A RAND NOTE

DETERMINANTS OF SCHOOLING ATTAINMENT AND ENROLLMENT RATES IN THE PHILIPPINES

Elizabeth M. King, Lee A. Lillard

April 1983

N-1962-AID

Prepared for The U.S. Agency for International Development

35th Year

Rand
SANTA MONICA, CA. 90406

This research was supported by the U.S. Agency for International Development under Grant No. OTR-G-1822.

Published by The Rand Corporation

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PREFACE

This Note is the first of three papers that discuss the methodology and findings of Rand research on schooling choice in the Philippines. Substantive results are presented on the determinants of enrollment rates and completed schooling levels, and their policy implications. The empirical procedure and its advantages over methods used in previous studies are discussed in greater detail in a second paper. The third paper is devoted to issues of intrafamily correlation of schooling attainment, also using Philippine data.

The research was supported by the U.S. Agency for International Development under Grant OTR-G-1822 to The Rand Corporation's Family in Economic Development Center. The Center's research emphasizes the role of human resources in the process of economic development, and of individual and family responses to development programs and policy.

This Note is based partly on Elizabeth King's Ph.D. dissertation at Yale University, which was supported by the Agricultural Development Council and the Battelle Population and Development Program. The Bicol Multipurpose Survey data used here were made available jointly by the Bicol River Basin Development Program, the Institute of Philippine Culture, and the U.S. Agency for International Development (Manila). The computer algorithm for the maximum likelihood estimation was written by Karl Schutz.

SUMMARY

The role of education in promoting growth and development by improving the technical and allocative efficiencies of economic actors is well recognized in the economic literature. The objective of this research is to analyze the decision of families to send their children to school, within the context of a low-income, rural setting. We focus on schooling choice in the Philippines for two reasons. Fairly extensive demographic and economic data are available for households in a selected region. Moreover, interesting trends in schooling levels have emerged in the past two decades. Schooling levels have been rising rapidly. This is partly a result of legislation, such as the reenactment of a compulsory minimum education law and school-building programs, that promotes universal elementary education. In 1960, 50 percent of the population aged 20-24 years had completed at least elementary education (6 years); in 1975, this proportion had increased to 73 percent. This increase was achieved both through greater enrollment rates and through lower drop-out rates.

Enrollment rates in higher education have also been increasing. In 1960, 17 percent of the population aged 20-24 years had high school diplomas; in 1975, this ratio had doubled. In 1960, 12 percent had some college education; in 1975, this fraction rose to 28 percent. This trend can be attributed more to the greater increase in the enrollment of women than of men in higher education. This sex-related pattern is contrary to the experience of most other developing countries.

By focussing on family decision-making, we aim to untangle some of the effects of school-related public intervention policies, of market forces such as incomes and wages, and of demographic characteristics on schooling attainment at the microeconomic level. Our empirical estimates are based on the survey data collected in 1978 by joint efforts of the Bicol River Basin Development Office, the U.S. Agency for International Development (Manila), and the Institute of Philippine Culture. The survey covered 1903 randomly selected households in the Bicol region of the Philippines. Seventy-five percent of the sample is rural, 15 percent is urban, and the rest is semi-urban. The urban families are located in three chartered cities, whereas the semi-urban

families reside in 14 townships. After we eliminate from our sample those families with no children of at least school age, and a few with missing data, we are left with 1492 families with 7464 children of at least school age. We define "of at least school age" to mean age 5 years and above, but we exclude those younger than 9 years who had never entered school. For the latter group, we have no information regarding final school attainment.

We use a simple model of family demand for human capital to obtain predictions regarding the determinants of schooling attainment. Our list of factors include

- the cost of attending school, as measured by the availability of schools in the village and distance to school;
- the opportunity cost of time spent in school, as measured by alternative uses of a child's time, such as work on the family farm;
- parents' education, which we use to measure parents' income (due to lack of reliable income data), parents' taste for education and their ability to supervise their children's schooling;
- family wealth, as measured by land ownership, and by the area and value of land owned;
- the child's birth order, to verify the finding in previous studies that first-borns are more likely to achieve higher schooling than later-borns;
- the child's birth cohort, which is intended to measure the result of cohort-specific demographic and environmental changes;
- the availability of electricity in the village; and,
- rural, urban or semi-urban residence which is meant to reflect other community characteristics not captured by the included variables.

Using data on the years when the first elementary school was established in the village, when land was acquired by the family, and when electricity became available in the village, together with child's age and duration of residence in the village, we specify cohort-specific measures of the school distance, land and electricity variables for individual children in the family. We refer to these variable specifications as relevant-time measurements.

Our empirical method addresses three statistical issues. One refers to censored observations--those students who were still enrolled in school during the survey. The second pertains to the discreteness of the schooling choice, and the nonormality of the schooling distribution. The method, which is an ordered polytomous choice model, treats the schooling decision explicitly as a discrete and nonnormally distributed variable. As a result, we do not use the truncated normal distribution to handle the censoring problem. The third issue relates to the intrafamily correlation of schooling among children.

The principal findings of our empirical work are best shown by simulating the implications of the parameter estimates on expected schooling levels, school enrollment rates and continuation probabilities. First, we calculate implied distributions for the full sample of males and females, as well as for different birth cohorts and for rural and urban samples. We also simulate the effects of specific variables by calculating schooling distributions using counterfactual values of these variables. Among our major results are the following:

• The threshold values are significantly different for males and females. As a result, we use separate samples of males and females.

• The included regressors account for approximately 40 percent of total variance. The intrafamily residual correlation among children is estimated to be .49, and is the same for brothers, siters, and between brothers and sisters.

• The schooling distribution has three modes, at the completion grades in elementary school, high school and college. The unconditional mean schooling attainment is 7.2 years for males and 7.7 years for females. Of females, 79 percent complete at least grade 6, and 29 percent are high school graduates. The corresponding fractions for males are 75 and 27 percent, respectively.

• The greatest difference in continuation probabilities between males and females occur in the last year of high school. The mean probability of going to college is 62 percent for females and 42 percent for males. Given college entry, the mean probability of completing college is still greater for females than for males--65 percent versus 52 percent.

• Distance to school has a negative impact on schooling attainment; hence, programs to build schools in the village would increase enrollment rates. For example, if an elementary school were available to everyone in the rural sample at a distance of one-half kilometer, enrollment rates and continuation probabilities increase at all levels in elementary school, with favorable repercussions in high school and college. A high school within a short distance further raises these distributions.

• Although land ownership affects schooling levels in three ways--a pure wealth effect which is positive, an opportunity cost effect which is negative, and a bequest effect, it exerts a net positive effect on schooling levels. To illustrate, if every child in the rural sample belonged to a family with at least two hectares of land, enrollment levels would rise at all levels, and the probability of having some high school education increases by about 8 percent for both males and females.

• Children with higher-schooled parents are more likely to have higher schooling. If both parents had one more year of schooling than their actual levels, the enrollment rate in high school rises by 6 percent, and the unconditional mean expected level increases by one-half year. If mothers had one more year of schooling, holding fathers' education at observed levels, the schooling distributions rise more for female than for male children, particularly at higher school levels. If fathers had one more year of schooling, holding mothers' education at actual levels, enrollment rates increase more for males than for females throughout high school, and more for females than for males in college.

• The advantage of being a first-born child seems more pronounced for male children than for female children. For females, those with no sisters in larger than one sibships seem to benefit more.

• The schooling distributions of children residing in urban and semi-urban areas dominate that of rural children. The probability that a rural child who enters school will complete the elementary level is 72 percent. The probability that he will then proceed to high school is 47 percent, and that he will graduate, given entry, is 22 percent. The corresponding ratios for an urban child are 85, 65 and 66 percent. The same disparities between the male rural and urban samples hold true for females.

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I. INTRODUCTION

Education is one of the primary modes through which a developing country may improve the productivity of its workers and further its development potential. Consequently, increasing education levels has been a major goal of development programs in less developed countries. However, individual schooling attainment is largely a family decision that is constrained by family resources and influenced by factors affecting the costs and benefits to families of sending children to school. Benefits to the family from additional schooling of children include greater child welfare as well as higher potential future returns to the family (e.g. old-age assistance to parents).[1] Costs to the family include the direct costs of school attendance and the opportunity cost of children's time in alternative productive activities. In low-income communities with limited access to capital markets, the costs of higher education borne by the family can be prohibitive. There, government can raise educational levels mainly through school-building programs and changes in school curricula that decrease the costs and enhance the benefits of schooling, and through mandatory attendance laws.

The purpose of this Note is to assess the relative importance of various determinants of educational attainment in developing countries, as exemplified by the Philippines,[2] where general schooling levels have risen sharply in the last two decades. In 1975, 73 percent of the population aged 20-24 (numbering 3.8 million) had a minimum of 6 years of schooling, as compared with 65 percent in 1970 and 50 percent in 1960. In 1975, 34 percent had high school diplomas at least, as compared with 29 percent in 1970 and 17 percent in 1960. This trend was accompanied by a notable increase in the number of public and private schools. The number of public secondary schools increased six-fold between 1960 and 1975, and thirty additional public colleges and universities were established throughout the country.

We focus on the mechanism of family choice regarding education, and using household survey data to identify the factors that affect school enrollment rates and completed levels, and to explain interfamily differences in schooling outcomes. In a model of family demand where education is both a consumption and an investment commodity, the determinants of schooling attainment include parental education and income, family wealth, the price of schooling and of other commodities, returns to education and to alternative investments, and the value of child's time. Most relevant to rural economies is the effect on schooling of land ownership and farming activities, and of distance from a town or city on schooling. The proper measurement of these determinants is an important part of the study. Section III describes the distinction between survey-time and relevant-time specifications (vis-a-vis the child schooling decision), and gives details about the sample survey.

A problem encountered in most studies of schooling that use family survey data is that many children are still enrolled in school at the time of the survey. Hence, there arises the issue of jointly analyzing school enrollment and attainment. We consider current enrollment as a censored observation, since we know only that the student will attain at least the grade level in which he is enrolled. An econometric model to treat this statistical issue and that of the nonnormality of the distribution of completed levels is developed in the next section.

The remainder of the Note is devoted to illustrations of the effects of regressors--aggregately or independently--on the distribution of completed schooling attainment, on enrollment rates by grade level, and on the decision to continue to higher levels. In general, we find that the education of both parents, land wealth, proximity to school, and being first-born tend to raise schooling attainment, whereas rurality and alternative uses of child's time are likely to decrease it. Our results imply that the schooling of male and female children should be treated as two distinct family choices. Variables such as sibling order, farming, and mother's education affect male and female schooling differently, while school availability, father's education and land ownership do not.

II. A MODEL OF SCHOOLING CHOICE

In the human capital model, an individual invests in his education up to the level at which marginal increases in earnings make the investment worthwhile. The quantity-quality model of family allocation considers child schooling also as consumption, and demand for it is jointly determined with number of children and other consumption commodities that enter the family's utility function (Becker and Lewis, 1973; De Tray, 1973). The emphasis on the family, rather than the individual, as the decision-making unit captures a predominant characteristic of low-income rural economies--the close economic ties between the child and his family. To emphasize the contributive roles of children in family decisions in this setting, child labor supply has been introduced in the model (Rosenzweig and Evenson, 1977; King, 1982).

A Simple Quantity-Quality Model

Consider a one-period model of the family's allocational choice in which parents maximize their utility under constraint, and accordingly apportion family resources to number of children, N, children's schooling, and a single composite commodity, C. In the following function,

$$U = U(C, N, S_b, S_g),$$

the utility derived from the average schooling of sons and of daughters, S_b and S_g, respectively, are allowed to be different. On the other hand, we ignore possible sex preference in number of children. Total expenditures on children's schooling is equal to $(\Pi_b S_b N_b + \Pi_g S_g N_g)$, where Π_b and Π_g are their respective implicit prices.

Assuming that child's time is spent either at work or at school, where there exists a market for child labor, the costs of child schooling include foregone earnings. Actual contributions of children to family income are assumed equal to total labor supply of sons and daughters living at home, valued at their respective market wages.[3] The family full-income budget constraint is then,

$$Y + V + (N_b w_b + N_g w_g)T - \Pi_b S_b N_b - \Pi_g S_g N_g - p_C C \geq 0$$

where Y is parental earned income; V is nonearned income from land owned; T is fixed total time resources of an individual child; $\Pi_i = w_i + p_S$, where w_i is the market wage of a child of sex i and p_S is a direct unit cost associated with school attendance; and p_C is the price of C. To simplify matters, child wages here are assumed exogenous to family choice.[4]

The first-order conditions of the model state that the level of desired schooling depends on the level of child wages, the direct unit cost of schooling, earned and nonearned income, and number of children. To draw out predictions from the model with respect to marginal changes in prices and incomes, the utility function must be weakly separable in the three commodity groups S, N and C, allowing us to analyze the allocation of schooling between the sexes conditional on the outcomes of the first-stage budgeting. In the second stage, the maximizing conditions include

$$U_{S_g}/\Pi_g = g\, U_{S_b}/\Pi_b,$$

where $g = N_g/N_b$. Consider that $U_{Sg} = U_{Sb}$ if $S_g = S_b$, or that parents are indifferent with respect to the schooling of sons or daughters. Given $w_b \geq w_g$, then $S_b = S_g$ only if the ratio of boys to girls in the family is less than unity, or specifically, $1/g = 1 - (w_b - w_g)/\Pi_b$. If $1/g = 1$, then sons must attain sufficiently less schooling than daughters, unless the share of opportunity costs in total unit cost of schooling is negligible.

The effect of a marginal change in w_i on schooling attainment of child i depends on offsetting substitution and income effects. Though the price and income effects of a change in P_S move in the same direction, its relative effect on S_b and S_g is indeterminate, and depends on the structure of the utility function and the level of wages w_g and w_b. An increase in earned and nonearned income is expected to increase demand for male and female schooling. The quantity-quality model emphasizes the jointness of the fertility decision and investments include capital. For example, the interaction effect between fertility and child schooling implies that investments in schooling are more costly given higher fertility since the choice has to apply to more units.[5] We ignore estimation of the fertility equation in this study.

An Econometric Model of Schooling Attainment

In estimating the simple quantity-quality model of schooling, several econometric issues arise. First, the model is silent on the distribution of schooling among siblings of either sex, and assumes that parents do not care about individual schooling levels. This implies estimating family demand for education using average schooling attainment of male and female children as measures of demand. Whether this is an appropriate measure is a testable hypothesis. A logical extension of the model would be to specify utility as a function of individual child schooling levels, and to analyze intrafamily correlation of schooling.

A convenient simplification, average attainment is inappropriate as a measure of the decision variable for yet another reason--years of schooling attainment is not a continuous variable. For example, having completed 8 years of schooling is not equivalent to attending grades 1 to 4 twice. Figure 1 clearly illustrates that schooling is more appropriately treated as a discrete and nonnormally distributed variable, rather than as a continuous normal variate as is typical in prior studies. In our sample, the distribution of completed schooling levels has three models at grades 6 (elementary school completion), 10 (high school completion) and 14 (college completion).

Lastly, when using household survey data in which a fraction of the sample has not completed schooling, the analysis must deal with censored observations.[6]

The following econometric model of schooling attainment permits the solution to these problems. Define t as an index of the desired level of schooling capital or as the propensity to attain more schooling, and let it be a regression function of measured individual characteristics, X, with residual e; that is, $t = \alpha'X + e$.

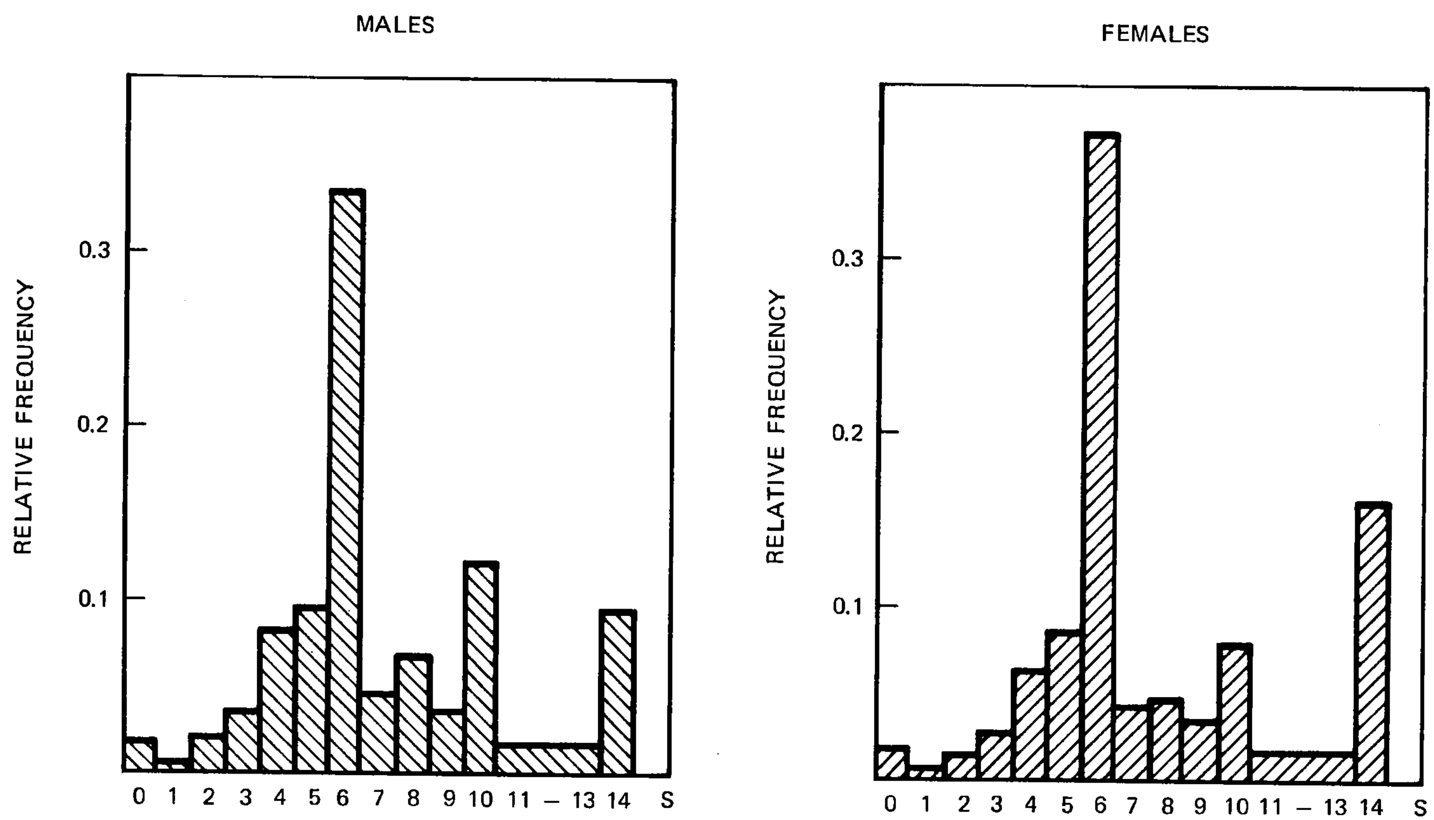


Fig. 1—Distribution of completed schooling levels by sex

Define also schooling thresholds τ_S such that the completed years of schooling level S is attained if and only if

$$\tau_S < t \le \tau_{S+1} \quad \Longleftrightarrow \quad \tau_S - \alpha'X < e \le \tau_{S+1} - \alpha'X,$$

with limiting thresholds defined by $\tau_0 = -\infty$ and $\tau_{16} = +\infty$. We normalize with respect to $\tau_7 = 0$. Levels of t that exceed successively higher threshold values imply higher schooling attainment. This is termed an ordered polytomous choice model. The likelihood function is defined by

$$L_i = F(\tau_{S+1} - \alpha'X_i) - F(\tau_S - \alpha'X_i), \; S_i = 0, 1, 2, \ldots, 16,$$ [7]

where F is the cumulative density for e. The sample log likelihood over all N observations is then

$$L = \prod_{i=1}^{N} L_i \; .$$

For persons who are not enrolled, number of years of schooling completed is assumed known.[8] However, for those currently enrolled in level S, the completion level is not known. We know only that the child will attain the level S or more; hence,

$$\tau_S < t \quad \Longleftrightarrow \quad \tau_S - \alpha'X < e$$

These censored observations have likelihood

$$L_i = 1 - F(\tau_S - \alpha'X_i) = F(-(\tau_S - \alpha'X_i)),$$

if dF(e)/de is symmetric.

Using our actual estimates of the threshold levels, Figure 2 shows the likelihood values for completing exactly 6 years of schooling (area A), and for being enrolled in grade 10 at the time of the survey (area B).

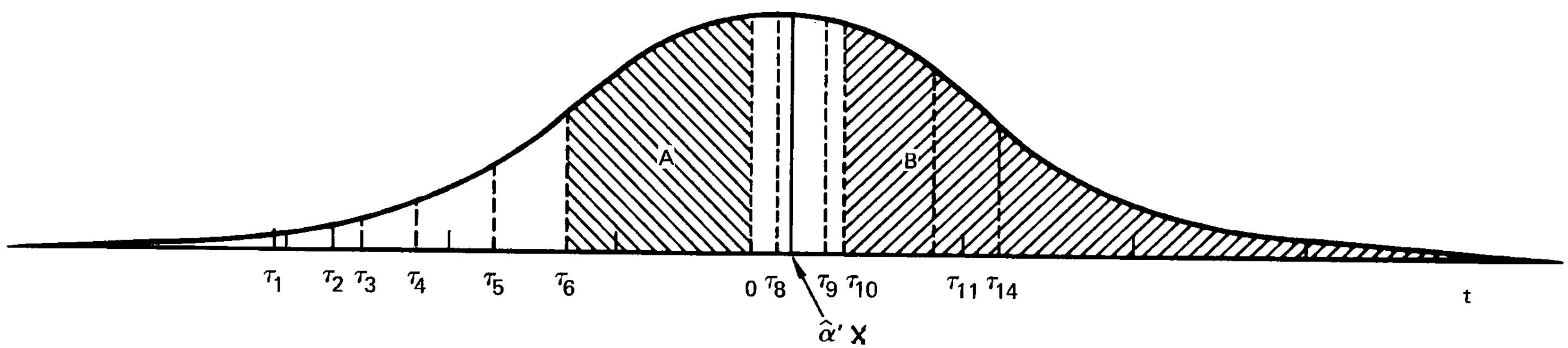


Fig. 2—Likelihood values for 6 years of completed schooling and enrollment in grade 10 using the male sample

III. THE BICOL SURVEY DATA

In this section, we describe our data source and characteristics of the sample. We also present a careful specification of the variables used in the estimation.

We use data from one of the twelve regions in the Philippines, the Bicol Peninsula. The Bicol region, located in the southeastern tip of the island of Luzon, had a population of 3.5 million in 1975, representing 8 percent of total population. Although it is the principal grower of a major export crop, coconut products, it is one of the poorest regions in the country. Despite its poverty, however, its literacy rates and educational attainment levels have not been among the lowest in the country. In the three provinces that we study, 74 percent of the population aged 20-24 in 1975 completed a minimum of 6 years, and 23 percent finished high school. The corresponding percentages in 1960 were 53 and 12, respectively, representing proportional increases in attainment levels similar to those reported for the country.

The region is interesting because communities in the basin of the Bicol River were chosen as a test case of an overall rural development strategy by the Philippine government. The families that we study were thus recently exposed to several environmental changes produced by projects for power and water resource development, flood control, agricultural research and rural electrification. The data are drawn from a survey of randomly selected households, conducted in 1978 with the aim of monitoring the impact of these projects on rural development.

Sample Selection Criteria in Bicol

The Bicol Survey collected various types of data--demographic, income, production and expenditure information at the individual and household level, as well as community data. It contains schooling attainment and other information on all children ever born in a family, not only on children living at home during the survey. Community-level data include information on schools and the availability of electricity. The survey sample of 1,903 households is meant to be representative of the Bicol River Basin population. Since the government program divides the region into "geographical area(s) of critical need and high growth potential", called Integrated Development Areas (IDA's), the IDA formed the basis of the sampling design, and the respondent households were selected from these areas using a multistage stratified random sampling process. The survey covered 100 villages (communities) located in 20 IDA's.[9] A large fraction of the sample (73 percent) is located in rural villages. Fifteen percent is found in the cities of Legazpi, Naga and Iriga, and 12 percent in semi-urban areas.

The families in the sample have a total of 11,684 children ever born. After excluding all children who were dead during the survey[10] and accounting for several data problems, the sample is reduced to 7,464 children in 1,492 families. Table 1 summarizes our sample selection criteria.[11]

Our final sample consists of all children aged 5 years and older, except those aged 5 to 8 years who were never enrolled in school. We arrived at these cutoff ages after examining the distribution of computed school entry ages of children who were enrolled during the survey. School entry age was derived simply by subtracting attained schooling from current age because the survey did not collect this information.[12] It is also reasonable to expect that children aged 5 to 8 years old who were not enrolled during the survey may yet enter school by the time they reach the age of 9 years. Although their individual characteristics are known, their observed zero year of schooling attainment does not really provide any information regarding future schooling. To deal with this problem, in our early work, we jointly modeled schooling attainment with school starting age. However, the schooling distribution parameters were not significantly different, and the cutoff age of 9 years was found to be reasonable.

Since the survey did not collect information on age of entry, repetition rates, acceleration, and temporary leaves, we make the following simple assumptions about the schooling process: (1) that children who were 9 years old and over who were not enrolled during the survey and have zero schooling will never attend school; and (2) that a child who has entered school attends it continuously until he achieves the desired schooling level; in other words, that drop-outs will not reenter.

TABLE 1

SAMPLE SELECTION CRITERIA

Selection Criterion	Number of Families		Number of Children
Total Survey Sample	1,903		11,684
Number of observations excluded due to: (by order of exclusion)	Number of excluded families	Number of families with excluded children	Number of excluded children
(a) No children	51	-	0
(b) Dead children	2	834	1562
(c) Missing age data	16	16	92
(d) Children under 5 years old	172	716	1398
(e) Missing sex data	7	7	57
(f) Missing education data	12	12	99
(g) Children 5 to 8 years old who have never been in school	145	598	986
(h) Both parents dead	4	4	17
(i) Missing data on parents	2	2	9
Final Sample	1,492		7,464

The structure of the Philippine educational system is patterned after that of the U.S. Children generally enter school at age 7, followed by 6 years of elementary school[13], 4 years of secondary school, and 4 or 5 years of college education. By law, every child must be enrolled in school at the beginning of the academic year following his seventh birthday, and must remain in school until his elementary education is completed. Enforcement of compulsory education is clearly not perfect, and varies across regions. Whereas most elementary schools are public schools, and therefore free, more than half of secondary schools and most colleges and universities are privately owned.

Enrollment Rates and Completed Levels

Table 2 presents the distribution of enrolled children by age and grade. The numbers indicate that most enrolled children were over-aged, given that the compulsory age of entry into grade one is 7 years. For example, only 14 percent of those enrolled in grade one at the time of the survey were 7 years old or under. Instead, most seem to have entered grade one by ages 8 and 9. The fraction of over-aged children in any grade level rises with grade, a pattern consistent with repetition and temporary leaves from school. Temporary leaves from school (but not repetition) may affect our results for recent birth cohorts, but no further information is available.

Table 3 presents the distribution of those enrolled and those out of school, by grade level and by sex. The mode of the distribution for school-leavers is at the completion of the elementary level, that is, grade 6. For those who proceeded to secondary school and college, the modes are at the completion of high school and college, respectively. Table 4 contains the distribution of completed schooling levels for different birth cohorts. Selection bias in the younger cohorts is likely to be severe, and illustrates the inappropriateness of analyzing a sample of only those who have completed school. Contrary to the generally positive trend in schooling attainment, younger cohorts seem to attain less, rather than more, schooling.

TABLE 2

DISTRIBUTION OF ENROLLED CHILDREN BY AGE AND SCHOOL GRADE

Age/Grade (S)	1	2	3	4	5	6	7	8	9	10
A. Males (N=1487)										
5	1									
6	5	1								
7	20	5								
8	77	28	3	1						
9	42	51	19	7	1					
10	26	36	70	27	7	2	1		2	
11	8	20	46	54	24	3				
12	6	9	25	39	48	13	1			
13	1	4	11	16	45	34	17	2		
14	1	2	3	11	23	37	24	11	1	1
15	1	1	4	2	17	19	18	18	8	
16			2	2	4	12	16	20	12	4
17				1	1	8	12	7	10	8
18			1	1		4	5	15	14	13
19					1	5	6	8	10	4
20				1			3	5	4	9
21	1	1		1		1	1	4	3	5
22								1		7
23							1		5	5
24						1		1	4	2
25						1				1
Total	188	158	159	163	171	140	105	92	73	33
(9+S)> (in %)	77.1	76.6	86.8	78.5	73.1	63.6	58.1	55.4	45.2	78.8
B. Females (N=1415)										
5										
6	7	1								
7	22	3		1						
8	78	27	4	2	1					
9	41	61	21	7	4					
10	16	47	50	30	8	2				
11	4	12	42	51	23	3	1			
12	3	6	13	42	47	22	4			
13		3	4	24	35	45	11	5		
14	1	1	5	9	14	27	34	9	2	
15			1	2	4	15	23	19	6	1
16	1			3	3	8	17	18	30	7
17				1	1	4	8	9	16	14
18						3	3	5	5	13
19						2	3	8	5	10
20					1	2		6	3	8
21					1		1	1		1
22								3	1	1
23						1		1		1
24						1				2
25										2
Total	173	161	140	172	142	135	105	84	122	60
(9+s)> (in %)	85.5	86.3	83.6	77.3	83.1	73.3	69.5	60.7	44.3	58.3

TABLE 3

SCHOOLING AND ENROLLMENT BY SEX OF CHILD
(In percent)

Completed Grade Level	Out of School Male	Out of School Female	Enrolled in School Male	Enrolled in School Female
0	2.67	2.31	-	-
Kindergarten	0.04	0.14	1.55	1.91
1	0.67	0.83	16.35	14.07
2	2.59	1.98	10.63	11.38
3	4.30	3.55	12.37	9.89
4	9.48	7.61	10.96	12.16
5	10.61	10.06	11.50	10.04
6	38.26	42.07	9.41	9.54
7	4.55	4.15	7.06	7.42
8	6.43	4.29	6.19	5.94
9	3.05	3.00	4.91	4.81
10	10.07	6.37	4.24	4.31
11	0.84	0.69	1.75	2.19
12	1.71	1.94	1.75	2.61
13	0.71	0.74	1.75	2.33
14	5.39	9.36	1.34	2.05
15	0.21	0.18	0	0.28
16	0.42	0.74	0.07	0
Total	100.00	100.00	100.00	100.00
N	2,394	2,168	1,487	1,415

TABLE 4

COMPLETED SCHOOLING LEVEL BY BIRTH COHORT
(Total number of out-of-school children=4563)

Completed Grade Intervals	- 1930	1931- 1940	1941- 1950	1951- 1960	1961- 1965	1966- 1971	1971- 1973
A. All							
Mean	7.6	7.1	7.7	6.9	5.5	2.0	2.0
None	2.29	1.53	0.98	1.08	0.97	38.98	0
1-5 years	37.40	27.79	21.79	21.94	34.68	54.24	100.00
6	17.56	33.26	36.75	41.83	53.06	5.65	0
7-9	6.87	13.79	11.30	15.98	9.84	0.56	0
10	7.63	9.41	9.35	10.33	1.45	0.56	0
11-13	4.58	1.97	4.96	3.85	0	0	0
14+	23.66	12.25	14.88	4.98	0	0	0
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
N	131	457	1230	1946	620	178	1
B. Males							
Mean	7.0	7.3	7.6	6.7	5.3	2.1	--
None	1.59	0.41	1.45	1.06	1.51	37.62	0
1-5 years	36.51	23.77	27.46	24.52	40.18	54.46	0
6	22.22	34.43	32.31	39.00	48.04	6.93	0
7-9	11.11	15.57	14.05	16.70	9.37	0	0
10	12.70	12.30	12.28	11.87	0.91	0.56	0
11-13	3.17	2.46	5.17	3.67	0	0.99	0
14+	12.70	11.07	12.28	3.19	0	0	0
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
N	63	244	619	1036	331	101	0
C. Females							
Mean	8.2	6.9	7.7	7.0	5.7	1.9	--
None	2.94	2.82	0.98	1.08	0.35	40.79	0
1-5 years	38.24	32.79	21.11	19.01	28.37	53.95	100.00
6	13.24	33.39	41.24	45.05	58.82	3.95	0
7-9	2.94	31.92	8.51	15.16	10.38	1.32	0
10	2.94	11.74	6.38	8.57	2.08	0	0
11-13	5.88	6.10	4.75	4.07	0	0	0
14+	33.82	13.62	17.88	7.03	0	0	0
			51				
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
N	68	213	611	910	289	77	1

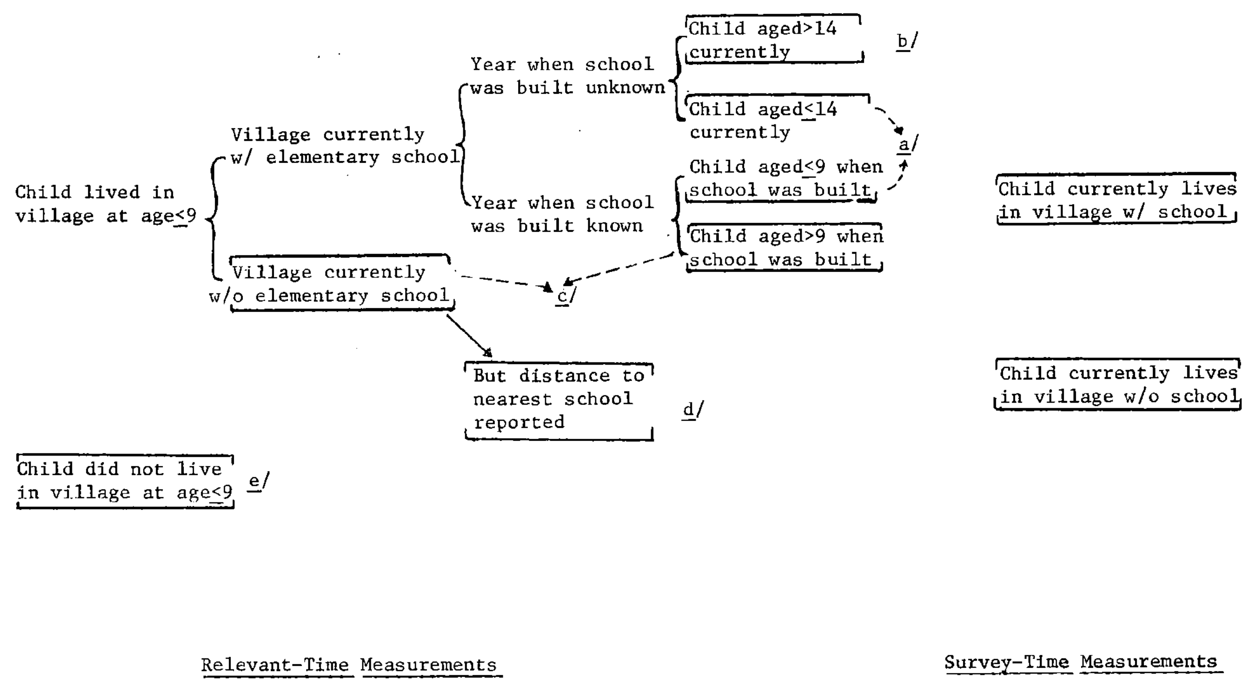
The proportion of male and female children in our sample who were still in school during the survey is about 40 percent. For these individuals, we know only that completed schooling attainment would be at least equal to the current enrollment level.

Relevant-Time v. Survey-Time Regressors

The costs of sending a child to school do not remain constant over time. They vary with the level of schooling and with time. In specifying the variables, great care is taken to obtain measurements that would reflect demographic change and other shifts in the environment over time. In a rapidly changing environment, currently observed values of explanatory variables can yield misleading indicators of the level and distribution of schooling costs. For example, take land ownership. Families accumulate land over time, through purchase, land reform, or inheritance. The amount of land owned when the child began school may have increased by the time the child completed school. Many new schools were built during the previous decade. Moreover, families migrate. One-fifth of the children in our sample did not live in the current village when they were 9 years old.

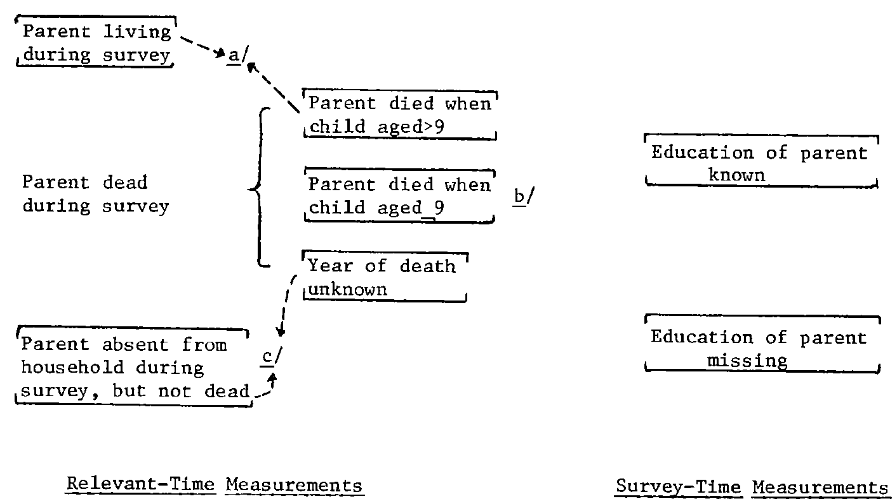
Variables are defined as of the time the child was entering school, which is fixed at 9 years. We refer to these measurements as relevant-time variables, as opposed to survey-time variables, which are defined at the time of the survey. To show the gains from careful specification of the regressors, we estimate the model using both sets of measurements. Figures 3-5 present relevant-time and survey-time specifications of a few regressors, namely, distance to school, parents' education, and land ownership and use.

In the case of older children, the measurement of variables at about the time of entry into school would be more relevant to the schooling choice than values observed during the survey. This advantage is less clear in the case of young children of school age. Since anticipated changes in the economic development could generate a different set of responses than unanticipated changes, the expected level of prices or incomes will also be driving allocational behavior. Hence, the choice of a "relevant" time period is arbitrary and may be irrelevant.



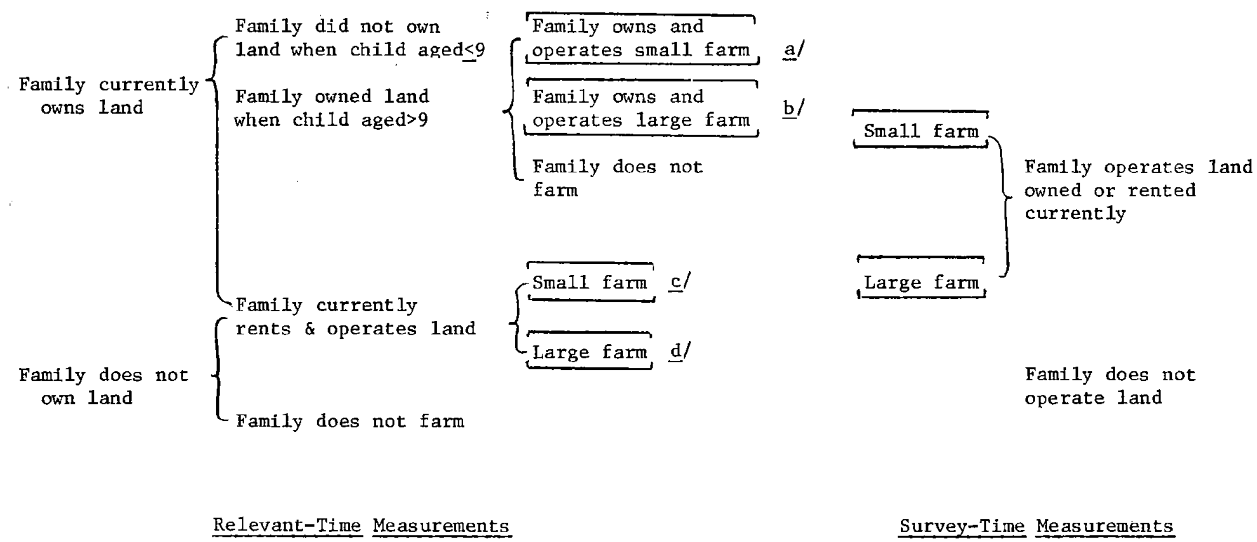
Notes: Categories (a)-(e) are used as relevant-time specifications of the distance of the household to the nearest elementary school. Sample means and standard deviations are given in Table 6.

Fig. 3 -- Relevant-Time and Survey-Time Measurements of Distance to Elementary School



Note: Categories (a)-(c) are used to define parental education variables. Sample means and standard deviations are given in Table 6.

Fig. 4 -- Relevant-Time and Survey-Time Measurements of Parents' Education



Notes: Categories (a)-(d) are used to define land use variables. Sample means and standard deviations are given in Table 6.

Fig. 5 -- Relevant-Time and Survey-Time Measurements of Land Ownership and Use

The presence of schools in the village and their distance to the household are used to measure schooling cost, but only if the school was present when the child was 9 years old. Using information on dates when elementary schools were built[14], jointly with data on the length of residence of the household in the village and child's age, we define a relevant-time cost of elementary schooling for each child in the family. The year when the first secondary school was established in the village is not available. Instead, we distinguish between children who were residing in the current village when they were 18 years old and those who were not, and allow reported distance to have a different effect for either age group.

Mean distances to school based on relevant-time and survey-time measurements do not seem to vary much for elementary schools and high schools in the village. However, households reported distances to the nearest school even when the nearest school was not located in the village. Assuming that children must commute to these schools, we define separate distance variables based on reported distances. The mean distance of 4 kilometers to the nearest high school outside the village is significantly farther than the mean distance to the high school in the village, which is .8 kilometer.

We define parental education variables separately with respect to whether the parent was living or dead when the child was aged 9 years. For a very few, year of death is not known.

The sample consists largely of agricultural households, and the survey gathered extensive information on family landholdings, including the year when land parcels were acquired.[15] We combined these data with information on cultivatorship and size of landholdings and the age of the child to specify land variables that would better measure the opportunity cost of a child's time during the schooling years. Table 5 below shows the distribution of families by ownership and use. Unfortunately, for tenants and leaseholders, the year when the land was first cultivated is not available. We note that the land variables will tend to underestimate actual amount of land owned and/or cultivated because the amount of land purchased and sold prior to the survey is unobserved, and that land tenure may have changed since acquisition.

TABLE 5

DISTRIBUTION OF FAMILIES BY LANDHOLDING ARRANGEMENTS

Landholding Arrangement	N	Percent
Owner-operator only	236	15.8
Owner-lessor only	71	4.8
Lessee only	498	33.4
Owner-operator and lessor	41	2.7
Owner-operator and lessee	107	7.2
Owner-lessor and lessee	6	0.4
Owner-operator, owner-lessor and lessee	7	0.5
Neither owns nor rents	526	35.2
Total	1492	100.0

Current land ownership and value are used to reflect family wealth. However, these are more appropriately treated as endogenous--an outcome of savings and nonhuman capital investment decisions of the family--and thus affected by the same factors that determine the schooling choice. In our sample, 39 percent of the families with land inherited all or part of their land parcels, so that not all of land currently owned is endogenous.

Of those who owned land, the mean duration of land ownership is about 15 years, with 35 percent having owned all or part of their total landholdings for at least 20 years.

The rest of the regressors in the model are defined in Table 6 together with their sample means and standard deviations.

TABLE 6

DEFINITION OF VARIABLES AND SIMPLE STATISTICS

Variables	Definition	MALES N	MALES Mean	MALES S.D.	FEMALES N	FEMALES Mean	FEMALES S.D.
Child Characteristics							
Birth cohort	Five ten-year birth cohorts, splined using (t-1950) as base						
-1930		63	1.6%	--	68	1.9%	--
1931-40		246	6.3%	--	215	6.0%	--
1941-50		627	16.2%	--	619	17.3%	--
1951-60		1273	32.8%	--	1121	31.3%	--
1961-73		1672	43.1%	--	1560	43.5%	--
Disabled	=1 if disabled; =0 otherwise. Includes impairment of vision and hearing, etc.	250	6.4%	--	239	6.7%	--
Sibling Order	Five nonoverlapping categories:						
Only child	(a) Only child	19	0.5%	--	25	0.7%	--
First child & only male (female)	(b) First child and only male (female), not (a)	43	1.1%	--	57	1.6%	--
First child	(c) First child, but not (a) or (b)	567	14.6%	--	580	16.2%	--
Only male (female)	(d) Only male (female), not (a), (b) or (c)	105	2.7%	--	122	3.4%	--
First male (female)	(e) First male (female), not (a), (b) or (c)	570	14.7%	--	545	15.2%	--
Land Ownership and Use							
Owns land	=1 if family currently owns; =0 otherwise	1351	34.8%	--	1220	34.1%	--
Land area	Area of land owned, in hectares for those with land; =0 otherwise	1351	5.05	8.15	1220	4.19	6.34
Land value	Market value of land in 10000 pesos for those with land; 0, otherwise	1351	1.63	2.76	1220	1.46	2.28
Owns land X first male (female)	Interaction of land and birth order variables	19	0.5%	--	23	0.6%	--
Land area X first male (female)		19	1.54	1.83	23	3.35	2.42
Land value X first male (female)		19	1.60	2.47	23	1.93	2.67
Small farm owner-operator (O-OP) at RT	=1 if family owned and operated a farm with area 5 hectares when child aged 9 years; =0 otherwise	589	15.2%	--	533	14.9%	--
Area, small farm, O-OP	Area of owner-operated small farm (hectares)	589	1.68	1.22	533	1.61	1.13
Large farm owner-operator at RT	=1 if family owned and operated a farm with area 5 hectares when child aged 9 years; =0 otherwise	180	4.6%	--	134	3.7%	--
Area, large farm, O-OP	Area of owner-operated large farm (hectares)	180	13.51	12.31	134	11.36	9.47
Small farm renter-operator (R-OP)	=1 if family currently rents or leases a farm with area 5 hectares; =0 otherwise	1441	37.1%	--	1268	35.4%	--
Area, small farm, R-OP	Area of renter-operated small farm (hectares)	1441	1.69	1.18	1268	1.42	1.08
Large farm renter-operator	=1 if family currently rents or leases a farm with area 5 hectares; =0 otherwise	261	6.7%	--	194	5.4%	--
Area, large farm, R-OP	Area of renter-operated large farm (hectares)	261	11.89	10.40	194	10.39	7.22
Small farm owner- or renter-operator (O/R-OP) at ST	=1 if family currently owns or leases, and operates a farm with area 5 hectares; =0 otherwise	1937	49.9%	--	1787	49.9%	--
Area, small farm, O/R-OP	Area of owner- or renter-operated small farm farm (hectares)	1937	1.69	1.18	1787	1.67	1.16

Table 6 ... continued

Variables	Definition	MALES N	MALES Mean	MALES S.D.	FEMALES N	FEMALES Mean	FEMALES S.D.
Large farm owner- or renter-operator at ST	=1 if family currently owns or leases, and operates a farm with area 5 hectares; =0 otherwise	500	12.9%	--	387	10.8%	--
Area, large farm, O/R-OP	Area of owner- or renter-operated large farm (hectares)	500	12.66	11.26	387	11.06	8.94
<u>Parents' Characteristics</u>							
Mother's birth cohort 1945	Mother was born before or after 1945; splined, using (t-1945) as base	3703	95.4%	--	3402	94.9%	--
Mother's birth cohort 1945		178	4.6%	--	181	5.1%	--
Mother's education, living at RT	Years of completed schooling, if living when child 9 years; 0, otherwise	3851	4.57	3.10	3546	4.63	3.14
Mother's education, dead at RT	Years of completed schooling, if dead when child 9 years; 0, otherwise	25	4.99	2.17	28	5.20	2.24
Mother's year of death unknown	=1 if mother was dead in 1978, but year of death unknown; =0 otherwise	5	0.1%	--	9	0.2%	--
Father's education, living at RT	Years of completed schooling, if living when child 9 years; 0, otherwise	3781	4.90	3.14	3490	5.05	3.12
Father's education, dead at RT	Years of completed schooling, if dead when child 9 years; 0, otherwise	60	4.14	2.04	51	4.26	2.28
Father's year of death unknown	=1 if father was dead in 1978, but year of death not known; =0 otherwise	40	1.0%	--	42	1.2%	--
Mother's education	Years of completed schooling, if known; 0, otherwise	3876	4.57	3.09	3576	4.64	3.13
Mother's education unknown	=1 if data missing; =0 otherwise	5	0.1%	--		0.2%	--
Father's education	Years of completed schooling, if known; 0, otherwise	3859	4.89	3.13	3566	5.02	3.10
Father's education unknown	=1 if data missing; =0 otherwise	22	0.6%	--		0.5%	--
<u>Distance to Elementary School</u> (kilometers)							
Distance, school present at RT	Distance, (i) if school was present when child aged 9 years, or (ii) if child currently aged 14 years and residing in village with school when year school was built is missing; 0, otherwise	2046	.67	.83	1806	.69	.87
Distance, school present, but year built unknown	Distance, if child currently aged 14 years and residing in village with school, but year when school was built is missing; 0, otherwise	232	.74	1.20	244	.70	1.07
No school at RT	=1 (i) if child currently resides in village with no school in village, or (ii) if school was built when child aged 9 years; =0 otherwise	885	22.8%	--	822	22.9%	--
Distance, if no school at RT, but distance reported	Distance, if "no school at RT" equals =1 but family reported a distance; 0, otherwise	674	.84	.87	648	.84	.79
Not residing in village at RT	=1 if child did not reside in village at age 9 years; =0 otherwise	718	18.5%	--	711	19.8%	--

Table 6 ... continued

Variables	Definition	MALES N	MALES Mean	MALES S.D.	FEMALES N	FEMALES Mean	FEMALES S.D.
Distance, school present at ST	Distance, if child currently resides in village with school; 0, otherwise	3000	.67	.85	2699	.69	.94
No school at ST	=1 if child currently resides in village with a school; =0 otherwise	881	22.7%	--	884	24.7%	--
Distance to Secondary School (kilometers)							
Distance, school present at RT, child aged 18	Distance, if child currently aged 18 years, and resides in village with school; 0, otherwise	258	.80	.93	260	.79	.93
Distance, school present at RT, child aged 18	Distance, if child currently aged 18 years, and has resided since age 18 years in village currently with school; 0, otherwise	188	.76	1.00	184	.85	1.02
No school at RT	=1 if child resides in village with no school currently; 0, otherwise	3057	78.8%	--	2766	77.2%	--
Distance, no school at RT, but distance reported	Distance if "no school at RT" equals =1 but family reported distance; 0, otherwise	2944	4.21	5.09	2653	4.03	4.56
Not residing in village at RT	=1 if child did not reside in village at age 18 years; =0 otherwise	378	9.7%	--	373	10.4%	--
Distance, school present at ST	Distance, if child currently resides in village with a school; 0, otherwise	512	.83	1.08	504	.81	.98
No school at ST	=1 if child currently resides in village with no school; =0 otherwise	3369	86.8%	--	3079	85.9%	--
Community Characteristics							
Rural	=1 if child resides in a rural village; =0 otherwise	3032	78.1%	--	2710	75.6%	--
Urban	=1 if child resides in an urban community; =0 otherwise	561	14.5%	--	557	15.5%	--
Semi-urban	=1 if child resides in a semi-urban community; =0 otherwise	288	7.4%	--	316	8.8%	--
Electricity since child aged 9 years	=1 if child resides in village with electric power since child aged 9 years; =0 otherwise	561	14.5%	--	557	15.5%	--
Electricity since child aged 10-18	=1 if child resides in a village with electric power since child aged 10-18 years; =0 otherwise	352	9.1%	--	315	8.8%	--

Note: RT and ST refer to relevant-time and survey-time variable specifications, respectively.

IV. PARAMETER ESTIMATES AND THEIR BROAD IMPLICATIONS

This section presents a quasi-analysis of variance, and the estimated full distribution of completed schooling, enrollment rates and continuation probabilities implied by the parameter estimates. Further implications of specific parameter estimates are discussed in Section V. Regression coefficients α and threshold values τ are presented in Tables 7 and 8, respectively. Parameter values are reported separately for males and females. While relevant-time specifications are preferred, current-time specifications are included to facilitate comparisons with other studies.

Both the logit and probit forms were considered for F. Since results were not affected, the probit specification (i.e., normality of e, with normalization $\sigma_e = 1$) was chosen to facilitate the adjustment for intrafamily correlations. Thus, $F = \Phi$ where Φ is the cumulative normal distribution function.

We use the full sample of all children in the family, provided they satisfy our selection criteria, as given in Table 1. The residual e is assumed to be independent between families but may be correlated across children within families. There are, on average, 2.9 boys and 2.7 girls per family. Intrafamily correlation in schooling attainment may be introduced through the specification of the residual e.[16] Our maximum likelihood procedure treats each child as an independent observation. This results in consistent estimates of parameters α and τ (see Keifer, 1982). Intrafamily correlation is estimated separately and used to obtain asymptotic standard errors, based on the procedure of Duan (1981).[17]

At an early stage in the research, before regressors X were introduced[18], we found significant differences between male and female threshold values τ, after controlling for a simple mean difference in t. The sexes were treated differently thereafter, and we allow their respective regression coefficients, α_b and α_g, to differ. The differences in the estimates occur primarily at higher grade levels. Threshold values are generally lower for females, implying that, even with equal values of the mean schooling propensity ($\alpha'X$), females are

TABLE 7

COEFFICIENT ESTIMATES (α 's) USING RELEVANT-TIME AND SURVEY-TIME VARIABLE MEASUREMENTS
(Standard errors in parentheses*)

Variables	Relevant-Time (RT) Males		Relevant-Time (RT) Females		Survey-Time (ST) Males		Survey-Time (ST) Females	
Constant	-.2302	(.0406)	-.2183	(.0426)	-.2241	(.0396)	-.2216	(.0425)
Child Characteristics								
Birth cohort - 1930	-.0722	(.0536)	-.0690	(.0402)	-.0472	(.0532)	-.0539	(.0400)
Birth cohort 1931-40	.0546	(.0213)	.0409	(.0217)	.0550	(.0212)	.0430	(.0216)
Birth cohort 1941-50	.0084	(.0132)	.0261	(.0143)	.0083	(.0128)	.0284	(.0138)
Birth cohort 1951-60	.0274	(.0108)	.0203	(.0116)	.0370	(.0102)	.0358	(.0110)
Birth cohort 1961-73	-.0820	(.0149)	-.0822	(.0162)	-.0761	(.0146)	-.0805	(.0158)
Disabled	-.1049	(.1143)	-.0972	(.1247)	-.1067	(.1139)	-.0857	(.1239)
Sibling order								
Only child	.1307	(.3481)	.2720	(.3489)	.1461	(.3460)	.2586	(.3479)
First child and only male (female)	.5666	(.2749)	.3262	(.2496)	.5879	(.2733)	.3111	(.2496)
First child	.1863	(.0818)	.0882	(.0846)	.1781	(.0816)	.0976	(.0845)
Only male (female)	.3294	(.1712)	.3410	(.1612)	.3081	(.1699)	.3695	(.1599)
First male (female)	.0618	(.0745)	.0462	(.0795)	.0533	(.0744)	.0391	(.0792)
Land ownership and operation								
Owns land at ST	.3138	(.0846)	.0808	(.0922)	.2693	(.0692)	.1688	(.0771)
Land area	.0137	(.0108)	.0166	(.0152)	.0002	(.0082)	-.0026	(.0127)
Land value	.6722	(.2450)	1.1460	(.3400)	.7947	(.2347)	1.2232	(.3328)
Owns land × first male (female)	-.3449	(.5619)	.4253	(.6291)	-.6310	(.5446)	.7676	(.6146)
Land area × first male (female)	-.4112	(.3297)	.0701	(.1937)	-.4902	(.3007)	.1301	(.1961)
Land value × first male (female)	4.0696	(5.1621)	-2.3849	(1.9768)	2.6169	(8.2909)	-4.9681	(1.6047)
Small farm owner-operator at RT	-.1215	(.1414)	.0048	(.1513)				
Area, small farm, O-OP	.0360	(.0595)	.0669	(.0673)				
Large farm owner-operator at RT	.1151	(.1970)	.1221	(.2336)				
Area, large farm, O-OP	-.0166	(.0145)	-.0262	(.0213)				
Small farm renter-operator	-.0597	(.0806)	-.1329	(.0855)				
Area, small farm, R-OP	.1133	(.0406)	.0978	(.0412)				
Large farm renter-operator	-.0017	(.1568)	-.0246	(.2118)				
Area, large farm, R-OP	.0128	(.0099)	.0131	(.0171)				
Small farm, owner- or renter-operator at ST					-.0734	(.0800)	-.1523	(.0851)
Area, small farm, O/R-OP					.0799	(.0310)	.0889	(.0330)
Large farm, owner- or renter-operator at ST					.1114	(.1219)	.0326	(.1475)
Area, large farm, O/R-OP					.0015	(.0074)	.0022	(.0119)
Parents characteristics								
Mother's birth cohort ≤ 1945	-.0272	(.0046)	-.0220	(.0049)	-.0275	(.0045)	-.0236	(.0048)
Mother's birth cohort > 1945	-.0098	(.0552)	.0182	(.0561)	-.0317	(.0540)	-.0031	(.0556)

Table 7 ... continued

Variables	Relevant-Time (RT) Males		Relevant-Time (RT) Females		Survey-Time (ST) Males		Survey-Time (ST) Females	
Mother's education, living at RT	.0842	(.0124)	.1042	(.0136)				
Mother's education, dead at RT	.0610	(.0830)	.1213	(.0745)				
Mother's year of death unknown	.5966	(.6705)	.5240	(.5269)				
Mother's education					.0864	(.0123)	.1025	(.0135)
Mother's education not known					.6347	(.6684)	.4562	(.6022)
Father's education, living at RT	.1055	(.0122)	.1102	(.0137)				
Father's education, dead at RT	.0919	(.0488)	.1257	(.0565)				
Father's year of death unknown	.3373	(.2415)	.6822	(.2441)				
Father's education					.1024	(.0120)	.1056	(.0136)
Father's education not known					.5068	(.3270)	.7379	(.4036)
<u>Distance to Elementary School</u>								
Distance, school present at RT	-.2161	(.0444)	-.1624	(.0462)				
Distance, school present but year built unknown	-.0290	(.6787)	-.0564	(.0757)				
No school at RT	-.1488	(.0810)	-.0706	(.0950)				
Distance, no school present	-.0152	(.0689)	-.0760	(.0764)				
Not residing in village at RT	-.3267	(.0929)	-.3611	(.0952)				
Distance, school present at ST					-.1624	(.0351)	-.1240	(.0351)
No school at ST					-.0394	(.0727)	-.0879	(.0761)
<u>Distance to Secondary School</u>								
Distance, school present and child ≤ 18	-.0029	(.1155)	-.1521	(.1074)				
Distance, school present and child > 18	-.0956	(.0955)	-.2154	(.0959)				
No school at RT	.0646	(.1056)	-.1103	(.1160)				
Distance, no school present at RT, but distance reported	-.0143	(.0061)	-.0035	(.0080)				
Not residing in village at RT	-.1041	(.1498)	-.1135	(.1501)				
Distance, school present at ST					-.0641	(.0645)	-.1936	(.0740)
No school at ST					-.0093	(.0943)	-.1018	(.1016)
<u>Community Characteristics</u>								
Rural	-.4145	(.1134)	-.1765	(.1116)	-.3462	(.1144)	-.1107	(.1125)
Urban	-.2225	(.1286)	.0755	(.1265)	-.1802	(.1266)	-.0808	(.1247)
Electricity since child aged ≤ 9	.1289	(.0968)	.1876	(.0982)				
Electricity since child aged 10-18	.2423	(.1009)	.5373	(.1106)				
Electricity since child aged 19-30	.0406	(.0923)	.1822	(.0991)				
Electricity at ST					.1941	(.0629)	.3319	(.0679)
Sample size	3881		3583		3881		3583	

Notes: * Corrected for intrafamily correlation using a multiplicative adjustment on the variance (Duan, 1981).

TABLE 8

ESTIMATES OF THRESHOLD VALUES (τ 's) FOR RELEVANT-TIME AND SURVEY-TIME SPECIFICATIONS
(Standard errors in parentheses*)

Threshold levels	Relevant-Time (RT)		Survey-Time (ST)	
$\tau_7 = 0$	Males	Females	Males	Females
τ_1	-2.7780 (.0873)	-2.8344 (.0914)	-2.7485 (.0864)	-2.8449 (.0922)
τ_2	-2.6637 (.0818)	-2.6996 (.0846)	-2.6329 (.0808)	-2.7049 (.0849)
τ_3	-2.3347 (.0686)	-2.4493 (.0743)	-2.3080 (.0678)	-2.4542 (.0747)
τ_4	-1.9785 (.0582)	-2.1364 (.0645)	-1.9588 (.0576)	-2.1375 (.0646)
τ_5	-1.4822 (.0479)	-1.6854 (.0541)	-1.4681 (.0474)	-1.6823 (.0540)
τ_6	-1.0794 (.0412)	-1.2663 (.0466)	-1.0697 (.0408)	-1.2617 (.0465)
τ_8	.1470 (.0181)	.1392 (.0189)	.1463 (.0180)	.1374 (.0187)
τ_9	.3830 (.0291)	.3074 (.0285)	.3810 (.0290)	.3050 (.0283)
τ_{10}	.5125 (.0492)	.4395 (.0414)	.5091 (.0484)	.4357 (.0461)
τ_{11-13}	1.0883 (.0528)	.7841 (.0475)	1.0806 (.0524)	.7693 (.0466)
τ_{14+}	1.4314 (.0675)	1.0466 (.0582)	1.4202 (.0670)	1.0282 (.0573)
	3881	3583	3881	3583

Notes: * Corrected for intrafamily correlation using a multiplicative adjustment on the variance (Duan, 1981).

more likely to attain higher grades, especially college and graduate levels.

Before discussing parameter implications, consider the explanatory power of the observed regressors in the equation for schooling propensity, t. Variance "due to X" is computed as $\hat{\alpha}'S_{XX}\hat{\alpha}$ and total variance is $(\hat{\alpha}'S_{XX}\hat{\alpha} + 1)$, using $\sigma_e = 1$. Since t is not directly observable, this is a quasi-analysis of variance (see Table 10). For both males and females, the regressors account for approximately 40 percent of total variance. In addition, the residual e is significantly correlated among members of the same family. The intrafamily correlation is estimated to be .49, and is identical (± .01) for brothers, for sisters, and between brothers and sisters.[19]

Table 9

A QUASI-ANALYSIS OF VARIANCE

Sex	Sample size	Total X,e	"Due to X"	Residual e	Share "Due to X"
Male	3881	1.639	.639	1.0	.39
Female	3583	1.733	.733	1.0	.42

Simulating the Effects of Explanatory Factors

From the model, we can derive different distributional implications about completed schooling levels and enrollment rates using the estimates of the parameters. First, consider the distribution of years of schooling, conditional on the vector X. The expected value of t, conditional on a particular vector of regressors X_0, is estimated to be $E(t|X_0) = \hat{\alpha}'X_0$. The probability of each schooling level is given by

$$P(S=s|X) = \Phi(\hat{\tau}_{S+1}-\hat{\alpha}'X) - \Phi(\hat{\tau}_S-\hat{\alpha}'X).$$

An estimate of the population distribution is obtained by averaging over sample values of X. The expected value of schooling is given by

$$E(S|X) = \sum_{s=1}^{16} s\ P(S=s|X)$$

which is not a linear function of X, as t is. Higher order moments may be computed similarly.

Moreover, predictions about schooling levels can be made conditional on enrollment at a given level S*. Clearly, S can take only S* or larger values since enrollment at S* means $t > \tau_{S*}$. The mean value of t, conditional on enrollment in level S*, is given by

$$\begin{aligned} E(t|t > t_{S*}) &= \hat{\alpha}'X + E(e|e > \hat{\tau}_{S*}-\hat{\alpha}'X) \\ &= \hat{\alpha}'X + \phi(\hat{\tau}_{S*}-\hat{\alpha}'X)/\{1 - \Phi(\hat{\tau}_{S*}-\hat{\alpha}'X)\} \end{aligned}$$

where ϕ denotes the standardized normal density function. In terms of the more relevant conditional probabilities of schooling levels, this is equivalent to

$$P(S=s|S \geq S^*,X) = P(S=s|X)/P(S \geq S^*|X) \text{ for } S=S^*,S^*+1,\ldots$$

where $P(S \geq S^*|X) = \sum_{s=S^*}^{16} P(S=s|X)$. Conditional moments (e.g. mean) and other relevant statistics can be calculated from these probabilities. For example, the continuation probability for a student enrolled in S* is $1 - P(S=S^*|S \geq S^*,X)$.

The Full Distribution of Completed Schooling

The following analysis of the schooling distribution is based on the full sample, including children enrolled at the time of the survey. Our procedure fully accounts for censored observations because parameters have been estimated using their information.

The distribution of completed schooling is the probability of each attained schooling level, computed for each individual and averaged over all. The probability of any given completed level, conditional on the individual's characteristics, represented by $\hat{\alpha}'X_i$ is

$$P(S=s|X_i) = \Phi(\hat{\tau}_{S+1}-\hat{\alpha}'X_i) - \Phi(\hat{\tau}_S-\hat{\alpha}'X_i).$$

These probabilities and the expected value of S, E(S), are presented in the first row of Table 10.

The three major modal schooling levels are clearly the completion grades in elementary school, high school and college. Mean schooling attainment is 7.25 years for males and 7.67 years for females. The female distribution stochastically dominates the male distribution, i.e., $P_g(S \geq S^*) \geq P_b(S \geq S^*)$ for every S^*. Of females, 78.8 percent complete the sixth grade at least, and 29.1 percent graduate from high school at least. Of males, 74.6 percent finish the sixth grade and 26.6 percent complete high school. Of those completing elementary school, 36.9 percent of females and 35.7 percent of males become high school graduates. The male-female gap widens at the college level as 20.4 percent of female and only 12.7 percent of male elementary school graduates complete college. Of high school graduates, 43.6 percent of females and 36.0 percent of males obtain college degrees.

Micro Probabilities of Enrollment and Continuation Probabilities

The discussion above is based on full sample proportions that are ratios of average probabilities. Our model facilitates as well the computation of similar probabilites, enrollment rates by grade level and continuation probabilities for each individual. The rest of Table 10 contains calculations that are averages of individual probabilities, e.g.,

$$P(S=s|S \geq S^*) = \frac{1}{N}\sum_{i=1}^{N} (\Phi(\hat{\tau}_{S+1}-\hat{\alpha}'X_i)-\Phi(\hat{\tau}_S-\hat{\alpha}'X_i))/\Phi(-(\hat{\tau}_S-\hat{\alpha}'X_i).$$

Successive rows of the triangle in Table 10 report the distribution of completed schooling conditional on attainment of at least grade level S^*, with probabilities summing to one for each row.

Conditional means are given in column 1 (and Figure 6A), and the probabilities of attaining at least grade level S^* are reported in column 2 (see also Figure 6B). The probability of attaining at least grade level S^* represents the full sample enrollment rate for that

TABLE 10

EXPECTED SCHOOLING LEVELS, ENROLLMENT RATES AND CONDITIONAL PROBABILITIES:
SIMULATIONS FOR FULL SAMPLES OF MALES AND FEMALES

			Conditional Probability P(S=s | S ≥ S*)												
S*	E(S | S ≥ S*)	P(S ≥ S*)	s=0	1	2	3	4	5	6	7	8	9	10	11-13	14+
A. Males (N=3881)															
0	7.25	1.000	.017	.005	.020	.035	.081	.095	.334	.045	.068	.034	.121	.049	.096
1	7.35	.982		.005	.021	.037	.083	.098	.340	.046	.068	.034	.122	.049	.096
2	7.37	.977			.021	.037	.084	.098	.342	.046	.068	.034	.122	.049	.096
3	7.46	.958				.039	.088	.102	.350	.046	.070	.035	.124	.050	.096
4	7.59	.922					.094	.108	.367	.048	.072	.036	.127	.051	.097
5	7.86	.842						.126	.414	.053	.078	.039	.136	.053	.100
6	8.16	.746							.492	.061	.089	.044	.151	.058	.105
7	9.90	.412								.143	.201	.095	.303	.104	.154
8	10.32	.367									.241	.113	.356	.120	.170
9	10.99	.300										.156	.480	.156	.208
10	11.32	.266											.578	.184	.237
11-13	13.04	.144												.478	.521
14+															
B. Females (N=3583)															
0	7.67	1.000	.017	.005	.014	.027	.062	.086	.373	.041	.047	.035	.080	.050	.161
1	7.77	.983		.006	.015	.028	.064	.089	.380	.042	.048	.035	.081	.050	.162
2	7.80	.977			.015	.028	.065	.090	.382	.042	.048	.035	.081	.050	.162
3	7.86	.963				.030	.067	.092	.389	.042	.048	.036	.081	.051	.162
4	7.96	.936					.071	.097	.403	.043	.050	.036	.083	.052	.164
5	8.17	.874						.110	.443	.046	.053	.039	.088	.054	.167
6	8.43	.788							.516	.052	.059	.043	.096	.058	.174
7	10.55	.415								.136	.147	.102	.215	.119	.280
8	11.05	.374									.175	.121	.253	.138	.312
9	11.64	.326										.153	.315	.169	.364
10	12.07	.291											.381	.202	.417
11-13	13.30	.211												.348	.651
14+															

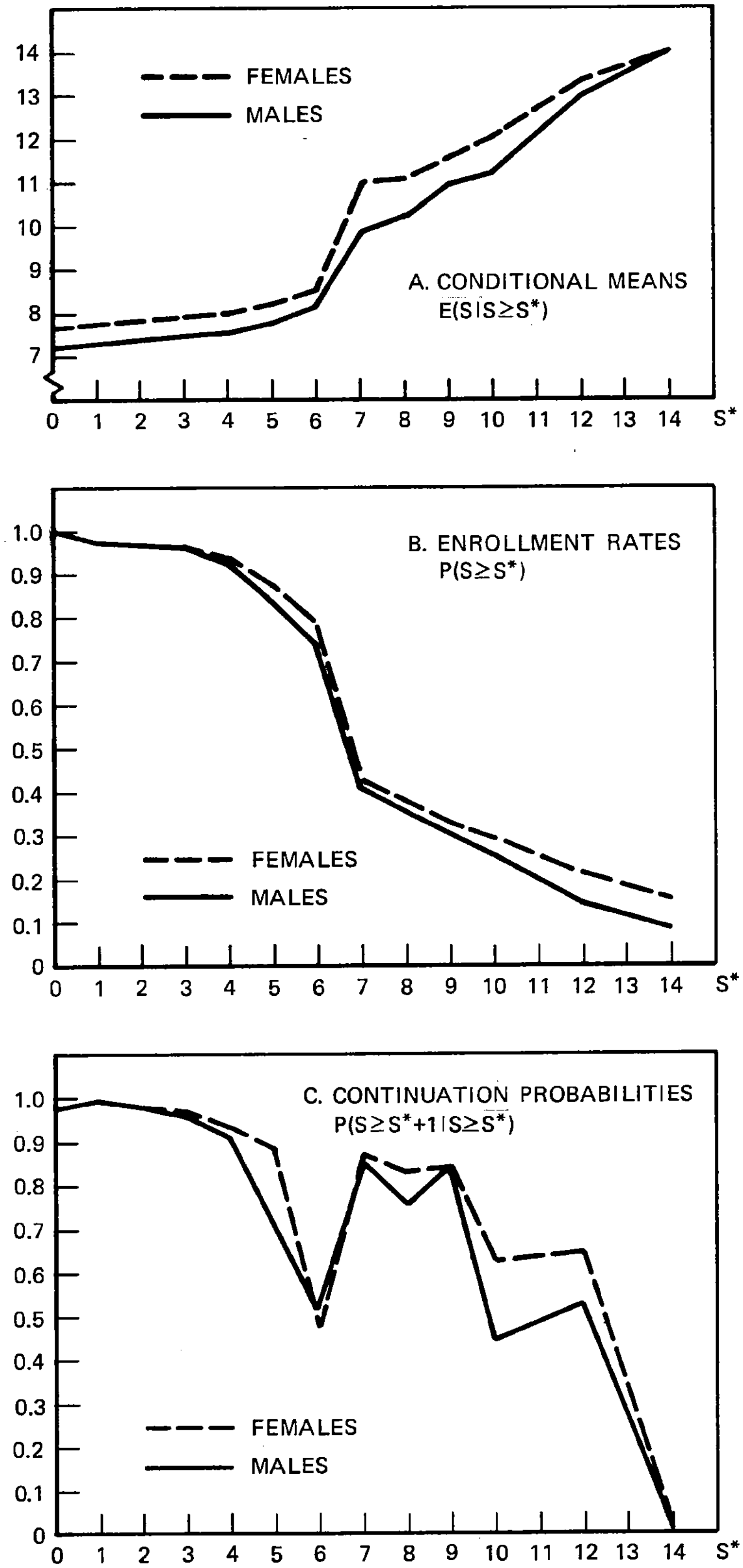


Fig. 6—Conditional means, enrollment rates, and continuation probabilities: simulations using the full samples

level. Enrollment rates are high through the fourth grade--above 92 percent--but drop drastically after the sixth grade, and continue to fall thereafter.

Average continuation probabilities by grade level are given by one minus the diagonal elements of the triangle of distributions. Continuation probabilities are systematically higher for females than males, except at the sixth grade, where the difference is 2.4 percent in favor of males (see Figure 6C). In fact, the sixth grade is where mean continuation probabilities are smallest. Only approximately 50 percent of elementary school completers enter high school. Note that grade six is the terminal year in elementary school and, by law, should be an individual's minimum schooling attainment.

The greatest difference in continuation probabilities between males and females occurs upon completion of high school. The mean probability of going to college is 62 percent for females and 42 percent for males, a difference of 20 percentage points. The average probability of completing college, given enrollment in college, is 65 percent for females and 52 percent for males, a difference of 13 percentage points.

V. SPECIFIC IMPLICATIONS OF DIFFERENCES IN MEASURED INDIVIDUAL, FAMILY AND COMMUNITY CHARACTERISTICS

In this section, we discuss the significance of various groups of regressors, and assess their implications for the distribution of completed schooling, for enrollment rates by grade level, and for continuation probabilities. These distributions, moments and probabilities are nonlinear functions of the predicted value of t ($=\hat{\alpha}'X$). Hence, the effect of an explanatory variable for any individual is nonlinear, and depends on the values of other regressors. We calculate the predictions for each individual, and then average over the sample.

Our vehicle in facilitating an understanding of the effects of the explanatory variables is the counterfactual simulation. A counterfactual simulation is an experiment in which one or more explanatory variables are assigned values that are not necessarily equal to actual values. The experiment might be defined for some or all individuals. Simulation results are presented in terms of deviations of outcomes from those reported in Table 10.

Relevant-Time v. Survey-Time Estimates

Despite our limited data on relevant-time prices, some interesting findings emerge. The survey-time coefficients of distance to school indicate that, given an elementary school in the village during the survey, the propensity to send children to school is smaller the farther the school is from home. As a result of separating the effect of distance to a school in the village from that to a school outside the village, the relevant-time results show a similar but larger negative effect of distance to an elementary school. Moreover, by accounting for length of residence in the village, we find that more recent migrants tend to have less schooling.

The survey-time estimates state that parental education has a positive and significant effect on child schooling. The relevant-time coefficients confirm this finding. Moreover, they suggest that while mother's education is a significant determinant of child schooling only if the mother is present at home, the influence of father's education on child schooling does not depend on his being present at home. This supports the view that father's education is mainly a measure of family income, and that mother's education also reflects the input of parents' time into child schooling.

Cohort Comparisons

Cohort effects on schooling propensity are introduced using a piecewise linear specification of the year of birth of children (as deviations from 1950). The expected positive trend is borne out except for the oldest and youngest cohort groups, which show negative coefficients. For the oldest cohort group, the negative coefficient estimate can be explained by the fact that those born around 1930 experienced the disruptive effects of World War II. For the youngest cohort group, the apparently perverse result can be attributed to unobserved temporary leaves from school with reentry. Evidence of this is provided by the number of overaged children enrolled during the survey, as noted in Table 2. Due to absence of further information, we are not able to isolate from our results for the current school-age cohort the effect of late starts, repetitions and temporary leaves.

The birth cohort of the mother is defined also as a piecewise linear function, and together with the child's cohort, measures the effect of age of mother at the time of child's birth. The coefficient estimates for these variables suggest that, controlling for sibling position, children born to younger mothers tend to have lower schooling propensity. The age of the mother at time of birth is possibly measuring a life-cycle income effect on child schooling. Earlier in the parents' earnings profile, incomes are expected to be lower. Moreover, recognizing that the timing of birth is another dimension of fertility choice, mother's age at birth could be signalling final outcomes regarding number of children, and hence, the desired quality of children through the interaction of quantity-quality decisions. Parents who desire to invest more in child schooling will more likely postpone the start of childbearing in order to build up physical capital.

Parents' Education

Parents' schooling measures not only family income and wages,[20] but also the tastes and capacity of parents to supervise child schooling. The coefficient estimates imply that children with higher-schooled parents will also have higher schooling. To show the implications of these estimates for enrollment rates and completed schooling levels, consider the experiments in which both parents have 1 and 2 more years of schooling than they actually have. Table 11 and Figure 7 present the results of these counterfactual simulations. The expected level of child schooling increases by about one-half year for every year's increase in parents' schooling. The increase in enrollment rates is greatest at the entry level to high school--by about 6 percent for every year's increase in parents' schooling--indicating falling drop-out rates after elementary school. The effects of this experiment on the schooling of male and female children are only slightly different.

An interesting result emerges from a corollary experiment which explores the relative effects of mother's and father's education. If the mother had 1 or 2 more years of schooling, holding father's schooling at observed levels, expected attainment and enrollment rates rise more for female children than for male children, especially at higher schooling levels. However, the same experiment for the father, holding mother's schooling at observed levels, induces more similar changes in expected schooling levels for males and females. Enrollment rates increase slightly more for males than females until high school completion, and more for females than males at the college level.

Sibling Order

Interest in sibling order in relation to allocational choice lies mainly in its interaction with number of children in determining demand for family resources at a given time (Lindert, 1977; Birdsall, 1980). First-born and last-born children are found to have an advantage over middle-born children with respect to benefitting most from family income and time resources, because of constraints of transferring resources across time periods.

TABLE 11

COUNTERFACTUAL SCHOOLING SIMULATIONS ON PARENTS' SCHOOLING
USING FULL SAMPLES OF MALES AND FEMALES

	Both Parents' Education						Mothers' Education						Fathers' Education					
	Males			Females			Males			Females			Males			Females		
S*	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
A. If 1 more year of schooling																		
0	0.52	1.000	-.006	0.50	1.000	-.006	0.53	1.000	-.003	0.25	1.000	-.003	0.24	1.000	-.003	0.24	1.000	-.003
1	0.49	.006	-.002	0.47	.006	-.002	0.19	.003	-.001	0.23	.003	-.001	0.22	.003	-.001	0.23	.003	-.001
2	0.48	.008	-.004	0.46	.008	-.004	0.18	.003	-.002	0.23	.004	-.002	0.22	.004	-.003	0.22	.004	-.002
3	0.46	.012	-.007	0.44	.013	-.006	0.18	.006	-.004	0.22	.006	-.003	0.21	.007	-.004	0.22	.006	-.003
4	0.44	.019	-.013	0.42	.022	-.012	0.16	.010	-.006	0.21	.010	-.006	0.20	.011	-.008	0.21	.009	-.006
5	0.41	.032	-.014	0.37	.037	-.013	0.15	.016	-.005	0.19	.016	-.006	0.18	.018	-.006	0.19	.015	-.006
6	0.38	.045	-.017	0.34	.050	-.016	0.13	.021	-.004	0.18	.023	-.007	0.16	.025	-.006	0.17	.022	-.007
7	0.24	.062	.002	0.23	.064	.002	0.09	.026	.001	0.12	.030	.001	0.11	.030	.001	0.11	.029	.001
8	0.21	.060	.003	0.20	.062	.003	0.08	.025	.002	0.10	.029	.002	0.09	.029	.002	0.10	.028	.001
9	0.16	.057	.003	0.16	.057	.003	0.06	.023	.001	0.08	.027	.002	0.07	.027	.002	0.08	.026	.001
10	0.14	.054	.009	0.14	.054	.009	0.06	.021	.007	0.07	.026	.005	0.07	.025	.008	0.06	.025	.004
11-13	0.49	.045	.008	0.06	.037	.007	0.02	.014	.004	0.03	.021	.004	0.03	.017	.005	0.02	.021	.004
14+			.037			.036			.010			.017			.012			.017
B. If 2 more years of schooling																		
0	0.79	1.000	-.010	1.06	1.000	-.010	0.41	1.000	-.005	0.52	1.000	-.006	0.50	1.000	-.006	0.53	1.000	-.006
1	0.75	.008	-.002	1.00	.010	-.003	0.38	.005	-.001	0.49	.006	-.002	0.47	.006	-.001	0.50	.006	-.002
2	0.73	.011	-.009	0.99	.013	-.007	0.38	.007	-.005	0.48	.008	-.004	0.46	.008	-.006	0.48	.008	-.004
3	0.71	.017	-.014	0.96	.020	-.012	0.36	.011	-.007	0.46	.012	-.007	0.44	.013	-.008	0.47	.012	-.007
4	0.68	.026	-.027	0.92	.033	-.024	0.34	.018	-.013	0.44	.019	-.013	0.42	.022	-.016	0.45	.019	-.013
5	0.63	.046	-.024	0.85	.057	-.027	0.30	.031	-.011	0.41	.032	-.014	0.37	.037	-.013	0.41	.032	-.014
6	0.58	.066	-.030	0.79	.084	-.042	0.28	.042	-.010	0.38	.045	-.017	0.34	.050	-.014	0.38	.045	-.017
7	0.37	.045	.003	0.50	.126	.003	0.18	.053	.002	0.24	.062	.002	0.23	.064	.002	0.25	.063	.002
8	0.31	.092	.007	0.42	.124	.005	0.16	.051	.004	0.21	.060	.003	0.20	.062	.005	0.21	.061	.003
9	0.25	.088	.005	0.34	.119	.005	0.13	.047	.003	0.16	.057	.003	0.16	.057	.003	0.17	.058	.003
10	0.21	.084	.011	0.28	.114	.017	0.11	.044	.014	0.14	.054	.009	0.14	.054	.017	0.14	.055	.009
11-13	0.08	.070	.019	0.11	.097	.015	0.05	.029	.008	0.49	.045	.008	0.06	.037	.010	0.05	.046	.008
14+			.053			.082			.021			.037			.027			.038

Note: Column (1) is $\Delta E(S|S \geq S^*)$. Column (2) is $\Delta P(S \geq S^*)$. Column (3) is $\Delta P(S=S^*)$.

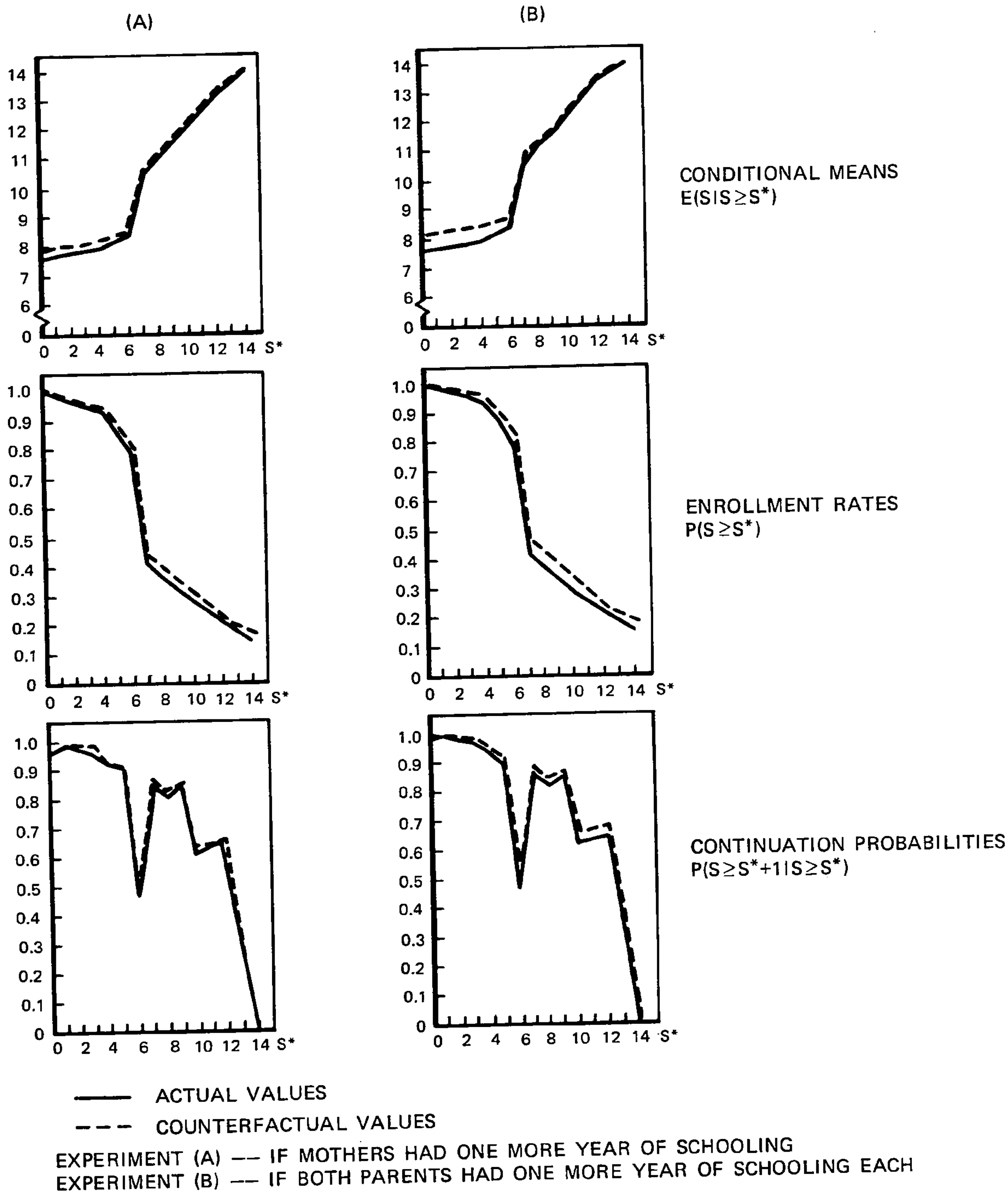


Fig. 7—Conditional means, enrollment rates, and continuation probabilities: counterfactual simulations on parents' schooling using the female sample

Our parameter estimates also imply that first-borns are more likely to have higher schooling than later-borns. Further, since we distinguish among first sons (daughters), first children, first-born and only sons (daughters), first-born children who are also an only son or daughter, and children in single sibships, we capture additional sibling order effects. In particular, the "crowding" interpretation does not explain one result for males--that an only child (single sibship) has less expected schooling than a first-born in a larger sibship. Being the only child of a given sex in larger sibships, in fact, implies greater schooling attainment than being first-born or being an only child. This points to other interpretations of birth order effects besides the IQ and strain-on-family resources interpretations.

Another sibling order effect on schooling relates to possible bequests by parents. Interacting sibling order with land ownership, we find than land ownership is associated with smaller schooling propensity for first sons and with positive schooling propensity for first daughters, though the estimates are not statistically significant. The signs are reversed for the interaction with land value, though again not significant.

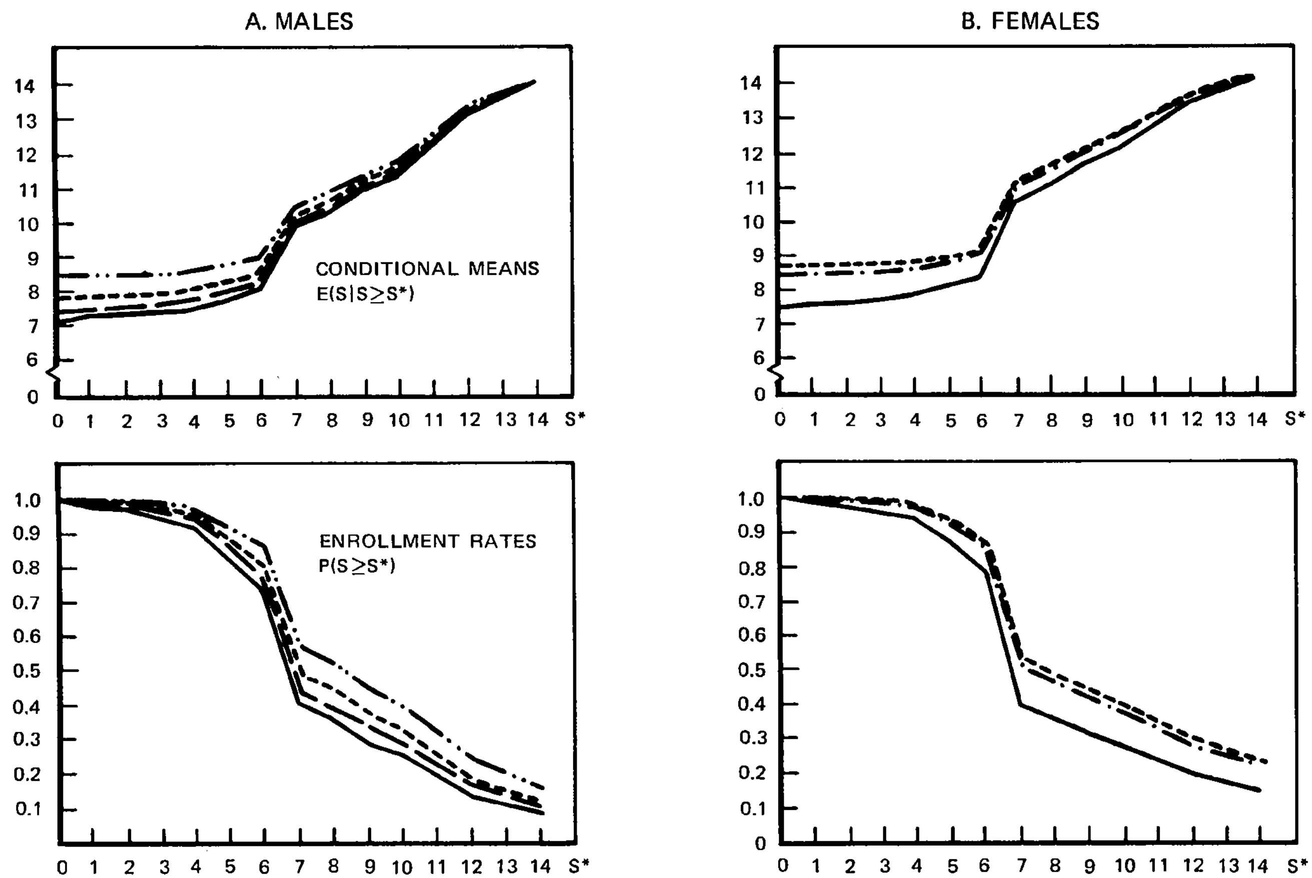
In Table 12 and Figure 8, we present simulation results based on samples of only first sons and first daughters. The effects of sibling order on schooling differ for males and females. First sons (daughters), who are neither only sons (daughters), nor only children, nor first-born and only sons (daughters), are treated as each of these, counterfactually. If a first son were also an only son, his expected schooling level would increase by .7 year, and by 1.3 years if he were a first-born child and an only son. Smaller increases are noted if the son were an only child. Enrollment rates for these different sibling positions diverge by as much as 16 percentage points at the entry level to high school for males, and by 13 percentage points for females. If the first daughter were also an only daughter, or an only child, or a first-born child and only daughter, her expected schooling would be one year greater, on average.

TABLE 12

COUNTERFACTUAL SCHOOLING SIMULATIONS ON SIBLING POSITION
USING FIRST-OF-SEX CHILDREN

	Using Actual Sibling Position			Using Counterfactual Values: If First Child			If Only Child			If Only Male/Female			If 1st Child & Only		
S*	(1)*	(2)*	(3)*	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
						A. First Males (N=571)									
0	7.17	1.000	.018	0.30	.000	-.004	0.17	.000	-.003	0.67	.000	-.008	1.28	.000	-.012
1	7.27	.982	.005	0.28	.004	-.001	0.15	.002	-.001	0.63	.008	-.002	1.21	.012	-.003
2	7.30	.977	.020	0.27	.005	-.004	0.14	.003	-.002	0.62	.010	-.007	1.19	.015	-.012
3	7.38	.957	.036	0.26	.009	-.006	0.14	.005	-.003	0.59	.017	-.012	1.15	.027	-.019
4	7.52	.921	.082	0.24	.014	-.010	0.13	.008	-.005	0.55	.029	-.021	1.08	.046	-.037
5	7.79	.839	.097	0.20	.024	-.008	0.12	.013	-.004	0.50	.049	-.018	0.99	.083	-.034
6	8.10	.742	.339	0.20	.032	-.008	0.10	.018	.004	0.45	.067	-.019	0.90	.117	-.047
7	9.85	.404	.045	0.14	.038	.002	0.08	.020	.001	0.31	.085	.003	0.60	.162	.003
8	10.29	.358	.068	0.11	.037	.003	0.06	.020	.002	0.26	.083	.006	0.51	.160	.009
9	10.96	.290	.034	0.09	.034	.002	0.05	.018	.001	0.21	.077	.004	0.41	.151	.007
10	11.29	.256	.121	0.08	.032	.010	0.04	.017	.005	0.19	.073	.023	0.37	.144	.041
11-13	13.03	.136	.048	0.03	.021	.006	0.02	.011	.003	0.08	.049	.014	0.15	.102	.026
14+			.088			.014			.012			.035			.076
						B. First Females (N=544)									
0	7.52	1.000	.017	0.11	.000	-.001	0.90	.000	-.008	1.08	.000	-.009	1.04	.000	-.009
1	7.62	.983	.006	0.10	.001	-.001	0.86	.008	-.003	1.03	.009	-.003	0.99	.009	-.003
2	7.65	.977	.014	0.10	.002	-.000	0.84	.010	-.005	1.02	.012	-.006	0.98	.012	-.006
3	7.71	.963	.028	0.10	.002	-.002	0.83	.016	-.010	0.99	.018	-.012	0.96	.018	-.012
4	7.82	.935	.064	0.09	.004	-.003	0.79	.026	-.020	0.95	.031	-.023	0.91	.030	-.023
5	8.03	.870	.090	0.08	.018	-.003	0.74	.047	-.023	0.89	.055	-.027	0.85	.053	-.026
6	8.30	.781	.384	0.08	.010	-.003	0.68	.068	-.039	0.82	.081	-.048	0.79	.079	-.046
7	10.48	.397	.042	0.05	.003	.000	0.42	.107	.001	0.51	.129	-.001	0.49	.124	-.001
8	10.99	.355	.048	0.04	.013	.000	0.36	.108	.003	0.43	.127	.004	0.41	.123	.004
9	11.59	.308	.035	0.03	.012	.001	0.29	.102	.004	0.34	.123	.005	0.33	.118	.004
10	12.03	.273	.079	0.03	.011	.002	0.24	.098	.014	0.29	.118	.017	0.28	.114	.016
11-13	13.29	.194	.048	0.01	.009	.002	0.09	.084	.013	0.11	.101	.016	0.10	.098	.015
14+			.146			.007			.071			.086			.083

Note: Column (1)* is $E(S \mid S \geq S^*)$. Column (2)* is $P(S \geq S^*)$. Column (3)* is $P(S=S^*)$. The corresponding unstarred columns represent deviations from the values in the first three columns.



LEGEND:

——— USING ACTUAL BIRTH ORDER, i.e. "FIRST MALE/FEMALE"
USING COUNTERFACTUAL BIRTH ORDER:

— — IF "FIRST CHILD"

—·—· IF "ONLY CHILD"

– – – – – IF "ONLY MALE/FEMALE"

—··— IF "FIRST CHILD & ONLY MALE/FEMALE"

NOTES:

The birth order variables are nonoverlapping categories. See Table 6 for definition.

Fig. 8—Conditional means and enrollment rates: counterfactual simulations on sibling order using the samples of first males and first females

Rural/Urban Residence

The coefficient estimates for rural and urban residence indicate that rural residence implies lower schooling attainment than semi-urban and urban residence. Urban residence means higher schooling relative to semi-urban and rural residence for female children, and about equal schooling as semi-urban residence for male children. Table 13 summarizes the characteristics of our rural and urban samples.

The effect of rural or urban residence on schooling choice reflects differences between rural and urban areas that have not been accounted for by included explanatory variables. One important difference relates to labor markets. In rural areas, where agriculture is inherently predominant, high seasonal demand for farm (hired or family) child labor is expected to increase the opportunity cost of school time. Land ownership and cultivatorship only partly capture this effect. Another source of the rural-urban difference is that the perceived returns to formal schooling may be smaller in the agricultural sector than in the non-agricultural sector.

In Table 14, we present simulation results for rural and urban children. Also see Figure 9. The outcomes for rural males and females are almost identical, so we present only the results for males. The probability that a rural child who enters elementary school will finish this level is 72 percent. The probability that he will proceed to high school given completion of the elementary level is 47 percent. The probability that he will complete high school given entry is only 22 percent.

The corresponding outcomes for the urban subsamples are notably higher. The probability that an urban child (male or female) who enters elementary school will finish is 85 percent. The probability of proceeding to high school given elementary school attainment is about 65 percent. The probability of completing high school given entry is 66 percent, and that of attending college after high school is 53 percent for males. The probabilities for females are each about 1 percentage point greater.

The following experiments have been undertaken only for rural children. We obtain policy relevant implications from our parameter estimates on distance to school, land ownership and rural electrification.

TABLE 13

MEANS OF SELECTED VARIABLES FOR THE RURAL AND URBAN SAMPLES

Variables	Urban				Rural			
	Male		Female		Male		Female	
Disabled (%)	31	5.5	31	5.6	209	6.9	184	6.8
Distance to school (kilometers)								
Elementary, in village	194	.82	186	.77	1781	.67	1542	.69
not in village	154	.41	152	.42	557	.75	489	.79
High School, in village								
Child's age ≤18	1	7.00	1	7.00	245	.79	237	.80
>18	1	7.00	1	1.00	173	.77	173	.90
not in village	502	2.91	500	2.99	2315	4.66	2015	4.49
Parents' education (years)								
Mother	558	6.52	552	6.58	3014	4.10	2685	4.11
Father	552	6.77	540	6.95	2952	4.45	2653	4.55
Land								
Owns land (%)	192	34.2	187	33.6	1076	35.5	942	34.8
Area owned (hectares)	192	6.56	187	5.19	1076	4.69	942	3.90
Land value (10000 pesos)	192	.28	187	.21	1076	.13	942	.12
Owner-operators								
Small farm (%)	69	12.3	60	10.8	495	16.3	435	16.1
Farm size (hectares)	69	1.31	60	1.06	495	1.73	435	1.67
Large farm (%)	15	2.7	13	2.3	149	4.9	103	3.8
Farm size (hectares)	15	12.86	13	16.57	149	13.78	103	11.22
Electricity (%)	389	69.3	384	69.0	930	30.7	840	31.0
N	561		557		3032		2710	

TABLE 14

EXPECTED SCHOOLING LEVELS, ENROLLMENT RATES AND CONDITIONAL PROBABILITIES:
SIMULATIONS FOR RURAL AND URBAN SAMPLES

S*	E(S|S ≥ S*)	P(S ≥ S*)	Conditional Probability P(S=s|S ≥S*) s=0	1	2	3	4	5	6	7	8	9	10	11-13	14+
								A. Rural Males (N=3022)							
0	6.82	1.000	.021	.006	.023	.040	.091	.105	.353	.045	.067	.033	.112	.041	.063
1	6.93	.979		.006	.024	.042	.094	.108	.360	.046	.068	.033	.113	.042	.063
2	6.96	.973			.025	.043	.095	.109	.362	.046	.068	.033	.113	.042	.063
3	7.06	.950				.045	.099	.113	.372	.047	.069	.034	.115	.042	.063
4	7.21	.910					.107	.121	.391	.049	.072	.035	.118	.043	.064
5	7.51	.819						.142	.445	.054	.079	.038	.128	.046	.067
6	7.83	.714							.534	.063	.091	.044	.144	.051	.072
7	9.68	.361								.155	.215	.100	.309	.099	.121
8	10.14	.316									.260	.120	.367	.116	.137
9	10.84	.249										.168	.503	.154	.174
10	11.18	.216											.612	.185	.203
11-13	12.99	.104												.504	.495
								B. Rural Females (N=2710)							
0	6.76	1.000	.023	.006	.024	.042	.093	.106	.352	.045	.066	.032	.109	.041	.061
1	6.88	.977		.006	.026	.044	.097	.110	.359	.045	.066	.033	.111	.041	.062
2	6.91	.971			.026	.045	.098	.111	.362	.045	.067	.033	.111	.041	.062
3	7.01	.947				.047	.102	.115	.371	.046	.068	.033	.112	.041	.062
4	7.17	.905					.111	.123	.391	.048	.070	.034	.116	.042	.063
5	7.48	.812						.146	.448	.054	.078	.038	.126	.045	.066
6	7.81	.705							.540	.063	.090	.044	.142	.050	.071
7	9.66	.354								.157	.217	.101	.308	.098	.118
8	10.12	.309									.263	.121	.366	.115	.135
9	10.82	.244										.170	.504	.153	.172
10	11.17	.211											.615	.184	.200
11-13	12.98	.102												.508	.492
								C. Urban Males (N=561)							
0	8.66	1.000	.008	.002	.011	.020	.050	.064	.270	.042	.068	.036	.146	.071	.211
1	8.71	.992		.002	.011	.021	.051	.066	.273	.043	.068	.036	.147	.071	.211
2	8.72	.989			.011	.021	.051	.066	.274	.043	.068	.037	.147	.071	.211
3	8.77	.979				.022	.053	.067	.278	.043	.069	.037	.148	.071	.212
4	8.84	.959					.056	.071	.287	.044	.070	.038	.150	.072	.212
5	9.02	.909						.080	.313	.047	.075	.040	.156	.074	.215
6	9.24	.844							.358	.052	.082	.043	.168	.078	.219
7	10.61	.575								.104	.155	.078	.279	.116	.269
8	10.95	.532									.180	.090	.316	.129	.286
9	11.49	.464										.117	.403	.157	.323
10	11.76	.428											.470	.180	.351
11-13	13.21	.282												.393	.606
								D. Urban Females (N=557)							
0	8.74	1.000	.009	.002	.010	.020	.048	.061	.261	.042	.068	.037	.152	.075	.214
1	8.79	.991		.003	.011	.020	.049	.063	.264	.042	.068	.037	.152	.076	.214
2	8.80	.989			.011	.020	.050	.063	.265	.043	.069	.037	.153	.076	.214
3	8.85	.978				.021	.051	.065	.269	.043	.069	.037	.153	.076	.215
4	8.93	.959					.054	.068	.278	.044	.071	.038	.155	.076	.215
5	9.10	.911						.077	.304	.047	.075	.040	.161	.079	.218
6	9.31	.850							.347	.052	.082	.043	.172	.082	.223
7	10.65	.589								.101	.151	.076	.279	.119	.273
8	10.98	.547									.175	.088	.315	.132	.290
9	11.51	.479										.115	.399	.160	.327
10	11.78	.442											.464	.181	.355
11-13	13.22	.290												.389	.611

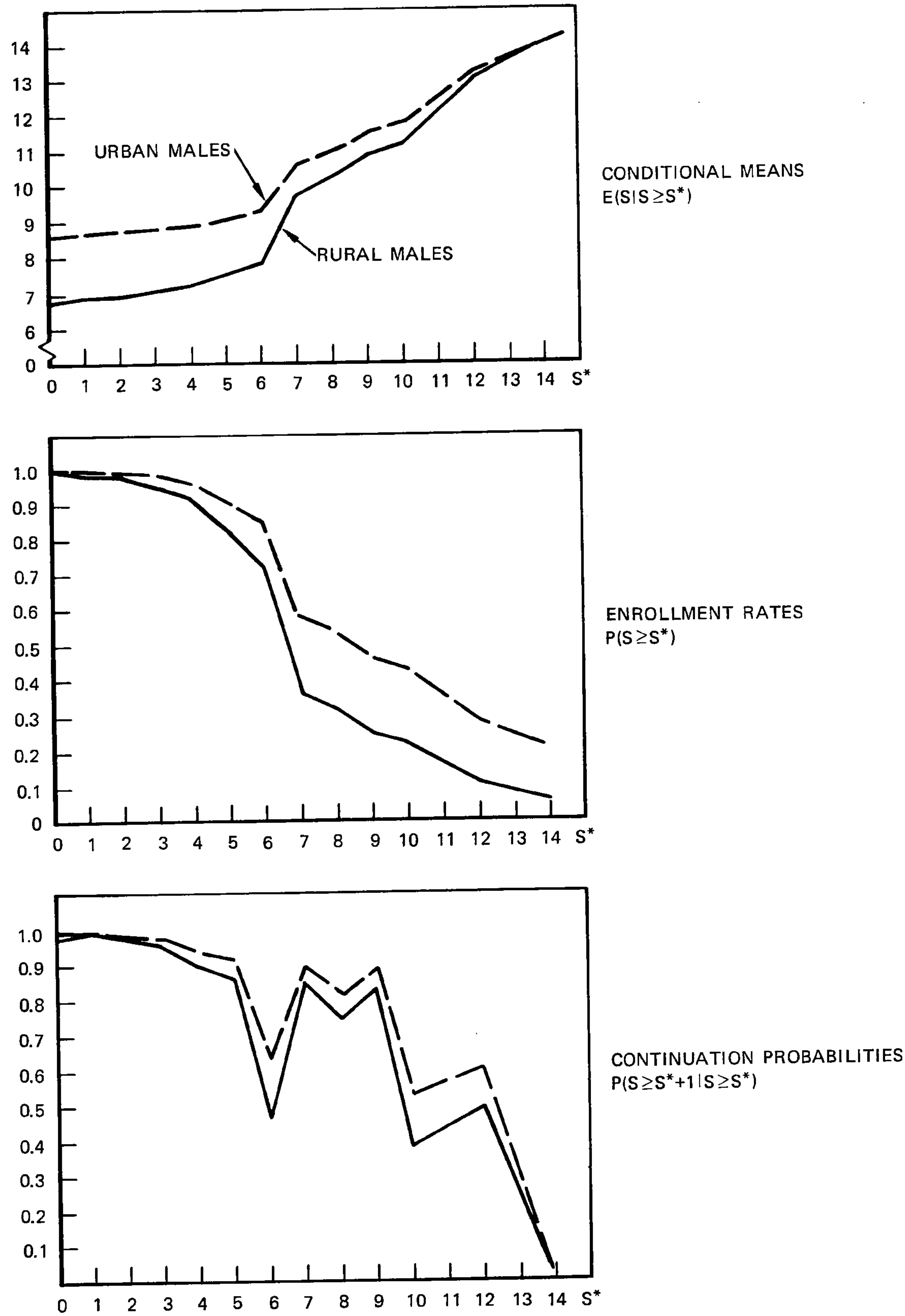


Fig. 9—Conditional means, enrollment rates and continuation probabilities: simulations for rural and urban males

Distance to School

About 70 percent of our rural sample reported presence of an elementary school in the village at the relevant time. However, only 15 percent had a high school in the village during the survey, given residence in the village at age 9. The average distance to an elementary school is less than 1 kilometer. Families which live in the village proper will more likely be within walking distance to school. Some of them, in fact, report zero distance. Those who reside in villages without an elementary school report an average distance of .75 kilometer to the nearest out-of-town school. The mean distance to the high school in the village is only slightly greater than that to the elementary school. However, the average reported distance to the nearest high school outside the village is more than 4 kilometers.

The effects of distance to school are presented in Table 15 as deviations from the predicted probabilities and expectations in Table 14. Figure 10 (A) provides an illustration. The experiments suppose that all rural children have an elementary school within distances of .5 and .1 kilometer, alternatively, at the relevant time. The difference in enrollment rates induced by decreasing distance from .5 to .1 kilometer is 2.5 percentage points at the elementary school level, with favorable repercussions at higher levels. If, in addition, there were a high school within 1 kilometer, enrollment rates and continuation probabilities rise further but not greatly. These effects are slightly greater for females than males.

Land Ownership and Use

Table 6 showed that one-third of the families in the Bicol sample are landless farmers (tenants or lessees), and another third are landless nonfarmers. The rest are mostly small farmers who cultivate their own land. To assess the effects on schooling propensity and distribution of land ownership, we undertake the following counterfactual experiment. Using the rural sample, we assign land ownership of 2 hectares and 5 hectares, alternatively, at a value of 2000 pesos per hectare, to all landless families, and families with less than 2 or 5 hectares of land. Then we increase the value of land to 5000 pesos per hectare, which is approximately the mean present value of land

TABLE 15

COUNTERFACTUAL SCHOOLING SIMULATIONS ON DISTANCE TO SCHOOL AND LAND USING THE RURAL SAMPLES

	Distance to School						Land Ownership			Rural Electrification		
	Males			Females			Males			Males		
S*	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
	Elementary school distance=.5 km						Area=2 ha. at P 2000					
0	0.16	.000	-.004	0.18	.000	-.005	0.59	.000	-.010	0.29	.000	-.005
1	0.14	.004	-.001	0.16	.005	-.001	0.54	.009	-.003	0.27	.004	-.002
2	0.14	.005	-.003	0.15	.006	-.003	0.53	.012	-.008	0.27	.006	-.004
3	0.12	.008	-.004	0.14	.009	-.005	0.50	.020	-.012	0.25	.010	-.005
4	0.11	.012	-.006	0.12	.014	-.007	0.46	.032	-.021	0.23	.015	-.010
5	0.10	.019	-.004	0.10	.020	-.004	0.40	.054	-.017	0.20	.025	-.005
6	0.09	.022	.003	0.09	.025	.003	0.37	.070	-.007	0.19	.033	.002
7	0.06	.020	.002	0.07	.021	.002	0.25	.077	.005	0.12	.038	.004
8	0.05	.018	.003	0.06	.020	.003	0.21	.073	.008	0.11	.036	.002
9	0.04	.015	.002	0.05	.016	.002	0.17	.065	.005	0.08	.032	.001
10	0.04	.013	.006	0.04	.015	.007	0.15	.059	.024	0.08	.030	.011
11-13	0.02	.007	.003	0.02	.007	.003	0.07	.035	.013	0.03	.018	.006
14+			.004			.005			.022			.012
	Elementary school distance=.1 km.						Area=5 ha. at P 2000					
0	0.37	.000	-.007	0.39	.000	-.008	0.76	.000	-.011			
1	0.34	.007	-.002	0.36	.008	-.002	0.71	.011	-.003			
2	0.34	.009	-.006	0.35	.010	-.006	0.69	.014	-.010			
3	0.31	.015	-.008	0.33	.016	-.009	0.66	.024	-.015			
4	0.29	.023	-.014	0.29	.025	-.014	0.61	.039	-.027			
5	0.25	.036	-.010	0.25	.039	-.010	0.54	.066	-.022			
6	0.23	.046	-.002	0.23	.049	-.001	0.49	.087	-.014			
7	0.16	.048	.003	0.16	.049	.003	0.33	.101	.005			
8	0.13	.045	.005	0.14	.047	.005	0.28	.096	.010			
9	0.10	.039	.003	0.11	.040	.004	0.22	.086	.007			
10	0.10	.036	.015	0.10	.037	.016	0.20	.075	.032			
11-13	0.04	.021	.008	0.05	.021	.007	0.09	.048	.017			
14+			.013			.021			.031			
	Elementary school distance=.1 km. and high school distance=.1 km						Area=5 ha. at P 5000					
0	0.40	.000	-.008	0.42	.000	-.009	1.01	.000	-.014			
1	0.37	.008	-.002	0.38	.009	-.002	0.94	.014	-.003			
2	0.36	.010	-.006	0.37	.011	-.007	0.93	.018	-.012			
3	0.33	.016	-.009	0.35	.017	-.010	0.88	.030	-.019			
4	0.30	.025	-.015	0.31	.027	-.015	0.81	.049	-.034			
5	0.27	.040	-.011	0.27	.042	-.010	0.72	.084	-.028			
6	0.27	.050	-.001	0.24	.053	-.001	0.65	.113	-.022			
7	0.17	.052	.003	0.17	.053	.003	0.44	.133	.005			
8	0.14	.048	.006	0.15	.050	.006	0.38	.128	.012			
9	0.11	.042	.004	0.12	.043	.004	0.30	.115	.009			
10	0.10	.038	.016	0.10	.040	.017	0.27	.107	.041			
11-13	0.05	.022	.008	0.05	.022	.008	0.12	.066	.021			
14+			.014			.015			.044			

Note:

Column (1) $\Delta E(S \mid S \geq S^*)$
(2) $\Delta P(S \geq S^*)$
(3) $\Delta P(S = S^*)$

These values are computed as deviations from numbers in corresponding columns in Table 14 (A and B).

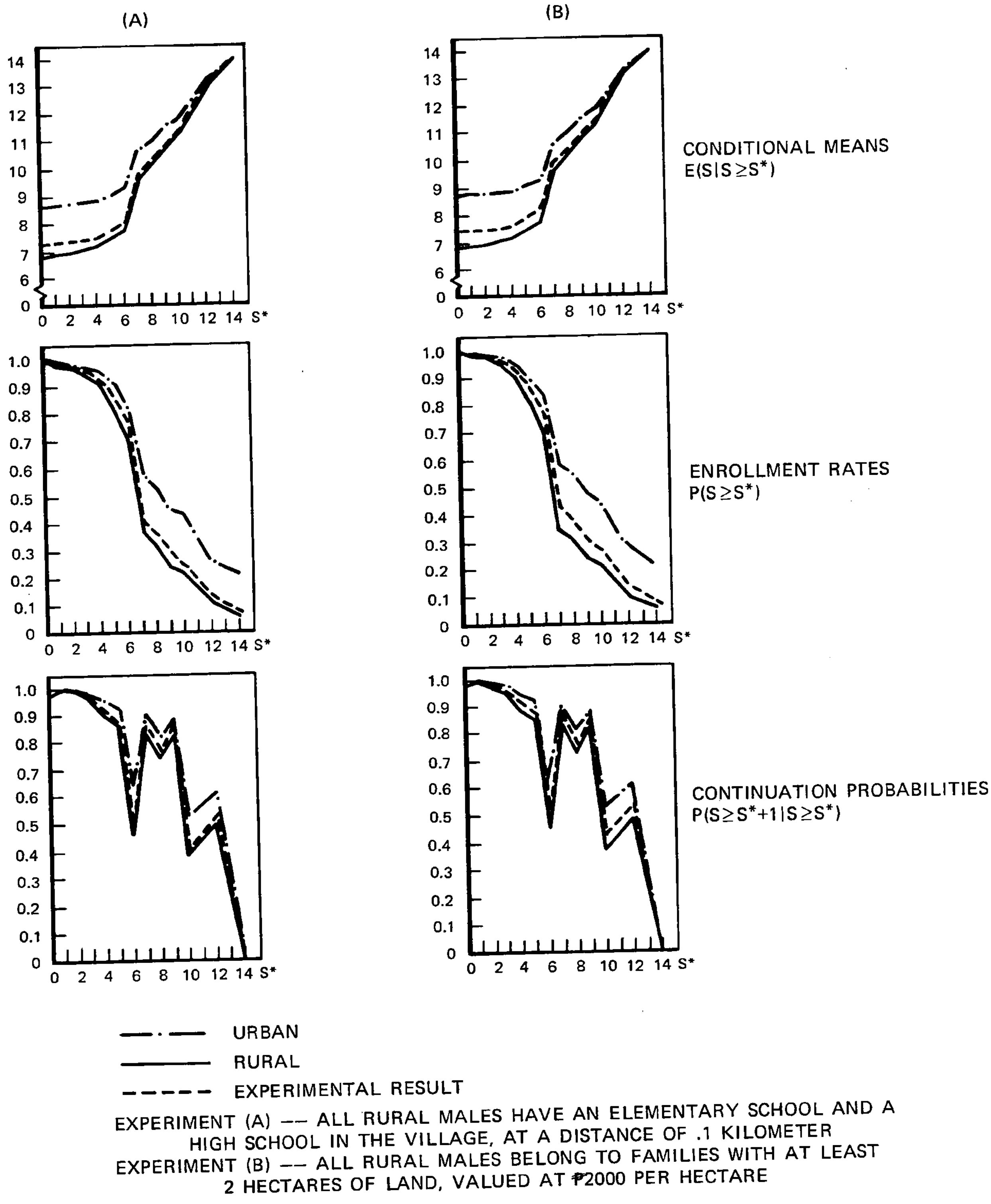


Fig. 10––Conditional means, enrollment rates and continuation probabilities: counterfactual simulations on distance to school and land ownership using the rural male sample

in the sample. Actual values apply to those that own at least 2 or 5 hectares of land. The results of this experiment are given also in Table 15 and in Figure 10 (B). Only the results for males are presented because they are similar to those for females.

Land ownership has a threefold effect on schooling propensity--a pure wealth effect which is positive, an opportunity cost effect which is negative, and a bequest effect which can be positive or negative. The net effect of these on an individual child's schooling depends on the relative implicit price of schooling among siblings, and on sibling order which produces the bequest effect. The results show that universal land ownership of at least 2 hectares tends to increase enrollment rates at all levels, but this impact is greatest at the completion level of elementary school and the first two years of high school. The probability of continuing to high school, given elementary level completion, is 53 percent, which is a 7 percent average change for males. The corresponding increases in continuation probabilities for high school completion given entry, and for college entry given high school completion, are about 5 percent each. The unconditional expected schooling level rises by an average of more than one-half year.

Increasing land area to 5 hectares and comparing the changes with results from the first experiment suggests the partial effect of size of land owned, given ownership. This 3-hectare increase induces even higher enrollment rates at all levels, especially at the secondary and college levels. The rise in the unconditional expected schooling attainment is one-fifth year.

An increase in the value of the land raises the opportunity cost of child's time as well as family wealth. The coefficient estimate of land value is positive, and greater for females than for males. However, the coefficient of the land-value sibling-order interaction variable has opposite signs for males and females--positive for males and negative for females. These effects offset each other to produce similar probabilities for both sexes. Increasing the price of land per hectare to 5000 pesos, holding land size constant at 5 hectares, raises enrollment rates by about 1 percentage point at the secondary level for every 1000-peso increase in the price of land.

Rural Electrification

The availability of electricity in the community can affect schooling through its effect on the general level of prices and market conditions, and on farm and household technology. Perhaps this explains the importance generally accorded to it in development programs.[21] In our sample, 31 percent of the rural observations lived in villages where electricity was available at age 9. The proportion is much larger for the urban sample--69 percent.

Suppose that electricity were available to all at age 9. Our results imply that enrollment rates would be higher especially at the high school level (by 3-4 percent), and average expected schooling completion would be greater by one-third year. The probability of proceeding to high school given elementary school completion would be 3 percentage points greater. The probability of completing high school would rise by 2 percent, and that of entering college given high school completion, by 3 percent. There is no observed differential effect for males and females.

VI. SUMMARY AND CONCLUSIONS

Using family survey data, such as the Bicol data, to analyze schooling choice raised several interesting substantive and methodological issues which we addressed in the research. First, in specifying the determinants of schooling attainment, we proposed relevant-time, rather than survey-time, measurements. Relevant-time measurements define the regressors using values at the time the child was going to school, as opposed to using values observed during the survey. Comparisons of the estimates show gains from our preferred specification of the variables.

We estimated an ordered polytomous choice model in which an individual attains successively higher schooling levels if his schooling propensity is greater than correspondingly ordered threshold values. The estimated sample-based threshold values were found to be lower for females than for males at the higher schooling levels, implying that equal schooling propensities for the sexes translate into greater schooling outcomes for females than for males. Schooling propensity is determined by individual and family characteristics that affect the costs and benefits of schooling. The empirical procedure treated schooling attainment more appropriately as a discrete non-normally distributed variable, instead of as a continuous normally distributed variable, as earlier studies have done. The observed multimodal distribution of completed schooling levels justifies such an approach. Moreover, the model fully accounts for censored observations. Information from individuals still enrolled in school during the survey, as well as from completers, was used in the estimation of the parameters.

The large amount of national resources being allocated to education in the Philippines and other developing countries provided a good motivation for the study. The macro picture in the Philippines shows a rapidly increasing trend in schooling levels for both sexes, with women catching up with, and possibly overtaking, men. To identify factors that explain schooling attainment and differences in schooling levels among families and between the sexes, we focused on a model of family allocation. We estimated the model using cross-section data on randomly selected families in the Bicol region. Measured individual, family and community differences explained about 40 percent of total variance in observed schooling levels. Family-specific and child-specific factors that are unobserved make up the residual. Counterfactual simulations were used to present the implications of the parameter estimates for enrollment rates, continuation probabilities, conditional moments and the probability distribution of schooling levels.

As in the census data, our parameter estimates indicate that the distribution of completed schooling of women dominates that of men in the Bicol area. There is not much difference between the sexes at the elementary school level, but a gap appears and widens at higher schooling levels. Of the included regressors, we found sibling order, mother's education and the family's farming activities to be important determinants of perceived sex-related differences in schooling attainment. Other factors affect male and female schooling more similarly.

The findings of the study are of interest to education planners, especially in developing countries. Although our list of observable factors is not complete--for example, we neglected to estimate the effect of outmigration from rural areas or the effect of alternative forms of savings and investments on schooling expenditures--the results bring out several important facets of the family's decision to educate its children. On the effects of distance to school, our estimates imply that school programs can importantly affect schooling choice by providing elementary schools at critical distances from the village population. The availability of an elementary school within a short distance raises enrollment rates at all school grades and, thus, completed schooling levels. Adding a high school within the same distance further increases schooling probabilities, but by smaller increments. The focus on elementary schools makes even greater sense if, in addition, they were relatively cheaper to establish than high schools.

The education of parents exerts a positive effect on their children's schooling. This "inheritability" of parental education, and its implications for social mobility and socioeconomic inequality, provides further incentives for raising the completed schooling levels of the current generation. Parents' education also measures family income, the ability of parents to supervise child schooling, and possibly that of children to learn.

Our estimates for land ownership indicate that the interfamily distribution of land wealth is positively associated with the distribution of schooling attainment among families. For families that cultivate land, intrafamily allocation may be affected by the relative productivity of labor among siblings. The effect of agricultural activities on schooling choice is further shown by rural-urban comparisons of schooling outcomes. Differences between rural and urban areas not accounted for by measured differences in the other included regressors, particularly the predominance of agriculture in rural areas, imply that perceived returns to schooling in agriculture are relatively lower than in non-agriculture. Efforts to redesign high school curricula in order to make them more relevant to farmers could encourage high school enrollment, especially for males.[22] Rapid improvements in agricultural technology could also increase demand for formal schooling as well as for extension classes.

We have studied the determinants of variation in schooling attainment between families, obtaining also specific results on sex differences in schooling choice. In another paper, we propose a model of intrafamily distribution of schooling, and use the parameter estimates obtained here to further explore their implications for intrafamily correlations.

FOOTNOTES

[1] The importance of these income transfers to parents has been shown for East Asian countries by the Value of Children project, (Arnold, et al., 1975). Expected economic help from children included help in housework, in the family farm or business, in child care and help in old age. Caldwell (1976), in explaining the demographic transition in developing countries, attributes to the difference between expected and actual contributions from children changes in fertility goals of parents. He hypothesizes that the closely-knit family structure in developing countries rewards high-fertility parents and encourages large families.

[2] There is evidence to suggest that the Philippines is a "relatively overeducated country". "Whether the measure is the ratio of total education expenditure to GNP (6.7 percent), the share of education expenditure in the budget of the national government (37 percent), the proportion of people with bachelor degrees in the active population aged 14-65 (6.5 percent), or the proportion of the relevant age groups 13-16 and 17-20 enrolled in secondary and higher education (62 and 25.5 percent, respectively), the Philippines in 1971 ranks just below the United States, above most of the countries of Western Europe and above all of the countries of Asia and Southeast Asia". (Blaug, 1972, pp. 42-43)

[3] The model is incomplete in its treatment of the benefits from children. For lack of adequate data, we ignore other forms of support from children; in particular, transfers from adult children to parents. These income remittances are expected to influence schooling choice in the following way. If greater support in old age were expected from sons than daughters, there is reason to invest more in the schooling of sons to the extent that education enhances future earnings. Whether sons attain more schooling depends on the trade-off between current and expected future contributions. On the other hand, if greater old-age support were expected from daughters than sons, then there is further reason to invest relatively more in the schooling of daughters.

To introduce income remittances into the model, decision-making must extend to at least two periods. Schooling investments are undertaken in the first period based on prices, family income and expected income transfers from children in the second period. Accumulated human capital, in turn, determines adult earnings and thus the level of income transfers, assuming a given propensity to remit income to parents. Applying a model with child labor supply and income remittances to Philippine data, King (1982) finds child wages to exert a negative effect on schooling levels, and predicted income transfers from children to have a positive effect.

[4] Rosenzweig and Evenson (1977) estimated child wage functions within a household model that explicitly includes the labor supply of of farm children in rural India. Their model was estimated using two-stage least squares. In the school enrollment function, child wage had a negative coefficient, significant for females but insignificant for males.

[5] Since the implicit prices of S and N are themselves functions of exogenous prices, the demand functions can be evaluated in terms of these fixed goods prices (Pollak and Wachter, 1975). However, because of the interaction effect between N and S, the Hessian derived from totally differentiating the first-order conditions contains the standard U_{ij} terms plus terms that pertain to how the consumption bundle itself alters the commodity prices. Thus, the signs of most of the compensated price effects in the model are not determined without imposing additional restrictions on the model. The difficulty lies partly in our ignorance about the structure of the family's utility function, and partly in the complexity of the decision process that is being analyzed. Rosenzweig and Wolpin (1980) have shown that in a quantity-quality interaction model, unless the cofactors of the Hessian matrix derived are known or restricted, neither the magnitude nor the signs of the observed compensated price effects can be determined.

[6] One procedure refers to the age-specific schooling index used by Rosenzweig (1978) and Birdsall (1982). This measure is computed as $S_{ij,kh}/S^*_{kh}$ where $S_{ij,kh}$ is the current schooling attainment of child i in family j, of age k and sex h, and S^*_{kh} is the mean schooling attainment of children of age k and sex h in the sample. A principal weakness of the method is that it does not use the information on whether a child is enrolled or not, treating completers and noncompleters identically; thus, it fails to account for censoring bias. For enrolled children, the index indicates only whether the child lags behind his cohort, either by starting school late or by temporary leaves or by grade repetition, or whether the child is ahead. Lags at younger ages depress the index more heavily than lags at older ages, a distortional feature of the measure.

Harrison (1980) imputes a final schooling attainment for all enrolled children, based on current age-specific and sex-specific enrollment rates of children in the sample. In particular, the imputed final attainment of an enrolled child of age k and sex h (and race m), is equal to the current schooling attainment S years plus the sum of the probabilities of a child in the same age-sex category being enrolled at (k+i) years of age, i=1,2,..., conditional on being in school during the survey. The final schooling attainment of children not currently enrolled is assumed to be equal to current years of schooling.

[7] In application, categories are combined for "some college but not a graduate" as $\tau_{11} < t \leq \tau_{14}$ and for "college graduate or more" as $\tau_{14} < t$. This was done to combine relatively thin cells. Results are not affected.

[8] This is not strictly correct and some will return at a later age to complete high school or college. These will be missed only if the survey occurs in the out-of-school gap. Data are not available to control this problem.

[9] More specifically, an IDA consists of one or more contiguous municipalities, or of "barangays" (villages) belonging to one or more municipalities that are observed to have similar socioeconomic problems and activities, and common watersheds.

[10] There was no information on the completed schooling level of dead children. A large fraction (80 percent) of deaths occurred by age five.

[11] Families with missing data on age of children were excluded from the sample only in cases where a simple adjustment, which interpolates the missing age observations using actual reported ages of children in the same family, could not be applied. This was true when most observations were missing in the family, and when the age of the oldest or youngest child was unreported, given that these children were likely to be of school age. This adjustment resulted in our excluding only 16 families from the sample due to missing or bad age data. The data on enrollment and schooling attainment were relatively complete for the remaining sample.

[12] The computed age would deviate from the unobserved true entry age due to repetition, acceleration, and temporary leaves from school. The difference is likely to increase with age.

[13] The elementary level consists of 4 years in the primary level, and 2 or 3 years in the intermediate level. Although the Elementary Education Act of 1953 designated 3 years of elementary education, most schools do not offer this third year due to lack of funds.

[14] Independent research was undertaken by one of us specifically to collect data on the year when elementary and secondary schools were established in the Bicol Survey villages. We thank Celia Capule for her invaluable assistance in organizing the project, and the Battelle Population and Development Program for funding it.

Although data on elementary schools were available from the regional school district office, similar information on high schools was not. Due to limited funds, the survey method was not used.

[15] Families may own several plots of land within the village. The survey collected data on area, present value, year acquired, method of acquisition (i.e., purchase, land reform, or inheritance), and use for up to 4 parcels owned.

[16] The residual specification for each is

$$e_{bi} = b_i + \varepsilon_i \quad \text{for males}$$

and $$e_{gj} = g_i + \varepsilon_j \quad \text{for females.}$$

The residuals ε_i and ε_j are independent for each child within and between families. The components b and g are family-specific.

[17] Estimates based on a randomly chosen sibling from each family, and thus, on independent observations, yield consistent estimates of parameters and standard errors, though based on a smaller sample. These alternate estimates have been computed, but are not significantly different from the full sample estimates and are not presented.

[18] The test was performed excluding the 49 regressors because a full interaction would be prohibitively expensive. The relative values

of τ values did not change upon including the regressors in separate analyses of males and females.

[19] A more complete treatment of sibling comparisons is given in Lillard and King (1983).

[20] The Bicol survey collected data on wages but coding errors were found. The corrected data tapes were not available as of this writing.

[21] One such study for the Philippines concludes that observed fertility declines were closely associated with rural electrification (Herrin, 1979).

[22] The Barrio Development School, a high school program enacted in 1969 by the Philippine government, is an example of an innovation in the public school system that is designed to keep more students in the rural agrarian areas both at work and in school. Its four-year curriculum, which includes a supervised farming program, classes in production agriculture and farm economics, was introduced in order to draw back to school the youth in rural villages who have decided to stay, live and work in the village as farm operators.

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