also include district revenues, scaled to FTE student, to account for resource differentials across districts. Together, these are our “supply side” variables.

Turning to the “demand side” of our model, we include demographic and socio-economic variables. Family income levels tend to be strongly correlated with family educational attainment and, presumably, a family environment supportive of student educational achievement. As we do, many studies of student achievement include ethnicity measures.<sup>19</sup> Frequently, a Caucasian family background is associated with greater student achievement. The reasons for this result are complex and varied. Our public schools may exhibit overt racism, or unwitting racism in testing or curriculum design. Wittingly or unwittingly, subtle racism may be present through educators having lower expectations for non-white children, and/or “low tracking” non-white children into less rigorous classes. Furthermore, there may be cultural differences, in which African American and Latino American societies place less emphasis on educational attainment.

## **The Empirical Model**

Our data set is a panel of all Georgia counties from 1998 through 2002. Though not ideal, our time period is limited by data availability and comparability at the time of writing. Since we observe school districts in cross-section and over time, two types of unobserved factors can potentially affect pass rates: first, unobserved heterogeneous characteristics of each school district; and second, unobserved secular trends over time that affect all school districts. Therefore, we estimate the model

$$PassRate_{it} = \beta_0 + \beta_1 AdvancedDegree_{it} + \beta_j x_{jit} + \delta_z D_z + v_{it},$$

where  $v_{it} = a_i + u_{it}$ .

In the model,  $i$  indexes school districts,  $t$  indicates year from 1998 to 2002,  $j$  represents each of the demographic/socio-economic control variables, and  $D_z$  represents the year dummies for years  $z > 1998$ . The composite error term,  $v_{it}$ , is the sum of the time-invariant fixed effect,  $a_i$ , and the regression error  $u_{it}$ , which is assumed to be uncorrelated with the set of independent variables. Our main parameter of interest is  $\beta_1$ , which captures the effect that more advanced degrees among teachers has on their students' pass rates.

Under these conditions, estimating the first differences of the model with ordinary least squares is known to generate unbiased and consistent estimates of the  $\beta$  and  $\delta$  parameters.<sup>20</sup> However, to economize on degrees of freedom, we instead estimate the model using generalized least squares under different assumptions concerning the relationships among panels and within the panels. In our models, we consider whether the data variances are the same or different across the counties; i.e., whether the panels are homoskedastic or heteroskedastic. Accordingly, we present models with no correction, models with White's correction for heteroskedasticity applied to the entire sample, and models where the data has been clustered by cross-sectional unit and corrected for heteroskedasticity. We believe clustering the observations is the

empirically soundest procedure. Clustering the data allows us to estimate standard errors that are robust to heteroskedasticity, while allowing the observations of a single school district to be correlated through time. Furthermore, we also consider whether the data displays no serial correlation, common AR(1) correlation, or county-specific AR(1) (listed as PSAR) correlation.

## Results

Table 4 presents the findings from estimating the above model. The goodness-of-fit measures indicate that the models are well-specified. In explaining the dependent variable, three of the independent variables dominate. First, *Percent White* is positive and significant, with a coefficient estimate of approximately 0.3 that can be interpreted as an elasticity measure (a one percent increase in the share of Caucasian students increases *Pass Rate* by an estimated 0.3 percent). *Pop. Density* and *Income* are also positive and significant. Both variables are log measures, so their magnitudes also follow elasticity interpretations. As their relatively large coefficient estimates indicate, both *Pop. Density* and *Income* have large marginal effects. We believe the foregoing results will be of no surprise to readers. The rest of the variables in the model have small estimated marginal effects with little or no statistical significance.

*Student/Teacher* has a positive estimate throughout, and is significant in Model 2 and Model 5, but in both these models the square of *Student/Teacher* is negative and significant. With the non-linearity, peer effects and the usual benefits of small class sizes might work in opposite directions and Georgia districts operate on the range on which peer effects dominate. However, with the current data we cannot test for this. Revenue shows up negative and significant in Model 3 and 5 but at low levels of significance, so we see little reason to put much emphasis on this variable.

The variable of interest is *Advanced Degree*, which is of a very small magnitude and not significant except in Model 4. After controlling for students population, area population density, area income, school revenue, and ethnic make-up, school systems with more Master's-qualified teachers fail to perform better on the Georgia High School Graduation Tests, *ceteris paribus*. Thus, the Georgia data from 1998 to 2002 offer no evidence that more credentials are associated with improved student performance. In fact, the results suggest a very mild negative effect. We pose some interpretations in the concluding section. But first we consider some of the opportunity costs of a funding a policy that has no discernible impact on student performance.

### **Policy Analysis:**

Now we consider the cost Georgia incurs through the policy of rewarding teachers for acquiring Master's degrees. Evaluated at the sample mean, consider a single standard deviation increase in *Advanced Degree*, from 50.73 percent of teachers possessing a Master's degree to 60.78 percent of teachers possessing a Master's degree. The sample mean number of teachers per school system is 634.37. A one standard deviation increase in the number of master's qualified teachers averages 63.75 teachers per school district. To further develop our argument, we adopt the following relatively conservative assumptions: 1) all teachers who earn a higher degree earn a master's degree, instead of a doctorate or specialist's degree, and 2) all teachers earn their degree in their fifth year or thereafter. This yields an average initial increase in state educational spending of \$203,229.45 per school system for the 64 newly Master's-qualified teachers. The total expenditure increase for the 153 panels (i.e., school districts) estimated would be \$31,094,106, which would grow over time as these teachers would continue to gain experience. Based on our evidence this would result in *no increase in GHS GT pass rates*.

Over \$200,000 extra spending per school system with no impact on GHSGT pass rates hardly sounds like a bargain for taxpayers. Consider that public spending is rivalrous: spending more on one politically desirable end usually means spending less on other politically desirable ends. For comparison's sake, at an annual minimum salary of roughly \$31,500, the state could afford to hire seven state troopers per county at the same cost.<sup>21</sup> Each county could buy an outfit a new ambulance and keep over \$14,000 for operating expenses.<sup>22</sup> Alternatively, each school district could hire over seven new entry-level teachers per year. Or, at an average total cost of \$7,945 per student per year, the state could pay the full college costs for four years at one of Georgia's public universities for seven students per school district per year.<sup>23</sup>

## **Conclusion**

Does paying teachers to gain a Master's degree lead better academic performance? Is Georgia's plan working? We find that it is not, despite its exorbitant cost. Furthermore, government spending programs are rival in nature. Within a given budget, more money spent on education means less money spent on environmental protection, or some other politically valuable end. As an example—one with which many career educators and professors will be familiar—consider that more spending on K-12 education often means less spending on publicly-supported higher education. However, a salary schedule that rewards K-12 teachers for getting a M.Ed. would seem to please everyone. The K-12 teachers have a direct, potentially useful route to bigger paychecks. As demand for graduate degrees expands, state university education departments generate more graduate hours and acquire more state funds. Elected officials and bureaucrats have the chance to tout their accomplishments, having done something that appears substantial and pragmatic to improve education in the state. The general taxpayer either pays a

higher tax bill, or forgoes other desired political goods and services. Unfortunately, the evidence does not indicate that this commonsensical, incentive based policy is working. However, the taxpayer's sacrifice is for a politically popular cause. It is hard for us to imagine a taxpayer's revolt over a salary system designed to place better qualified teachers in classrooms, regardless of the scholarly findings.

Nevertheless, the cost of this policy seems especially high. Suppose that the state chooses instead to spend money as needs-based college scholarships instead of as an incentive for K-12 teachers. Assume the (statistical) seven potential college students who receive funding would otherwise be unable to attend college. Diverting these funds from a teacher's incentive to a college scholarship seems likely to be a Kaldor-Hicks efficient policy change. In terms of income returns and, from the state's point of view, tax returns generated by the extra income, the money is better spent on college scholarships.

We arrive at a "Devil in the details" argument. Even when the state does something smart—and we believe Georgia's salary scheme to pay teachers who earn better qualifications qualifies—it is very difficult to design a cost-effective policy intervention. Sometimes policies fail to achieve their desired end because they are ill-conceived. Sometimes they fail to achieve their desired end because interest group pressures interfere in their planning or execution. But sometimes policies fail because there is simply a limit to government's ability to solve problems. Perceived deficiencies in society or the economic process will not always have a governmental solution, no matter how well designed the corrective policy may be. It is not really a question of determining teachers' income elasticity of labor. The insignificant (or negative!) coefficients on *Advanced Degree* from Tables 4 and 5 argue that relying on teachers' formal qualification

certification as an instrument to improve GHSGT pass rates will be very expensive and impractical.

Georgia's expensive failure represents Hayekian knowledge problem we find in politicized markets for private services. The normal market mechanism—changing prices—for guiding behavior is disrupted by the political intervention. As a result, the government must fulfill the functions previously performed price changes. In Georgia's educational case, the state has attempted a quasi-market solution to increase educational performance. The result has been that Georgia's policy provides sufficient incentive to motivate teachers to acquire more advanced degrees, but the policy fails because having more teachers with advanced degrees does not seem to lead to improved educational outcomes. We conclude, as Nikita Khrushchev once told us, that “economics is a subject that does not greatly respect one's wishes.”

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**Table 1: Key to Variables**

Variable Name	Description
<i>Pass Rate</i>	Percent of juniors who qualify to graduate on Georgia's exit exam on first sitting
<i>Advanced Degree</i>	Percent of classroom teachers with a master's degree or higher qualification
<i>Student/Teacher</i>	Student to teacher ratio
<i>Percent White</i>	Caucasian (non-Latino) percentage of student body
<i>Students</i>	Thousands of students in the school system
<i>Pop. Density</i>	Log of the area's population density
<i>Income</i>	Log of income per capita in the area
<i>School Revenue</i>	Log of school system total revenue per full time equivalent student

**Table 2: Summary Statistics**

Variable	Obs	Mean	SD	Min	Max
<i>Pass Rate</i>	760	61.79	12.42	18	92
<i>Advanced Degree</i>	760	50.73	10.05	12.48	95.18
<i>Student/Teacher</i>	760	14.99	1.75	0.90	28.90
<i>Percent White</i>	760	59.92	24.58	0.97	100.00
<i>Students</i>	760	9.08	17.67	0.363	124.28
<i>Pop. Density</i>	760	4.31	1.12	2.06	7.83
<i>Income</i>	760	9.92	0.18	9.43	10.75
<i>Revenue</i>	760	8.69	0.15	8.31	9.14

**Table 3: Correlation Coefficients**

	<i>Pass Rate</i>	<i>Advanced Degree</i>	<i>Student/Teacher</i>	<i>Percent White</i>	<i>Students</i>	<i>Pop. Density</i>	<i>Income</i>	<i>Revenue</i>
<i>Pass Rate</i>	1							
<i>Advanced Degree</i>	0.05	1						
<i>Student/Teacher</i>	0.14	-0.04	1					
<i>Percent White</i>	0.65	0.09	0.06	1				
<i>Students</i>	0.22	-0.01	0.11	-0.11	1			
<i>Pop. Density</i>	0.44	0.02	0.16	0.13	0.71	1		
<i>Income</i>	0.37	0.00	-0.03	0.07	0.65	0.69	1	
<i>Revenue</i>	-0.10	-0.02	-0.35	-0.17	0.11	0.02	0.32	1

**Table 4: GLS Estimates of *Pass Rate***

	Model 1	Model 2	Model 3	Model 4	Model 5
<i>Advanced Degree</i>	-0.023 (0.030)	-0.011 (0.025)	-0.044 ** (0.019)	-0.007 (0.019)	0.004 (0.012)
<i>Student/Teacher</i>	0.635 (0.498)	0.812 ** (0.348)	0.466 (0.302)	0.606 (0.374)	0.912 *** (0.200)
<i>Student/Teacher<sup>2</sup></i>	-0.014 (0.019)	-0.023 * (0.012)	-0.005 (0.014)	-0.012 (0.013)	-0.027 *** (0.004)
<i>Percent White</i>	0.308 *** (0.013)	0.300 *** (0.014)	0.310 *** (0.009)	0.301 *** (0.013)	0.305 *** (0.010)
<i>Students (1000's)</i>	0.010 (0.026)	0.003 (0.025)	0.017 (0.011)	0.024 (0.017)	0.011 (0.013)
<i>Pop. Density</i>	2.48 *** (0.427)	3.08 *** (0.485)	2.38 *** (0.261)	2.68 *** (0.351)	3.23 *** (0.281)
<i>Income</i>	12.57 *** (2.611)	8.77 *** (2.45)	11.14 *** (1.71)	6.91 *** (2.12)	8.42 *** (1.45)
<i>Revenue</i>	-6.34 (3.945)	-5.68 (3.69)	-4.05 * (2.47)	-0.559 (2.89)	-3.71 * (2.16)
<i>Constant</i>	-42.93 (37.50)	-14.95 (37.10)	-46.16 (21.59)	-36.89 (27.60)	-30.39 (21.47)
N	760	760	760	760	760
Wald Chi <sup>2</sup>	1151.8	1043.8	2426.0	1342.8	2773.3
Log likelihood	-2666.2	-2400.1	-2474.1	-2343.3	-2189.5
Panels heteroskedastic?	No	No	Yes	Yes	Yes
Panels autocorrelated?	No	AR1	No	AR1	PSAR1
Year dummies?	Yes	Yes	Yes	Yes	Yes

\* Significant at the 90 percent level

\*\* Significant at the 95 percent level

\*\*\* Significant at the 99 percent level

Standard errors appear in parentheses. All estimates include year effects.

## Endnotes:

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<sup>1</sup> Support for the argument that higher quality teachers lead to higher quality educational services may be found in Hanushek, Eric. “The Economics of School Quality.” *German Economic Review* 6(3):269-286 and Hanushek, Eric, John F. Kain, Daniel M. O’Brien, and Steven G. Rivkin. *The Market for Teacher Quality*. NBER Working Paper 11154. Cambridge: NBER, 2005.

<sup>2</sup> Most of Georgia’s school districts are defined by county. Details are discussed in the empirical section later in the paper.

<sup>3</sup> “Georgia High School Graduation Tests.” [cited 15 November 2006] Available at [http://www.doe.k12.ga.us/\\_documents/curriculum/testing/ghsgt-bro.pdf](http://www.doe.k12.ga.us/_documents/curriculum/testing/ghsgt-bro.pdf)

<sup>4</sup> “Testing Programs: Georgia High School Graduation tests.” [cited 15 November 2006] Available at <http://www.doe.k12.ga.us/curriculum/testing/ghsgt.asp>

<sup>5</sup> “Georgia High School Graduation Tests.” [cited 15 November 2006] Available at [http://www.doe.k12.ga.us/\\_documents/curriculum/testing/ghsgt-bro.pdf](http://www.doe.k12.ga.us/_documents/curriculum/testing/ghsgt-bro.pdf)

<sup>6</sup> The state’s policy regarding initial administration of the GHSGT is that students take the test for the first time as juniors. If a student fails, she has two other opportunities to take the exam before graduation ceremonies in May. Presumably the lag time allows the state to grade and process the exams.

<sup>7</sup> “The Governor’s Office of Student Achievement: About GOSA.” [cited 15 November 2006] Available at <http://www.gaosa.org/about.html>

<sup>8</sup> “State Superintendent of Schools: Kathy Cox.” [cited 15 November 2006] Available at <http://www.doe.k12.ga.us/doe/superintendent/goals.asp>

<sup>9</sup> Boatwright, S.R. and Bachtel, D. C. various issues. *The Georgia County Guide*. Athens, GA: Center for Agribusiness and Economic Development, University of Georgia.

<sup>10</sup> Please note that *Pass Rate* is the school system percent of students passing the GHST on first administration, and is *not* the school system average absolute score. It is possible that the state changed its threshold for “pass” versus “fail” over the sample period, but we have no way to verify whether any such changes occurred. However, the simple (as opposed to student-weighted) average pass rates in the five sample years were 61.6 percent, 61.4 percent, 64.5 percent, 58.4 percent, and 63.1 percent respectively. To us, there is not obvious evidence of pass rate inflation or deflation over the sample period.

<sup>11</sup> The Georgia Department of Education reports certification data across three strata of school system employees: “Administrators,” “Support Personnel,” and “PK-12 Teachers.” We use the information from “PK-12 Teachers” to calculate *Advanced Degree*. We have no additional information regarding the actual job duties of anyone listed in any of the three groupings.

<sup>12</sup> For an excellent, if ageing, review see Hanushek, Eric. “The Economics of Schooling : Production and Efficiency in Public Schools.” *Journal of Economic Literature* 24(3):1141-1177.

<sup>13</sup> Hanushek, “The Economics of Schooling.”

<sup>14</sup> Hanushek, Eric, John F. Kain, and Steven G. Rivkin. *Do Higher Salaries Buy Better Teachers?* NBER Working Paper 7082. Cambridge: NBER, 1999.

<sup>15</sup> Hanushek, et al. *The Market for Teacher Quality*.

<sup>16</sup> E.g., Hanushek, “The Economics of Schooling.”

<sup>17</sup> Hanushek, “The Economics of Schooling.”

<sup>18</sup> Hanushek, “The Economics of Schooling.”

<sup>19</sup> Hanushek, “The Economics of Schooling.”

<sup>20</sup> Woolridge, Jeffrey M. *Econometric Analysis of Cross Sectional and Panel Data*, 2002.

<sup>21</sup> “GSP-Trooper.” [cited 15 November 2006] Available at [http://dps.georgia.gov/00/article/0,2086,5635600\\_40260395\\_40135511,00.html](http://dps.georgia.gov/00/article/0,2086,5635600_40260395_40135511,00.html)

<sup>22</sup> Figure is based on a 2006 mid-year purchase order by Henry County, Georgia. Available at <https://hwebb.boca.co.henry.ga.us/boc/Archives/Minutes/June19,2006Minutes.htm>.

<sup>23</sup> “Average Undergraduate College Costs.” [cited 15 November 2006] Available at <http://www.ed.gov/students/prepross/college/thinkcollege/early/students/edlite-college-costs.html#ga>.