EXPLAINING THE PERFORMANCE GAP BETWEEN PUBLIC AND PRIVATE SCHOOL STUDENTS

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INTRODUCTION

Are private schools more effective than public schools? Proponents of private education argue that private schools offer higher quality at lower costs [West, 1991]. Others such as Levin [1991] contend that public schools are better suited to meet the nation's educational demands. Several studies provide some empirical support of the relative efficiency of private schools in finding that students from these schools outperform public school students on standardized tests [Peterson and Howell, 2004; Barnard, Frangakis, Hill, and Rubin, 2003; Neal, 1997; Sander, 1996; Evans and Schwab, 1995; Sander and Krautmann, 1995; Coleman, Hoffer, and Kilgore, 1982]. On the other hand, Krueger and Zhu [2004] and Witte [1992] find that the private school effect on achievement is very small when controls for student, family background, and other characteristics, are considered. However, these findings do little to resolve the debate because we do not know if a significant private school test score effect (even with controls for student, family, and school characteristics) is due to a sector effect, or if omitted school or student characteristics are responsible for the private school advantage.

We contribute to the debate by estimating how much of the achievement test score gap can be explained by differences in student, family, and school characteristics. Our results, based on the National Longitudinal Survey of Youth (henceforth, NLSY), indicate that differences in these characteristics explain about 78 percent of the test score gap. This finding suggests that students who attend private schools possess more of the characteristics associated with high test scores. Broken down further, our results indicate that 45 percent of the test score gap is explained by differences in family characteristics and 26 percent is explained by differences in school attributes (the remaining 7 percent is due to differences in student characteristics such as age, race, and gender). Respondents educated in public schools, however, appear to have some advantage in converting particular attributes into higher test scores. Differences in estimated coefficients indicate an advantage that stems from the school and family backgrounds of these individuals. Placing the average publicly educated respondent

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in a private school setting results in a higher test score. Placing the average private school respondent in a public school is associated with a lower test score. These changes in test scores are driven largely by differences in the quality of the children in the two school systems.

The remainder of the paper proceeds as follows. Section 2 describes the data, model, and the decomposition of the gap in test scores. Section 3 contains our empirical results. The empirical results establish a private school achievement test score effect. However, this effect diminishes with controls for family and school background. Separate equations for those educated in public and private schools are presented, and used to perform the decomposition analysis. The paper concludes with a discussion of policy implications.

DATA AND MODEL

Data from the NLSY are used to estimate achievement test scores for black and white young men and women who attended public and private schools. The survey contains test score, school quality, family background, and other demographic information for participants who were between the ages of 14 and 22 in 1979. An advantage of the NLSY is the detailed information on family and school background that allows us to test for a private school sector effect, holding these characteristics constant. Others test for a private school effect and use controls for demographic background and private school attendance, but are unable to control for specific school characteristics [Peterson and Howell, 2004 and Krueger and Zhu, 2004]. Given this approach, it is difficult to know if any remaining private school effect is due to specific school characteristics that have been omitted, or due to a broader sector difference. The NLSY provides the detail to avoid this problem.

In 1980, NLSY respondents completed the Armed Services Vocational Aptitude Battery (ASVAB) that measures performance on arithmetic reasoning, mathematics and word knowledge, paragraph comprehension, general science, numerical operations, coding speed, mechanical comprehension, electronics information, and auto and shop information. While there is not an overall performance measure for the ASVAB, the math and verbal portions of this exam are used to derive an Armed Forces Qualifications Test score (AFQT) that ranges from 1 to 99. Specifically, the AFQT is derived from the mathematics and word knowledge portions as well as the paragraph comprehension and arithmetic reasoning sections of the ASVAB. Results of these tests are used by the armed forces to determine minimum entry requirements and to match recruits with military occupations.

Researchers have used the AFQT as a measure of educational achievement. For example, O'Neill [1990, p. 32] states that the AFQT "...is an achievement test of verbal and mathematical skills and reflects the quality of schooling received as well as the effects of parental background." While the AFQT and ASVAB are not widely used outside the armed services, the components of these tests are highly correlated with better-known achievement and assessment measures. For example, Frey and Detterman [2004] report a correlation of 0.82 between the SAT and an index created from all ASVAB components. Further comparison between AFQT and common achievement test results are illustrated by the Enlisted Commissioning Program of the U.S. Marine Corps that requires a minimum AFQT score of 74, or a minimum SAT of 1000, or a minimum ACT score of 22 (USMC). Given the emphasis on verbal and math skills, and the high correlation of AFQT components with common achievement measures, we feel this test score allows for valid comparisons of educational outcomes for those from public and private schools.

Survey respondents were asked if the current or last school they attended, for grades 1-12, was public or private. Respondents were asked this question in 1979 when they were between the ages of 14 and 22, consequently, this question effectively identifies the sector of the respondent's high school. The NLSY identifies a private school as "private or parochial." No further distinction is made regarding the religious affiliation of private schools. Based on the response to this public/private school question, we construct a binary private school variable that indicates if the high school attended by the respondent was private. We are unable to identify the sector of the respondent's elementary school, nor are we able to identify the length of time an individual attended a private high school. Nationwide, about 10 percent of students are enrolled in private schools. Within the NLSY, only about 5 to 6 percent attended private schools. This difference is likely due to the NLSY focus on the high school sector.

After adjusting for a large number of missing values, the sample contains 1,582 respondents who attended public schools and 88 respondents who attended private schools. These data are used to estimate the following model:

$$AFQT = \alpha_1 + \beta_1 Private + \beta_2 \mathbf{X} + \beta_3 \mathbf{Z} + \beta_4 \boldsymbol{\lambda} + \mu$$

where *AFQT* is the respondent's percentile test score that ranges from 1 to 99. *Private* has a value of one for those respondents indicating that their current or past school, for grades 1-12, was private (else, zero). **X** is a vector of individual characteristics (race, gender, and age at AFQT test time). **Z** is a vector of family background characteristics such as parents' education, father's occupation, mother's work history, number of siblings, and the availability of reading materials in the home. **λ** is a vector of school characteristics obtained from the NLSY survey of the respondent's school. These measures include class size and the education, starting pay, and turnover of teachers. We estimate the model with the vectors **X**, **Z**, and **λ** included sequentially. This procedure allows us to examine the robustness and significance of the private sector effect as family and other school background characteristics are included. This approach also allows us to calculate F Wald statistics to determine if the variables included in vectors **Z** and **λ** contribute significantly to the explanatory power of the model as a group.

The model (with vectors **X**, **Z**, and **λ**) is also estimated separately, without the dummy *Private* variable, for those who attended public and private schools. These estimates allow us to apply the Blinder-Oaxaca decomposition technique to determine how much of the AFQT test score gap can be explained by differences in the averages between the two samples and how much of the gap is explained by differences in the coefficients from the two estimates [Blinder, 1973 and Oaxaca, 1973]. The following illustrates the decomposition for a simplified model. The separate equations for those attending private and public schools can be expressed as:

$$AFQT_{priv} = \alpha_{priv} + \beta_{priv}X_{priv}$$
$$AFQT_{pub} = \alpha_{pub} + \beta_{pub}X_{pub}$$

The difference in test scores can be expressed as ($AFQT_{\text{priv}}$ - $AFQT_{\text{pub}}$), or as a difference in the equations which can be expressed as following standard form:

$$AFQT_{priv} - AFQT_{pub} = \Delta AFQT = (\alpha_{priv}-\alpha_{pub}) + (\beta_{priv}-\beta_{pub})X_{pub} + \beta_{priv}(X_{priv} - X_{pub})$$

This decomposition technique is often used to explain racial or gender differences in earnings. See Darity, Guilkey, and Winfrey [1996], Blinder [1973] and Oaxaca [1973] as examples. In this application, the term, $\beta_{priv}(X_{priv} - X_{pub})$, tells us how much of the gap in AFQT scores can be attributed to differences in the average characteristics between those who attended private and public schools. The term, $(\beta_{priv}-\beta_{pub})X_{pub}$, tells us the test score gap that can be attributed to differences in slope coefficients. Differences here would be tied to differences between the private and public sectors. The difference in regression intercepts $(\alpha_{priv} - \alpha_{pub})$ indicates the difference ascribed to initial endowments.

These specifications allow us to calculate the test score of a publicly educated student in a private school setting by solving the private equation using the public school averages. This is achieved by solving the following equation for $AFQT^*_{pub}$:

$$AFQT^*_{pub} = \alpha_{priv} + \beta_{priv}X_{pub}$$

Where $AFQT^*_{pub}$ is the estimated test score for the individual described above. We conduct a similar exercise to calculate the test score for the average privately educated respondent in a public school setting by solving the following equation for $AFQT^*_{priv}$:

$$AFQT^*_{priv} = \alpha_{pub} + \beta_{pub}X_{priv}$$

The specifications described above allow us to examine many issues relevant to the literature. One issue we are unable to address concerns a family's selection of private or public schools. Ignoring this issue of sample selection may bias the results of our estimates. Heckman [1979] describes a process to correct regression estimates for selection bias. In our setting, this process would involve the estimation of an auxiliary probit model of school choice. The results of this estimate would be entered into the models described above. However, the NLSY does not contain much of the detailed data needed to estimate school choice (tuition, etc.). In fact, the only data we possess that influence school choice, or the demand for private education, are the independent variables listed in the equations above. Hence, to avoid multicollinearity we do not use the independent variables to estimate school choice and then to use them again in the estimate of AFQT scores.

RESULTS

Table 1 presents summary statistics for the variables included in the model, by type of school attendance. The AFQT test score is a percentile rating that ranges from 1 to 99. The average percentile for private school students is 60.432 and 48.468 for public school students. The raw difference between the two groups is 11.95 percentile points. This difference is statistically different at the 0.05 level. The sample for private schools contains slightly higher percentages of blacks and females. Additionally, individuals in this group are older at the time of the AFQT test. Children attending private schools come from families with greater access to libraries, more educated parents, fathers who are more likely to be professionals, fewer siblings, and mothers who are less likely to work full-time. Chiswick [1988] argues that these kinds of differences in family resources and environments are associated with differences in child quality and productivity of schooling. That is, the children of parents who invest more time and other family resources in the development of their offspring's human capital will perform better in school, attain higher levels of education, and earn more after graduation. Differences in averages between these two groups support this explanation with respect to parental resources and the private-public AFQT test score difference.

Private schools have smaller class sizes and more teachers with advanced degrees. But, these schools are also characterized by lower teacher starting pay and higher teacher turnover. These kinds of school characteristics would, in theory, have conflicting affects on student achievement. Moreover, views differ regarding the relation between school inputs and achievement test performance. For example, in earlier summaries of the literature addressing school inputs and student achievement, Hanushek [1986; 1989; 1996a; 1996b; 1997; 1998] argues that there is no consensus regarding the relation between school inputs, such as class size or expenditures, and test score performance. However, Krueger's [2003] examination of the studies used in Hanushek's summaries indicates that a disproportionate weight is assigned to a small number of articles providing multiple estimates based on small sample sizes, or inappropriately specified econometric models. When Krueger assigns equal weight to each study, instead of equal weight to each estimate from a single study, he finds a much more consistent, and positive relation, between smaller class size and student performance in the literature. Furthermore, recent studies are consistent with Krueger's conclusion. Many of these studies focus on the relation between class size and performance on achievement test scores. For example, Angrist and Lavy [1999] find that reducing class sizes in Israeli public schools induces higher test score performance among fourth and fifth graders, but not among third graders. Also, Case and Deaton [1999] examine school outcomes in South Africa and find that smaller classes have marked effects on the enrollment, educational achievement, and numeracy test scores of black children. Using data from Tennessee's class size experiment, Project STAR, Krueger [1999] and Krueger and Whitmore [2001] find positive effects of early

(K-3) small class exposure on subsequent ACT and SAT scores. Our data allow us to examine the effect of class size and teacher characteristics on test scores. Results of this examination are discussed below.

TABLE 1
Summary Statistics for Privately and Publicly Educated Youth

Variable	Description	Private Mean	Public Mean*
AFQT	Performance on the Armed Services	60.432	48.468
	Qualification Test	(24.84)	(28.14)
Race	Respondent's race (black =1)	0.216	0.199
Age	Respondent's age at test time	19.136	18.862
		(2.24)	(2.11)
Sex	Respondent's genders (female =1)	0.523	0.501
		(0.50)	(0.50)
Library Card	Dummy variable indicating	0.921	0.781
	a library card at age 14	(0.27)	(0.41)
Mother's Education	Highest grade completed by	13.102	11.846
	respondent's mother	(2.41)	(2.58)
Father's Education	Highest grade completed by	13.432	11.942
	respondent's father	(3.38)	(3.430)
Father's Profession	Dummy Variable indicating	0.534	0.348
	professional father.	(0.50)	(0.48)
Mom Work	Dummy variable if mother worked	.614	.679
	+35 hours/week at R's age 14	(.49)	(.47)
# Siblings	# siblings in household	2.750	3.293
		(1.81)	(2.11)
Pupil-Teacher Ratio	Ratio of total enrollment to total	17.306	19.304
	teachers at respondent's school	(5.07)	(4.60)
Teacher Start Pay	Average starting salary for new	9,185.92	10,786.48
	teachers at respondent's school	(1,382.38)	(994.98)
Teacher Turnover	% of teachers who left school	11.761	8.094
		(9.00)	(8.32)
Teacher Ed	% of teachers with MA degree	48.341	47.125
		(20.62)	(23.00)
N		[88]	[1582]

* Parentheses contain standard deviations. Source: NLSY.

Table 2 presents the regression results explaining AFQT scores. As mentioned earlier, we estimate the model by sequentially including the vectors of family and school background characteristics. Our initial estimate includes only measures of individual characteristics (see results under column **Vector *X***). Results indicate that those from private schools scored 11.891 percentile points higher on the AFQT than public school attendees, holding age, race, and gender constant. This difference is approximately equal to the raw difference between these two groups (11.964 points). At the time of the test, respondents in our sample were between 15 and 23 years of age. Consequently, for most of these respondents, another year of age is also associated with another year of education. Therefore, the coefficient for age indicates that those who are older, and more educated, score higher on the achievement test. This result is robust across all specifications. Blacks score significantly lower on the test. Females, on the other hand, do not have significantly different scores than males.

The robustness and significance of the private school coefficient can be examined by including additional factors in the model. The results in column **Vector *X, Z*** show

how family background characteristics impact the coefficient for *Private*. Specifically, the *Private* coefficient declines in magnitude, but remains significant. In this version of the model, the *Private* coefficient indicates a 4.154 point advantage on the AFQT exam, and is significant at the .10 level. The family background variables also impact the race coefficient, but leave essentially unchanged the age and sex coefficients.

TABLE 2
AFQT Estimates with Controls for Family Background and School Quality

Variable	Vector X	Vectors X, Z	Vectors X, Z & λ
Constant	17.398***	-26.533***	-13.574
	(5.69)	(5.80)	(8.50)
Private	11.891***	4.154*	3.279
	(2.80)	(2.45)	(2.62)
Age	1.913***	2.009***	1.997***
	(0.30)	(0.26)	(0.26)
Race	-26.63***	-19.227***	-19.43***
	(1.56)	(1.453)	(1.47)
Sex	0.539	0.792	0.971
	(1.25)	(1.087)	(1.09)
Family Background:			
Library Card	—	4.461***	4.600***
		(1.39)	(1.39)
Mother's Education	—	2.038***	2.028***
		(0.28)	(0.28)
Father's Education	—	1.477***	1.454***
		(0.23)	(0.23)
Father's Professional	—	6.544***	6.553***
		(1.34)	(1.347)
Mother Worked	—	-3.900***	-3.767***
		(1.17)	(1.17)
# Siblings	—	-1.328***	-1.280***
		(0.28)	(0.29)
School Quality:			
Pupil-Teacher Ratio	—	—	-0.318***
			(0.12)
Teacher Start Pay	—	—	-0.0005
			(.001)
Teacher Turnover	—	—	-0.143**
			(0.07)
Teacher Ed	—	—	.002
			(0.03)
F Wald=	—	92.09***	2.81***
F=	89.51***	102.85***	74.59***
R^2 (adj.)=	0.175	0.379	0.382
Sample Size=	1670	1670	1670

Source: NLSY. Parentheses contain standard errors.
*** significant at the .01 level (two-tailed test)
** significant at the .05 level (two-tailed test)
*** significant at the .10 level (two-tailed test)

The coefficients for the family background measures support the implications of Chiswick's child quality hypothesis. Children from families who emphasize education (indicated by parental education coefficients) perform better on the test. Children from families who devote more resources toward a child's education (indicated by the presence of library cards, a professional father, a mother who does not work full-time, and fewer siblings to share resources) attain higher scores. The family background variables may also capture the genetic transmission of abilities that are also associated with higher test scores. Regardless, we note that the total effect of these kinds of family characteristics is greater than that of the private coefficient per se. This may imply that family background is more important than sector with regard to test scores. The individual family background coefficients are consistently significant. The F Wald test statistic (92.09) indicates that, in addition, the family background characteristics are significantly related to AFQT scores as a group (the critical F statistic is 2.32 at the 0.01 level).

The private test score coefficient diminishes further in magnitude and loses statistical significance when detailed school quality measures are included (see results under column **Vector *X, Z* & λ**). Witte [1992] also reports a lower private test advantage when controlling for school characteristics. Such a result suggests that the private school test score effect is due, in part, to specification error regarding the omission of school quality measures. In addition to having an impact on the private school coefficient, some of the school quality variables are also related to test scores in a statistically significant way (according to some t-tests). Furthermore, all of these variables are significantly related to test scores when considered as a group (according to the F Wald test). These finding are contrary to Hanushek's [2002, p. 31] conclusion that "... the vast number of estimated real resource effects gives little confidence that just adding more of any of the specific resources to schools will lead to a boost in student achievement." Our results, however, do find some school resource effects. For example, we find that AFQT scores decrease slightly as pupil-teacher ratios and teacher turnover increase. These effects are statistically significant at the .01 and .05 levels, respectively. While statistically significant, the coefficients imply rather small impacts. For example, a 50% reduction in the pupil-teacher ratio from 18 to 9 is associated with an increase in test performance of 2.862 points. Similarly, decreasing teacher turnover from 10 to 5 percent increases scores by .715 points. Starting teachers pay and the percent of teachers with advanced degrees do not have statistically significant impacts on test scores. The coefficient for starting teacher pay is negative, suggesting that higher starting salaries are associated with lower scores.

The F Wald test provides an alternative to the t-test of individual coefficients. Specifically the Wald test examines whether the school quality variables impact the explanatory power of the model as a group. In this case, the F Wald statistic is 2.18, which implies that school characteristics do have a significant impact on test scores, as a group (the critical F statistic is 2.04 at the 0.01 level). This result stands in contrast to Hanushek's conclusion that is based on an examination of individual coefficients and t-values from various studies. The results of the Wald test raise the question as to whether the impact of school inputs can be isolated, and measured, individually (through t scores) or corporately (through F scores).

The results indicate that the private school effect remains positive and significant (at the .10 level) after controlling for family background (results under **Vector *X, Z***), but falls below conventional levels of statistical significance when controls for school quality are included (results under **Vector *X, Z* & λ**). Other studies demonstrate that family background measures alone are sufficient to eliminate, in terms of statistical significance, the private school advantage. For example, Krueger and Zhu [2004] find that participation in New York's voucher experiment is associated with a positive and statistically significant effect on the achievement test scores of black students. But, these results are based on a simple model that omits measures of family background. When measures of family income and parental work history are included, the effect of vouchers decreases in magnitude and loses statistical significance. Differences in the types of family background variables used here and in other studies may explain this result. For example, we do not have family income information at the time NLSY students were in school. Also, family income is likely highly correlated with many of the school quality variables used in Table 2. If so, the inclusion of these variables may also capture unmeasured family characteristics that contribute to the elimination of the private school effect.

While the results from the fully specified model reported in Table 2 indicate that private school attendance is not related to achievement test scores in a statistically significant way, others have reported that private school attendance increases the test scores of black students residing in the inner-city [Peterson and Howell, 2004]. This finding, often referred to as the "Catholic school puzzle," may be due to quality differences between public and private schools located in the inner-city [Coleman, Hoffer and Kilgore, 1982; Neal, 1997; Shokraii, 1997]. As mentioned above, our data do not distinguish Catholic schools from other private institutions, however the data can be used to illustrate some of the differences between inner-city public and private schools. For example, blacks residing in the inner-city who attended private schools have an average AFQT score of 28.1, versus an average of 21.3 for inner-city black students who attended public schools. But, average data from our school quality variables suggest that this test score difference is not rooted in school quality differences. For example, inner-city public schools employ a higher percentage of teachers with masters degrees (56.0 percent versus 48.8 percent for inner-city private schools), and also have lower teacher turnover (8.8 percent versus 13.5 percent). Public schools in the inner-city also offered higher salaries to starting teachers in 1979 ($11,204.8 versus $9,309.0) and have smaller class sizes (21.3 students per teacher versus 28.1 for inner-city private schools). These data suggest that the private-school advantage in the inner-city is even more of a "puzzle".

Higher inner-city private school test scores, along with lower central city private school quality measures, may be explained by a private school efficiency advantage in combining fewer resources into relatively higher test scores. Another possible explanation is that the difference in inner-city test scores can be attributed to the kind of family background differences that are associated with higher test scores. These possibilities could be examined further by estimating AFQT scores for black residents of the inner-city who attended private and public schools. However, the NLSY does not have sufficient data on black private school attendees of the inner-city to conduct this test in a statistically significant manner.[1] Consequently, because of the limitations of this data set we are unable to investigate implications of the Catholic school puzzle further.

So far, we have illustrated the standard approach in the literature that is based on an estimate of test scores as a function of private school attendance. This approach often yields results implying that private school attendance increases student achievement. This result has been used as evidence that private schools are relatively more effective in educating children. Our results confirm this sector effect, and further illustrate how the private school test effect diminishes and eventually loses statistical significance as control measures are added. A question remains, however, as to the nature of the observed public-private test score gap. Specifically, how much of this gap can be explained by sector differences in school characteristics and family background? To answer this question we decompose the test score gap using the Blinder-Oaxaca technique.

This technique requires that we estimate the model separately for respondents who attended private and public schools. These estimates include the **X**, **Z**, and **λ** vectors of independent variables. Table 3 presents these results. According to Table 3, the results for private school students differ in notable ways from the results for public school students. For example, age is associated with a higher test score for private school students indicating that these individuals have an advantage in converting another year of maturity (or education) into a higher test score. Blacks from private schools score about a point higher than blacks in public institutions. Of the family background characteristics, only the father's occupation is statistically significant. Of the school quality measures, only the pupil-teacher ratio at private schools is statistically related to performance on the AFQT. The results for public schools mirror those from Table 2 described above.

The separate estimates for the private and publicly educated are used to decompose the test score gap. The gaps, measured in test score points, that can be attributed to differences in average characteristics are reported under the column $\beta_{priv}(\boldsymbol{X}_{priv}-\boldsymbol{X}_{pub})$ in Table 3. Point gaps attributed to differences in slopes are reported under the column $(\beta_{priv}-\beta_{pub})\boldsymbol{X}_{pub}$. We report the point gap for each variable and subtotals for the family background and school quality categories. Mathematically, the approximate twelve-point raw AFQT test score gap is the sum of the portion explained by differences in averages (9.31), plus the portion due to differences in coefficients (-5.76), plus the difference in regression intercepts (8.52). Or, 9.3 - 5.8 + 8.5 = 12. The difference in average test scores reported in Table 1 is 11.964 (60.432 - 48.468). The difference between the decomposed gap and the raw gap is attributed to rounding error.

The decomposition implies that 78% of the gap (9.3 points) is explained by differences in the averages of respondents who attended public or private schools (the differences in averages are obtained from Table 1). Over 5 points (45 percent) of the test score gap is due to differences in family characteristics. About 26 percent of the gap (3.1 points) is attributed to differences in the averages of the school characteristics. The difference due to coefficients is negative (-5.76) because, in aggregate, the estimated coefficients for public school attendees are relatively larger. This suggests that respondents who attended public schools are better able to convert changes in a given attribute into higher test scores. This explanation is also supported by the subtotals for family background (-23.61) and school quality (-15.85). The subtotals are negative because the public coefficients are greater than the private coefficients in these categories. The exception concerns that ability of the privately educated to convert another year of age (education) into a higher test score.

TABLE 3
AFQT Estimates with Controls for Family Background and School Quality

Variable	Private	Public	$\beta_{priv}(X_{priv} - X_{pub})$	$(\beta_{priv} - \beta_{pub})X_{pub}$
Constant	-5.537	-14.052	—	—
	(32.48)	(8.90)		
Age	3.582***	1.927***	0.98	31.22
	(0.98)	(0.27)		
Race	-18.734***	-19.698***	-0.32	0.19
	(5.83)	(1.53)		
Sex	5.281	0.706	0.12	2.29
	(4.57)	(1.123)		
	Explained Gap Subtotals:		0.78	33.70
Family Background:				
Library	8.526	4.541***	1.19	3.11
Card	(9.31)	(1.42)		
Mother's	0.288	2.088***	0.36	-21.32
Education	(1.09)	(0.29)		
Father's	0.665	1.495***	0.99	-9.91
Education	(0.88)	(0.24)		
Father's	10.796**	6.322***	2.01	1.56
Professional	(5.36)	(1.40)		
Mother	4.129	-4.227***	-0.27	5.67
Worked	(5.16)	(1.21)		
# Siblings	-2.035	-1.209***	1.11	-2.72
	(1.47)	(0.29)		
	Explained Gap Subtotals:		5.39	-23.61
School Quality:				
Pupil-Teacher	-0.978*	-0.285**	1.95	-13.38
Ratio	(0.50)	(0.12)		
Teacher Start	-0.0009	-0.0005	1.44	-4.31
Pay	(0.002)	(0.001)		
Teacher	-0.075	-0.146**	-0.28	0.57
Turnover	(0.26)	(0.071)		
Teacher Ed	0.028	0.001	0.03	1.27
	(0.11)	(0.03)		
	Explained Gap Subtotals:		3.14	-15.85
	Explained Gap Totals:		9.31	-5.76†
F=	4.853***	74.58***		
R^2 (adj.)=	0.365	0.377		
Sample Size=	88	1582		

Source: NLSY. Parenthesis contain standard errors.
*** significant at the .01 level (two-tailed test)
** significant at the .05 level (two-tailed test)
* significant at the .10 level (two-tailed test)
† The sum of the explained gap totals, plus the difference in the intercepts (αpriv -αpub = 8.52), equals the difference in average AFQT scores , accounting for rounding error, (or 9.31 - 5.76 + 8.52 = 12.07)

Examining the results for individual variables in column $(\beta_{priv}-\beta_{pub})X_{pub}$ reveals some notable differences between those from public and private schools. For example, respondents who attended public schools appear to have a particular advantage with converting parents' education and pupil-teacher ratios into test scores. Differences in education coefficients for mothers and fathers account for -31.23 points (-21.32, -9.91), while the difference in the effect of pupil-teacher ratio explains -13.38 points. The differences described above are larger than the raw score difference, but are offset largely by the greater ability of the private school students to convert another year of age into a higher test score (31.22 points). The total explained by differences in coefficients is obtained by summing the subtotals for each of the categories (family background, school quality, etc.) or 33.7 + (-23.61) + (-15.85) = -5.76.

The results in Table 3 allow us to compare test scores for students with particular attributes in different educational settings. These results are reported in Table 4. For example, to determine the change in AFQT test scores associated with placing a publicly educated respondent in a private school setting, we solve the private school equation using the public averages (see column 4 in Table 4). Others have examined New York's private school voucher experiment to determine *if* placing publicly educated students in private schools is associated with higher test scores [Peterson and Howell, 2004, Krueger and Zhu, 2004, and Barnard, Frangakis, Hill, and Rubin, 2003]. Our method provides insight into *how* individual, family, and school characteristics contribute to changing test scores with a change in school setting.

TABLE 4
Average and Estimated AFQT Scores
Estimated by Substituting Private (Public) Averages into
Public (Private) Equations

Respondent Characteristic	Private School Averages in Private School Equation	Private School Averages in Public School Equation	Public School Averages in Private School Equation	Public School Averages in Public School Equation
Age	68.55	36.88	67.56	36.35
Race	-4.05	-4.25	-3.73	-3.92
Sex	2.76	.37	2.65	0.35
Family Background	23.26	49.08	17.87	41.48
School Quality	-24.73	-11.19	-28.14	-12.02
Constant	-5.54	-14.05	-5.54	-14.05
Average, or Estimated (*) AFQT Score	60.25	56.84*	50.67*	48.19

For comparison we also report in Table 4 the solved equations for private school (using private averages) and public school (using the public averages). The solved test scores of 60.25 and 48.16 for private and public schools reported in columns two and five are comparable to the respective test score averages reported in Table 1 (60.432 and 48.468). Differences can be attributed to rounding error. In addition to reporting the estimated and average total scores from the solved equations, we also report the subtotals for individual, family, and school characteristics. We find that placing a publicly educated youth in a private school setting increases the AFQT score from 48.19 to 50.67, an increase of 2.48 points (compare fourth and fifth columns). The subtotals for particular characteristics indicate that when the average publicly educated respondent is placed in a private school setting, they gain 31.2 points due to the higher coefficient for age, but lose 23.61 (17.87 – 41.48) points due to the lower effect of family characteristics. Additionally, 16.12 points (-28.14 – -12.02) are lost due to differences in the effects of school characteristics.

Placing a privately educated respondent in a public school setting results in a decrease of 3.41 points (60.25-56.84). However, the average private respondent gains 25.82 (49.08 - 23.26) points from the public school family background as well as saving 13.54 (-11.19 – -24.73) points due to differences in the effects of school characteristics. It appears, as argued above, that students who attended public schools have relative advantages in converting changes in family and school characteristics into higher test scores (indicated by the relatively higher coefficients for these measures for the publicly educated). On the other hand, the privately educated have an advantage in converting another year of age into higher test scores (indicated by the relatively higher coefficient for age for the private educated).

CONCLUSION

We find that NLSY respondents who attended private schools, on average, scored 12 more points on the AFQT achievement test than respondents who attended public schools. However, when test scores are estimated with controls for family background, the measured private school advantage decreases to 4 points, but remains statistically significant. When detailed school quality measures are included, the private school advantage diminishes further (3 points) and loses statistical significance.

Our decomposition analysis indicates that 9 points of the raw gap can be explained by differences in individual, family, and school characteristics, indicating that the privately educated have more of the attributes associated with higher test performance. However, family background seems to play a larger role than school characteristics. For example, 5 points of the gap are explained by differences in family background while only 3 points are due to differences in school characteristics. Therefore, a family plan of placing public school children in private schools would not erase the test score difference, nor would a social policy of making public schools more like private institutions.

While the privately educated possess more of the attributes associated with higher test scores, public school attendees posses some advantages in converting characteristics into a higher score. This advantage is principally rooted in the differential effects (coefficients) associated with family background and school quality. This advantage may be explained by diminishing returns (private students have more attributes, but lower returns), or to differences in the relative efficiency of the families and schools of public school attendees.

NOTES

1. Very few of the 88 private school respondents used to estimate the results reported in Tables 1–4 reside in the inner-city. To increase the number of observations for the inner-city private school data described above, we included observations with missing values for the family background variables. These individuals would not be included in our sample of 88 and are included here only to illustrate the school quality differences between inner-city public and private schools. Still, sample sizes remain

low. The number of observations for the inner-city AFQT scores is 25 for private school attendees (574 for public school attendees). The sample sizes for the inner-city private school quality variables listed above range from 16 to 25 observations. Using this small sample of inner-city youth to estimate an AFQT regression for the privately educated would encounter problems associated with few degrees of freedom. Additionally, due to the high number of missing values, such estimates would not include measures of family background.

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