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Education in the Rural Indian Household

A Gender Based Perspective

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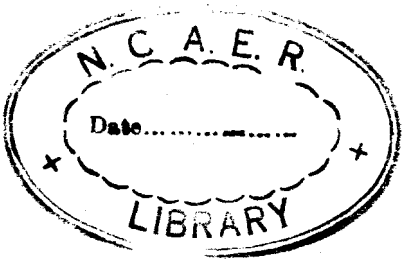

MOTIVATION[1]

"Gender inequalities in wages, education, nutrition and health are widely deplored, but they are less often empirically analyzed to understand what institutions and conditions create and change them, and what they imply for how well a society uses its productive resources."[2] While the last few years have seen an increasing interest in studying gender disparities in education in India, there are many unanswered questions. This paper studies the household decision making process to understand the reasons for low educational attainment, particularly the gender gap, in rural India.

Using primary data from a household survey in 1993-94, this paper models the educational attainment of boys and girls between the ages of six and fourteen years within an econometric framework. The role of supply side factors *i.e.* features of the schooling system which are key policy variables for schooling attainment have been largely neglected in previous studies. These have been highlighted in this paper. Further, most previous empirical work fails to correct for several problems that are inherent in studying the determinants of schooling attainment. The issues of potential endogeneity of income, left censoring and right censoring of the 'schooling attainment' variable are critical problems that have received scant attention in earlier studies. This paper

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1. I would like to thank NCAER, India, for allowing me to use their new data set (the UNDP data set) and the Rockefeller Foundation and Ford Foundation grants via the Economic Growth Center that have funded my research and enabled me to acquire the data. I would also like to thank Professor T. Paul Schultz, Professor T.N. Srinivasan and Professor Jean Lanjouw for their valuable advice and the members of the Prospectus Workshop in Micro-economics for their comments. I would also like to thank Ms. Ratna Sudarshan and Dr. Jean Dreze for their helpful comments.

2. Schultz, T. Paul.(ed.) *Investment in Women,s Human Capital.* Chicago: University of Chicago Press, 1995, p.1.

discusses and corrects for these problems to provide more accurate estimates of the impact of various variables on schooling attainment.

Why do we observe a pro-male bias in how households allocate their resources to education? This is a pivotal question that has important policy implications. The education of women is important not only for considerations of efficiency and equity but also for the positive social externalities that women's education appears to confer. It has been widely documented that higher levels of women's education and hence, lower gender gaps in education, are associated with lower infant mortality rates, lower fertility and population growth rates and better nutrition and education of children.[3] The data reveal that being of the female sex in a rural Indian household is indeed a disadvantage in the context of opportunities for education. Girls not only have lower enrollment rates but also lower schooling attainment and a higher probability of drop out of school. It is thus crucial to investigate this issue in the context of India which has a long history of a strongly patriarchal society.

BRIEF LITERATURE SURVEY

The economic literature on gender bias in intra-household allocation has grown rapidly in the 1980s and 1990s. However, most studies focus on how households decide to allocate consumption goods such as food and clothing. Economists have begun modeling health and education investments by households only in the last few years. Low schooling levels in general and male-female differentials in schooling attainment reflect the stark reality that is observed in some developing country household. In India, the female literacy rate in 1991 was 39.3%

3. Schultz, *Investment in Women's*...p. 46.

whereas the male literacy rate was 64.1% with wide variations across urban and rural areas as well as across states.[4]

Several studies have focused on investment in the human capital of children in developing countries. Behrman estimates household production functions for translating nutrients into health related outcomes for girls and boys in rural India.[5] In another study by Pitt, Rozensweig and Hassan, they conclude that in rural Bangladesh boys are given nutrition than their female siblings because they engage in more energy intensive activities. But boys suffer a deterioration in health from the effort put into these activities. In fact they find some support for a net bias in favour of girls.

Investing in education is one of the key decisions that household make regarding their children. Education is the crucial determinant of human capital invested in children. There is a wealth of anecdotal evidence that points to the bias against sending girls versus boys to school in developing country households, particularly in South Asia. Nevertheless, empirical studies quantifying the factors affecting schooling attainment within a rigorous analytical framework and correcting for the econometric problems discussed later are few, particularly for India.

All of the studies find that parental characteristics such as education affect educational attainment of children and in most cases father's education has a greater impact on sons and vice-versa for

4. Tata Services Ltd, Department of Economics and Statistics. *Statistical Outline of India, 1994-95*. 1991 Census data.
5. Behrman, J. "Intrahousehold Alloation of Nutrients in Rural India: Are Boys Favored? Do Parents Exhibit Inequality Aversion?" *Oxford Economic Papers*. Vol. 40.

mothers. Household income is also important determinant of schooling.

Few of the studies include variables reflecting the schooling system, except some which include the distance to schools. Most of the studies use OLS to estimate determinants of children's schooling attainment. These include Unni on Gujarat in India (1996), Shariff on India (1996), Handa on Jamaica (1996), Jamison and Lockheed (1987) on Nepal, Case and Deaton (1996) on South Africa, Chernichovsky (1985) on Botswana and Parish and Willis (1993) on Taiwan.

Agnes Quisumbing (1995) uses survey data from three generations in rural Philippines to examine the role of inter-generational transfers of education and land to children. Her study concludes that "grandparents significantly affect gender specific investments in children's education only in resource-constrained families".[6] Parental characteristics such as education also affect gender bias in education. The panel nature of her data allows her to use fixed and random effects specifications.

Aysit Tansel (1997) uses LSMS data from Ghana to estimate a schooling model using a two limit tobit model.[7] The potential endogeneity of household income is corrected for using an instrumental variables procedure (as in this paper). In addition to household and individual characteristics, distance to schools is included. Nevertheless, no other factors describing the schooling system are included.

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6. Quisumbing, Agnes R. "The Extended Family and Intrahousehold Allocation: Inheritance and Investments in Children in the Rural Philippines". *FCND Discussion Paper*, IFPRI, Washington D.C. : March, 1995.

7 Tansel, Aysit. "School Attainment, Parental Education and Gender in Cote D'Ivoire and Ghana," *Journal of Educational Development and Cultural Change*, 45: 4, July, 1997.

Nancy Birdsall's was one of the first studies using Brazilian census data to study the effects of public inputs such as the quality of schooling on children in rural and urban areas. This is one of the few studies that combines household data along with some features of the schooling system to analyze schooling attainment. She finds that public inputs in schooling are critical determinants of schooling for children. Her measures of the quality of schooling (the mean education of teachers in the area and average teacher's salaries) however, are crude. She does, nevertheless, correct for possible sample selection bias.[8] Other studies including school quality are those by Hanushek and Lavy[9] Case and Deaton (1996) and Behrman and Wolfe (1986, 1987).[10]

Another empirical analysis by King and Lillard focuses on the bias introduced by censoring in estimating the impact of the determinants of schooling attainment in the Philippines.[11] They use an ordered multinomial choice model to correct for right censoring of their observations. This paper draws on this methodology to correct for censoring. Glewwe and Jacoby (1992) use this methodology for Ghana and Jessica Holmes (1997) uses it for Pakistan.[12]

Duraisamy used household level survey data from Tamil Nadu, a state in South India, to study gender differences in child schooling in

8. Birdsall, Nancy. "Public Inputs and Child Schooling in Brazil." *Journal of Development Economics* (18) pp. 67-86 North Holland, 1985.
9. Hanushek, Eric and Victor Lavy. "School Quality, Achievement Bias and Dropout Behaviour in Egypt." *The World Bank*, LSMS Working Paper no. 107.
10. Berhman, J. and Wolfe. B. "Investments in Schooling in Two Generations in Pre-Revolutionary Nicaragua." *Journal of Development Economics* 27: 395-419, 1987.
11. King, Elizabeth M. and Lee. A. Lillard. "Determinants of Schooling Attainment and Enrollment Rates in the Philippines." RAND, Santa Monica, April, 1983.
12. Glewwe, Paul and Hanan Jacoby. "Estimating the Determinants of Cognitive Achievement in Low-Income Countries: the Case of Ghana." *The World Bank*, LSMS Working Paper No. 91, 1992.

urban and rural areas. His measures of schooling include enrollment (i.e. whether enrolled in school or not) and grade attainment (i.e. number of years of schooling achieved, not accounting for grade repeating). He includes parents' characteristics such a mother's and father's education, a proxy for consumption expenditure per adult (to control for income) and, where available, distance from schools as explanatory variables. He also estimates a fixed effects model to control for community specific variables such as the quality of schools that could bias the coefficient estimates if correlated with included variables. Lack of data precludes him from including these as independent variables in his estimation. Duraisamy's paper is one of the first attempts to directly estimate determinants of schooling by gender in India. However, he does not include any variables except distance to schools that reflect the schooling system.[13]

Duraisamy and Malathy conduct another study using district level data in order to get wider geographical coverage to study gender bias issues in India. They use data on public program subsidies to schooling to account for inter-regional differences within the country.[14]

Jeemol Unni uses survey data from the rural areas of five districts in Gujarat to study some of the determinants of schooling and the differences in schooling between boys and girls.[15] She estimates OLS

13. Duraisamy. "Gender, Intrafamily Allocation of Resources and Child Schooling in South India." and Tansel, Aysit. "School Attainment, Parental Education and Gender in Cote D'Ivoire and Ghana." Center Discussion paper no. 692, Economic Growth Center, Yale University, 1993.

14. Duraisamy and Malathy. "Impact of Public Programs on Fertility and Gender Specific Investment in Human Capital of Children in Rural India." In *Research in Population Economics* ed. Paul Schultz. Vol. 7, 1991, p. 179.

15. Unni, Jeemol. "Who is Schooled and Why? Gender Differentials in Education." Presented at the Conference on Gender Perspective in Population, Health and Development at NCAER, January, 1996.

regressions for the completed grades of schooling with household and individual characteristics as explanatory variables. Using the number of children in the household as a regressor is, however, problematic since it is an endogenous variable. Once again none of the empirical problems that plague OLS estimation in this contest are discussed or corrected for in her paper.

Jean Dreze and Mrinaline Saran conduct case studies and provide an interesting comparison of education and gender differences in education in two villages: Palanpur in North India and She Tan in China.[16] They highlighted the poor quality of the schools and teaching in Palanpur as being important determinants of low educational achievement.

This survey reveals the preliminary nature of the research on household decisions in the allocation of education in low income countries in general and in India, in particular. Characteristics of the schooling system have been particularly neglected as have characteristics of the household besides income and parental education. In fact, the study of schooling attainment in general suffers from a lack of attention to factors such as the direct and indirect costs of schooling and school quality. In addition, as mentioned earlier, several important empirical problems have scarcely been dealt with in most previous studies (and in none of the studies on India). Some of these will be addressed in this paper.

16. Dreze, Jean and Mrinaline Saran. "Primary Education and Economic Development in China and India: Overview and Two Case Studies", September, 1993, p. 64.

THEORETICAL MODEL

The intra-household behaviour literature distinguishes between three theoretical models of resource allocation within the household. The first is the unified preference function or consensus approach. The second is the Nash-bargaining approach. Finally, there is the collective approach where pareto efficient allocations of household resources are derived. The first, which has been the traditional approach, assumes that households have unified preferences and thus maximize a joint utility function to determine demands for goods (including schooling) and leisure. In this framework, gender bias manifests itself in the different weights parents assign to children of opposite sexes in their utility function and whether parents pursue equity or efficiency in the allocation within household.[17] This model, however, assumes that individual preferences are aggregated by the household or that there are 'altruistic' parents. An alternative approach, the bargaining model developed by McElroy and Horney, assumes different individual preferences which are reconciled by a bargaining process to produce a joint decision making model. The strength of individual bargaining powers is critical to this model.[18] Individuals have separate utility functions in this model. Chiappori questioned the rigid structure imposed by a bargaining model of this type and proposed a third collective approach where individuals have altruistic preferences and consume private as well as public goods.[19] In a series of papers,

17. Patton, Jessica. "The Intra-Household Allocation of Resources in the Cote d'Ivoire: Is there Evidence of Gender Bias? Development Studies Working Papers, Centro Studi Luca D'Agliano - Queen Elizabeth House, 1993, pp. 8-9.
18. McElroy and Horney. "Nash-bargained Household Decisions," *International Economic Review*, 1981, 22(2), pp. 333-50.
19. Chiappori, Pierre-Andre. "Rational Household Labour Supply," Econometrica, 1988, 56(1), pp. 63-89.

Chiappori and other authors have shown that any pareto efficient allocation of resources within households can be derived from the maximization of a weighted sum of individual utility function with appropriate weights.

Ideally it would be useful to test which model is supported by my data. However, the lack of data on asset ownership and individual non-labour income by gender (which are indicators of the bargaining power of individuals within a household) prevents a direct test of the alternative models.

A common preference utility function is adopted here where altruistic parents maximize a joint household utility function (in accordance with Becker's 1965 household production model).

The utility function has the form:

$$\text{Max. } U = U(C, N_B, N_G, S_i, R_B+R_G)$$

(derived from King and Lillard, 1983)

i = boy or girl

where S_i is the years of schooling for the child, C is the composite consumption good, N_i is the number of boys or girls and R_i is the discounted potential lifetime earnings of the child.

The household maximizes this utility function subject to a full income budget constraint which has the form:

$$Y+V+N_iW_iT_I - P_iS_iN_i - P_CC >= 0$$

Where Y is earned income of the parents, V is their non earned income, W_i is the market wage of the child, T_i is the time spent by the child in wage work, P_i is the price of schooling for the child (including

direct and indirect costs such as the opportunity cost of time) and P_C is the price of the consumption good.

The household is also constrained by an earnings production function for boys and girls which has the form:

$$R_i = f[\alpha_i(S_i), S_i, X, Z]$$

Where $\alpha_i(S_i)$ is the returns to schooling (per year), X is a vector of schooling inputs, Z is a vector of household characteristics such as education of the mother and father.

Thus the reduced form determinants of the quantity of schooling are:

$$S_i^* = F(Y, V, P_i, P_c, W_i, X, Z,) \text{ where } i = \text{boy/girl.}$$

Thus schooling demand for boys and girls depends on earned and non-earned income, the cost of schooling and the composite consumption good, child specific characteristics, family background, community and school characteristics. The empirical counterparts to these variables and the testable hypotheses will be discussed in the following sections.[20]

DATA

The data used are from a household survey of 35,130 rural Indian households drawn from sixteen states in 1993-94 conducted by NCAER (National Council of Applied Economic Research), India. Further, surveys of the 1765 villages where these households lived were also conducted as part of the same project. Data from these have also been used. A multi-stage sampling design was used for the survey. Districts (sub-units within states) were cross-classified. Income from agriculture and the rural female literacy rate were the variables used to form

20. Child wages are not included in the empirical analysis due to data limitations.

homogenous strata. From these strata, a certain number of districts were selected with probability proportional to the rural population in the district. Further, villages were chosen linear systematically with sampling intervals chosen to be partially self-weighting.[21]

All variables pertain to each child between the ages of 6 and 14 years. This sample contains 41,922 observations. Data on children who may have left the household more than six months before the survey are not available. However, all children who live in the household are inclued. Village level variables act as measures of community opportunities, services and prices for the 1765 villages sampled. Table 1 provides the summary statistics pertaining to the data set.

Table 1
Means and Standard Deviations of Variables

VARIABLE	ALL		MALE		FEMALE	
	MEAN	STD. DEV	MEAN	STD. DEV	MEAN	STD. DEV
If ever enrolled	0.71	0.45	0.77	0.42	0.65	0.48
(Yes=1, No =0)						
Schooling Attainment	1.09	0.90	1.19	0.89	0.99	0.91
(0 = none, 1 = below primary, 2= primary school, 3 = middle school						
Sex	0.53	0.5	NA	NA	NA	NA
(M = 1, F = 0)						
Sex of household head	0.96	0.2	0.96	0.19	0.96	0.19
(M = 1, F = 0)						
Age (years)	9.84	2.59	9.86	2.59	9.8	2.58
Father's education	1.59	1.79	1.59	1.8	1.59	1.79
(0=none, 1=below primary, 2 = primary school, 3=middle school)						
Mother's education	0.59	1.18	0.59	1.17	0.6	1.18
(0=none, 1=below primary, 2 =						

21. NCAER draft report on HDI indicators using this data set. *See* also Shariff and Sudarshan (1995) *(Contd.)*

(Table 1 Contd.)

VARIABLE	ALL		MALE		FEMALE	
	MEAN	STD. DEV	MEAN	STD. DEV	MEAN	STD. DEV
primary school, 3=middle school)						
Social background	0.64	0.48	0.64	0.48	0.65	0.48
(SC/ST): Yes = 1, No = 0						
Major source of Income	0.85	0.36	0.85	0.36	0.85	0.36
(Agricultural =1, Non-agricultural=0)						
Per capita income (Rs)	4052	4779	4078	4445	4022	5124
Distance from primary school (km)	0.16	0.68	0.16	0.68	0.16	0.68
Distance from middle school (km)	1.13	1.72	1.13	1.72	1.13	1.72
Male teachers as a % of total teachers	0.76	0.29	0.76	0.29	0.76	0.29
Proportion of trained teachers	0.65	0.35	0.65	0.35	0.65	0.35
Free Uniform	0.10	0.30	0.10	0.30	0.10	0.30
(Yes =1, No = 0)						
Free meals at school	0.16	0.37	0.16	0.36	0.16	0.37
(Yes =1, No = 0)						
Free slates and books	0.23	0.42	0.23	0.42	0.23	0.42
(Yes =1, No = 0)						
Scholarships	0.15	0.36	0.15	0.36	0.16	0.36
(Yes =1, No = 0)						
Other such programs	0.10	0.30	0.10	0.29	0.10	0.31
(Yes =1, No = 0)						

Educational attainment is modelled using different indicators that are constructed using the survey data.

Firstly, enrollment is used as a reflection of the educational status of children in the households. The dependent variable here is whether the child has ever been enrolled in school at all. All children between the ages of six and fourteen are included in the sample. Since it is a binary variable, a probit analysis has been done. A logit model was also estimated. The results are not significantly different. Thus only the probit results are reported here (*See* Table 2). The results are discussed in detail later. It is observed in the data that 28.57% of the children in

the sample were never enrolled in school at all. For girls this proportion is as high as 35.07% of all girls in this age group. For boys the same proportion is 22.71%.

Table 2
Enrollment in School: Probit Analysis Marginal Effects
Dependent variable: whether person was ever enrolled in school Yes=1 No = 0

VARIABLE	ALL		FEMALES		MALES	
	Without state dummies	State dummies included	Without state dummies	State dummies included	Without state dummies	State dummies included
Sex	0.13 (25.80)	0.14 (27.37)	NA	NA	NA	NA
Father's education	0.06 (27.56)	0.06 (29.12)	0.07 (20.21)	0.07 (21.70)	0.06 (18.95)	0.06 (19.77)
Mother's education	0.08 (16.35)	0.06 (13.2)	0.12 (14.95)	0.09 (12.05)	0.04 (8.11)	0.03 (6.44)
Sex of hh head	0.03 (1.58)	0.05 (2.48)	0 (0.09)	0.03 (0.79)	0.06 (2.39)	0.07 (2.80)
Social background	0.04 (8.94)	0.04 (7.57)	0.06 (6.46)	0.05 (5.27)	0.04 (6.01)	0.03 (5.50)
Income source	0 (0.31)	-0.03 (3.61)	-0.02 (1.74)	-0.04 (3.76)	0.01 (1.17)	-0.01 (1.65)
*Ln per capita income	0.08 (7.65)	0.09 (9.57)	0.09 (5.47)	0.13 (7.91)	0.07 (5.46)	0.07 (5.74)
Distance from primary school	-0.01 (1.83)	-0.01 (1.79)	-0.02 (2.83)	-0.01 (1.93)	0 (0.29)	0 (0.64)
Distance from middle school	-0.01 (4.57)	-0.01 (5.18)	-0.01 (2.98)	-0.01 (4.34)	-0.01 (3.24)	-0.01 (2.81)
Male/Total teachers	-0.15 (15.26)	-0.07 (6.89)	-0.21 (13.82)	-0.11 (6.73)	-0.09 (7.72)	-0.04 (2.96)
Trained/total teachers	-0.01 (1.10)	-0.01 (0.95)	-0.02 (1.50)	-0.01 (0.82)	0 (0.07)	0 (0.29)
Free uniform	0 (0.64)	0 (0.25)	0.02 (1.21)	0.02 (1.05)	-0.02 (2.04)	-0.02 (1.30)
Free meals	0.09 (11.29)	0 (0.42)	0.10 (8.39)	0 (0.32)	0.07 (7.91)	0.01 (0.55)
Free books	0 (0.11)	-0.01 (1.78)	0.02 (1.72)	-0.02 (1.98)	-0.01 (1.64)	0 (0.55)
Scholarships	0.02 (3.17)	0.02 (1.94)	0.02 (1.56)	0.01 (1.03)	0.03 (3.00)	0.02 (1.96)
Other programs	0.06 (7.38)	0.04 (4.53)	0.09 (6.48)	0.05 (3.30)	0.04 (4.05)	0.03 (2.98)
Dage: 7 years	0.20 (19.67)	0.20 (19.73)	0.19 (11.08)	0.2 (11.48)	0.19 (16.52)	0.19 (16.16)
Dage: 8 years	0.25	0.26	0.25	0.27	0.24	0.24

(Contd.)

(Table 2 Contd.)

VARIABLE	ALL		FEMALES		MALES	
	Without state dummies	State dummies included	Without state dummies	State dummies included	Without state dummies	State dummies included
	(26.19)	(26.98)	(15.61)	(16.55)	(21.37)	(21.72)
Dage: 9 years	0.32 (28.83)	0.32 (28.37)	0.33 (18.11)	0.33 (17.89)	0.30 (22.37)	0.29 (22)
Dage: 10 years	0.29 (30.29)	0.30 (31)	0.27 (16.91)	0.28 (17.55)	0.29 (25.66)	0.29 (26.10)
Dage: 11 years	0.34 (28.98)	0.34 (28.37)	0.32 (16.64)	0.32 (16.61)	0.35 (23.65)	0.33 (23.15)
Dage: 12 years	0.28 (27.81)	0.29 (28.28)	0.27 (16.15)	0.29 (16.79)	0.27 (23.00)	0.27 (23.08)
Dage: 13 years	0.29 (27.92)	0.28 (27.13)	0.25 (14.86)	0.25 (14.45)	0.30 (24.17)	0.29 (23.62)
Dage: 14 years	0.27 (25.26)	0.26 (24.79)	0.23 (13.27)	0.24 (13.18)	0.28 (21.97)	0.27 (21.51)
No. of observations	31016	31016	14590	14590	16426	16426
Chi-squared Statistics	Chi(24) 7229.33	Chi(39) 8395.44	Chi(23) 3645.38	Chi(38) 4403.76	Chi(23) 3207.44	Chi(38) 3758.73

* The natural logarithm of per capita income is instrumented for using area of cultivated land owned by the household. This is predicted logarithm of per capita income.

Note: All standard errors have been corrected for heteroscedasticity using White's correction.[22] T-statistics in parentheses.

OLS estimations were carried out to model schooling attainment in terms of the level of schooling achieved. However, using OLS is not the best estimation procedure to use due to several problems that are discussed in the next section. Several alternative procedures have been used. These are discussed in the following section. All procedures use 'schooling attainment' as the dependent variable. There are four categories: A value of 0 is equivalent to no schooling at all, 1 signifies completion of less than primary level of Schooling, 2 is equivalent to completing primary school and 3 is equivalent to completing middle school. Primary school usually entails completing Grade V in most regions of the country. Middle school entails completing Grade VIII.

22. White's method corrects the variance-covariance matrix. It is used because it is a general test and does not make any assumption about the nature of heteroskedasticity.

The explanatory variables that have been used are common to both dependent variables and all estimation procedures. They can be divided into two broad categories: demand side factors including characteristics of the individual and of the household, and supply side factors which are characteristics of the schooling system.

Individual characteristics included are dummy variables for each age (so as not to impose a pattern on the data) and a dummy variable for the sex of the child. Household characteristics include the educational level of each parent (measured in the same manner as schooling attainment of the children). A dummy variable for the sex of the head of the household is also included. The social background of the household is included to explore the effect of caste and social status on education. This is a dummy variable where 0 indicates that the child belongs to a scheduled caste or tribe (backward castes) and 1 that he/she does not i.e. that the child is from a 'higher' caste household. Per capita income is included to study the impact of financial constraints on schooling attainment. This is a potentially endogenous variable. The method used to correct for the endogeneity is discussed in the section entitled 'Empirical Problems in Estimation'. Income per adult would be a more suitable measure since per capita income does not exclude fertility decisions. However, this variable is not available in my sample. It will be used, if possible, instead of per capita income in future work.

The supply side regressors include the distance from primary and middle schools. These have been cited in the literature as being an important determinant of schooling.[23] The qualitative studies

23. *See* Tansel (1993), Duraisamy (1993) and King and Lillard (1983).

undertaken by NCAER cite interviews with parents who were reluctant to send their daughters to school, particularly after they had attained puberty, if the schools were far because they feared for their safety. The proportion of male teachers to the total number of teachers in the village schools have also been included as explanatory variables. The qualitative/sociological literature suggests that large numbers of male teachers often discourage parents from sending their girls to school.[24]

The proportion of trained to total teachers is used as an indicator of the quality of schooling. The measure of trained teachers is obtained by dividing the sample into trained teachers: who are either graduates with training, graduates without training or have completed Grade XII with training, and untrained teachers form the rest of the sample. Finally, also included are dummy variables to indicate whether any incentive schemes are offered by the schools in the village. These include free uniforms, slates and books, mid-day meals, scholarships or any other programs. Other programs include free boarding for some students, merit scholarships, free footwear and other programs. Such schemes serve to reduce the financial burden of education on parents and are thus expected to have a positive effect on schooling attainment, perhaps differentially by gender.

All estimation procedures have been applied to the entire sample of all children between 6 and 14 years of age with a dummy for sex included, as well as to separate samples of only girls and only boys.

EMPIRICAL SPECIFICATION

This paper models the household's demand for schooling attainment of children within an econometric framework. The reduced

24. *See* Saxena, Singh and Gupta (1995) for evidence on several states in India.

form equation that is estimated using different estimation techniques for both schooling enrollment and schooling attainment as dependent variables is:

$$E_{ij} = a + b*C_{ij} + c*M_j + d*F_j + e*H_j + f*V_i + \varepsilon_{ij}$$

where:

E_{ij}: educational attainment for child i,in household j (captured by different indicators explained in more detail below)

a: a constant

C_{ij}: child specific characteristics

M_j: characteristics of the mother

F_j: characteristics of the father

H_j: other characteristics of the household

V_i: characteristics of the schooling system in the village of household j

ε_{ij}: error term

EMPIRICAL PROBLEMS IN ESTIMATION

1. Income As A Determinant of Schooling Endogeneity of Income and Measurement Error

Per capita income is included as an explanatory variable to capture the impact of financial constraints on education. Per capita income is, however, potentially endogenous. Schooling attainment is expected to depend on income in an environment where capital markets are imperfect. However, per capita income itself is influenced by the leisure/labour decisions of the household. In particular, income available increases if the mother works outside of household activities. The endogeneity issue arises because households in which more children are sent to school (or for longer periods of time) are likely to be the ones where the mother participates in the labour force.

Thus, schooling of children = f (per capita income) where f' >0

Per capita income = g (mother's work) where g' >0

Mother's work = h (schooling of children) where h' >0

⇨ Per capita income = g(h (schooling of children) = j(schooling of children) where j'>0

Thus we have a simultaneity problem where schooling determines income and vice-versa. If this endogeneity is not dealt with, OLS coefficients in the schooling equation will be biased upwards.

Another potential source of endogeneity in the schooling-income relation is the fact that income available also increases if the child works instead of going to school. Once again we observe a simultaneity problem.

Schooling of children = f (per capita income) where f' >0

Per capita income = g (child's work) where g'>0

Child's work = h (schooling of child) where h' <0

⇨ Per capita income = j (schooling of children) where j' <0

Thus, in this case, we would expect OLS estimates of the coefficient on per capita income in the schooling equations to be biased towards zero.

The direction of the bias caused by the endogeneity of mother's and child's labour supply cannot be specified with certainty, however, for a model with more than one regressor. The empirical results do indicate, nevertheless, that endogeneity does bias OLS estimates.

The problem of using income as an explanatory variable is further compounded due to likely measurement error. Survey data on household income are often plagued with measurement error. If this is not corrected

for, OLS estimates of the coefficient on per capita income would be biased towards zero.[25] The bias is caused by the correlation of the error term with the regressor that is measured with error, resulting in inconsistency of the OLS estimator.

This paper uses the instrumental variables technique to deal with the potential endogeneity as well as likely measurement error in the per capita income variable. The area of cultivated land owned by the household is used as the instrument for per capita income. This is likely to be correlated with household permanent income (particularly in rural areas as in my sample). Furthermore, since land is seldom bought or sold, the amount of land owned is not a choice variable linked with the household's labour/leisure decisions. It is thus expected to be highly correlated with per capita income but uncorrelated with the error in the schooling equation. Thus area of cultivated land owned by the household is used to identify this model.

Two stage least squares estimation has been used. The first stage involves regressing the natural logarithm of per capita income on all of the explanatory variables including the instruments. In the second stage predicted values from the first stage regression were included in an TSLS regression with schooling attainment as the dependent variable. The first stage results have also been reported in Appendix I as have the partial F-statistic and the partial R-squared in Table 8 in accordance with Bound *et al.*[26] The Hausman specification test was performed to test whether per

25. Greene, William. Econometric Analysis. New York: New York University, 1993,p. 281.
26. Bound, John, David A. Jaeger, and Regina M. Baker, "Problems with Instrumental Vriables Estimation When the Correlation Between the Instruments and the Endogenous Explanatory Variable is Weak," *Journal of the American Statistical Association,* 1995, 90: 430.

capita income is exogenous in the schooling equations. The test statistics reject the hypothesis that per capita income is an exogenous variable (*See* Table 9).

2. Left Censoring

A common problem that has seldom been addressed in the literature on schooling is that of left censoring. Since a large number of children in many developing countries are never enrolled in school at all, data on schooling often contain a large number of zeros for the dependent variable. In my sample this is true for 29% of all children, 23% of the male sample and as much as 35% of the female sample (*See* Table 1). There is thus a probability mass point at zero. The distribution of observed schooling is a censored distribution of desired schooling attainment. This is similar to the censoring problem that has received much attention in the labour supply literature where a large number of zeros are often observed for the number of hours worked by women. In this case it is inappropriate to use OLS since the assumption of linearity is not valid. Excluding the zeros is not valid either since this would introduce sample selection bias.

This paper estimates a tobit model where maximum likelihood estimation is used to correct for the left censoring observed in the data. The error is assumed to be normally distributed in the tobit model. The likelihood function is the product of the two likelihood functions for the observations that are zero and non-zero respectively. Maximum likelihood estimation provides consistent and efficient parameter estimates in this model. The general formulation of the model is:

$$y^* = \beta x + e,$$

$$y = 0 \text{ if } y^* <= 0$$

$$y = y^* \text{ if } y^* > 0$$

where y is observed schooling attainment and y^* is the latent variable and x is the vector of regressors.

The probability of participation in schooling (i.e. of ever being enrolled at all) is implicitly used in the computation of the likelihood function. However, this form of the tobit model, while dealing with left censoring, does not allow the coefficients of the probability of schooling equation and the schooling attainment equation to differ. It thus does not distinguish between zero schooling attainment and non-enrollment. This restriction has been relaxed in this paper by also estimating a generalized Tobit model with sample selection.[27]

In this model, the probability of schooling equation and the schooling attainment equations are estimated jointly allowing the coefficients on the regressors to differ across the two equations. Thus the restriction that the coefficients are the same which is imposed by the simple Tobit model is relaxed here.

The equation that determines the sample selection (i.e. the probability of enrollment model) is:

$$Z^* = \gamma' w + u$$

where the latent variable is $Z = 1$ if the child was ever enrolled

$Z = 0$ if the child was never enrolled

i.e. $Z = 1$ if $Z^* > 0$; $Z = 0$ else.

and w is the vector of regressors discussed above.

This is jointly estimated with the tobit model above:

$$Y = \beta' x + e$$

where Y is observed only if $Z = 1$

27. Amemiya, T. "A Review of Tobit Models", *Journal of Econometrics,* 1984, Vol. 24,pp. 3-63.

Y is the schooling attainment.
This is important when Cov(u,e) = ρ which is non-zero.

The generalized tobit procedure assumes a bivariate normal distribution for the errors in the two equations. In the case of my schooling model, x = w i.e. the explanatory variables are the same in the two equations. There is no *a priori* reason to believe that the regressors should be different. However, the coefficients might be different.

A likelihood ratio test is performed to compare the two versions of the Tobit model. The likelihood ratio is computed. It is $\lambda = L(R)/L(U)$ where L (R) is the estimated maximized likelihood from the unrestricted model i.e. the simple tobit model and L(U) is the estimated maximized likelihood from the unrestricted model i.e. the generalized tobit model. The likelihood ratio test statistic is :
$-2\ln(\lambda)$ which is a chi-squared statistic with the degrees of freedom equal to the number of restrictions.

3. Right Censoring

One major problem in studies of the determinants of schooling is that the final attainment for children who are still in school at the time of the survey is unknown. This is the problem of right censoring since we know that final schooling attainment is greater than or equal to the current number of completed years. This is particularly crucial for the young sample used in this paper, since 94% of the children who ever went to school at all are still in school at the time of the survey (due to the age group being limited to 6-14 years). Most previous studies of schooling attainment have failed to correct for this censoring problem in a satisfactory manner.

Drawing on King and Lillard, this paper uses an ordered multinomial choice model to account for the right-censored observations to obtain consistent and unbiased estimates of the coefficients. Most previous studies do not distinguish between children who have completed schooling and those who are still in school. As in King and Lillard, this paper distinguishes between those who have completed schooling and those who are still in school and the complete and incomplete spells contribute separately to the likelihood function. This model has the additional benefit that it accounts for the left censoring as well i.e. the mass point at zero discussed above, since schooling is treated as a discrete variable where successively higher levels of schooling attainment are interpreted as 'better' outcomes. This is thus our preferred specification. Since the dependent variable is ordinal in nature, the ordered probit framework is appropriate rather than a multinomial probit framework.

An ordered probit framework is used under the assumption that the error term is normally distributed. Define t as the desired schooling attainment.

$$t = \alpha X + e$$

where X is the vector of regressors and e is the residual term. However, t is unobserved. What is observed is the actual schooling attainment, S:

$$S = 0 \text{ if } t <= \tau_0$$

$$S = 1 \text{ if } \tau_0 < t <= \tau_1$$

and so on until

$$S = J \text{ if } \tau j\text{-}1 <= t$$

and so on. The τ's are unknown parameters (threshold levels of desired schooling) that are also estimated. For children who were not studying at

the time of the survey, the schooling attainment is assumed to be known i.e. it is the observed schooling category, S.

The likelihood function for these children who are no longer in school (uncensored observations) is:

$$L(U) = F((\tau_{s+1}) - \alpha'X) - F(\tau_s - \alpha'X) \text{ for } S = 0, 1 .....$$

F is the cumulative density function for the error term (in this case the normal cumulative density function).

However, for the children still studying in school, final attainment is unknown. We do know that the child will attain *at least* the level S or more i.e. the desired level of schooling, t is greater than the observed category of schooling, S.

$$\text{i.e. } \tau_{s-1} < t \text{ i.e. } \tau_{s-1} - \alpha'X < e$$

The likelihood function for these children (the censored observation) is:

$$L(C) = 1 - F(\tau_{s-1} - \alpha'X) = F(-(\tau_{s-1} - \alpha'X))$$

since that dF(e)/de is symmetric.

The likelihood function that is maximized is thus:

$$L = \pi L(U)\, \pi L(C).^{28}$$

RESULTS AND INTERPRETATION

Schooling Enrollment

The results of the probit analysis of enrollment in school are presented in Table 2. A five per cent significance level has been used consistently to evaluate and be able to compare the results of all the regressions. Asymptotic t-statistics are in parentheses for all tables. The marginal effects are reported here. *See* Appendix-I for the actual coefficients and t-statistics. State dummies (where included) have not

28. *See* Holmes, Jessica, "Measuring the Determinants of School Completion in Pakistan: Overcoming some empirical Issues," Yale university, 1996, for a good discussion of the ordered probit framework.

been reported for conciseness. However, there were all significant at the 5% level suggesting that there are state specific factors affecting enrollment that are not captured in this analysis.

What is striking about the above results is the strong positive impact that being of the male gender has on enrollment.[29] Being male increases the probability of ever being enrolled in school by 14%. Being of the female sex is indeed a disadvantage in terms of educational opportunities available to the child in a rural Indian household. In fact, the data reveals that only 64.93% of all girls between the ages of 6 and 14 years were ever enrolled in school at all, whereas 77.29% of boys in the same age group were enrolled. The overall enrollment rate in this age group was 71.43% (See Figure I). The gender bias in the intra-household allocation of education is evident.

Both father's and mother's educational attainment have a positive and statistically significant impact on enrollment. It is possible that better educated parents are less credit constrained and can thus invest more in schooling. They may also be able to reduce the cost of their child's schooling. Further, better educated parents may be more altruistic. Finally, better educated parents might enjoy the non-pecuniary benefits of child's schooling more than less educated parents.[30]

In fact, mother's education has a greater positive influence (of about 6%) on the probability that a girl will be enrolled in school than for a boy. Father's education has an almost identical impact on both boys and girls.

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29. The results discussed are always for the estimates where state dummies were included in the estimations unless otherwise specified.
30. This discussion draws on Tansel, Aysit, "School Attainment, Parental Education and Gender in Cote D'Ivoire and Ghana," Yale University, Economic Growth Center Discussion Paper No. 692, 1993.

Also, mother's education has a greater influence than father's education on the daughter's probability of enrollment. Similarly, father's education has a greater influence than mother's education on the son's enrollment. These results are similar to previous conclusions. Duncan Thomas finds using Brazilian data that mother's education has a bigger effect on her daughter's height whereas father's education has a bigger effect on his son's height.[31] Similarly, Jeemol Unni finds that mother's schooling positively affects daughter's schooling and has no impact on son's schooling and vice-versa for father's schooling in her study of Gujarat, India.[32] Duraisamy (for India) and Tansel (for Ghana and Cote D'Ivoire) find that mother's schooling has a bigger impact on the schooling of both boys and girls.[33]

Another parental characteristic that has a significant impact on enrollment in the pooled sample and on male enrollment is the sex of the household head. Boys in households with a male head have a seven per cent higher probability of being sent to school. Girls, on the other hand, do not derive the same benefit.

A household characteristic that stands out as being influential is per capita income. The coefficient on the natural logarithm of per capita income is positive and statistically significant in all estimations. This is consistent with a model for the demand for schooling in an environment with imperfect capital markets and credit constraints. The potential endogeneity of per capita income has been accounted for by using a two step instrumental variables procedure in the probit analyses. This is discussed in further detail in the section on the two stage least squares

31. Thomas, Duncan. "Like Father Like Son; Like Mother Like Daughter: parental Resources and Child Height," *Journal of Human Resources*, 1994.
32 Unni (1996).

procedure for the schooling attainment equation. What is particularly interesting is that income increases the probability of enrollment by 13% for girls but only by 7% for boys. This suggests that poorer households give preference to boys' education in the allocation of limited finances. Jeemol Unni finds similar results in her study of Gujarat.[34]

Being from a higher social caste positively impacts both boys and girls raising the probability of enrollment by 4% with a slightly higher impact on girls. 'Income source' also has a statistically significant impact in the pooled sample and the all girls sample only. Being from an agricultural as versus a non-agricultural household reduces the probability of enrollment for girls, but not for boys.

It is interesting to observe the impact of the supply side variables reflecting the state of the schooling system in the village. These have been neglected in previous studies, particularly in those on India. They are, however, potentially crucial determinants of schooling attainment. Distance from the primary school has a negative influence on the probability that a girl will be enrolled in school. While this is not statistically significant at the five per cent level, it is significant at the six per cent level. Primary school distance is, however, statistically insignificant for the male sample. Distance from the middle school is negative and highly significant for the enrollment equations for both boys and girls. Primary school distance is a bigger deterrent and reduces the probability of girls enrolling in school by 2% while middle school distance reduces this probability by 1%. Tansel finds this in her study of Cote d'Ivoire.[35]

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33. Tansel (1993) and Duraisamy (1993).
34. Unni (1996).
35. *See* Tansel (1993).

Since distance is an indicator of the indirect price of schooling (acting as a proxy for transport costs and the opportunity cost of time), it is expected to impact girls more than boys. While there is no *a priori* theoretical reason to expect it, this is a result that has been supported by the previous empirical studies that do include distance to school as a variable.[36] Girls' education may be more price elastic if the opportunity cost of time are higher for girls who help with household chores. Safety concerns are often greater for girls. Thus the implicit price fall associated with closer schools would be greater for girls. This is supported by the 'distance to primary school' variable. While distance reflects the time and expenditure incurred in sending children to school, it may also indicate safety concerns (particularly for girls).

It is striking to note that the proportion of male teachers in the schools in the village has a negative and significant effect on enrollment. A higher proportion of male teachers reduces the probability of girls' enrollment by 11% and boys' enrollment by 4%. This may be interpreted as parents being more reluctant to send their daughters to school if the teacher is male in a traditional Indian household. Concerns for safety of the daughters as well as cultural values restrict girls' interaction with men, particularly after they attain puberty. The lower, but still significant impact on boys, enrollment, may imply that the proportion of male teachers is also perceived as a (negative) indication of the quality of schooling.

The proportion of trained teachers, which has been used as an indicator of the quality of schooling, does not have a significant influence on enrollment for boys or girls. Amongst the incentive schemes offered

36. Tansel finds this in Ghana, see Tansel (1993) p.15, Duraisamy finds similar results for distance to middle school in India; *see* Duraisamy (1993).

by schools to encourage enrollment, providing scholarships positively and significantly affect enrollment for boys and for the whole sample (at the 6% level). 'Other programs' such as free boarding for poor students, free footwear in some states and scholarships to poorer students, particularly girls, positively and significantly affect enrollment for both boys and girls. These are incentive schemes that relieve the financial burden on households and thus encourage enrollment. In another study of the impact of free textbooks and uniforms by Kremer *et al.* in rural Kenya, they found that free textbooks encouraged enrollment and reduced drop out rates; however test scores were not affected significantly.[37]

It is interesting to compare the impact of all these factors when state dummies are not included in the estimations to when they are included. This is particularly interesting for the schooling characteristics that are included in the model since they may reflect other state specific policies or variables that are excluded. Both distance to primary school and distance to middle school are robust to the specification including state dummies. The marginal effects remain virtually unchanged and they remain significant. The impact of the proportion of male teachers is approximately halved when state dummies are included. However, it continues to be a significant variable. The other variables that are significant in the specification including state dummies are school provision of scholarship and 'other programs'. The marginal impact of these variables falls slightly and significance levels rise when compared with the model that excludes state dummies. Nevertheless, they remain significant at the 5% level (at the 6% level for scholarships in the pooled sample). The factor that becomes significant and has a large marginal

37. Kremer, Michael, Sylvie Moulin, David Myatt, and Robert Namunyu. "Textbooks, Class Size, and Test Scores: Evidence From a Prospective Evaluation in Kenya." Paper presented at Microeconomics Workshop on Labour and Population, March 7, 1997.

impact of about 9% when state dummies are excluded is the dummy variable representing whether schools provide free midday meals. On the other hand, in the specification including state dummies, midday meals have a negligible marginal effect close to zero and are insignificant. There is a wide disparity across states in the proportion of schools that provide free meals. When state dummies are included the within state variation in provision of meals and its impact on enrollment is not captured by this model. It will be interesting to study the impact of midday meals and the other schemes for the particular states where a large proportion of schools do provide them in further research.

In order to test whether the coefficients of the variables for the male and female samples are statistically different, I also estimated the probit model including interaction terms of these variables with the dummy for gender. The variables that had statistically differential impact at the 5% level were mother's education, distance from primary school, the proportion of male teachers and the provision of free books and 'other programs'. All of these thus have a significant larger effect on the probability of girls' enrollment than on the probability of boys' enrollment.[38]

SCHOOLING ATTAINMENT

The key empirical problem that has been largely neglected in the studies of schooling attainment is that of left and right censoring. In our sample, the enrollment rate is 71%. Thus 29% of the observations on dependent variable are zero. In addition, in the sample that this paper uses, 94% of the children who went to school at all were still in school at the time of the survey. Thus the final schooling attainment of these

38. The provision of free books has a strange negative impact on girls' enrollment.

children is unknown. An OLS estimation procedure ignores both left and right censoring and assumes that current schooling attainment is the same as final atainment. Nevertheless, this is the most commonly used estimation in the literature. While both tobit and the generalized tobit procedures discussed earlier correct for this left censoring, they do not deal with the right censoring. An ordered probit model is estimated to include both uncensored and right-censored observations (as discussed in the section on 'Empirical Specification' earlier). Since this treats schooling attainment as an ordinal variable, it takes into account both left and right censoring and is our preferred specification. The results are reported in Table 3.

Table 3
Censored Ordered Probit Estimates

VARIABLE	ALL		FEMALE		MALE	
	State dummies excluded	State dummies included	State dummies excluded	State dummies included	State dummies excluded	State dummies included
Sex	0.46 (29.22)	0.49 (30.74)	NA	NA	NA	NA
Father's education	0.22 (39.47)	0.24 (41.87)	0.21 (26.50)	0.24 (28.90)	0.24 (30.10)	0.25 (31.30)
Mother's education	0.25 (25.56)	0.21 (20.09)	0.32 (23.22)	0.26 (18.03)	0.18 (12.15)	0.15 (9.40)
Sex of hh head	0.13 (1.98)	0.20 (2.98)	-0.03 (0.29)	0.06 (0.59)	0.283 (3.06)	0.33 (3.36)
Social background	0.18 (10.81)	0.16 (9.96)	0.17 (7.18)	0.16 (6.97)	0.18 (7.94)	0.18 (7.42)
Income source	0 (0.01)	-0.06 (2.69)	-0.05 (1.66)	-0.10 (3.04)	0.05 (1.50)	-0.04 (1.08)
Ln per capita income	0.15 (14.06)	0.14 (12.70)	0.18 (12.32)	0.18 (11.67)	0.11 (7.35)	0.10 (6.39)
Distance from primary school	-0.02 (1.40)	-0.02 (1.16)	-0.05 (2.44)	-0.03 (1.49)	0.01 (0.73)	0 (0.12)
Distance from middle school	-0.03 (6.65)	-0.03 (7.21)	-0.03 (3.88)	-0.04 (5.59)	-0.03 (5.24)	-0.03 (4.43)
Male/Total teachers	-0.50 (17.13)	-0.25 (7.77)	-0.66 (16.11)	-0.37 (8.03)	-0.34 (8.06)	-0.14 (2.89)
Trained/total teachers	0.01 (0.51)	0.01 (0.43)	-0.02 (0.64)	0 (0.05)	0.05 (1.44)	0.03 (0.88)
Free uniform	-0.03 (1.10)	-0.02 (0.64)	0.04 (1.03)	0.04 (0.89)	-0.11 (2.65)	-0.08 (1.77)

(Contd.)

(Table 3 Contd.)

VARIABLE	ALL		FEMALE		MALE	
	State dummies excluded	State dummies included	State dummies excluded	State dummies included	State dummies excluded	State dummies included
Free meals	0.25 (10.32)	0 (0.02)	0.25 (7.55)	0 (0.03)	0.26 (7.36)	-0.02 (0.37)
Free books	0.01 (0.38)	-0.04 (1.67)	0.07 (2.35)	-0.05 (1.55)	-0.05 (1.63)	-0.03 (0.86)
Scholarship	0.08 (3.42)	0.04 (1.60)	0.06 (2.09)	0.03 (0.92)	0.09 (2.77)	0.06 (1.52)
Other program	0.17 (6.30)	0.11 (3.91)	0.22 (5.83)	0.13 (3.09)	0.12 (2.98)	0.10 (2.31)
Dage: 7 years	0.71 (23.51)	0.72 (23.21)	0.59 (13.73)	0.62 (14.00)	0.81 (18.94)	0.80 (18.28)
Dage: 8 years	0.86 (29.91)	0.89 (30.39)	0.75 (18.04)	0.80 (18.76)	0.96 (23.72)	0.99 (23.87)
Dage: 9 years	1.12 (32.15)	1.12 (31.75)	1.00 (20.36)	1.01 (20.36)	1.23 (24.42)	1.22 (23.96)
Dage: 10 years	0.99 (34.06)	1.03 (34.57)	0.80 (19.36)	0.85 (20.03)	1.18 (28.33)	1.21 (28.30)
Dage: 11 years	1.17 (31.59)	1.17 (31.22)	0.97 (19.08)	0.99 (19.27)	1.38 (25.06)	1.36 (24.49)
Dage: 12 years	1.00 (32.70)	1.02 (33.06)	0.84 (19.25)	0.88 (19.98)	1.14 (26.44)	1.16 (26.38)
Dage: 13 years	1.02 (33.56)	1.02 (33.27)	0.80 (18.64)	0.80 (18.48)	1.24 (28.18)	1.24 (28.04)
Dage: 14 years	0.94 (30.58)	0.94 (30.19)	0.71 (15.94)	0.73 (16.04)	1.15 (26.65)	1.14 (26.10)
Constant	-1.90 (17.34)	-0.82 (4.82)	-1.70 (10.94)	-0.67 (2.97)	-1.61 (10.23)	-0.58 (2.27)
No. of observations	33174	33174	15636	15636	17538	17538
Chi-squared	Chi(24) 44753.33	Chi(39) 45749.05	Chi(23) 19067.7	Chi(38) 19781.52		Chi(38) 25768.16

Note: State dummies were included in all estimations and were significant. They have not been reported for conciseness. T-statistics in parenthesis.

The impact of the individual and household factors on schooling attainment are similar to their effect on the probability of enrollment (discussed earlier). The reasons why these are influential are similar to those discussed for schooling enrollment. They are thus not repeated here. Once again, being female has a strongly negative and significant impact on schooling attainment. Both father's and mother's education positively affect schooling attainment and are significant. Similar to its effect on enrollment, mother's education has a greater influence on the schooling

attainment of a girl than that of a boy (and a greater influence than father's education). Father's education has a slightly bigger impact on boys (and a bigger impact than mother's education). King and Lillard find the same results for schooling of children in the Philippines.[39] Having a male household head has a positive impact on the schooling attainment of boys, but not girls. The impact of belonging to a higher caste is also positive and significant for both girls and boys. Being from an agricultural as compared to a non-agricultural household has a negative and significant impact on the schooling attainment of girls only. Jeemol Unni finds similar results in her paper on Gujarat.[40] Per capita income is a significant determinant of schooling attainment, with a greater impact on girls, as in the case of enrollment.

Amongst the school related factors, the variables that significantly affect schooling attainment are the distance from middle school, the proportion of male teachers in the school and the provision of 'other programs' as incentives to encourage children to come to school. The distance to middle school and the provision of 'other programs' have a slightly greater effect on girls than on boys. As in the case of enrollment, a higher proportion of male teachers in the schools discourages girls from continuing onto higher grades. The impact is larger for girls than for boys. Primary school distance seems to be a significant deterrent to enrolling girls, but not for continuing their education once they are enrolled. Similarly, scholarships provided by schools are successful in inducing more boys to enroll in school but do not have a significant effect on years of schooling completed once they are enrolled.

39. King and Lillard (1983).
40. Unni (1996), p.6.

Once again we can compare these results to the estimations where state dummies are not included. While distance to middle school is not affected by this specification, primary school distance and the provision of free books become significant determinants of girls' schooling attainment when state dummies are excluded. Scholarships and mid-day meals are also significant determinants of schooling attainment for boys and girls in the model where state dummies are excluded. As in the probability of enrollment model, the impact of the proportion of male teachers at school is approximately halved. Nevertheless, it continues to be significant. Thus, when state dummies are included, the within state variation for some of the schooling variables and their impact on schooling attainment in those states are not captured by our model.

The coefficients from the ordered probit model cannot be directly compared with those from OLS. The marginal effects of changes in the regressors on schooling attainment are thus reported in Table 4, 5 and 6. These are the derivatives of the expected value of schooling attainment with respect to each regressor. For the regressors with positive coefficients, a marginal increase in x, the regressor, shifts the predicted probability distribution of schooling attainment to the right. As the marginal effects reveal, the impact of all the regressors with positive coefficients are to shift the probability distribution enough to the right so that the probability of completing 'level 3' i.e. middle school, rises and therefore the probabilities of completing 'below primary' and 'primary' school fall. Similarly, the marginal impact of the explanatory variables with negative coefficients are large enough to reduce the probability of completing middle school and thus slightly increasing the probability of completing pre-primary and primary school.

Table 4
Censored Ordered Probit: Marginal Effects (All)

VARIABLE	ATT=0	ATT=1	ATT=2	ATT=3
Sex	-0.142	-0.023	-0.029	0.193
Sex of hh head	-0.056	-0.009	-0.011	0.077
Father's education	-0.069	-0.011	-0.014	0.094
Mother's education	-0.061	-0.010	-0.012	0.083
Income source	0.018	0.003	0.004	-0.025
Ln per capita income	-0.040	-0.006	-0.008	0.055
Social background	-0.048	-0.008	-0.010	0.065
Distance from primary school	0.004	0.001	0.001	-0.006
Distance from middle school	0.010	0.002	0.002	-0.013
Male/Total teachers	0.073	0.012	0.015	-0.010
Trained/total teachers	-0.003	-0.001	-0.001	0.004
Free uniform	0.006	0.001	0.001	-0.008
Free meals	0	0	0	0
Free books	0.012	0.002	0.002	-0.016
Scholarships	-0.012	-0.002	-0.002	0.016
Other programs	-0.033	-0.005	-0.001	0.045
Dage: 7 years	-0.209	-0.033	-0.042	0.284
Dage: 8 years	-0.260	-0.041	-0.052	0.354
Dage: 9 years	-0.325	-0.052	-0.065	0.442
Dage: 10 years	-0.299	-0.048	-0.060	0.407
Dage: 11 years	-0.340	-0.054	-0.068	0.463
Dage: 12 years	-0.297	-0.047	-0.060	0.404
Dage: 13 years	-0.296	-0.047	-0.060	0.404
Dage: 14 years	-0.273	-0.044	-0.055	0.372
Constant	0.238	0.038	0.048	-0.324

Table 5
Censored Ordered Probit: Marginal Effects (Male only)

VARIABLE	ATT=0	ATT=1	ATT=2	ATT=3
Sex	NA	NA	NA	NA
Sex of hh head	-0.080	-0.016	-0.027	0.123
Father's education	-0.061	-0.012	-0.021	0.094
Mother's education	-0.036	-0.007	-0.012	0.055
Income source	0.009	0.002	0.003	-0.013
Ln per capita income	-0.025	-0.005	-0.009	0.038
Social background	-0.043	-0.009	-0.015	0.066
Distance from primary school	0.001	0	0	-0.001
Distance from middle school	0.007	0.001	0.002	-0.011
Male/Total teachers	0.033	0.007	0.011	-0.051
Trained/total teachers	-0.008	-0.002	-0.003	0.012
Free uniform	0.019	0.004	0.007	-0.030
Free meals	-0.004	-0.001	-0.001	0.006
Free slates	0.007	0.002	0.003	-0.011
Scholarship	-0.013	-0.003	-0.005	0.021

(Contd.)

(Table 5 Contd.)

VARIABLE	ATT=0	ATT=1	ATT=2	ATT=3
Other programs	-0.024	-0.005	-0.008	0.036
Dage: 7 years	-0.195	-0.039	-0.067	0.302
Dage: 8 years	-0.241	-0.049	-0.083	0.373
Dage: 9 years	-0.298	-0.060	-0.102	0.460
Dage: 10 years	-0.294	-0.059	-0.101	0.454
Dage: 11 years	-0.332	-0.067	-0.114	0.513
Dage: 12 years	-0.282	-0.057	-0.097	0.435
Dage: 13 years	-0.301	-0.061	-0.103	0.465
Dage: 14 years	-0.278	-0.056	-0.096	0.430
Constant	0.142	0.029	0.049	-0.219

Table 6
Censored Ordered Probit: Marginal Effects (Female only)

VARIABLE	F ATT = 0	M ATT = 0	F ATT =1	M ATT =1	F ATT =2	M ATT = 2	F ATT = 3	M ATT = 3
Sex	NA	NA	NA	NA	NA	NA	NA	NA
Sex of hh head	-0.019	-0.080	-0.002	-0.016	-0.001	-0.027	0.022	0.123
Father's education	-0.079	-0.061	-0.009	-0.012	-0.005	-0.021	0.093	0.094
Mother's education	-0.089	-0.036	-0.010	-0.007	-0.006	-0.012	0.105	0.055
Income source	0.035	0.009	0.004	0.002	0.002	0.003	-0.041	-0.013
Ln per capita income	-0.060	-0.025	-0.007	-0.005	-0.004	-0.009	0.071	0.038
Social background	-0.054	-0.043	-0.006	-0.009	-0.003	-0.015	0.063	0.066
Distance from primary school	0.010	0.001	0.001	0	0.001	0	-0.011	-0.001
Distance form middle school	0.013	0.007	0.001	0.001	0.001	0.002	-0.015	-0.011
Male/Total teachers	0.125	0.033	0.014	0.007	0.008	0.011	-0.147	-0.051
Trained/total teachers	0.001	-0.008	0	-0.002	0	-0.003	-0.001	0.012
Free uniform	-0.014	0.019	-0.002	0.004	-0.001	0.007	0.016	-0.030
Free meals	-0.001	-0.004	0	-0.001	0	-0.001	0.001	0.006
Free slates	0.018	0.007	0.002	0.002	0.001	0.003	-0.021	-0.011
Scholarships	-0.011	-0.013	-0.001	-0.003	-0.001	-0.005	0.013	0.021
Other programs	-0.043	-0.024	-0.005	-0.005	-0.003	-0.008	0.050	0.036
Dage: 7 years	-0.208	-0.195	-0.023	-0.039	-0.013	-0.067	0.245	0.302
Dage: 8 years	-0.271	-0.241	-0.030	-0.049	-0.017	-0.083	0.318	0.373
Dage: 9 years	-0.341	-0.298	-0.038	-0.060	-0.022	-0.102	0.460	0.460
Dage: 10 years	-0.286	-0.294	-0.032	-0.059	-0.018	-0.101	0.336	0.454
Dage: 11 years	-0.335	-0.332	-0.037	-0.067	-0.021	-0.114	0.393	0.513
Dage: 12 years	-0.298	-0.282	-0.033	-0.057	-0.019	-0.097	0.350	0.435
Dage: 13 years	-0.270	-0.301	-0.030	-0.061	-0.017	-0.103	0.318	0.465

(Contd.)

(Table 6 Contd.)

VARIABLE	F ATT = 0	M ATT = 0	F ATT =1	M ATT =1	F ATT =2	M ATT = 2	F ATT = 3	M ATT = 3
Dage: 14 years	-0.245	-0.278	-0.027	-0.056	-0.016	-0.096	0.288	0.430
Constant	0.226	0.142	0.025	0.029	0.014	0.049	-0.265	-0.219

The censored ordered probit model was also estimated including interaction terms of the variables with the dummy for gender. The factors that have a statistically differential impact (at the 5% level) on the schooling attainment of boys and girls are mother's education, source of income, per capita income, the sex of the household head and the proportion of male teachers at school. All of these, except the sex of the household head, have a greater impact on girls.

The ordinary least squares results are reported in Table 7. As mentioned earlier, the coefficients from the censored ordered probit model cannot be directly compared to those from the OLS model. However, we know that there is a downward bias in variable coefficients in the OLS estimations since censoring is not accounted for. This bias towards zero is seen when we compare the OLS estimates with the censored ordered probit estimates. We can also compare the marginal effects from the censored ordered probit estimates to the OLS coefficients. The marginal impact of completing middle school, i.e. 'level 3' are similar in many cases to the OLS coefficients. The signs and t-statistics are similar for most coefficients in both sets of estimates. It is not possible to do a rigorous comparison between the two models since OLS treats the dependent variable as a measurement whereas the ordered probit procedure treats it as an ordinal variable. Nevertheless, we know that the censored ordered probit is the preferred procedure since it accounts for left and right censoring and the ordinal nature of the variable.

Table 7
Schooling Attainment OLS Regression

Dependent variable: Schooling attainment

VARIABLES	ALL		FEMALES		MALES	
	State dummies excluded	State dummies included	State dummies excluded	State dummies included	State dummies excluded	State dummies included
Sex	0.20 (24.57)	0.20 (25.68)	NA	NA	NA	NA
Father's education	0.105 (37.13)	0.12 (41.43)	0.108 (25.45)	0.12 (29.40)	0.104 (27.7)	0.11 (30.04)
Mother's education	0.074 (19.04)	0.04 (10.40)	0.102 (16.47)	0.07 (10.55)	0.049 (9.12)	0.02 (4.05)
Sex of hh head	0.026 (0.79)	0.06 (2.14)	-0.04 (0.84)	0.01 (0.19)	0.095 (2.18)	0.13 (2.95)
Social background	0.098 (10.89)	0.09 (10.53)	0.097 (7.20)	0.09 (7.01)	0.097 (8.09)	0.09 (7.96)
Income source	-0.016 (1.34)	-0.03 (2.78)	-0.338 (1.94)	-0.05 (2.94)	-0.001 (0.05)	-0.02 (1.05)
Ln per capita income	0.074 (13.47)	0.07 (11.90)	0.092 (11.28)	0.08 (10.62)	0.056 (7.60)	0.05 (6.22)
Distance from primary school	-0.014 (2.00)	-0.01 (1.89)	-0.025 (2.32)	-0.02 (1.67)	-0.003 (0.31)	-0.01 (0.92)
Distance from middle school	-0.015 (6.10)	-0.02 (6.67)	-0.013 (3.62)	-0.02 (5.16)	-0.015 (4.60)	-0.01 (3.90)
Male/total teachers	-0.2 (14.00)	-0.08 (5.42)	-0.295 (13.64)	-0.15 (6.21)	-0.116 (6.22)	-0.03 (1.44)
Trained/total teachers	0.076 (6.62)	0 (0.25)	0.06 (3.52)	-0.01 (0.35)	0.09 (5.87)	0.01 (0.74)
Free uniform	0.033 (2.03)	0.01 (0.64)	0.08 (3.38)	0.05 (1.83)	-0.01 (0.47)	-0.02 (0.77)
Free meals	0.139 (12.21)	-0.04 (2.00)	0.146 (8.68)	-0.04 (1.93)	0.138 (8.94)	-0.04 (2.20)
Free books	0.061 (5.66)	0 (0.03)	0.081 (5.07)	0 (0.21)	0.047 (3.29)	0 (0.19)
Scholarships	0.099 (8.36)	0.02 (1.50)	0.085 (4.83)	0 (0.17)	0.112 (7.18)	0.04 (2.21)
Other programs	0.055 (4.10)	0.03 (2.05)	0.082 (4.17)	0.04 (2.02)	0.027 (1.50)	0.01 (0.68)
Dage: 7 years	0.254 (20.22)	0.25 (20.02)	0.213 (11.57)	0.22 (11.89)	0.292 (17.09)	0.28 (16.44)
Dage: 8 years	0.342 (28.34)	0.34 (28.78)	0.3 (16.9)	0.31 (17.78)	0.386 (23.55)	0.38 (23.36)
Dage: 9 years	0.444 (31.93)	0.43 (31.38)	0.402 (19.67)	0.40 (19.74)	0.484 (25.78)	0.46 (24.95)
Dage: 10 years	0.562 (41.98)	0.56 (42.34)	0.476 (24.43)	0.48 (25.03)	0.642 (35.15)	0.63 (35.03)
Dage: 11 years	0.812	0.80	0.7	0.70	0.914	0.90

(Contd.)

(Table 7 Contd.)

VARIABLES	ALL		FEMALES		MALES	
	State dummies excluded	State dummies included	State dummies excluded	State dummies included	State dummies excluded	State dummies included
	(46.79)	(47.30)	(26.69)	(27.59)	(39.97)	(39.90)
Dage: 12 years	0.916	0.91	0.814	0.81	1.01	1.00
	(54.28)	(54.87)	(32.49)	(33.16)	(44.65)	(44.83)
Dage: 13 years	1.08	1.07	0.926	0.92	1.21	1.21
	(60.10)	(60.81)	(34.25)	(35.04)	(51.46)	(51.76)
Dage: 14 years	1.25	1.25	1.06	1.05	1.41	1.39
	(61.23)	(61.21)	(34.42)	(34.79)	(52.68)	(52.41)
Constant	-0.43	0.12	-0.361	0.20	-0.288	0.25
	(7.73)	(1.97)	(4.39)	(2.11)	(3.86)	(2.94)
Number of observations	33174	33174	15636	15636	17538	17538
Adjusted R-squared	0.33	0.36	0.31	0.35	0.4	0.37

Note: All standard errors have been corrected for heteroscedasticity using White's correction.[41] T-statistics in parentheses. State dummies were included in all estimations and were significant. They have not been reported here for conciseness.

The estimates of the threshold values for the censored ordered probit models are reported in Table 7. τ_0 is normalized to zero. Threshold values are lower for boys, implying that, even with equal values of the mean schooling propensity (α'X), boys have higher probabilities of completing higher grades of schooling.

Table 8
Generalized Tobit Model

VARIABLE	ALL	FEMALES	MALES
Sex	0.11	NA	NA
	(15.38)		
Sex of hh head	0.01	-0.02	0.06
	(0.21)	(0.41)	(1.45)
Father's education	0.07	0.07	0.08
	(31.67)	(19.57)	(25.86)
Mother's education	0.03	0.04	0.01
	(7.95)	(7.86)	(2.53)
Income source*	-0.02	-0.03	-0.01
	(1.82)	(1.76)	(0.48)

(Contd.)

41. White's method corrects the variance-covariance matrix. It is used because it is a general test and does not make any assumptions about the nature of heteroskedasticity.

(Table 8 Contd.)

VARIABLE	ALL	FEMALES	MALES
Ln per capita income	0.05	0.06	0.04
	(10.30)	(8.36)	(6.26)
Social background	0.06	0.05	0.07
	(8.14)	(4.58)	(7.47)
Distance from primary school	-0.01	-0.01	-0.01
	(1.74)	(1.12)	(1.18)
Distance from middle school	-0.01	-0.01	-0.01
	(4.83)	(3.41)	(3.13)
Male/Total teachers	-0.04	-0.07	0
	(2.77)	(3.36)	(0.17)
Trained/total teachers	0.01	0.01	0.01
	(1.25)	(0.76)	(1.09)
Free uniform	0.01	0.05	-0.02
	(0.83)	(2.34)	(0.89)
Free meals	-0.06	-0.07	-0.04
	(4.55)	(3.68)	(2.29)
Free slates	0.02	0.01	0.01
	(1.59)	(0.33)	(0.61)
Scholarships	0.01	0	0.03
	(1.08)	(.01)	(2.40)
Other programs	0	0	-0.02
	(0.05)	(0.27)	(1.39)
Constant	0.53	0.54	0.50
	(9.01)	(6.10)	(6.32)
Number of observations	33174	15636	17538
Chi-squared statistic	Chi(39)	Chi(38)	Chi(38)
	45749.05	25768.16	19781.52

T-statistics in parentheses. State and age dummies were included in all estimations and were significant. They have not been reported here for conciseness.

Another empirical problem this paper addresses is the potential endogeneity and measurement error of income. The instrument used in the two stage least squares regression is the area of cultivated land owned, as discussed earlier. The coefficient on the instrument from the first stage regression is 0.01 and it is statistically significant at the 5% level for the pooled sample as well as for the male and female samples individually. The first stage estimates are reported fully in Appendix II as suggested by Bound *et al.*[42] The Hausman test statistics for all the 2SLS estimations (reported in Table 10) reject the hypothesis that per

42 Bound et al (1995).

capita income is exogenous in all the samples. Further, the Partial R-squared for the instrument and the F statistic on the excluded instruments are reported in Table 9 below. They confirm that the area of cultivated land owned by the household is a valid instrument for per capita income.

Table 9:

ALL	**ALL**
F (excluded instruments) (1, 30991)	Partial R squared (excluded instruments)
5035.14	0.12
MALES	**MALES**
F (excluded instruments) (1, 16402)	Partial R squared (excluded instruments)
2819.21	0.12
FEMALES	**FEMALES**
F (excluded instruments) (1, 14566)	Partial R squared (excluded instruments)
2220.48	0.11

For all three samples (pooled, male only and female only) the coefficient on the natural logarithm of per capita income increases in the 2SLS estimation when compared with the OLS estimate. As discussed earlier in the section entitled 'Empirical Problems in Estimation', the coefficient on per capita income is expected to fall if the endogeneity of mother's labour supply is a significant concern. However, if the endogeneity of child's labour supply and/or measurement error associated with per capita income are the reasons that bias the OLS coefficients (i.e. the bias induced by them is larger than that associated with the endogeneity of mother's labour supply) the 2SLS estimate would then be larger. This is what we observe for the pooled sample, the all male sample and the all female sample. The direction of the biases cannot be specified exactly, however, due to the inclusion of other regressors in the estimations. Nevertheless, both

endogeneity of labour supply decisions and the measurement of error problem do bias the OLS estimate of per capita.

Per capita income remains a significant determinant of schooling determinant for both boys and girls in the 2SLS model. However, the difference between its impact on boys and girls is no longer statistically significant. Tansel finds that in most of her samples for Ghana and Cote d'Ivoire per capita expenditure, when instrumented for by assets and unearned income, remains a significant determinant of male and female schooling attainment.[43] Duraisamy finds that after the endogeneity of income is corrected for by using 2SLS for his Indian sample, income remains a significant determinant only for boys' schooling.[44]

The differential impact of the other explanatory variables on males and females that was discussed with respect to the OLS estimation is also observed in the 2SLS model. The coefficients and t-statistics for the other variables (besides per capita income) are nearly identical to the OLS model. They are thus not reported here for conciseness. Table 9 provides a comparison between the estimates for per capita income for the two models.

The generalized tobit and tobit models were also estimated since, as discussed earlier, they correct for left censoring. However, the censored ordered probit model is the preferred specification. Nevertheless, the tobit results are reported for the sake of comparison. The simple tobit model is compared to the generalized Tobit model which allows the coefficients for the enrollment and the schooling attainment equations to differ. A likelihood ratio test is performed to

43. Tansel (1993)
44. Duraisamy (1993)

compare these two versions of the Tobit model. The likelihood ratio test statistics are reported in Table 10 below. They test whether the two models are equivalent. Since they are significant, this hypothesis is rejected.

Table 10
OLS vs. 2SLS

VARIABLE	ALL: OLS	ALL: 2SLS	FEMALE: OLS	FEMALE: 2SLS	MALE: OLS	MALE: 2SLS
Ln per capita income	0.07	0.14	0.08	0.13	0.05	0.15
T-statistic	(11.90)	(9.42)	(10.62)	(6.66)	(6.22)	(6.77)
Hausman test for 2SLS		-103.46		634.52		-66.06

Table 11
Likelihood Ratio Tests

POOLED SAMPLE	CHI-SQUARED [24] 13398.30
ALL MALE SAMPLE	CHI-SQUARED [23] 6878.26
ALL FEMALE SAMPLE	CHI-SQUARED [23] 6545.48

As the above test statistics indicate, the generalized Tobit model is the preferred one. This indicates that it is best to estimate the enrollment and schooling attainment equations jointly, allowing the coefficients on the variables to differ. The marginal effects are similar to the OLS estimates. Nearly all the factors are, however, slightly less influential in the generalized Tobit model as compared to the OLS estimates.

It is interesting to compare the results of these estimations to reasons reported by households in the qualitative studies done by NCAER. Distance from school was one of the primary reasons reported, particularly for girls. "... the parents thought it risky to make

their girls walk for two-three kilometrs".[45] Domestic chores was a major factor reported in the case of girls for dropping out of school, an aspect that is not captured in the econometric analysis in this paper. Financial constraints stand out as the single most important reason reported by households for both boys and girls. This is borne out by the econometric work in this paper since per capita income, scholarships and other programs that provide financial benefits have significant impacts on enrollment and schooling attainment. A factor that was more often cited by boys is losing interest in studies. Once again domestic chores was often cited by girls, not boys and household economic activity more for boys than for girls.

CONCLUSION AND FUTURE RESEARCH AGENDA

The estimates and the conclusions that can be drawn from them have critical implications for public policy. As expected, parents' education has, in general, positive repercussions on children's educational attainment, as measured by all indicators of education used. Since mother's education has a particular impact on that of girls, this further strengthens the case for targeting women's education at the school level as well via adult education programs. This finding indicates that by emphasizing women's education, the gender gap in educational achievement can be substantially reduced across generations.

Financial constraints are certainly a key determinant of educational attainment. Thus highly subsidized schooling would provide an incentive for increasing both boys' and girls' education. Direct

45. Kulkarni, Veena. "Analysis of School Drop-outs". Paper for the International Conference on "Gender Perspectives in Population, Health and Development in India", January. 1996, New Delhi, p. 4.

measures to reduce poverty and raise the standard of living of people would certainly have a positive effect in terms of increasing education.

Supply side factors i.e. the state of the schooling system in the village has a strong impact on women's education, particularly on whether they ever get enrolled at all. Since the distance to primary and middle schools is negatively correlated with both enrollment and schooling attainment, policy should focus on constructing more schools so that each community has one in its vicinity. This is particularly important for older girls who go to school for a shorter duration of time because their parents do not want them to travel far.

Particularly interesting is the finding that providing incentives in the form of scholarships or other financial incentives promotes education, particularly whether children are enrolled at all.[46] Further work will attempt to study some of these schemes in specific states and analyze why they are successful in some states, but not others. It is possible, for example, that some state or district governments are more effective at implementing these schemes and preventing corruption. Once again this points to an area in which education policy could provide an institutional structure that relieves some of the financial burden on the parents to encourage education. Encouraging more women teachers would also have a beneficial effect since a larger proportion of male teachers discourages both boys and girls from attending school in communities. This area has scope for further research with more refined measurement of quality such as the

46. *See* Tilak, Jandhyala. "How Free is 'Free' Primary Education in India" in NIEPA Occasional Paper, 1995, New Delhi, for an analysis of some of these incentive schemes.

teacher/student ratio. I plan to further develop this analysis with the entire data set collected by NCAER.

The three empirical issues that this paper focuses on are the potential endogeneity of income, left censoring and the censoring of final schooling attainment. These have not been dealt with in most previous studies. While income remains a significant impact of enrollment and attainment, the differential impact by gender disappears when endogeneity is accounted for. Accounting for left and right censoring corrects for the downward bias in the OLS estimations.

There is ample scope for future research in this area. There are problems with the data, particularly related to those who have migrated outside of the household and are not reported as household members because they have lived away for more than six months. The reason for migration often vary between boys and girls, the former usually leaving for employment purposes and the latter after they get married. This is a censoring problem that has not been dealt with in previous work.[47] In addition, further work will include instrumental variable estimates combined with the Tobit and Ordered Probit models. These procedures would be further complicated since they would not provide correct standard errors. However, an attempt will be made to correct these standard errors.[48]

Further, inter-state comparisons would also be useful. Cross-tabulations and graphical analysis is another interesting dimension to

47. *See* Holmes, 1997.

48. I am grateful to Prof. Paul Schultz for pointing this out to me. Smith and Blundell (1986) provide a method for correcting standard errors in the Tobit model. It may be possible to extend this procedure.

study regional and inter-generational differences.[49] Some preliminary graphs are presented in Figure I through V. The wide disparities between states such as Kerala and Rajasthan, for instance, may be explored further. Further analysis for different economic and social groups as well as urban/rural comparisons are important areas of future research. This research will be the basis of a separate paper. This research has significant implications for policy, especially if supply side determinants appear to be important to the gender gap in education. Wider accessibility of schools, for instance, may be the key to reducing this bias.

It may be possible, in future revisions to include the sex ratio of siblings at birth to capture the fertility (quantity)/quality trade-off in households' investment in children. Also, a similar analysis as the one done in this paper can be conducted for older children, especially to investigate the role of the marriage market in determining gender differences in drop out rates.

If, as the new growth theory advocates, human capital is pivotal to growth, the micro-economic analysis of education is of critical importance. Women's education is beneficial not only for growth but also for human development, since it confers positive social externalities on future generations. Thus raising educational levels in general and closing the gender gap in educational allocation should be one of the key targets of developing country policymakers.

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49. I am grateful to Jeemol Unni for several specific suggestions regarding such cross-tabulations.

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APPENDIX - I

ENROLLMENT IN SCHOOL: PROBIT ANALYSIS

(Coefficients and T-statistics)

Dependent variable: whether person was ever enrolled in school Yes=1 No=0

VARIABLE	ALL		FEMALES		MALES	
Sex	0.438	0.476	NA		NA	
	(25.80)	(27.36)				
Father's education	0.205	0.220	0.199	0.217	0.218	0.232
	(27.56)	(29.12)	(20.21)	(21.70)	(18.95)	(19.77)
Mother's education	0.261	0.210	0.338	0.270	0.175	0.140
	(16.34)	(13.19)	(14.95)	(12.05)	(8.11)	(6.44)
Sex of hh head	0.112	0.179	-0.009	0.082	0.227	0.271
	(1.58)	(2.48)	(0.09)	(0.79)	(2.39)	(2.80)
Social background	0.16	0.139	0.165	0.137	0.153	0.143
	(8.94)	(7.57)	(6.46)	(5.27)	(6.01)	(5.50)
Income source	-0.007	-0.090	-0.060	-0.133	0.040	-0.058
	(0.31)	(3.61)	(1.74)	(3.76)	(1.17)	(1.65)
*Ln per capita income	0.254	0.320	0.255	0.373	0.262	0.277
	(7.65)	(9.57)	(5.47)	(7.91)	(5.46)	(5.74)
Distance from primary school	-0.023	-0.023	-0.052	-0.038	0.005	-0.012
	(1.83)	(1.79)	(2.83)	(1.93)	(0.29)	(0.64)
Distance from middle school	-0.022	-0.026	-0.020	-0.031	-0.022	-0.02
	(4.57)	(5.18)	(2.98)	(4.35)	(3.24)	(2.81)
Male/total teachers	-0.490	-0.241	-0.620	-0.329	-0.352	-0.147
	(15.26)	(6.89)	(13.82)	(6.71)	(7.72)	(2.96)
Trained/total teachers	-0.026	-0.025	-0.051	-0.031	0.003	-0.011
	(1.10)	(0.95)	(1.50)	(0.81)	(0.07)	(0.29)
Free uniform	-0.021	-0.009	0.050	0.051	-0.096	-0.068
	(0.64)	(0.25)	(1.12)	(1.04)	(2.04)	(1.30)
Free meals	0.287	0.014	0.291	0.015	0.295	0.027
	(11.29)	(0.42)	(8.39)	(0.32)	(7.91)	(0.55)
Free books	-0.002	-0.046	0.052	-0.071	-0.051	-0.020
	(0.11)	(1.78)	(1.72)	(1.94)	(1.64)	(0.55)
Scholarships	0.077	0.052	0.053	0.039	0.105	0.076
	(3.17)	(1.93)	(1.56)	(1.03)	(3.00)	(1.96)
Other programs	0.217	0.143	0.258	0.141	0.174	0.138
	(7.38)	(4.53)	(6.48)	(3.24)	(4.05)	(2.98)
Dage: 7 years	0.668	0.680	0.544	0.577	0.767	0.762
	(19.67)	(29.72)	(11.08)	(12.09)	(16.52)	(16.16)
Dage: 8 years	0.847	0.889	0.725	0.788	0.952	0.988
	(26.19)	(26.98)	(15.60)	(17.20)	(21.37)	(21.72)
Dage: 9 years	1.08	1.09	0.949	0.968	1.19	1.19
	(28.83)	(28.37)	(18.11)	(18.43)	(22.37)	(22.01)
Dage: 10 years	0.972	1.01	0.778	0.830	1.15	1.19
	(30.29)	(31.00)	(16.91)	(18.26)	(25.66)	(26.01)
Dage: 11 years	1.15	1.15	0.926	0.951	1.37	1.37
	(28.98)	(28.37)	(16.64)	(16.90)	(23.64)	(23.15)
Dage: 12 years	0.946	0.984	0.790	0.846	1.08	1.11
	(27.81)	(28.28)	(16.15)	(17.33)	(23.00)	(23.08)
Dage: 13 years	0.964	0.960	0.737	0.737	1.18	1.18
	(27.92)	(27.12)	(14.86)	(15.07)	(24.18)	(23.62)
Dage: 14 years	0.900	0.901	0.684	0.695	1.09	1.09
	(25.27)	(24.79)	(13.27)	(13.41)	(21.97)	(21.51)

(Contd.)

(Appendix I Contd.)

VARIABLE	ALL		FEMALES		MALES	
Constant	-2.63	-2.21	-2.24	-2.39	-2.63	-1.69
	(9.84)	(6.95)	(5.96)	(5.61)	(6.86)	(3.49)
Number of observations	31016	31016	14590	14590	16426	16426
Chi-squared	Chi(24)	Chi(39)	Chi(23)	Chi(38)	Chi(23)	Chi(38)
Statistic	7229.33	8395.44	3645.38	4403.76	3207.44	3758.73

* The natural logarithm of per capita income is instrumented for using area of cultivated land owned by the household. This is predicted logarithm of per capita income.

Note: All standard errors have been corrected for heteroscedasticity using White's correction.[50] T-statistics in parenthesis.

50. White's method corrects the variance-covariance matrix. It is used because it is a general test and does not make any assumptions about the nature of heteroskedasticity.

APPENDIX – II

FIRST STAGE RESULTS

Dependent variable is the natural logarithm of per capita income

VARIABLE	ALL	MALES	FEMALES
Sex	0.045 (6.02)	NA	NA
Father's education	0.074 (27.87)	0.074 (20.94)	0.074 (18.44)
Mother's education	0.068 (15.99)	0.071 (12.53)	0.064 (10.07)
Sex of hh head	0.126 (4.46)	0.166 (4.14)	0.085 (2.14)
Social background	0.076 (9.77)	0.072 (6.90)	0.08 (6.90)
Income source	-0.144 (14.24)	-0.152 (11.32)	-0.134 (8.81)
Cultivated land area	0.01 (65.23)	0.01 (47.77)	0.009 (44.43)
Distance from primary school	0.03 (5.08)	-0.031 (4.01)	0.03 (3.25)
Distance from middle school	-0.025 (11.21)	-0.024 (7.95)	-0.026 (7.85)
Male/total teachers	-0.263 (19.36)	-0.252 (13.81)	-0.275 (13.56)
Trained/total teachers	-0.058 (5.47)	-0.064 (4.48)	-0.051 (3.23)
Free uniform	-0.074 (5.18)	-0.073 (3.69)	0.074 (3.62)
Free meals	0.015 (1.30)	0.017 (1.07)	0.014 (0.86)
Free books	0.039 (4.13)	0.025 (1.96)	0.054 (3.90)
Scholarships	-0.103 (9.59)	-0.101 (6.74)	-0.106 (6.86)
Other programs	-0.098 (7.72)	-0.117 (6.61)	-0.077 (4.28)
Dage: 7 years	-0.001 (0.06)	0.03 (1.51)	-0.035 (1.61)
Dage: 8 years	0.007 (0.48)	0.037 (1.91)	-0.027 (1.29)
Dage: 9 years	0.041 (2.57)	0.077 (3.61)	0.002 (0.07)
Dage: 10 years	0.023 (1.63)	0.04 (2.12)	0.004 (0.20)
Dage: 11 years	0.072 (4.2)	0.101 (4.45)	0.041 (1.55)
Dage: 12 years	0.061 (4.10)	0.074 (3.73)	0.047 (2.08)
Dage: 13 years	0.122 (8.03)	0.149 (7.41)	0.091 (3.96)
Dage: 14 years	0.1 (6.27)	0.131 (6.12)	0.065 (2.71)
Constant	7.7	7.69	7.76

(Contd.)

(Appendix II Contd.)

VARIABLE	ALL	MALES	FEMALES
	(232.66)	(166.14)	(166.5)
Number of observations	31016	16426	14590
Adjusted R-squared	0.24	0.25	0.23

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