The Quality and Efficiency of Private and Public Education: A Case-Study of Urban India

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Introduction

Much of the research in the economics of education has focussed on the economic consequences of the quantity (years) of education and ignored the role of quality. A prominent example of this is the Mincerian earnings function. Yet, years of education may be a very imperfect indicator of human capital acquired if schooling quality varies greatly, as within many developing countries.

Evidence from a number of recent econometric studies calls into question the conventional emphasis on quantity[1]. These studies, which examine the association between different indicators of quality of schooling received and labour market performance, share the common conclusion that school quality (variously defined) is statistically important in explaining variations in the productivity of individuals[2]. The evidence on the link between quality of schooling and productivity indicates that, from an economic efficiency perspective, quality aspects of education deserve attention.

An important aspect of the debate on the quality of schooling is the private versus public provision of education. Whereas traditionally most governments have preferred to keep all or most of educational 'production' in the public domain for equity reasons, budgetary resource shortages in the face of growing school-age populations have recently

[1] For instance, Behrman and Birdsall (1983), Boissiere, Knight and Sabot (1985), Card and Krueger (1992), Glewwe (1992), Moll (1992) and Rumberger and Thomas (1993).

encouraged many governments to re-examine the role of the private sector in education. This re-examination is, in part, a reaction to the recognition that universal free provision of education does not necessarily best serve equity goals and, in part, a recognition of the limitations of the public sector's own administrative capacity to deliver an efficient service.

Various reasons have been postulated for private schools' superior efficiency. Since they are accountable to parents who pay their fees, private schools may have to exert themselves harder to provide good instruction to pupils. Competition among providers can be good for quality of services. Decentralised management, which is a hallmark of private operators, is conducive to greater efficiency. By contrast, 'X-efficiency' factors can result in poor management and staff motivation in state schools. Although these arguments have some force *a priori*, until recently they had little empirical support.

Section 1 briefly reviews the methods and the international evidence on the relative effectiveness - we use the terms effectiveness and quality interchangeably - of private and public schools. The background and relevance of such a study for India are discussed in section 2. Section 3 describes the data and presents the analytical framework within which the relative cost-effectiveness of schools in the different management sectors is assessed. Section 4 presents estimates of the main relations: a model of choice of school-type and achievement production functions with appropriate corrections for endogenous selection into particular school-types. Section 5 uses these estimates to compute a measure of the relative effectiveness of different school-types. This measure is then combined with estimates of unit costs by school-type to assess the relative economic efficiency of schools

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[2] Productivity is conventionally proxied by earnings. The usual caveats apply about the assumption that earnings are a good indicator of productivity; it is particularly important to note this qualification in certain settings, for example, where minimum wages apply, as in public sectors in many developing countries.

in different management sectors. Equity issues are considered in section 6, and the final section concludes.

I Review of Methods and Evidence

Economists have approached the issue of school quality empirically through the framework of educational production functions. Typically, school quality, defined by some outcome of schooling, is regressed on inputs into the education process such as students' characteristics, their home backgrounds, and school and teacher variables. Although earnings performance is not the only post-school outcome of education, it is nevertheless one of the most important. Since achievement on standardised cognitive skill tests is significantly related to earnings of ex-pupils in many studies (see Boissiere, Knight and Sabot 1985 and Hanushek 1986), it serves as a good proxy for the outcome of education[3].

The objective here is to examine whether substantial differences exist in the quality of private and public schools. It is clear that one cannot compare the raw achievement scores of pupils and claim that the school-type whose students had the highest average score was the most effective. If students with more ability or students from more privileged home backgrounds systematically choose to attend private schools, then such superior achievement as they reveal cannot be attributed wholly to the type of school attended. The approach must be to measure school effectiveness on the basis of any achievement differences that remain after home background and sample selection have been taken into account.

The issue of the comparative effectiveness of private and public schools has been addressed empirically mainly in the developed countries. Two broad methodological approaches have been adopted in the literature. One is where a single achievement function is fitted for both school types and a private school dummy is used as a regressor. The coefficient on the private school dummy is interpreted as a measure of the standardised achievement advantage of private schools over the public schools. This approach suffers from two important shortcomings. Firstly, by estimating a single equation for the sample of all schools, it imposes the restriction that the values of the coefficients on variables other than school-type are equal in both school-types. If the educational production function varied substantially between the school-types, this restriction would introduce serious misspecification biases. Secondly, a school-type dummy is likely to be endogenous since choice of school-type may itself be determined by individuals partly on the basis of expected achievement in private and public schools.

Studies that use this method (Psacharopoulos 1987; Halsey, Heath, and Ridge 1980; Williams and Carpenter 1991; and Govinda and Varghese 1993) conclude that in countries as diverse as the UK, Tanzania, Australia, India, and Colombia, private school pupils significantly outperform their public school counterparts even after controlling for measured pupil characteristics and home backgrounds.

The second, more satisfactory, approach is where two separate achievement production functions are fitted: one for the private and one for the public sector. This avoids endogeneity and the restriction of a similar production function across school sectors. The private school quality advantage (or disadvantage) over public schools is calculated using Oaxaca's (1973) method, that is, by predicting a score for a person who has the average characteristics of a public school pupil if she were to attend a private school.

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[3] Some studies have employed other measures of school quality such as college continuation or drop -out rates, students' attitudes and school attendance rates.

This predicted score is then compared with the actual public school average achievement score.

In a large and widely discussed US study which used this method (Coleman, Hoffer and Kilgore 1982), private schools were concluded to be more effective than public schools in imparting cognitive achievement. However, this study in particular and this approach in general have been criticised for failing to control for an important unmeasured student characteristic, namely innate ability (see Murnane *et al* 1985 for a review of the criticisms and issues). Coleman and Hoffer (1987) partly addressed this criticism when they returned to the issue, this time with panel data on the sample sophomores who had become seniors two years later. The use of panel data meant that the bias in regression estimates due to omitted unmeasured factors such as ability or motivation would be greatly lessened. This analysis confirmed previous results of a private school achievement advantage.

Apart from the problems of endogenous school-type dummy and of omitted variable bias, there is a further problem with the methodologies reviewed, namely that of sample selection, that is, non-random selection of children into different school-types on the basis of their unobserved characteristics. Recent econometric studies of non-random sampling have analysed the bias introduced by non-random sample selection on conventional estimators such as least squares, and have produced a variety of consistent estimation techniques and empirical models. The most commonly used are econometric models which correct for sample-selection effects by unifying censored regression models and discrete choice models. The Heckman-Lee two-step procedure of selectivity bias correction has come to dominate the applied literature using sample selection models because of its relative simplicity.

Jimenez *et al* (1988, 1990, 1991a, 1991b) addressed both analytical issues, that is sample selection bias and bias due to omitted unobserved characteristics such as ability[4]. They pioneered the econometric resolution of the problem of endogenous sample selection in comparisons of private and public schools, using Heckman's two-step correction procedure. Moreover, their work has been on less developed countries (Thailand, Colombia, Tanzania, the Dominican Republic and the Phillipines). The studies share a common methodology and similar results, namely that private school students generally outperform their public school counterparts even after controlling for selection effects and for the backgrounds of the pupils. In addition, the unit costs of private schools are reported to be lower than those of public schools in all five countries[5].

II Indian Case Study: the Background

The documented evidence for India points to very low schooling quality. This is true both for educational inputs (such as non-existent or very poor teaching materials and facilities) and educational outputs (such as low cognitive achievement levels of Indian students in international comparisons and low levels of literacy among those who have acquired some schooling). Given the importance of cognitive skills for individual productivity, India may be forgoing economic growth because of its poor quality of educational investment. Yet in India, as in most developing countries, there is little empirical research on the determinants of educational quality[6].

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[4]As Maddala (1983) observes, the two are not mutually exclusive. Persons with more ability may also be more capable of making the correct choices.

[5] In the case of the Dominican Republic, the private school category was divided into 'ordinary' and 'elite' private schools. The unit costs of the elite private schools were greater and those of the ordinary private schools lower than those of public schools. In all the five countries studied, the private school sector is popularly viewed as the elite sector. In Kenya, where the government school sector is generally viewed as the elite sector, the rate of return to private schooling is lower than that to government schooling (Knight and Sabot 1990), suggesting that private schools - in this case, local community schools - are lower in quality than government schools.

[6] One notable exception is a recent study by Govinda and Varghese (1993) which uses regression analysis to examine the determinants of student achievement in India. However, to investigate the effect of school-type on achievement, it uses the dummy variable approach and fits a single equation for both private and public

There are two *a priori* indications to suggest that private schools in India may be of higher quality than publicly financed schools. Firstly, the examination performance of pupils in private schools is markedly better than that of pupils in government schools. Secondly, there is high and growing demand for fee-charging (unaided) private schools even in remote rural areas. It is widely held that the demand for places in free government-funded schools is low because of their perceived low quality. According to many accounts, government-funded schools are starved of resources. However, gross examination scores of school pupils are unreliable guides to the quality of schools unless standardised for the quality of their students. Also, high demand for private schools may not necessarily reflect their superior quality: it may be demand for a differentiated product, since many of the private schools are English-medium schools.

It is of interest to examine the following questions: Is the popularity of private fee-charging schools in India to be explained by their superior quality? Is there a case for improving the quality of public schools? Is there a case for permitting or encouraging the expansion of the private school sector?

III The Data and the Model

Whereas most studies into school effectiveness by management-type divide schools into two categories - public and private - such a division would be misleading for India where schools called 'private' constitute two quite different types, namely private aided (*PA*)

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schools. Nevertheless, this study makes a valuable contribution to the scanty research on quality issues in education in India and much of its analysis is by school management-type (private, aided, and public).

and private unaided (*PUA*). *PA* schools are those which, though nominally privately managed, are almost entirely funded by the state government and are heavily regulated. For example, in Uttar Pradesh (UP) as in most states, they cannot charge tuition fees or recruit or pay their own staff. The UP Education Service Commission appoints or approves staff. By constrast, *PUA* schools are autonomous and fully self-financed. They charge fees and recruit and pay their own staff[7]. In consequence, we adopt a method of school comparison that takes into account three different school-types, government (*G*), private aided (*PA*) and private unaided (*PUA*).

The data for this study were drawn from a purpose-designed stratified random sample survey of schools in urban Lucknow district of UP. Data were collected from 928 students of class 8 (13 to 14 year olds) in 30 schools across the different school sectors. Student achievement was measured using adaptions of standardised tests of numeracy and literacy prepared for Knight and Sabot (1990) by the Educational Testing Service, Princeton NJ. While public examination scores would have been a convenient measure of student achievement - since they are easily available data - their use was rejected because of the severe lack of public confidence in exam marks as a reliable guide to students' skill development in India[8]. This lack of confidence implies that access to higher levels of education and to jobs in the formal sector is increasingly based on tests designed by the individual schools, colleges, and employers.

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[7] Despite these differences, *PA* and *PUA* schools are often lumped together in official data collection and in research papers. For example, the only round of the National Sample Survey that collected data on participation in education (in 1986) , distinguished only between private and public schools. Govinda and Varghese (1993), who study the determinants of achievement among primary school children in India, also fail to distinguish between *PA* and *PUA* schools in their regressions.

[8] This problem is noted in Government of India's *New Policy on Education* (GOI 1985, p30) which states that mass cheating, leakage of exam papers, tampering with results, and other unethical practices are rife in the examinations of the various exam boards.

The Ravens Progressive Matrices test was used to obtain a measure of ability of sample students. In addition, pupils filled out a questionnaire giving details of personal, parental, and household characteristics. A school questionnaire collected information on school income and expenses as well as on teaching materials and other facilities. The sampling, data, and tests are described in detail in Kingdon (1994).

Using the subscript *j* to denote the three school sub-samples, the educational production functions, also known as cognitive achievement equations, are given by:

$$A_{ji} = \beta_j X_{ji} + U_{ji} \qquad (1)$$

where *i* represents the *i*th student, *A* is the achievement score, β is a 1 x K vector of parameters, *X* is a K x 1 vector of exogenous variables that explain student achievement, and the *U* is the disturbance term.

If students in each of the three school sub-samples shared the same unmeasured characteristics, OLS estimation would offer unbiased estimates of the parameters in the three school-type achievement equations. However, if more highly motivated or more ambitious students selected themselves into *PUA* schools then students in the *PUA* sub-sample would, on average, be more motivated and ambitious than those in the rest of the student population. Thus, the *PUA* sub-sample would not be a random draw from the whole student population and least squares would yield inconsistent parameter estimates.

Following Heckman (1979) and Lee (1983), the achievement equations can be corrected for selectivity by including the inverse of Mills ratio λ_{ji} so that

$$A_{ji} = \beta_j X_{ji} + \theta_j \lambda_{ji} + \eta_{ji} \qquad (2)$$

where $\lambda_{ji} = \frac{\phi(H_{ij})}{\Phi(H_{ij})}$

and $H_{ij} = \Phi^{-1}(P_{ij})$.

$\phi(.)$ is the standard normal density function, $\Phi(.)$ the normal distribution function, η_{ij} is an error term, and P_{ij} is the probability that the ith student chooses the jth school-type.

The probability of selection into each school-type is first estimated by fitting a model of choice of school-type and the selectivity term (λ) computed from these probabilities is used as an additional regressor in the achievement equations (2) to control for selectivity bias in the second step of the Heckman correction. The coefficients on the lambda terms λ_j will be a measure of the bias due to non-random sample selection. If these are statistically different from zero, the null hypothesis of 'no bias' is rejected.

IV Empirical Results

(a) The school-choice model

Whereas selectivity-correction models are most commonly used in binary applications, the interest here is in modelling choice between three different school-types. The unordered multinomial probit model of school choice would have been suitable for our purpose but it was effectively unavailable because it is computationally burdensome. Following Lee's (1983) transformation, an unordered multinomial logit (MNL) model was employed[9].

[9] Although the strong *a priori* restriction of ordering did not seem appropriate, we did estimate an ordered probit model for the sake of comparison. We also experimented with binary probit models (*i.e.* for each of the three school-types, we modelled attending or not attending that type of school as a binary choice), primarily to confirm that the imposition of the MNL structure was justified. A comparison of the goodness-of-fit measures such as the psuedo R^2, the table of predicted and actual outcomes, and the log likelihood showed that the MNL model performed better empirically than competing models.

In specifying the school choice equation, the rich dataset permitted starting with a large number of independent household variables. Hendry's general-to-specific approach to model selection was followed to obtain a parsimonious final specification. Table 1 presents the definitions of the variables used in the school-choice and achievement equations and Table 2 sets out their means and standard deviations by school-type. Table 3 reports the results of the preferred MNL school choice model. The base, or reference, category is *G* whose regressor coefficients are set to zero. Thus there are two sets of parameters: the first referring to *PA* schools and the second to *PUA* schools.

Ability, as measured by children's score on the Raven's test (*SRAVEN*), plays a powerful role in choice of school-type. That *SRAVEN* is a significant independent variable in the school choice equation is as expected. Higher ability significantly increases the probability of going to a *PUA* school and significantly decreases the probability of attending a *G* school.

The coefficients on the caste and religion dummies indicate that self-sorting into school-types occurs along caste and religious lines, at least to some extent. Mother's education in years (*MEDYRS*) has a significant but complex effect on school choice.

Table 1

Definitions of variables used in the school-choice and achievement equations

Variable	Description
ACHIEVE	Student's total cognitive achievement score, that is total of *SMATH* and *SREAD*
SMATH	Student's score on numeracy (maths) test
SREAD	Student's score on the literacy (reading) test
SRAVEN	Score on the ability (Raven's Progressive Matrices) test
CHAGE	Child's age in months
CEDASP	Child's educational aspirations; an index from 1 to 6 of the highest education to which child aspires, eg, 1=upto class 8, 4=first degree, 6=profesional degree
TAKESTU	Student takes private home tuition or private coaching? yes=1, no=0

HSTUDY	Number of hours of home study per week
BOOKHOM2	Greater than 50 books at home? yes=1, no=0
BOOKHOM3	Greater than 100 books at home? yes=1, no=0
TRTIME	Travel time to school each way, in minutes
VACWRK	Child works during vacations and/or out of school hours? yes=1, no=0
NUMSIB	Number of siblings
MALE	male=1, female=0
WEALTH	Index of monetary value of assets in the household, divided by 10
WEALTHSQ	Square of *WEALTH*
LOWCASTE	Belongs to the low caste? yes=1, no=0
MUSLIM	Religion Muslim? yes=1, no=0
SIKHCHR	Religion Sikh or Christian? yes=1, no=0
MEDYRS	Mother's education in years, divided by 10
MEDYRSQ	Square of *MEDYRS*

Note: The variable *WEALTH* was constructed by assigning the following values to owned assets: Car=50, scooter=15, video=15, fridge=6, telephone=5, TV=3, tape recorder and gas cooker=2 each and radio, bed(s), bicycle, and clock=1 each. Many children may not have known their parents' income but all knew the answer to the factual question on which of these assets their family owned.

Household *WEALTH* increases the chances of attending a *PUA* school very strongly and reduces the probability of attending *PA* and, especially, *G* schools. In a credit-constrained country with imperfect capital markets such as India, richer households can better afford to invest in fee-charging *PUA* education. Even if the private rate of return to *PUA* education is the same for all households and above the rate of interest, richer households have better access to that school-type.

Table 2
Mean characteristics of students by school-type

Variable	*G*	*PA*	*PUA*	Whole Sample
ACHIEVE	18.74	19.22	33.94	24.97
	(8.58)	(8.22)	(10.38)	(11.78)
SMATH	8.97	8.36	17.09	12.02
	(4.35)	(4.37)	(6.40)	(6.70)
SREAD	9.77	10.86	16.85	12.95
	(5.22)	(5.08)	(5.27)	(6.10)
SRAVEN	25.40	28.15	36.03	30.53
	(9.88)	(10.13)	(10.59)	(11.23)
CHAGE	163.24	164.49	164.31	164.07
	(14.58)	(14.59)	(11.09)	(13.29)

CEDASP	4.11	4.34	5.06	4.56
	(1.46)	(1.30)	(1.11)	(1.34)
TAKESTU	0.35	0.39	0.28	0.33
	(0.48)	(0.49)	(0.45)	(0.47)
HSTUDY	16.81	22.20	24.51	21.61
	(10.53)	(9.14)	(10.71)	(10.64)
BOOKHOM2	0.25	0.28	0.26	0.26
	(0.43)	(0.45)	(0.44)	(0.44)
BOOKHOM3	0.16	0.23	0.44	0.29
	(0.37)	(0.42)	(0.50)	(0.46)
TRTIME	19.68	15.57	17.76	17.60
	(12.07)	(11.11)	(11.94)	(11.82)
VACWRK	0.20	0.16	0.09	0.14
	(0.40)	(0.37)	(0.29)	(0.35)
NUMSIB	4.31	4.59	3.28	3.99
	(1.65)	(1.74)	(1.45)	(1.71)
MALE	0.55	0.39	0.63	0.53
	(0.50)	(0.49)	(0.48)	(0.50)
WEALTH	1.21	1.59	3.95	2.42
	(0.90)	(1.20)	(2.35)	(2.11)
WEALTHSQ	2.27	3.97	21.09	10.33
	(3.63)	(6.22)	(21.51)	(16.67)
LOWCASTE	0.24	0.15	0.04	0.13
	(0.43)	(0.36)	(0.20)	(0.34)
MUSLIM	0.21	0.36	0.12	0.22
	(0.41)	(0.48)	(0.32)	(0.41)
SIKHCHR	0.01	0.01	0.06	0.03
	(0.11)	(0.08)	(0.24)	(0.17)
MEDYRS	0.64	0.76	1.11	0.87
	(0.48)	(0.44)	(0.45)	(0.50)
MEDYRSQ	0.64	0.77	1.43	1.00
	(0.63)	(0.63)	(0.81)	(0.79)
LAMBDA (λ)	0.96	0.89	0.53	0.77
	(0.31)	(0.33)	(0.56)	(0.47)
N	252	290	360	902

Note: The figures in parentheses are standard deviations. For yes=1/no=0 type of variables, the mean represents the percentage of ones in the sample. The definitions of variables are given in Table 1. λ is the selectivity variable computed from the first step school-choice equation.

Table 3
Determinants of choice of school-type

Variable	***PA***	***PUA***
Constant	-1.33	-3.37
	(-3.04)	(-5.84)
SRAVEN	0.02	0.07
	(2.28)	(6.04)
LOWCASTE	-0.22	-1.19
	(-0.86)	(-3.17)

MEDYRS	1.12 (1.84)	-1.81 (-2.46)
MEDYRSQ	-0.76 (-1.71)	1.03 (2.07)
NUMSIB	0.08 (1.44)	-0.13 (-1.69)
WEALTH	0.29 (2.86)	1.00 (9.38)
MALE	-0.62 (-2.86)	1.23 (5.05)
MUSLIM	0.84 (3.66)	-0.79 (-2.53)
SIKHCHR	-0.58 (-0.62)	1.40 (2.01)

Log likelihood	-682.87
Restricted log likelihood	-981.08
Pseudo R^2 (McFadden's)	0.304

Note: McFadden's R^2 measure is calculated as 1 - ln(L)/ln(L_0) where ln(L) is the log likelihood and ln(L_0) is the restricted log likelihood, ie log likelihood with just the constant term. The figures in parentheses are t-statistics. The base school-type is *G*.

The number of children in the household (*NUMSIB*) affects parents' ability to pay for the education of any particular child. Having many siblings, therefore, significantly reduces the probability of attending a *PUA* school and increases the chances of going to a *PA* school. This finding provides empirical support for the notion that there is a quantity-quality trade-off with respect to the number of children in a family.

The effect of gender on the probability of selecting particular school-types is consistent with the stereotype in India that parents care more about the education of male children and are willing to spend more on their education: being male has a particularly large, positive impact on the probability of going to a *PUA* school.

(b) Achievement Production Functions

We turn next to the achievement equation, the equation of most interest. The dependent variable (*ACHIEVE*) is the students' score on the cognitive achievement tests: the total of the scores in numeracy (*SMATH*) and literacy (*SREAD*), the maximum possible scores for which are 36 and 29 marks respectively. Thus, the maximum value of *ACHIEVE* is 65.

The achievement equations reported here correct for sample selection, as discussed in section III. The specification reported excludes a number of variables that were in the first step (school choice) equation because they were insignificant in the achievement equations; we prefer this model because the exclusion restrictions help to identify the selectivity variable, λ.

Introducing λ in the achievement equations induces a specific form of heteroskedasticity (Heckman 1979, Lee 1983). In order to obtain valid inferences, the corrected variance-covariance matrix of errors was constructed. The reported t-values are based on the heteroskedasticity-consistent standard errors. Table 4 presents the selectivity-corrected achievement equations for each school sub-sample.

Innate ability, as measured by performance on the Raven's test (*SRAVEN*), is one of the most significant determinants of achievement scores in all three school-types. Child's age affects achievement negatively in all school-types, perhaps reflecting class repetition and the negative influence of low motivation to do well at school. Child's educational aspiration (*CEDASP*) exerts a positive influence on achievement in all school-types, though its impact is strongest in *PUA*. *CEDASP* captures the influence of parents' education and some of the unobserved influence of motivation or ambition.

The gender dummy suggests that boys have significantly better achievement scores than girls in all three types of school. Separate regressions fitted on the mathematics test score *SMATH* and the reading test score *SREAD* (reported in the appendix) show that boys have significantly higher achievement in numeracy skills in all three school-types, but that in literacy skills they did not, except in the *PA* sector[10].

The coefficient of *TAKESTU* suggests reverse causation, that is, low school achievement of a child induces parents to arrange for private home tuition. *NUMSIB* exerts a powerful negative effect on achievement in *PA* and *PUA* schools, suggesting that the greater the number of siblings, the less the parental attention that any one child will get toward learning in the home.

Family's financial status, as proxied by the monetary value of owned assets (*WEALTH*), is a significant determinant of achievement. Moreover, as might be expected *a priori*, achievement improves with financial status but at a decreasing rate. That *LOWCASTE* and *MUSLIM* are significant only in the *G* and *PA* equations respectively suggests that peergroup effects may be important for achievement since lowcastes and Muslims are concentrated in the *G* and *PA* sectors respectively.

(c) The effect of correction for sample selection bias

The signs on the coefficients of λ in the three achievement equations are consistent with the prior expectation that there is positive selection into fee-charging *PUA* schools and negative selection into the tuition-free *G* and, to a lesser extent, *PA* schools. This result

[10] We suggest that some unmeasured influences at home or at school are at play. For example, parents and/or teachers may *expect* girls to perform less well in maths. In India, as in many other societies, girls are less inclined than boys to choose maths in secondary education (class 9 and above). If so, then girls will be less motivated than boys to do well in maths in class 8 (the sample class) since many of them do not intend to continue with maths.

contradicts the counter-intuitive findings of Jimenez *et al* (1991a and 1988), both of which find statistically significant negative selection into private schools, although in both studies private school students come from more elevated socio-economic backgrounds[11].

The sample selection parameters in the three achievement equations can be interpreted as follows[12]. The positive sign on λ_{PUA} implies that a child whose measured background characteristics indicate that she would have a low probability of attending a *PUA* school, but who is actually observed in the *PUA* sub-sample (a non participant-type in sector *PUA*) , will tend to have higher achievement the less likely she is to participate in the *PUA* sector. The negative sign on λ in the *G* equation implies that a non-participant type in sector *G* will tend to have lower achievement, the less likely she is to participate in the *G*

[11] Selectivity models are prone to specification uncertainty, that is, the coefficient and even sometimes the sign of the selectivity variable λ are not robust to the exclusion restrictions made to identify the model.

[12] Most work using sample selection models has concentrated on the econometric problems posed by these models (such as identification of the selectivity variable, the restrictive nature of the normal error distribution assumption and heteroskedastic variances) and has largely ignored the economic interpretation of the sample selection parameters (see Dolton and Makepeace 1987).

Table 4

Selection-corrected achievement equations

Variable	*G*	*PA*	*PUA*
Constant	21.184 (3.27)	14.696 (2.25)	21.905 (2.72)
SRAVEN	0.373 (4.73)	0.256 (6.18)	0.454 (9.54)
CHAGE	-0.093 (-2.88)	-0.020 (-0.64)	-0.129 (-3.51)
CEDASP	0.063 (0.18)	0.534 (1.56)	1.216 (3.32)
TAKESTU	-1.124 (-1.20)	0.148 (0.17)	-2.205 (-2.44)
HSTUDY	0.097 (2.18)	0.015 (0.34)	0.116 (3.16)
BOOKHOM2	0.594 (0.58)	-0.415 (-0.43)	0.598 (0.57)
BOOKHOM3	3.487 2.80	1.065 (1.02)	1.008 (1.04)
TRTIME	0.077 (2.03)	0.119 (8.05)	0.010 (1.41)
VACWRK	0.177 (0.16)	-3.859 (-3.21)	-2.309 (-1.72)
NUMSIB	-0.076 (-0.26)	-0.629 (-2.21)	-1.502 (-4.89)
MALE	2.635 (2.80)	4.385 (3.25)	2.896 (2.70)
WEALTH	6.988 (3.55)	0.564 (0.45)	3.802 (3.85)
WEALTHSQ	-0.832 (-2.00)	0.184 (0.75)	-0.272 (-3.14)
LOWCASTE	-4.308 (-3.06)	-1.102 (-0.93)	-1.451 (-0.69)
MUSLIM	1.646 (1.19)	-3.307 (-2.43)	0.346 (0.25)
λ	-7.766 (-1.80)	-2.944 (-1.18)	3.250 (1.79)
$\overline{R}^2$	0.364	0.311	0.493

sector. More intuitively, very bright children from disadvantaged backgrounds make it to *PUA* schools whilst very dull children from privileged backgrounds end up in *G* schools.

We had started out expecting strong selectivity effects on achievement. The relative weakness of the statistical significance of the selectivity effects (the λ term is significant only at the 10% level in the *G* and *PUA* equations) may be partly because variables included in the achievement equation are good at capturing unobserved influences on achievement. It may also partly be due to the high standard error of λ in each of the three equations, which in turn is due to its high collinearity with some of the variables in the model. Most of the variables from the first-step school choice equation (from which λ is derived) are included in the second-step achievement equations as well[13]. Although the selectivity terms do not appear to be statistically very significant owing to large standard errors, their coefficients are large. Moreover excluding the λs, that is, estimating an OLS model instead, makes an appreciable difference to the coefficients of some of the explanatory variables. Table 5 presents the estimated OLS achievement equations.

[13] In order to reduce collinearity in the model to identify λ, *MEDYRS*, its square and *SIKHCHR,* which are all first-step variables, were excluded because of their relative statistical insignificance in the three achievement equations. It should be noted that the above is an empirical rather than an *a priori*, theoretical justification. Many econometric studies which use the Heckman correction have faced this trade-off between theoretical purity and practical difficulty in more severe forms (for example, Willis and Rosen 1979, Nakosteen and Zimmer 1980, Cox and Jimenez 1990). The solution in these studies is to identify the selectivity variable λ by not including all exogenous variables from the choice-equation in the second step equation. Indeed, Willis and Rosen (*op. cit.*) adopt what they term "a very strong dichotomy with no commonalities", that is, they employ no common variables in the two steps. Nakosteen and Zimmer use only one common variable, as do Cox and Jimenez. Compared to the drastic exclusion restrictions of the above studies, ours are rather modest and at least justifiable on empirical grounds. We report the specification which yields the strongest selectivity effects, namely the one which excludes *MEDYRS*, its square and *SIKHCHR*. This provides a test of the hypothesis of non-random sample selection in our data in its strongest form. Alternative specifications and further discussion of this issue can be found in Kingdon (1994).

Table 5
OLS achievement regression equations

Variable	*G*	*PA*	*PUA*
Constant	18.412	11.463	29.040
	(2.86)	(1.87)	(4.04)
SRAVEN	0.260	0.255	0.408
	(5.43)	(5.98)	(9.99)
CHAGE	-0.093	-0.020	-0.132
	(-2.82)	(-0.65)	(-3.49)
CEDASP	0.113	0.540	1.196
	(0.32)	(1.52)	(3.14)
TAKESTU	-1.094	0.226	-2.181
	(-1.12)	(0.25)	(-2.33)
HSTUDY	0.098	0.013	0.116
	(2.11)	(0.28)	(3.04)
BOOKHOM2	0.634	-0.466	0.652
	(0.59)	(-0.47)	(0.60)
BOOKHOM3	3.375	1.064	1.089
	(2.60)	(0.98)	(1.09)
TRTIME	0.080	0.118	0.012
	(2.07)	(3.10)	(0.35)
VACWRK	0.001	-3.940	-2.348
	(0.00)	(-3.17)	(-1.69)
NUMSIB	-0.154	-0.465	-1.344
	(-0.53)	(-1.82)	(-4.38)
MALE	2.953	3.232	1.797
	(3.13)	(3.38)	(2.01)
WEALTH	5.486	0.862	2.566
	(2.90)	(0.68)	(3.49)
WEALTHSQ	-0.901	0.078	-0.192
	(-2.00)	(0.33)	(-2.49)
LOWCASTE	-2.874	-0.985	-0.065
	(-2.54)	(-0.80)	(-0.03)
MUSLIM	0.341	-2.178	1.383
	(0.28)	(-2.19)	(1.09)
$\bar{R}^2$	0.360	0.311	0.490

Note: The Breuch-Pagan test did not reject the null of homoskedastic standard errors at the 95 percent significance level in any of the three equations.

For most variables the presence of λ makes a small difference to the coefficients but for certain variables the difference is notable and in the expected direction. For example, in the *G* school achievement equation, including the selectivity variable greatly increases the coefficient on *SRAVEN* (by nearly 2.5 standard errors)[14]. In other words, the OLS estimate of the contribution of *SRAVEN* to achievement is substantially underestimated. The coefficient on *WEALTH* also goes up (by about one standard error). In the *PUA* equation,

[14] A Hausman specification test on the coefficient of *SRAVEN* rejects the null of no selection bias at the 10 percent level of significance (t = 1.80).

the coefficients on *SRAVEN*, *MALE* and *WEALTH* increase correspondingly by 1.0-1.5 standard errors. In the *PA* school achievement regression, coefficients are not very different as between the OLS and λ-inclusive equations but this is expected because selection effects are smaller there.

Thus, correction for sample selection bias makes an appreciable difference to inferences about the effect of some variables on achievement level. Further, as the next section shows, allowing for selectivity makes a large difference to the quality comparisons between the school-types.

V Comparisons of Cost-Effectiveness by School-Type

The purpose of this section is to investigate whether and to what extent any one school-type is more effective than others after standardising for home background and sample selectivity, and then to examine how correction for endogenous sample selection affects the relative efficacy of different school-types.

(a) Differences in Outputs by School-Type

The method of comparing the relative effectiveness of the different school-types is as follows: Choose a pupil at random from the entire student population in the district and give her the average characteristics of the full sample of pupils, say, $\overline{X}$. Now predict a score for this student if she were to attend a *G* school, another score if it were a *PA* school, and a third score if it were a *PUA* school. That is, predict a standardised achievement score in each school-type ($\hat{A}_j$) as:

$$\hat{A}_j = \hat{b}_j \overline{X} \qquad (3)$$

where $\hat{b}$ is the estimated coefficient vector (including the coefficient on λ) and $\overline{X}$ is a vector of mean values of the explanatory variables, averaged over the entire sample. The achievement advantage of *PUA* schools over *G* schools, for example, can be calculated as $\hat{A}_{PUA} - \hat{A}_G$ and so on[15]. The standardised achievement scores thus calculated and the relative achievement advantages of different school-types are presented in Table 6.

The specification reported in Table 4 is the one which gives the strongest selectivity. That is, we are presenting the most conservative estimate of the *PUA* advantage *vis-à-vis G* and *PA* schools and of *G* schools relative to *PA* schools. Table 6 also shows that the OLS model overestimates the *PUA* advantage over *G* and *PA* schools and actually reverses the sign of the *PA -G* comparison. The correction for sample selection bias greatly reduces the *PUA* schools' achievement advantage over *G* and *PA* schools and wipes out the small *PA* advantage over *G* schools. These results suggest that sample selection is important in school education in India and that the least squares model is therefore inappropriate for a comparison of the quality of different school-types.

[15] Pairwise comparisons which are based on standardising by mean charactersitics in the different sectors ($\overline{X}_G$, $\overline{X}_{PA}$ and $\overline{X}_{PUA}$) can also be carried out, as in Jimenez and Cox (1990). The pairwise method gives results similar to those of the method based on standardising by the overall means ($\overline{X}$). For example, a pairwise comparison gives a *PUA*-*G* advantage of 1.82 points standardising by *PUA* means ($\overline{X}_{PUA}$) and of 1.86 points standardising by *G* means. ($\overline{X}_G$), compared with 1.46 points standardising by the overall means ($\overline{X}$).

Table 6

Raw and standardised achievement scores and relative advantage points by sector and subject: *G*, *PA* and *PUA* schools

	Achievement points			Achievement advantage points		
	G (a)	***PA*** (b)	***PUA*** (c)	***PUA-G*** (c-a)	***PUA-PA*** (c-b)	***PA-G*** (b-a)
Mathematics						
Raw	8.97	8.36	17.09	8.12	8.73	-0.61
Standardised (d)	**11.38**	**10.09**	**12.80**	**1.42**	**2.71**	**-1.29**
				(18)	(31)	(-211)
Reading						
Raw	9.77	10.86	16.85	7.08	5.99	1.09
Standardised (e)	**13.78**	**13.73**	**13.82**	**0.04**	**0.09**	**-0.05**
				(1)	(2)	(-5)
Achievement						
Raw	18.74	19.22	33.94	15.20	14.72	0.48
Standardised (d+e)	**25.16**	**23.82**	**26.62**	**1.46**	**2.80**	**-1.34**
				(10)	(19)	(-279)
OLS standardised achievement points	**20.57**	**22.60**	**27.56**	**6.99**	**4.96**	**2.03**

Note: The figures in brackets are the standardised achievement advantages as a percentage of the raw achievement advantages. The negative signs imply achievement disadvantages.

Table 6 shows that the unadjusted (raw) mean achievement advantage of *PUA* schools over *G* and *PA* schools in all subjects falls greatly when personal endowments and selectivity of pupils are controlled for. For example, *PUA* schools' raw mathematics-score premium over *G* schools of 8.12 points falls to just 1.42 points. This implies that, of the *PUA* schools' mathematics advantage of 8.12 points *vis a vis G* schools, 82 percent is to be explained by student intake and only 18 percent can be attributed to school influences. The *PUA* schools' raw mathematics advantage over *PA* schools falls from 8.73 points to 2.71 points, so that 31 percent of the observed *PUA* maths advantage is due to school-related factors and 69 percent due to student intake. The predicted mathematics score of a child in a *PUA* school (12.80 points) is 27 percent higher than her predicted maths score in a *PA* school, where it would be 10.09 points. In other words, *PUA* schools are 27 percent more effective than *PA* schools in their maths teaching.

G schools' tiny mathematics advantage over *PA* schools increases after controls, suggesting that *G* schools are more effective in imparting numeracy skills than *PA* schools. It is notable that all three school-types are roughly equally effective in imparting reading skills. The raw reading score premiums virtually disappear when student background and selectivity are controlled.

Our finding of a PUA school achievement advantage is in line with, though not strictly comparable to, Govinda and Varghese's (1993) findings for the Indian state of Madhya Pradesh. The authors conclude that, even after controlling for home background and measured teacher and school characteristics, "school management-type - government or private - emerges as the most significant factor influencing learner achievement" (pp261-2).

(b) Differences in Inputs by School-Type

The unit cost of each school in the sample was estimated by dividing the total school expenditure of the year 1989-90 by the total number of students. Table 7 presents the average per pupil expenditures (PPE) for each school-type. It shows that recurrent PPE of *G* and *PA* schools is similar and about double the PPE of *PUA* schools. These differences in unit costs arise most importantly because *PUA* schools' per pupil salary expenses are much lower than those in *G* and *PA* schools. This in turn is due both to *PUA* schools' much lower average salary levels and their more intensive use of teachers. Whereas in 1990, sample teachers' average monthly salary in *PUA* schools was Rs. 1533, in *G* and *PA* schools it was Rs. 2532 and Rs. 2449 respectively. These relative magnitudes of pay in different school-types are in close conformity with findings in several studies for different parts of India, for example, Kansal (1990) for Delhi, Jain (1988) for Gujarat, and Govinda and

Varghese (1993) for Madhya Pradesh. Indeed, in both Jain and Govinda and Varghese, *PUA* teachers' average pay is only half that of *G* teachers' pay[16].

Apart from their much lower pay rates, *PUA* primary schools use their teachers more thriftily by having higher pupil-teacher ratios than other school-types. In our survey, the pupil-teacher ratios in primary schools were 14.6, 20.4, and 25.3 in *G, PA* and *PUA* schools respectively[17], though at the secondary level, all school-types had crowded classes, with 30 to 35 pupils per teacher. *PUA* primary schools have higher pupil-teacher ratios because they are successful in attracting students whereas *G* and *PA* primary schools suffer from low demand because of their perceived poor quality. Several researchers have noted that in India there is growing demand for fee-charging private schools while the free schools are relatively under-utilised[18]. It is also conspicuous that the government-funded (*ie* *G* and *PA*) schools spend very little on non-salary costs, with the consequence that they are very under-resourced.

Table 7

Annual per pupil expenditures by school-type (Rupees)

School type	Recurrent expenditure per pupil			Capital expenditure per pupil
	Salary	Non-salary	Total	
G	1958.40	50.00	2008.40	66.93
PA	1780.93	46.87	1827.80	11.97
PUA	735.94	262.96	998.90	72.85

16 These widely differing pay levels reflect a segmented labour market. *PUA* schools, like many small private organisations in India, openly flout the *de jure* requirement to pay the high government-prescribed minimum salaries.

17 The pupil-teacher ratios in official statistics are not presented by school managment-type but they show that the ratio, in Lucknow district, in 1986-87 for all primary schools taken together was 27 (GOUP 1987, p193) which is much higher than the figures in our survey. However, it is very well known that official statistics seriously exaggerate the number of primary age students in school (Dhingra 1991 *inter alia*), so that the published pupil-teacher ratios are likely to be widely over-estimated.

18 For example, based on their survey of schools in Delhi, Chadha and Singh (1988) state "what is incredible are the absolute low levels of income at which demand for private schooling exists. It is incredible because government schools are virtually free". Nor is this phenomenon confined to urban areas. As Shiva Reddy (1991) notes, "Because of the deterioration in the quality of instruction in publicly finanaced schools, private

We use the recurrent PPEs as the relevant measure for school cost-effectiveness comparisons because many capital expenditures are made less frequently than once a year. Lack of relevant data on the relationship between cognitive skills and earnings prevents the calculation of the most appropriate measure of economic efficiency: social rates of return by school-type. However, table 8 combines the unit costs of Table 7 with the predicted achievement scores of Table 6 and presents 'cost per unit of output' by school-type.

Table 8
Unit costs, achievement and cost per achievement-point
(*G, PA* and *PUA* Schools)

	G (a)	***PA*** (b)	***PUA*** (c)	***PUA:G*** (c/a)	***PUA:PA*** (c/b)	***PA:G*** (b/a)
Cost per student (C)	2008	1827	998	0.50	0.55	0.91
Predicted mathematics score (M)	11.38	10.09	12.80	1.13	1.27	0.89
Cost per mathematics point (C/M)	176	181	78	0.44	0.43	1.03
Predicted reading score (R)	13.78	13.73	13.82	1.00	1.00	1.00
Cost per reading point (C/R)	146	133	72	0.50	0.55	0.91
Predicted total score (T =M+R)	25.16	23.82	26.62	1.06	1.12	0.95
Cost per score point (C/T)	80	77	38	0.47	0.49	0.96

The first row shows that, on average, *PUA* schools are about twice as *cost-advantageous* as *G* and *PA* schools. Table 8 also shows that there is in mathematics (but not in reading) an *achievement* advantage associated with attending a *PUA* school. Combining *PUA* schools' 100 percent unit cost advantage over *G* schools with their 13 percent mathematics advantage leads to the conclusion that *PUA* schools are much more cost-effective than *G* schools in their mathematics teaching. They produce the same level of numeracy skills as *G* schools but at a mere 44% of the cost of *G* schools. They produce the same level of reading achievement as in *G* schools but at half the cost. The comparison of *PUA* schools with *PA* schools is of similar magnitudes. *PA* schools' 3 percent mathematics

(fee-charging) schools are spreading even in remote areas". Kingdon (1994) analyses in detail the reasons for the *PUA* schools' much lower unit costs and presents corroborative evidence from other parts of India.

disadvantage *vis a vis G* schools together with their 9 percent reading advantage implies that, overall, they are equally or very slightly more cost-effective than *G* schools.

To summarise, the results show that *PUA* schools' ability to benefit from labour market segmentation and their more thrifty use of teachers implies a unit cost advantage over government-funded (*G* and *PA*) schools. This reinforces their achievement advantage over the other school-types, so that they are unambiguously and substantially more cost-effective or internally efficient than both *G* and *PA* schools, which are roughly equally efficient.

VI Equity considerations

The public provision or funding of education is intended to play an important equity role in India, as in many LDCs where informational and administrative costs prevent the implementation of optimal transfers on any widespread basis. However, universal free provision does not necessarily best serve equity goals. Besley and Coate (1991) derive three conditions that are necessary for public provision of a discretely demanded private good[19] such as education to be redistributive: private sector provision must be allowed, private sector quality level should be at least a little higher than the public sector quality level, and quality must be a normal good.

In the Indian context, the mechanism for redistribution would be as follows. Since in any given year, an individual can 'consume' education either in the free (*G* and *PA*) sector or in the fee-charging (*PUA*) sector but not both, choosing the free option restricts the individual to consuming the good at the publicly set quality level. Individuals may be

[19] Discretely demanded goods are those for whom at most one unit of the good can be consumed by an individual at any given time. For example, one can have schooling at grade 8 either in a free school or in a private school at any given time but not in both schools.

unhappy with this quality level and may choose to consume the good at a higher quality level in the private sector, if one exists, even if they have to pay for it. Herein lies the power of publicly funded provision to redistribute income. If quality is a normal good, as the school choice model of Table 3 suggests, then those who choose to participate in the fee-charging school system are going to be those with higher incomes.

Table 9

***PUA* enrolments as a percentage of total enrolments in urban areas, by level (1986)**

School Level	Uttar Pradesh		India	
	Number of *PUA* schools	***PUA* enrolments (% of total)**	**Number of *PUA* schools**	***PUA* enrolments (% of total)**
Lower Primary (grades 1 to 5)	3171	39.9	8794	18.0
Upper Primary (grades 6 to 8)	1750	32.5	6320	14.6
Secondary (grades 9 to 12)	119	6.2	3237	8.9

Source: Fifth All India Education Survey (NCERT 1992), Table 53 and Table 170.`

By the above rule, the income-redistributive effect of state-funded education is sustained precisely by the existence of the *PUA* option. Thus, in urban UP, for example, *G* and *PA primary* schools are equitable but not the *G* and *PA secondary* schools: whereas *PUA* primary schools are freely allowed to exist, *PUA* secondary schools are tightly controlled. Although official statistics greatly understate their numbers[20], they nevertheless show that *PUA* primary schools are more numerous than *PUA* secondary schools, as seen in Table 9.

It is clear that there is a bottleneck in the availability of *PUA* secondary schools in both India and UP, though this is particularly severe in UP where the enrolment share of

[20] While all *PUA* secondary schools must be 'recognised', that is, have the official stamp of approval, *PUA* primary schools do not have to be recognised or even registered. Official statistics include only recognised *PUA* schools, though they acknowledge that there is a large (but unknown) number of unrecognised *PUA* primary schools (GOI 1993, p4).

PUA schools falls from 33% in upper primary to a mere 6% in secondary education[21]. Under these circumstances, thousands of well-off students who choose fee-charging primary schools end up in free secondary schools and become recipients of heavy public subsidies, crowding out the poorer students[22].

Easing the *de facto* impediments to the founding of private schools would create greater fee-charging school capacity in secondary education and permit the well-off to opt out to the fee-paying sector, ensuring that subsidies are targetted at the poor.

The conventional socialist critique of private schools - namely that they enable well-off children to get better education and, therefore, have better life-chances - has moral force but is practically flawed. This is because the well-off can, and do, improve their children's life-chances through privately paid, out-of-school instruction. For example, well-off students in India gain hugely disproportionate access to prestigious medical and engineering courses by attending expensive private coaching outside mainstream secondary school, though the recent increased 'reservation' of certain places for students from backward castes is allegedly designed to improve the representation of the disadvantaged. The rapid growth of the private tuition industry in India - which constitutes a surrogate education system - has become a cause of concern because of its perceived detrimental effects on the main education system (National Commission of Teachers 1986, p80; GOI 1985, p30). This

[21] It appears that this bottleneck occurs because government rules on recognition are applied much more stringently and government interference in the running of *PUA* schools is much greater in secondary education. For example, compliance with minimum wage and maximum fee legislation is more closely monitored in secondary schools, where traditionally teachers unions have been the strongest.

[22] Several authors have observed that a supply-constrained public education sector tends to get monopolised by children from relatively privileged backgrounds (for example, Knight and Sabot 1990 for Kenya and Tanzania, and Muzammil 1992 for India).

'subsidiary market in education' as Muzammil (1992) calls it, is growing in response to private demand[23].

Attempts to restrict private education are thus unsuccessful in preventing the well-off from disproportionately gaining access to education or to better-quality education. Given these realities, improving the equality of educational opportunities implies upgrading the quality of subsidised provision. However, budgetary constraints limit the government's ability to invest in improving the quality of free schools in India. If permitting the founding of more *PUA* secondary schools were to release public resources which facilitated quality-upgrading in free education, it would be conducive to greater equity.

VII Conclusion

The findings from the case study of Uttar Pradesh suggest that the popularity of fee-charging private schools in India is explained by their superior quality. Government and Private Aided schools are similar in their cost-efficiency but compare unfavourably with Private Unaided schools. This suggests that the quality and cost-efficiency of government-funded schools needs to be greatly improved. It also suggests that encouraging Private Unaided schools would lead to gains in efficiency as these institutions are both more technically efficient and more cost-efficient. Permitting more fee-charging schools in secondary education would also be equity-promoting because they support the redistributive role of publicly funded provision, allowing educational subsidies to be better targetted at the poor.

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[23] The pursuit, by those who can pay, of better or more instruction through private tuition, is not unique to India. According to Foondun (1992), private tuition-taking has reached 'epidemic' proportions in Bangladesh, Sri Lanka, Nepal, India, Korea, Malaysia, Mauritius, Kenya, Sudan, and Thailand.

The present work represents a contribution to the scant empirical research on quality issues in education, both in India and internationally. It offers some empirical evidence on an issue which has become topical but which has largely been a subject of speculation. The rigorous methodology used here in the comparisons of public and private schools represents a clear advance over what exists in India presently. While our result of a private school superiority in quality and efficiency is in line with findings for several developing countries - for example, Thailand, Colombia, Tanzania, the Phillipines, and the Dominican Republic - (Jimenez 1991b), it is not inevitable (see Knight and Sabot 1990 for Kenya). Additional research, with nationwide data on India and comparable cross-country data internationally, is warranted in order to be confident about the generalisability of the conclusions reached here. Deeper research on the causes of private schools' better quality would usefully complement the present work. It would highlight the practices of private schools that make them more effective, suggesting ways in which public schools may improve their quality through emulation of those practices.

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Appendix
Selection-corrected achievement equations for maths and reading scores

	G		*PA*		*PUA*	
Variable	**Numeracy**	**Literacy**	**Numeracy**	**Literacy**	**Numeracy**	**Literacy**
Constant	7.609	13.575	5.615	9.082	13.424	8.482
	(2.25)	(3.26)	(1.47)	(2.23)	(2.60)	(1.83)
SRAVEN	0.130	0.243	0.125	0.131	0.273	0.181
	(3.07)	(4.87)	(5.15)	(5.07)	(8.99)	(6.59)
CHAGE	-0.033	-0.060	-0.007	-0.012	-0.100	-0.029
	(-1.98)	(-2.87)	(-0.42)	(-0.64)	(-4.22)	(-1.38)
CEDASP	0.159	(-0.097)	0.295	0.238	0.656	0.560
	(0.88)	(-0.44)	(1.48)	(1.12)	(2.78)	(2.65)
TAKESTU	-0.074	-1.050	0.465	-0.317	-1.300	-0.904
	(-0.15)	(-1.75)	(0.90)	(-0.57)	(-2.25)	(-1.74)
HSTUDY	0.058	0.039	-0.011	0.027	0.083	0.033
	(2.46)	(1.38)	(-0.43)	(0.96)	(3.55)	(1.54)
BOOKHOM2	-0.014	0.608	-0.629	(0.213)	0.894	-0.297
	(-0.03)	(0.92)	(-1.12)	(0.36)	(1.33)	(-0.49)
BOOKHOM3	1.185	2.302	0.121	0.944	1.163	-0.155
	(1.80)	(2.90)	(0.20)	(1.44)	(1.87)	(-0.28)
TRTIME	0.010	0.067	0.064	0.055	-0.011	0.021
	(0.50)	(2.73)	(6.60)	(13.35)	(-2.51)	(5.26)
VACWRK	-0.514	0.690	-1.286	-2.573	-1.889	-0.420
	(-0.88)	(0.95)	(-1.82)	(-3.42)	(-2.19)	(-0.54)
NUMSIB	-0.004	-0.071	-0.181	-0.448	-0.625	-0.877
	(-0.03)	(-0.38)	(-1.09)	(-2.52)	(-3.15)	(-4.96)
MALE	2.401	0.234	1.474	2.911	2.494	0.402
	(4.90)	(0.39)	(1.86)	(3.45)	(3.65)	(0.65)
WEALTH	2.193	4.795	-0.119	0.684	1.984	1.818
	(2.07)	(3.87)	(-0.16)	(0.88)	(3.13)	(3.20)
WEALTHSQ	-0.233	-0.600	0.109	0.075	-0.150	-0.122
	(-1.02)	(-2.32)	(0.76)	(0.50)	(-2.70)	(-2.44)
LOWCASTE	-1.583	-2.725	0.012	-1.114	-0.976	-0.475
	(-2.18)	(-2.99)	(0.02)	(-1.50)	(-0.72)	(-0.40)
MUSLIM	0.531	1.115	-1.211	-2.096	-0.345	0.691
	(0.72)	(1.27)	(-1.52)	(-2.46)	(-0.39)	(0.88)
λ	-1.601	-6.165	-1.068	-1.876	1.296	1.954
	(-0.67)	(-2.31)	(-0.73)	(-1.20)	(1.11)	(1.87)
$\bar{R}^2$	0.313	0.300	0.167	0.297	0.452	0.347

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