THE RELATIVE EFFECTIVENESS OF PRIVATE AND PUBLIC SCHOOLS: EVIDENCE FROM TWO DEVELOPING COUNTRIES

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Abstract

We estimate quality differences between private and public secondary schools in two developing countries: Colombia and Tanzania. Quality is measured by student performance on standardized achievement tests. We focus on the sample selection aspects of making quality comparisons. Estimated sample-selection effects suggest that Colombian students sort themselves by type of institution (private or public); but Tanzanian students are selected by a hierarchical mechanism, with worse students entering private institutions. These effects are consistent with the different institutional frameworks for educational choice in these countries.

For both countries, private schools offer an achievement advantage. Standardizing for differences in student and school attributes, private school students have higher achievement test scores.

I. Introduction

In 1982 a group of authors (Coleman, Hoffer and Kilgore 1982) published their finding that private schools in the United States are more effective than public schools in helping students to acquire cognitive skills. This study, which coincided with a government initiative to channel a portion of public subsidies to private schools, caused lively debate in both scholarly and popular circles (Murnane 1985, Hanushek 1986). The proposed initiative is based on the premise that increased (i.e., "fairer") competition between public and private schools will foster efficiency. The fiscal stakes are enormous, since public schools account for 85% of all enrollment at primary and secondary levels (James 1986).

A similar issue is beginning to confront many developing countries. Tightened fiscal constraints have limited the increases in educational budgets necessary to expand access to highly subsidized and publicly provided education (World Bank 1986). Moreover, many analysts and policymakers are concerned that education is being inadequately and inefficiently provided by the public sector. An obvious alternative is to allow a greater role for private schools. However, relatively little is known about the present role of private schools in developing countries or how they operate.[1]

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[1]In many countries, private schools are banned or are subject to such heavy regulation that it is virtually impossible for them to exist (Roth 1986). Yet, in other countries, private schools account for a significant proportion of primary and secondary enrollment. For 38 countries for which data are available, averages of 16% of primary and 31% of secondary school enrollments are in private schools (James 1986).

This paper is an inquiry into the existence and, more importantly, the nature of the private/public achievement differential in Colombian and Tanzanian secondary schools.[2] First, to what extent can the differential in academic achievement be attributable to student characteristics, rather than school inputs? A true experiment of the private school effect would ask one of the following questions: if we were to pick a student randomly from a population, would that student do better in a public or in a private school? Or, if we were to place a private school student in a public school, what would his/her achievement score be? However, if students were free to choose whatever option they preferred, these questions could not be adequately answered simply by holding constant for observed student characteristics and comparing achievement in private and public schools from present samples. There are a number of reasons for this: (a) If students sort themselves into those institutions where they think they can perform the best, there would be positive selection in both private and public school samples. (b) Another alternative is that students are hierarchically sorted. The best students are selected into public schools (say). There would thus be positive selection into public schools but negative selection into private schools. In either case, the analyst cannot observe the characteristics of private school students among the public school sample or vice versa. Because the subsamples

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[2]A recent paper by Psacharopoulos (forthcoming), who uses the same data base, is one of the first attempts to compare the effectiveness of public and private schools in developing countries. Students in private schools do better on academic subjects than those in public schools. Since private schools are also cheaper to run, he argues for a greater role for private school provision in these subjects. The reverse applies for specialized/vocational subjects, perhaps due to significant scale economies that inhibit entry of small private institutions, unless they are of low quality.

are not a random draw from the student population, the assumptions of the basic linear model are violated. These could lead to biased estimates of the achievement effect.

Second, to what extent can the private/public differential in academic achievement be explained by differences in school inputs? If private school students still do better after controlling for some general indicators of school quality, such as teachers' salaries and the student/teacher ratio, then, the differential must be due to organizational advantages in private schools. Such a finding would suggest that the implicit efficiencies and incentives within private systems cannot be easily mimicked through obvious changes in public schools' educational production functions. The case for private provision (even with partial public financing) would be made even stronger.

The rest of the paper proceeds as follows: first, we present a theoretical model of school choice and student achievement; second, we estimate private-public achievement test differences for Colombian secondary schools taking sample-selection effects into account; and finally, we repeat the empirical work for Tanzania, which has a different institutional setup for secondary education than Colombia.

II. The Model

1. Self-sorting

Assume that the parent chooses an education plan for his child that maximizes the child's lifetime earnings, net of tuition costs. For simplicity, lifetime earnings are denoted by a scalar, E. The parent's problem is to maximize

$$- T + \frac{E}{(1+r)}, \qquad (1)$$

where T denotes tuition costs and r is the rate of interest faced by the parent. To maximize net lifetime earnings, the parent chooses from an array of schooling possibilities, some public and some private. Each is a six-year academic secondary program, and we assume that switching from public to private (or vice versa) midstream through the program is not feasible. Parents lock into either a private or a public school.

Among the array of schooling possibilities, suppose that parent i has narrowed his choices to two; one private and one public. The (undiscounted) lifetime earnings from the private school is given by E_{pi} and that of the public school is given by E_{gi}. Tuition costs are subscripted similarly. Let the latent variable determining school choice be t. The parent will choose the private school iff

$$t_i = (1+r_i)(T_g - T_p) + E_{pi} - E_{gi} > 0 \qquad (2)$$

If we assume that $T_p > T_g$ (private schools are more expensive) then $\partial t_i/\partial r_i < 0$. A lower discount rate raises the probability of choosing a private school.

In the case where capital markets are "perfectly imperfect" (i.e. one cannot borrow or lend on any terms), the equation for t is very similar. The only modification is to replace dollar values (e.g., $- T_p$) with utility values ($U(- T_p)$) and the market discount rate with the subjective rate of discount for utility. With capital market imperfections, tastes affect the schooling decision. Specifically, attitudes toward delayed gratification enter the picture. Dropping the subscript i for convenience, we can express the

discount rate (either market or subjective) as a function of family background variables, Z, so that

$$r = r(Z). \tag{3}$$

We assume that the earnings function takes a very simple form.

$$E_j = E(K_j) \quad j = p,g, \tag{4}$$

where K_j denotes the human capital stock produced by secondary schooling. Lifetime earnings increase with K. In turn, K is produced by student ability, A, and school attributes, S, so that

$$K_j = K_j(A,S). \tag{5}$$

Consider the additional structural equation

$$S = S(Z). \tag{6}$$

School characteristics depend on parental resources and other family background variables. We substitute (6) into (5) and the result into (4) and then (2). We then substitute (3) into (2). Our expression for the latent variable t then becomes

$$t = t(Z, A). \tag{7}$$

Linearizing and adding a stochastic component yields the analog of (7) used in the empirical work below:

$$t_i = \alpha_1 Z_i + \alpha_2 A_i - \mu_i. \tag{8}$$

Human capital, K, is proxied by achievement test scores. The estimating

equations for test scores are the empirical versions of equation (5). These equations are

$$K_{pi} = \beta_1 S_{pi} + \beta_2 A_{pi} + \varepsilon_{pi} \qquad (9)$$

and

$$K_{gi} = \gamma_1 S_{gi} + \gamma_2 A_{gi} + \varepsilon_{gi} \qquad (10)$$

The selection problem is that the expected values of the K (achievement test scores) are conditional on sector choice. Therefore we are looking at $E(\varepsilon_{pi} \mid t_i > 0)$ and $E(\varepsilon_{gi} \mid t_i \leq 0)$. As long as μ_i and the ε_i are correlated, the error terms will not have the classical properties. The expected value of the error terms is not equal to zero, and the estimated β's and γ's will suffer from omitted variable bias if simple OLS is applied to (9) and (10). If we assume that (μ,ε) is distributed bivariate normal with mean zero then

$$E(\varepsilon_{pi} \mid t_i > 0) = -\frac{\sigma_{12}^p}{\sigma_1^p}\frac{\phi(t_i)}{F(t_i)} = \frac{-\sigma_{12}^p}{\sigma_1^p}\lambda_{pi}$$

and

$$E(\varepsilon_{gi} \mid t_i \leq 0) = \frac{\sigma_{12}^g}{\sigma_1^g}\frac{\phi(t_i)}{1-F(t_i)} = \frac{\sigma_{12}^g}{\sigma_1^g}\lambda_{gi}$$

The terms λ_{pi} and λ_{gi} are the inverse Mills ratios which will be estimated in the first stage of Heckman's (1979) generalized Tobit. The inverse Mills ratio term is the ratio of the ordinate of the standard normal at t ($\phi(t)$) to the probability of being in the sample ($F(t)$, $1-F(t)$). The term $-\sigma_{12}^p$ is minus

one times the covariance between the error terms in (8) and the error terms in (9). Suppose we observe a low value for μ_i (a higher probability of choosing a private school). We may observe a corresponding high value for ε_{pi}. Thus the term $-\sigma_{12}^{p}$ should be positive if positive self-selection exists. If students sort themselves into sectors to maximize their scores, we should observe positive values for the coefficients of each inverse Mills ratio term.

2. Hierarchical sorting

Alternatively, suppose that students are hierarchically sorted into secondary schools. Students might, for example, be allocated to schools on the basis of their measured ability. For the sake of illustration assume that slots in public schools are reserved for students with higher measured ability. Suppose now we observe a low value for μ_i. In this instance, we may observe corresponding low values for both ε_{pi} and ε_{gi}. Under such a meritocratic system, we might expect positive selection effects in the public sector, but negative selection effects in the private sector. The hypothesized values of the selection effects will depend on the institutional setup for secondary education. A framework that allows freedom of school choice should produce positive selection effects in each sector. A meritocratic system, however, may produce positive selection effects for the "elite" sector but negative selection effects for the "non-elite" sector.

III. Data and Specification

The data set used in this paper was generated from a World Bank study of diversified (i.e. academic plus vocational) education (Psacharopoulos and Loxley [1985]). A detailed description of the data is available in

Psacharopoulos and Loxley (1985) and Psacharopoulos (forthcoming).

Two questionaires were used: one for schools and one for students. The school-specific data contain information related to the quality of the facilities, such as mean student-teacher ratios and teacher salaries. The student data contain information on family-background, financial, school-spending, and demographic variables. Two tests were administered to students: an aptitude test, designed for college-admission purposes, and an achievement test (administered by the World Bank) to test specialty-specific proficiency. The surveys were undertaken in 1981, and samples of students were polled a year later to collect information on post-graduation activities.

The Colombian data set covers 129 secondary schools and 8,051 students. We focus on academic students. Academic students account for the majority (70 percent) of secondary students in Colombia.[3] Most of the discussion below centers on the sample of academic students who took the college-entrance-related mathematical and verbal aptitude tests.

As with Colombia, we focus exclusively on students in the Tanzanian academic bias.[4] The structure of the Tanzanian data set is very similar to that of Colombia. Here we note the main differences. First, aptitude test scores are available for all Tanzanian students. Second, two achievement tests are available for academic students: one for English and one for

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[3]Academic students are underrepresented in the total of 8,051 because students who enrolled in special diversified schools (Institutos Nacionales de Educacion Media) were oversampled.

[4]The other biases are agricultural, commercial and technical. The academic bias accounts for about a quarter of all secondary students in Tanzania.

mathematics. Our measure of achievement for Tanzania is an average of these. Third, we do not have information on whether students repeated primary or secondary grades in Tanzania.

The entire Tanzanian data set covers 4,181 students and 57 schools. The sample covers a quarter of the secondary student population. Our sample of academic students contains 1,024 observations.

The first task is to specify the vector of variables that will enter the probit equation for school choice. The list we use is as follows: city size, gender, urban place of birth, number of siblings, father's education, mother's education, father's occupation, father's income, father's income missing, family owns car, family owns business, student repeated a primary grade, and number of books in the household. All are entered as dummy variables, with the exception of siblings and father's income.

The choice of variables fits the ideas discussed above. The probit contains a vector of family background variables and an ability proxy (whether the student repeated a primary grade).[5]

School quality is measured by student performance on the academic achievement test. The achievement test score is our empirical analog of the human capital variable K in the theoretical section above.

The next task is to specify the achievement test score equation: the empirical version of equations (9) and (10). Human capital is a function of

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[5]Ideally, a pre-secondary IQ-type ability variable would be desirable. A possible candidate is the aptitude test scores from secondary school. If aptitude is time invariant, this variable would be acceptable for the probit equation. Since performance on the test could be influenced by the quality of the secondary school, however, we take the conservative approach of using only the primary-repeat variable as a proxy for pre-secondary ability.

student ability and school characteristics. Student ability is measured by aptitude test scores (mathematical and verbal) and whether the student repeated a secondary grade. School characteristics are measured by mean teacher salary and student-teacher ratio.

IV. Basic Results

1. Colombia

The first sample we examine is the group who took the aptitude (math and verbal) test (N = 1,004). Variable codes, means and standard deviations for each school group (private and public) are shown in the first two columns of table 1. Private school students have better family backgrounds than public students. Fathers of private school students have incomes that are almost twice those of public school student's. Parents of private school students have more education than those of public school students. A greater proportion of private school families live in a large city and own a car. With respect to school characteristics, public school mean teacher salaries are much higher than those of private schools (among non-missing values) and a greater proportion of private schools do not report mean teacher salary. Student-teacher ratios are lower in private schools. Average aptitude scores are close between the two schooling groups, but private students have a 2.4 point advantage in average achievement test scores.

The probit analysis is presented in the first two columns of table 2. The Colombian results generally mirror the findings reported in table 1. Here are some examples. If father's occupation is laborer (FOCC1 = 1), the probability of choosing private school is reduced from the sample mean of 58 percent to 29 percent. A $10,000 increase in father's income increases the

probability of choosing a private school by 5.07 percentage points. The student ability measure, PREPEAT, is positive and marginally significant, suggesting that being a less able student increases the probability of going to a private school.

The estimates that interest us most are the achievement test score equations. For Colombia, these are shown in table 3. First, the coefficients of the selectivity terms indicate positive and statistically significant selection bias for both private and public school students. For private school students, the selection bias is equal to 1.33 ACATEST points.[6] For public school students the selection bias is larger: 3.14 ACATEST points. Net selection bias, therefore, favors public school students.

Performance on the verbal aptitude (APVERB) test is a strong determinant of achievement test scores. Math aptitude (APMATH) is a weaker variable. Males do significantly better than females in private schools, but not in public schools. Mean teacher salaries are strong determinants of ACATEST scores. TSAL1 is a dummy that takes on a value of one if TSAL is above the entire sample median (16,130). Above-median TSAL raises public ACATEST scores by almost 5 points (the reference category is TSAL missing). TSAL of median or lower for private schools reduces ACATEST scores by 3.2 points.

Student-teacher ratios also affect ACATEST performance. For public school students, being in the worst (highest) TSR category (TSR1 = 1) clearly hurts test performance. Public students in these large classrooms have an ACATEST average that is 6.5 points lower than the reference category (TSR missing). The TSR pattern is non-monotonic for both private and public school

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[6]Coefficient of lambda times mean value of lambda for each subsample. Note that in each generalized Tobit estimate a GLS procedure is used to adjust standard errors for possible heteroscedasticity associated with using Heckman's (1979) two-stage technique.

students, but the general pattern reveals that private students tend to perform better in larger classrooms while public students tend to perform better in smaller classrooms.

2. Tanzania

The selection process for secondary schools works differently in Tanzania than in Colombia. In Colombia, students can freely choose between private or public schooling. The sorting model presented in the theoretical section above is most appropriate for Colombian students. In Tanzania, public-sector secondary slots are controlled to prevent an oversupply of secondary graduates.[7] School choice is severely limited in Tanzania. Tanzania has a planned economy. Public schools are generally perceived as higher quality than private schools. Entrance into public schools is heavily determined by an examination given during the final year in primary school. Further, entrance into public schools is affected by government-imposed regional quotas. In sum, the Tanzanian selection system for public secondary schools is meritocratic, and the public sector is considered to be the elite sector.

No fees are charged in public schools. Private schools are viewed as an alternate and expensive option for students who were not accepted to public schools and whose parents have a high demand for secondary education.

For Tanzania, variable means for private and public school students are presented in the last two columns of table 1. Private school students on average have better family backgrounds than public school students. Parental

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[7]For a detailed description of Tanzania's education system, see Psacharopoulos and Loxley (1985, Chapter 6). The discussion that follows is drawn from this source.

education is a year higher for private school students. A higher proportion of private school fathers have a professional occupation; their incomes are a thousand shillings higher than public school fathers. The number of books in the household is higher for private school students.

Though public school students come from poorer backgrounds, their average aptitude test scores (APVERB, APMATH) exceed the private school average. This is true for achievement test scores as well but the difference is much less pronounced. Both the average and the dispersion (standard deviation) in teacher salaries are higher for private schools. The student-teacher ratio is slightly higher for private schools.

The probit equation for school type is given in the last two columns of table 2. The probit analysis for Tanzania indicates that being male increases the probability of attending a private school. Having a mother with some education increases the probability of attending a private school, but father's education seems not to matter. Father's income is positively related to private school attendance, but the statistical significance of the coefficient is weak. Father's occupation is a strong determinant of private status, however. Students with professional fathers are more likely to attend private school than students in farm families. The educational environment in the home, measured by the number of books in the household (NBOOKS) affects private school attendance; the higher the number of books, the larger the probability of private school attendance.

If public schools are indeed elite schools, the probit results suggest that the Tanzanian system for allocating students is meritocratic. Public school students tend to come from poorer, less education-oriented backgrounds.

The first and third columns in table 5 show the ACATEST equations adjusted for sample selection. The pattern for the selectivity terms is different for Tanzania. Recall that in the Colombian case we found positive self-selection for both private and public schools. Here, we find negative selectivity effects for private school students and positive selectivity effects for public school students. For private school students, the estimated selection bias is equal to -3.364 x 1.036 = -3.49 ACATEST points. For public school students, the comparable figure is 0.862 x 0.452 = 0.39 ACATEST points. This hierarchical pattern for sample-selection effects squares with the institutional setting of the Tanzanian education system, where the public sector is an elite enclave. The hierarchical Tanzanian pattern for sample selection differs from the sorting pattern that was found for Colombia, where students can freely choose their sectors.

As in the Colombian case, aptitude test scores are strong determinants of achievement test scores. Males do better in both private and public schools in Tanzania. Teacher salaries are positively and strongly associated with ACATEST scores in private schools, but inversely related to scores in public schools. The variable TSR is divided into half-tiles for private students and quartiles for public students. Private students tend to perform better in larger classrooms while public students perform best in intermediate-sized classrooms (TSR3 = 1).

V. Private-Public ACATEST Differences

Do private schools offer an achievement advantage? To answer this question, we must use the estimates from table 3 to calculate standardized private-public ACATEST differences. By way of preview, the answer is yes; a

private school achievement advantage exists and it is large.

To calculate the standardized private-public ACATEST differences, first consider the predicted ACATEST scores from table 3:

$$\text{PRIVHAT} = \hat{b}_p \bar{X}_p + \hat{c}_p \bar{\lambda}_p \tag{11}$$

$$\text{PUBHAT} = \hat{b}_g \bar{X}_g + \hat{c}_g \bar{\lambda}_g \tag{12}$$

PRIVHAT denotes the predicted value of ACATEST evaluated at private sample means. Let subscript $j = p,g$. The $\hat{b}_j$ denote estimated coefficient vectors (including constant terms but not selectivity terms) and the $\hat{c}_j$ denote the coefficients on the selectivity terms. The $\bar{X}_j$ are vectors of mean values of the explanatory variables and the $\bar{\lambda}_j$ are the average values of the inverse Mills ratio terms.

Now consider the difference, PRIVHAT - PUBHAT = Δ:

$$\Delta = \hat{b}_p \bar{X}_p + \hat{c}_p \bar{\lambda}_p - \hat{b}_g \bar{X}_g - \hat{c}_g \bar{\lambda}_g.$$

It is convenient to rewrite Δ as:

$$\Delta = [\hat{b}_p(\bar{X}_p - \bar{X}_g) + \hat{c}_p(\bar{\lambda}_p - \bar{\lambda}_g)] + [(\hat{b}_p - \hat{b}_g)\bar{X}_g + (\hat{c}_p - \hat{c}_g)\bar{\lambda}_g] \tag{13}$$

The first bracketed term in (13) is the portion of the private-public difference explained by differences in endowments. The second bracketed term is the standardized private-public difference, taking sample selection into account. This is the main term of interest. It shows, setting aptitude and school characteristics equal to public school means, the private school effect on ACATEST scores.

1. Colombia

First we focus on the term $(\hat{b}_p - \hat{b}_g)\overline{X}_g$. This term represents the unconditional private school effect. Consider a sample of both private and public school students. Now focus on the subset of those with the average characteristics of public schoolers. In other words, standardize according to public school means. Pick at random an individual from this subset, and predict a private-public difference for him. Based on the estimates in table 3, the estimated value of $(\hat{b}_p - \hat{b}_g)\overline{X}_g$ is 5.820. This is the unconditional private school effect on ACATEST scores.

Now consider a different experiment. Start with the same subset of individuals (both private and public) with the mean characteristics of public schoolers. Now, delete the private schoolers and consider only the public schoolers. This is a conditional experiment where the private school effect is calculated for an individual chosen at random who has already opted for public school. Based on the estimates in table 3, the estimated value of this conditional private school effect, $(\hat{b}_p - \hat{b}_g)\overline{X}_g + (\hat{c}_p - \hat{c}_g)\overline{\lambda}_g = 4.512$.

The conditional private school advantage is less than the unconditional private school advantage because, though positive self-selection exists in each sector, it is larger for public school students.[8]

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[8]We also estimated the generalized Tobits for different subsamples in Colombia. Suppose we consider all students, including those who did not take the aptitude tests (APVERB and APMATH). The sample size is 1,471. The variable APMISS is used to flag missing values. When APMISS = 1, APVERB and APMATH are coded to zero. Two interesting results arise here. First, the ACATEST scores for those who did not take the aptitude test are 2.75 points lower than the average for private students. In contrast, the ACATEST scores are 1.75 points higher than average for non-takers of the aptitude tests in the public schools. Further, when non-takers of the aptitude tests are added to the public sample, the coefficient of the selectivity variable shrinks dramatically.

Next we analyze the standardized private school advantage by school characteristics. These estimates, conditional on self-selection, are presented below.

	TSAL1	TSAL2	TSALMISS
TSR1	8.78	9.59	12.59
TSR2	5.35	6.17	9.16
TSR3	1.58	2.39	5.39
TSR4	-1.47	-0.50	2.48
TSRMISS	0.18	1.00	3.99

The way to read the table is as follows. Suppose we have a sample of students who chose public school and whose characteristics are equal to public school means, except that TSAL1 = 1 and TSR1 = 1. We look at the first entry in the table, 8.78, and this is the estimated conditional private school advantage for this group.

The private school advantage is larger the larger are student-teacher ratios, (e.g., TSR1 = 1) and the lower are mean teacher salaries (e.g., TSAL2 = 1). In a nutshell, private schools exhibit a stronger advantage under what seems like adverse conditions. The estimated private school advantage is highest (12.59) when TSR1 = 1 and TSALMISS = 1 and is lowest (-1.47) when TSAL1 = 1 and TSR4 = 1.

Next we turn to the simple OLS estimates (columns 2 and 4) in table 3. The OLS estimates roughly mirror the patterns found in the adjusted equations, but some numerically important estimation differences arise (e.g. the TSAL and TSR coefficients for public school students). The estimated private school effect from the OLS equations (standardizing by public school means) is 3.783.

This number has no behavioral interpretation, however, because sample-selection effects are not taken into account.

Finally, let us consider an index number issue. If we repeat the entire private-public difference calculation above, but standardize by private school means, the estimated private school advantage is larger. The estimated unconditional private school advantage is 8.377 and the conditional private school advantage is 7.428. The estimated private school effect depends on our choice of index.

We then enter TSAL and TSR linearly rather than as dummies (table 4, column (a)). Missing values are set to sample means and flagged by TSALMISS and TSRMISS.

This specification makes it easier to gauge the effects of TSAL and TSR, though it is less preferred, because we know the effects of TSR are nonlinear. Notice that TSR has opposing effects on ACATEST scores: positive for private schools and negative for public schools. In addition, TSAL is slightly negative for private schools. Also, note that in this specification the inverse Mills ratio terms are positive but not statistically significant. The probit from table 2 was used to generate the selectivity terms.

The final specification is presented in table 4, column (b). In this specification, the school characteristics, TSAL and TSR, are deleted. Only aptitude test scores, the gender dummy, and the selectivity variables are included. The rationale for this specification is to calculate the private school effect but not to condition the effect on school attributes. In other words, here we view the private school effect as a "black box." The effect may come from differences in measured school attributes, like TSR, or it may come for unobserved attributes, like differences in disciplinary policy.

Repeating the calculation based on equation (13) yields the following

results. First, the specification gives an estimated unconditional private school effect of 7.838. The comparable figure based on the original specification (table 3) is 5.860. Leaving out school attributes raises the unconditional differential. The estimated net selectivity effect in this specification is larger as well, indicating that the selectivity terms are picking up some of the effects of the omitted school attributes. The part of the achievement differential that reflects selection bias is 5.403 points in favor of public school students. The conditional private-public effect, therefore, is 7.838 - 5.403 = 2.435. The comparable figure from table 3 is 4.551. In sum, deleting school characteristics from the achievement test equations raises the estimated unconditional private school advantage, but lowers the conditional private school advantage.

2. Tanzania

We use the estimates from table 5 to calculate standardized private-public differences in ACATEST scores. We follow the same methodology as in the Colombian case, standardizing by public-school means. Like the Colombian case, private schools in Tanzania have an achievement advantage.

The unconditional private school advantage is equal to 8.247 ACATEST points. This is the expected private-public ACATEST score difference for a student chosen at random from a group having mean public-school-student characteristics. The conditional private school advantage is smaller -- 6.337 ACATEST points. The reason for the smaller difference is that sample selection bias is positive for public school students but negative for private school students.

One possible reason why private students might outperform their public

school counterparts is that the chances of desirable government employment or university attendance are greatly enhanced by public school credentials (Psacharopoulos and Loxley [1985, pp. 151-152]). The marginal benefits of scholastic effort for private school students is likely to be higher than public school students, since the latter have already been tracked onto a successful career path. This would explain why an achievement score advantage exists for private schools despite the fact that they are of lower quality.

The coefficient of TSAL1 is much larger for private than public students, indicating that the private school advantage is highest among schools that have more highly paid teachers. Higher teacher's salary clearly improves student performance in Tanzanian private schools.

The unadjusted OLS estimates are presented in the second and fourth columns of table 5. The patterns of the estimated coefficients are similar to their generalized Tobit counterparts, but coefficient values do differ between the adjusted and unadjusted equations, particularly for the private institutions. For example, the coefficient on MALE in the adjusted private sector equation (1.746) is 17 percent lower than that of the unadjusted equation (2.116). The standardized private-public ACATEST difference implied by the OLS estimates is 4.736. As before, this number has no behavioral significance since it is calculated from coefficients obtained without adjusting for selection bias.

Finally, once again note the index number problem. If we repeat the exercise above but standardize by private, rather than public, means, the estimated private-public difference is 6.81 (unconditional) and 2.431 (conditional).

For a substantial proportion of the sample, values for TSAL or TSR are

missing. Table 6 shows the ACATEST regressions for samples with non-missing values only. Like table 5, sample selection bias favors public school students. Here, estimated sample selection bias is positive and marginally significant for public school students and negative (but insignificant) for private school students.

To illustrate more clearly the effects of TSAL and TSR on achievement, the two are entered as continuous variables in table 6, column (a). This specification, estimated for the full sample, shows the powerful effect of TSAL on ACATEST for private schools. A two-thousand shilling increase in TSAL (about 1 standard deviation) raises ACATEST by about 11 points. TSAL has a negligible effect on public ACATEST scores. The regression also shows the positive relationship between classroom size (TSR) and private ACATEST scores.

The final specification for Tanzania is given in table 6, column (b). School characteristics, TSAL and TSR, are deleted. This is the same "black-box" specification used above. The black-box specification implies a much smaller standardized private-public achievement advantage. The unconditonal private school advantage is 2.042 ACATEST points. The conditional private school advantage is 0.676 ACATEST points.

VI. Conclusion

The measurement of private-public differences in school performance is a key ingredient in debates about educational policy in both developed and developing countries. In almost all circumstances, controlled experiments are not feasible measurement tools. Instead, we must recognize that school choice may be endogenous and control for possible selection bias.

In the cases studied here, adjustment for selection bias affects the

measurement of private-public achievement differences. The configuration of the estimated sample-selection effects mirrors the corresponding institutions in a sensible way. In Colombia, where students are free to choose their sectors, estimated sample-selection effects are positive in each sector. In Tanzania, where student choice is somewhat limited and public schools are viewed as elite, selection bias is negative for private school students and positive for public school students.

In addition to estimating sample-selection effects, we show that secondary school characteristics are often powerful determinants of student performance. This finding is important, especially given the paucity of evidence for relationships between schooling inputs and student performance found in related studies for the United States (Hanushek [1986, pp. 1160-1162]). Our results indicate that student performance can be affected by measured school inputs in these developing countries.

Finally, our results indicate that private schools offer an achievement advantage. Students in observationally equivalent settings perform much better in private schools. Our results are robust. The estimated private school advantage is large and empirically important in both Colombia and Tanzania.

Table 1 -- Definitions, Means, and Standard Deviations of Variables by School Type[a]

Variable Definitions	Code	Colombia		Tanzania	
		Private	Public	Private	Public
Resident of Large City	BIGCITY	52.9	30.3	---	---
Gender (male=1)	MALE	42.6	41.0	66.2	61.6
Urban Residence	URBAN	89.5	82.0	14.1	16.0
Number of Siblings	SIBS	4.8 (2.9)	5.2 (2.8)	6.0 (2.9)	5.8 (3.0)
Father's Education (years)	SF	8.7 (4.2)	6.8 (3.8)	6.6 (3.2)	5.7 (2.5)
Primary Grad/3 years[b]	SF1	16.3	27.0	16.7	24.5
Some Secondary/4 years[b]	SF2	24.9	19.4	8.4	9.4
Secondary Grad/7 years[b]	SF3	16.8	8.5	22.8	15.0
Some College/8 years[b]	SF4	4.6	3.5	31.8	26.6
College Grad/11 years[b]	SF5	12.7	5.2	14.5	12.6
< Primary or Missing/0 years[b]	SF0	24.7	36.4	5.8	11.8
Mother's Education (years)	SM	7.8 (3.7)	6.3 (3.5)	5.1 (2.6)	4.1 (2.0)
Primary Grad/3 years[b]	SM1	19.9	28.9	29.2	28.8
Some Secondary/4 years[b]	SM2	27.3	17.1	15.1	14.4
Secondary Grad/7 years[b]	SM3	22.7	9.0	23.5	15.1
Some College/8 years[b]	SM4	1.9	1.9	18.7	15.3
College Graduate/11 years[b]	SM5	2.7	2.8	4.2	3.8
< Primary or Missing/0 years[b]	SM0	25.5	40.3	9.3	22.6
Father's Occupation	---	---	---	---	---
Agriculture/Farmer[b]	FOCC1	17.2	14.5	44.3	45.2
Laborer/Craftsman[b]	FOCC2	5.3	16.4	10.3	10.8

Table 1 (continued)

Variable Definitions	Code	Colombia		Tanzania	
		Private	Public	Private	Public
Employee/Teacher	FOCC3	35.2	32.7	7.7	6.6
Self-Employed/Sales	FOCC4	25.9	25.8	14,8	8.7
Owner/Professional	FOCC5	13.4	8.5	13.2	8.3
Other	FOCC6	---	---	9.6	20.5
Father's Income[c] (pesos/shillings)	YFATH	34114 (47898)	17610 (19959)	6121 (10427)	5116 (10556)
Father's Income Missing	YFAMISS	26.6	23.7	---	---
Family Owns Car	FAMCAR	43.3	22.5	---	---
Family Owns Business	FAMBUSS	23.5	17.1	---	---
Repeated Primary Grade	PREPEAT	20.3	16.6	---	---
Repeated Secondary Grade	SREPEAT	36.9	34.1	---	---
Number of Books in Household	NBOOKS	82.6 (54.7)	70.2 (53.3)	46.4 (33.3)	32.4 (31.5)
NBOOKS = 150/ = 100	NBOOK1	37.1	28.2	21.2	12.9
NBOOKS = 70/ = 50	NBOOK2	23.0	20.6	43.7	25.9
5 < NBOOKS < 70/ = 25	NBOOK3	35.2	43.1	2.6	10.8
NBOOKS = 5/ = 10	NBOOK4	4.6	8.1	26.4	38.7
NBOOKS = 0	NBOOK0	---	---	6.1	11.8
Aptitude Test Score, Verbal (points)	APVERB	51.1 (9.6)	50.5 (10.0)	48.3 (10.5)	51.7 (10.5)
Aptitude Test Score, Math (points)	APMATH	50.8 (9.4)	51.2 (10.4)	47.0 (10.3)	51.3 (9.4)
Mean Teacher Salary (pesos/shillings)[b,c]	TSAL	10752 (15667)	20659 (15053)	1316 (2291)	1143 (596)
TSAL > 16130/ > 1300	TSAL1	3.4	55.9	12.9	48.1
TSAL $\leq$ 16130/ < 1300	TSAL2	39.5	17.1	30.9	36.5

Table 1 (continued)

Variable Definitions	Code	Colombia		Tanzania	
		Private	Public	Private	Public
TSAL Missing	TSALMISS	57.0	27.0	56.2	15.4
Student-Teacher Ratio (students)[b,c]	TSR	19.9 (5.2)	23.3 (5.7)	25.4 (11.2)	23.7 (9.2)
TSR > 26/ $\geq$ 30	TSR1	10.0	28.4	15.8	15.0
21<TSR$\leq$26/ 24<TSR<30	TSR2	10.1	13.3	55.6	10.7
18<TSR$\leq$21/ 20<TSR<24	TSR3	11.1	23.0	6.4	24.1
TSR $\leq$ 18/ $\leq$ 20	TSR4	23.5	19.1	21.5	21.3
TSR Missing	TSRMISS	45.2	16.1	0.01	28.9
Achievement Score (points)	ACATEST	50.8 (8.54)	48.4 (10.67)	50.6 (10.7)	51.8 (8.5)
Selectivity Variable[d]	λ	0.560 (0.29)	0.772 (0.38)	1.036 (0.30)	0.970 (0.22)
Number in Sample	N	582	422	311	713

[a]Sample: Academic students who took college - related aptitude tests (APVERB and APMATH). All means are percentages unless otherwise indicated. Standard deviations in parentheses.

[b]All definitions to left of slash refer to Colombia; to right of slash refer to Tanzania.

[c]Computed for non-missing values.

[d]Computed from probit equations in table 2.

Table 2 -- Probit Analysis, Dependent Variable -- School Choice Private (=1), Public (=0)[a]

	Colombia		Tanzania	
Explanatory Variable	Coefficient	Asymptotic t-value	Coefficient	Asymptotic t-value
CONSTANT	-0.644	-2.619	-1.697	-6.481
BIGCITY	0.654	7.269	---	---
MALE	0.074	0.891	0.223	2.404
URBAN	0.072	0.530	-0.186	-1.471
SIBS	-0.015	-0.947	-0.004	-0.264
SF1	-0.046	-0.353	-0.107	-0.530
SF2	0.174	1.241	-0.035	-0.152
SF3	0.331	1.881	0.201	0.943
SF4	-0.034	-0.137	-0.079	-0.375
SF5	0.379	1.773	-0.227	-0.922
SM1	0.069	0.557	0.543	3.408
SM2	0.328	2.344	0.380	2.079
SM3	0.435	2.554	0.655	3.556
SM4	-0.451	-1.396	0.570	2.949
SM5	-0.477	-1.685	0.636	2.257
FOCC1	-0.012	-0.071	0.356	2.583
FOCC2	-0.760	-3.883	0.351	1.951
FOCC3	-0.268	-1.742	0.201	0.964
FOCC4	-0.315	-2.057	0.509	2.881
FOCC5	---	---	0.525	2.762
YFAMISS	0.396	3.202	---	---
YFATH	0.130×10^{-4}	4.138	0.547×10^{-5}	1.310

Table 2 (continued)

Explanatory Variable	Colombia		Tanzania	
	Coefficient	Asymptotic t-value	Coefficient	Asymptotic t-value
FAMCAR	0.365	3.428	---	---
FAMBUSS	-0.060	-0.486	---	---
PREPEAT	0.192	1.718	---	---
NBOOK1	---	---	0.623	3.230
NBOOK2	0.123	1.011	0.606	3.553
NBOOK3	0.121	1.090	-0.424	-1.699
NBOOK4	0.172	0.851	0.091	0.539
ln L	-574.09		-568.69	
N	1004		1024	

[a]Sample: Non-INEM, academic students who took college-related aptitude tests (APVERB and APMATH).

Table 3 -- Colombia

Generalized Tobit Analysis: Dependent Variable -- Achievement Test Score (ACATEST).[a] (t-values in parentheses)

Explanatory Variable	School			
	Private		Public	
	Adjusted	Unadjusted	Adjusted	Unadjusted
CONSTANT	28.278 (12.389)	29.663 (6.462)	16.251 (6.462)	19.293 (7.858)
APVERB	0.349 (9.529)	0.349 (9.934)	0.472 (10.884)	0.486 (10.887)
APMATH	0.049 (1.297)	0.051 (1.340)	0.070 (1.692)	0.064 (1.494)
MALE	1.785 (3.106)	1.726 (2.978)	- 0.325 (-0.420)	- 0.314 (-0.393)
SREPEAT	- 0.198 (-0.292)	- 0.330 (-0.484)	0.614 (0.795)	0.462 (0.583)
TSAL1	0.975 (0.398)	0.144 (0.059)	4.785 (3.209)	6.926 (4.890)
TSAL2	- 3.183 (-2.460)	- 3.349 (-2.564)	- 0.187 (-0.123)	1.020 (0.668)
TSR1	2.087 (1.140)	2.637 (1.433)	- 6.512 (-3.568)	- 8.764 (-4.938)
TSR2	7.635 (4.496)	7.373 (4.307)	2.460 (1.487)	0.521 (0.323)
TSR3	0.024 (0.014)	0.402 (0.237)	- 1.374 (-0.720)	- 4.010 (-2.194)
TSR4	1.862 (1.737)	1.623 (1.503)	3.362 (2.254)	2.709 (1.786)
λ	2.376 (2.118)	--- ---	4.072 (3.851)	--- ---
R^2	0.23	0.22	0.55	0.53
F	15.09	16.07	45.57	47.19
N	582	582	422	422

[a]Sample: Non-INEM, academic students who took college-related aptitude tests (APVERB and APMATH).

Table 4 -- Colombia

Generalized Tobit Analysis: Dependent Variables -- Achievement Test Scores (ACATEST)[a] (t-values in parentheses)

Explanatory Variable	School			
	Private		Public	
	(a)	(b)	(a)	(b)
CONSTANT	25.972 (9.445)	30.098 (14.010)	24.938 (7.814)	10.044 (4.342)
APVERB	0.339 (9.039)	0.340 (9.120)	0.488 (10.961)	0.576 (12.467)
APMATH	0.038 (0.986)	0.041 (1.090)	0.072 (1.697)	0.092 (2.056)
MALE	1.721 (3.005)	1.644 (3.086)	- 0.938 (-1.203)	-0.900 (-1.100)
SREPEAT	- 0.536 (-0.778)	---	0.707 (0.892)	---
TSAL	$- 0.986 \times 10^{-4}$ (- 1.112)	---	0.339×10^{-3} (4.341)	---
TSALMISS	2.968 (2.605)	---	1.570 (1.116)	---
TSR	0.264 (2.693)	---	- 0.554 (-7.259)	---
TSRMISS	- 2.332 (-2.099)	---	- 2.583 (-1.770)	---
λ	0.647 (0.586)	0.952 (0.871)	2.042 (1.624)	6.276 (6.185)
R^2	0.19	0.17	0.52	0.44
F	14.61	29.95	49.98	81.98
N	582	582	422	422

[a]Sample: Non-INEM, academic students who took college-related aptitude tests (APVERB and APMATH).

Table 5 -- Tanzania

Generalized Tobit Analysis: Dependent Variable -- Achievement Test Score (ACATEST). (t-values in parentheses)

Explanatory Variable	School			
	Private		Public	
	Adjusted	Unadjusted	Adjusted	Unadjusted
CONSTANT	19.745 (3.879)	16.933 (3.348)	19.839 (10.937)	20.116 (11.250)
APVERB	0.235 (5.449)	0.243 (5.514)	0.226 (8.143)	0.226 (8.110)
APMATH	0.356 (8.355)	0.348 (7.959)	0.345 (11.157)	0.345 (11.114)
MALE	1.746 (2.107)	2.116 (2.512)	2.499 (2.926)	2.524 (2.937)
TSAL1	12.386 (6.607)	11.745 (6.141)	1.644 (2.099)	1.722 (2.202)
TSAL2	4.032 (3.997)	3.935 (3.799)	2.508 (2.051)	2.553 (2.075)
TSR1	2.263 (0.508)	1.369 (0.304)	-1.941 (-2.107)	-1.990 (-2.151)
TSR2	0.119 (0.025)	-0.542 (-0.113)	-0.845 (-0.947)	-0.946 (-1.065)
TSR4	2.935 (1.604)	2.917 (1.557)	-3.069 (-4.349)	-3.101 (-4.371)
λ	-3.364 (-2.829)	--- ---	0.862 (0.749)	--- ---
R^2	0.67	0.66	0.42	0.42
F	67.87	73.77	57.36	64.50
N	311	311	713	713

Table 6 -- Tanzania

Generalized Tobit Analysis: Dependent Variables -- Achievement Test Scores (ACATEST). (t-values in parentheses)
Full Sample: TSAL and TSR Entered as Continuous Variables.

Explanatory Variable	School			
	Private		Public	
	(a)	(b)	(a)	(b)
CONSTANT	17.908 (4.852)	12.120 (4.657)	18.906 (7.482)	20.216 (12.942)
APVERB	0.238 (5.509)	0.365 (7.753)	0.236 (8.334)	0.223 (8.029)
APMATH	0.350 (8.229)	0.450 (9.306)	0.352 (11.351)	0.356 (11.494)
MALE	1.709 (2.055)	2.258 (2.424)	2.181 (3.426)	1.938 (3.515)
TSAL	0.0054 (5.674)	---	-0.422×10^{-3} (-0.364)	---
TSALMISS	0.513 (0.352)	---	-2.529 (-1.323)	---
TSR	0.145 (2.288)	---	0.046 (1.167)	---
TSRMISS	1.467 (0.311)	---	2.758 (2.550)	---
λ	-3.321 (-2.778)	-1.709 (-1.235)	1.115 (0.970)	1.314 (1.147)
R^2	0.67	0.54	0.41	0.41
F	75.50	91.40	62.08	121.37
N	311	311	713	713

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