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The determinants of schooling investments of rural Filipino households, 1985-2002

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Abstract

This paper aims to investigate the demand-side factors affecting the schooling progression of Filipino children of school age, using household panel data collected over a span of 17 years. The following patterns emerge: (1) daughters complete more years of schooling than sons; (2) parental pro-daughter preferences become stronger when the children reach tertiary school age; (3) household permanent income significantly and positively affects schooling progression and its effect is far greater than that of transitory income; and (4) the effect of transitory income does not appear to be statistically significant. Our results are consistent with the theoretical implications of the educational investments of credit-constrained households.

JEL classification: D13, O15
Keywords: Gender, household income, child schooling

1. Introduction

One of the major puzzles in the economics of education in developing countries is the coexistence of the high rates of return to schooling and the low educational investments.[1] This coexistence suggests that credit and insurance markets are not functioning well for education. Thus, poorer households may choose lower levels of schooling investments since the marginal cost of funds to finance human capital investments is high due to credit constraints caused by low parental wealth (Hoff and Lyon [1995]; Ljungqvist, [1993]). Consequently, parental wealth and income restrict a poor child from achieving a socially optimal level of schooling (Taubman [1989]).

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[1] The rates of returns on schooling investments in developing countries stand at a much higher rate than the rates of returns on investments in physical capital (Psacharopoulos [1985, 1994]).

If parents follow a pure investment strategy, they will be motivated to invest in a child who will give them the maximum returns on their investments (Deolalikar [1993]; Kingdon [1998]). Accordingly, parental gender preferences over schooling investment may matter significantly if there are differential rates of returns to the schooling of boys and girls. For example, parents may preferentially invest more in the schooling of a daughter if they know she will give them old age support or will send more remittances when employed.

Most of the existing studies deal with the determinants of schooling investment of parents in a static framework. Moreover, these studies estimate reduced-form equations of school attendance, school entry and drop-out incidence, current enrollment and test scores as variables to represent schooling investments.[2] Yet years of schooling can be best represented as a stock variable, not as a flow variable as in the past studies, because current schooling outcome is determined by both the current and past household decisions that embody a long history of exogenous influences and endogenous decisions. Schooling decisions, however, may be better represented as a dynamic sequential decision process as considered in the studies of Lillard and Willis [1994], Sawada and Lokshin [2001], and Strauss and Thomas [1995]. In other words, schooling investment decisions are inherently dynamic and respond systematically to changes in the relative returns on the schooling of boys and girls and the changes in the household economic environment.

In this study, we aim to identify the demand-side determinants of incremental years of schooling completed by children who are of school age at the time of the survey. Specifically, our study tries to investigate the changes in the educational investment demand function. We use data on the schooling progression of the same set of children belonging to the same set of households over a span of 17 years, beginning in 1985 in five rural villages. Improving access to schooling by increasing the supply of schools has been the dominant development agenda in developing countries since the 1960s (Lockheed et al. [1991]). However, the traditional supply-side interventions in education usually change demand for education significantly, which partially offset the original policy effectiveness (Jimenez and Sawada [2001]). Therefore, demand-side studies such this study would be valuable in identifying precise policy intervention measures.

We investigate the impact of household characteristics such as household incomes, mothers' schooling and fathers' schooling, as well as child characteristics such as age and gender. Particularly, we distinguish between permanent and transitory income effects in order to compare the differentiated effects of the two types of incomes. Treating permanent and transitory incomes separately in our regression model, we conduct statistical tests of the theoretical restrictions imposed by the existence of binding credit constraints. Isolating the effects of permanent

[2] See Berhman and Knowles [1999] for a comprehensive review of studies on educational investments in developing countries.

and transitory incomes is also justified by the use of the simultaneous Tobit regression model suggested by Smith and Blundell [1986].

This paper has five remaining sections. Section 2 describes the villages studied and the sample households and children. Section 3 outlines the trends in school enrollment and completed years in school. Section 4 presents a brief theoretical framework and the estimation method. Section 5 discusses the results. Finally, Section 6 concludes and spells out our future tasks.

2. Description of sample villages, households, and individuals

2.1 The data set and the sample villages

The data in this study come from four rounds of household surveys conducted in 1985, 1989, 1998 and 2002 in five rice-growing villages in the rural Philippines.[3] The 1985 data were collected by the International Rice Research Institute (IRRI) (David and Otsuka [1994]; the 1989 data by Quisumbing [1994]; the 1998 data by Estudillo, Quisumbing and Otsuka [2001a, 2001b, 2001c, 2001d]); and the 2002 data by the present authors in collaboration with IRRI.

The 1985 data concerned household characteristics, namely, age, gender, and schooling attainment of individual members; sources of household income; adoption of new rice technology; asset acquisition; and rice farming practices. The 1989 data do not have information on household income but have information on the other data collected in 1985. Data for both 1998 and 2002 are broadly similar to the 1985 data set, although parts of the questionnaire collected inheritance data, as well.

Three of the village sites are located in Panay Island (P1, P2, and P3) and two villages are located in Central Luzon (CL1 and CL2), as indicated in Figure 1. P1 is fully irrigated and rice can be grown five times in a span of two years. P1 has good road conditions thereby allowing some household members to commute daily to work in nearby Iloilo City. P2 is rainfed, with a favorable rainfall pattern allowing rice to be grown twice a year—during the early and later part of the monsoon season. P3 is rainfed and has a hilly terrain; only one cropping season of rice is possible in one year. P3 had been isolated from the urban labor market up until 1995 when a bridge was constructed along the river that separates this village from the *poblacion* or town center.

CL1 is fully irrigated, being serviced by the Pantabangan dam which began its operation in 1978. Since then, rice can be grown twice a year in this village. CL2 is rainfed and rice is grown only once a year; the land is laid fallow or planted to nonrice crops during the dry season. CL1 and CL2 are also easily accessible from the urban centers by roads. A bridge was constructed in CL2 in 1997.

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[3] See David and Otsuka [1994] for a detailed description of the study sites.

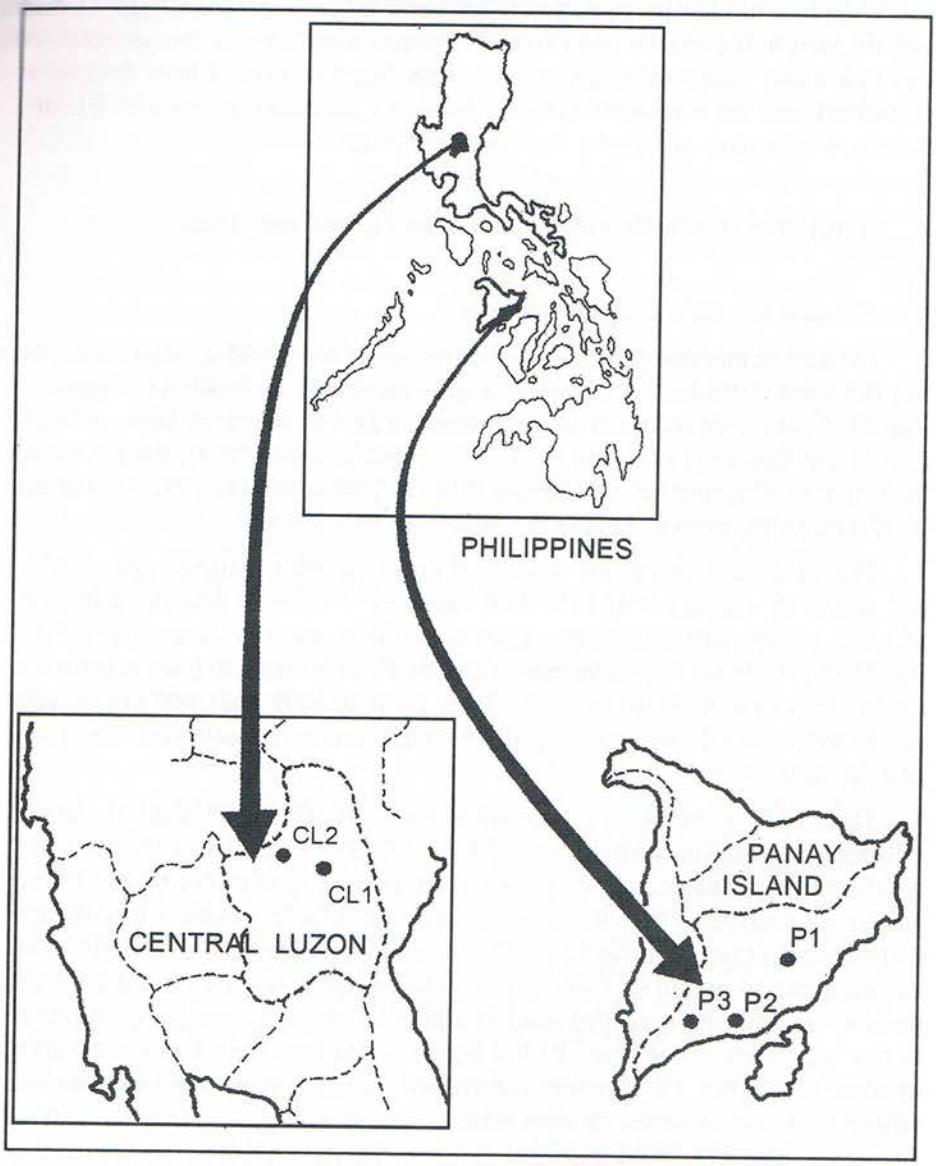

Figure 1. Location of the study villages

By 2002, all of these villages had gained an easy access to public primary schools up to the sixth grade.[4] In the first survey in 1985, P3 had a public primary school but up to the fourth grade only. None of these villages have secondary schools, which are often located in the *poblacion*. The rural Philippines saw an increase in the number of public secondary schools beginning in 1986 when secondary education was constitutionally mandated to be free. Tertiary schools are located in the cities and are usually privately operated except for a few state colleges and universities.

The land reform program was successfully implemented in all the village sites except in P3. The major purpose of the land reform program is to transfer the land to the actual cultivators and promote leasehold tenancy by making share-tenancy illegal. According to Otsuka [1991], the land reform program was effectively implemented in favorable rice-growing areas. In fact, there was a marked increase in the number of holders of the Certificate of Land Transfer (CLT) and leasehold tenants, and a decline in the number of share tenants in CL1, CL2, P1, and P2—the villages that are either fully irrigated or favorably rainfed. According to Deninger, Olinto and Maertens [2000], former share tenants experienced an increase in wealth thus enabling them to send their children to school owing to the benefits they derived from the implementation of land reform. We found no incidence of share tenancy among our sample farmers in Central Luzon in 1998. In contrast, share-tenancy remained a common land tenure contract in P3, which has an unfavorable production environment.

2.2 The sample households

We had 369 sample households in the first survey in 1985 (Table 1). We tried to keep the same sample size over time but the number of sample households declined in subsequent surveys due to attrition caused by out-migration (particularly of the landless households); lack of interest in the surveys; and absence during the survey period. By 2002, we only had 247 sample households that remained from the original 369 households in 1985.

Our sample households consisted of roughly 80 percent farm households and 20 percent landless households. Farm households are those headed by owner-farmers or those who have access to cultivation rights, such as holders of the CLT (giving proof that the farmer is an amortizing landowner),[5] leasehold tenants, and share tenants. Landless households are those headed by daily agricultural wage workers or, in a few cases, nonagricultural wage workers.

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[4] Primary school covers grades 1-6. P2 has no primary school but has an easy access to two primary schools located in two nearby villages. In this village, the enrollment rates of both boys and girls in primary schools are almost 100 percent.

[5] Holders of the CLT are former share tenants who are qualified to become owner-farmers by paying land amortization fees to the Land Bank for a period of 15 years.

The respondents and their spouses finished more than six years of schooling (Table 1).[6] Their children, who are older than 15 years old and no longer in school, finished close to 10 years of schooling. There was a 40 percent enrollment rate in tertiary school among our sample children in 1985 and 54 percent enrollment rate in 1998. These figures indicate an increase in human capital investments over time. Our earlier study in these five villages showed that while the husband and wife decided jointly on the schooling investments of children (David [1994]), the mothers' (but not fathers') completed years in school seemed to have exerted a positive and significant effect on the schooling attainment of school-aged children in 1998 (Estudillo, Quisumbing and Otsuka [2001c]).[7]

Farm income was by far the most dominant source of income of sample households in 1985 but its share in total household income declined from 71 percent in 1985 to 41 percent in 1998 (Table 1). In contrast, the share of non-farm wage income increased by 24 percentage points and the share of remittance income increased by 6 percentage points from 1985 to 1998.

Given these developments, an important question arises, namely: To what extent does household income affect child progression in school, especially since schooling critically determines the lifetime occupational choices of children as well as social mobility and inequality?[8] Particularly important is the identification of the differentiated effects of permanent and transitory income components since the optimal policy intervention depends on the nature of poverty.[9] For policy design, it is extremely important to distinguish the transitorily poor from the chronically poor (Lipton and Ravallion [1995]; Hume [2003]). When short-lived transient poverty is dominant, the appropriate policy response should be the provision of social insurance programs such as micro-credit, crop insurance, workfare and price stabilization programs. On the other hand, the reduction of chronic poverty requires costly and continuous interventions such as land reform;

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[6] It is interesting to mention that the sisters of the respondents obtained, on the average, 7.2 years of schooling, which is 0.5 years more than what their brothers obtained; test of the difference of means revealed that this schooling gap is highly significant (Estudillo, Quisumbing and Otsuka [2001a]). Moreover, the respondents who are mainly involved in rice farming, on the average, finished a lower level of schooling compared to their brothers and sisters.

[7] In Malaysia, a higher parental education allows higher educational attainment for all children regardless of gender (Parish and Willis [1993]). In India, too, there is a significant positive relationship between mother's literacy and child schooling which reflects the productivity effects of home teaching (Behrman et al. [1999]). In the United States, the probability of a child going to college is high for college-educated parents and in a household with smaller size of sibships (Connelly and Gottschalk [1995]). In the United States and Germany, the education of parents and children are highly correlated (Couch and Dunn [1997]).

[8] In Pakistan, for example, household income is positively associated with cognitive skills and the income-associated differences in cognitive skills come from differences in permanent income and household characteristics (Alderman et al. [1997]). An increase in permanent income increases the demand for schooling and creates a home environment that is conducive to child learning.

[9] Empirical evidence suggests the importance of transient poverty wherein households move in and out of poverty over time (Walker and Ryan [1990:93-97]; Jalan and Ravallion [1998]; Hume [2003]).

free public schools; and the development of modern rice varieties to increase the productivity of the poor in the long run.

Another important point of inquiry is whether borrowing constraints or insurance market imperfections significantly affect the schooling investment decisions of parents. If schooling is considered a pure investment, parents may invest in the schooling of a child until the marginal rate of return on each additional year of schooling equals the marginal rate of return on alternative assets, e.g. financial assets. If credit is perfectly available, there will be few channels by which income may be significantly associated with schooling investments. Moreover, sibling rivalry on household educational resources may not emerge, making child gender and birth-order effects not as important. On the other hand, if credit is limited, household investment decisions are not separable from consumption decisions, so that household available resources such as income and assets affect the shadow interest rate of schooling investments.[10]

2.3 The sample individuals

A Filipino child usually starts primary schooling at around the age of seven and finishes at around the age of 12. Secondary schooling commences at around the age of 13 and is completed at around the age of 16; this is followed by tertiary schooling. Overall, a child is required to spend 14 to 15 years in school (6 years in primary, 4 years in secondary, and 4 to 5 years in tertiary school) to obtain a university degree.

Table 1. Characteristics of sample households

Survey years	*1985*	*1989*	*1998*	*2002*
Sample households	369	331	247	247
Father's schooling (in years)	6.1	6.7	7.2	7.2
Mother's schooling (in years)	6.1	6.7	7.4	7.4
Sources of income (%)				
Farm	71	n.a.	41	n.a.
Nonfarm wages	16	n.a.	40	n.a.
Remittances	13	n.a.	19	n.a.
Total	100	n.a.	100	n.a.
Total income ('000 Pesos/year)	18.1	n.a.	91.3	n.a.

"n.a." means not available.

US$1=Php20.90 in 1985 and US$1=Php54.99 in 1998.

[10] In Peru, for example, children in lower income households, particularly those with credit constraints, withdraw early in primary school (Jacoby [1994]). Moreover, using household panel data from South India, Jacoby and Skoufias [1997] analyze how the seasonal pattern of education in India responds to anticipated and unanticipated shocks. Their findings show that the lack of self- and mutual-insurance devices negatively affects child schooling.

The number of school-aged children in our sample was 638 in 1985; 685 in 1989; and 241 in 1998 and 2002 (Table 2). The age range was chosen to capture the progression to at least one year of additional schooling before the next survey period. For example, the 638 children in 1985 were between 3 and 20 years old in 1985, which means that those at age 3 should have been at age 7 and should have started schooling by 1989 and those at age 20 should have been at age 24 and, if continuing in school, should have completed their last year of schooling by 1989. Our sample children are those born from 1965 to 1981 in the 1985 survey; those born from 1969 to 1991 in the 1989 survey; and those born from 1978 to 1994 in the 1998 and 2002 surveys.

We had 357 households with children who were of school age (between age 7 and 21) in 1985 and 132 households in 1998. On the average, each household had more than two children of school age in 1985 and this number increased to more than three in 1989 and then declined again to slightly more than two in 1998 (Table 2). The changes in the average number of children of school age simply reflect the changes in the age structure of the younger members of the households. Male children accounted for a larger proportion of our sample in 1985 and 1989.

3. Trends in school progress

It is well documented that men fare better than women in terms of primary and secondary school enrollment in many developing countries, even though such gender gap in school enrollment has narrowed in recent years (Schultz [1993]; Quibria [1995]; World Bank [2001]). The decline in the gender gap in school enrollment indicates that parents' behavior, far from being static, responds systematically to changes in the relative returns to schooling of men and women.

In general, investments in the schooling of women yield a higher rate of return than investments in the schooling of males (Psacharopoulos [1985, 1994]). In Malaysia, parents are motivated to invest more in the schooling of girls in response to increased returns to the schooling of females (Deolalikar [1993]). In the Philippines, parents invest more in the schooling of girls in response to increased employment opportunities available for women in the non-farm sector (Estudillo, Quisumbing and Otsuka [2001b]). In India, however, parents invest less in girls' schooling because girls face a lower rate of economic return in the labor market (Kingdon [1998]).

Figure 2 shows the enrollment rates in the secondary and tertiary school levels in the whole Philippines in 1980 and 1995 and in our sample villages in 1985 and 1998. Primary school enrollment was close to 100 percent for both boys and girls in the whole Philippines and our village sites as well. Secondary and tertiary school enrollment rates increased for both boys and girls. The gender gap in secondary school enrollment in favor of girls disappeared in 1995 for the whole

Table 2. Number of sample households and children

Survey years	*1985*	*1989*	*1998*	*2002*
Sample children of school age[1]	638	685	241	241
Male children	346	374	128	128
Female children	292	311	113	113
Average number of children of school age per household	2.5	3.7	2.6	2.6
Male children	1.9	2.0	1.4	1.4
Female children	1.6	1.7	1.2	1.2

[1] Children born between 1965 and 1981 in the 1985 sample; children born between 1969 and 1991 in the 1989 sample; and children born between 1978 and 1994 in the 1998 and 2002 samples.

Philippines perhaps due to the mandatory free high school education since 1986. In our sample villages, however, the gender gap in favor of girls in secondary school enrollment emerged in 1998.

Figure 3 shows the birth year and schooling levels (in terms of the average number of years completed by age) of school-age children in our village sites in 1985, 1989, 1998 and 2002. It is evident that there was an increase in schooling attainment over time, which means that households invested more in the schooling of later-born children. The educational preference in favor of younger children might be due partly to the reduction in liquidity constraints of the households in the later stage of its life cycle and partly due to the decline in direct schooling costs shouldered by the parents as a result of the expansion of free public school systems. It is also possible that the increasing job opportunities in the non-farm sector have increased returns to schooling, thereby stimulating investments in the schooling of younger children.

There has been no marked gender preference in primary school in all the survey years simply because almost all children are sent to primary schools. There is a slight gender bias in favor of girls in secondary school but this is far less compared to the gender bias in tertiary school. It appears that parents tend to invest relatively equally in the schooling of children until secondary school is completed. Later-born children have also started to attend tertiary school: the average years of schooling completed by children at age bracket 16 to 20 is 9 years in 1989; 10 years in 1998; and 11 years in 2002. At this age bracket, on the average, girls have completed significantly more years in school than boys.

An earlier study found that the eldest daughter received more schooling than her siblings in the respondents' generation born around the 1940s and in the generation of respondents' children born around the late 1960s (Estudillo, Quisumbing and Otsuka [2001a]). These findings appear to be contrary to the

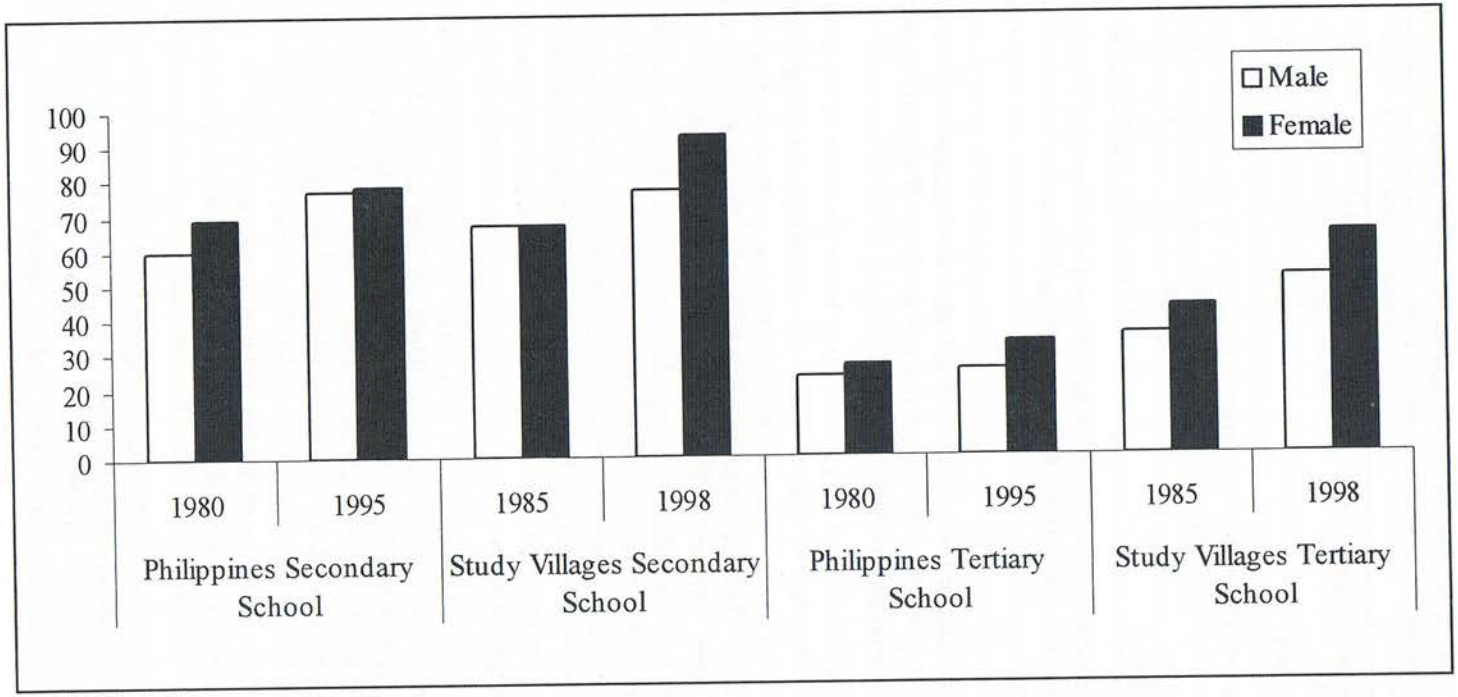

Figure 2. School enrollment rates in the Philippines and study villages

Source: *UNESCO Statistical Yearbook* (1999) for the Philippine data.

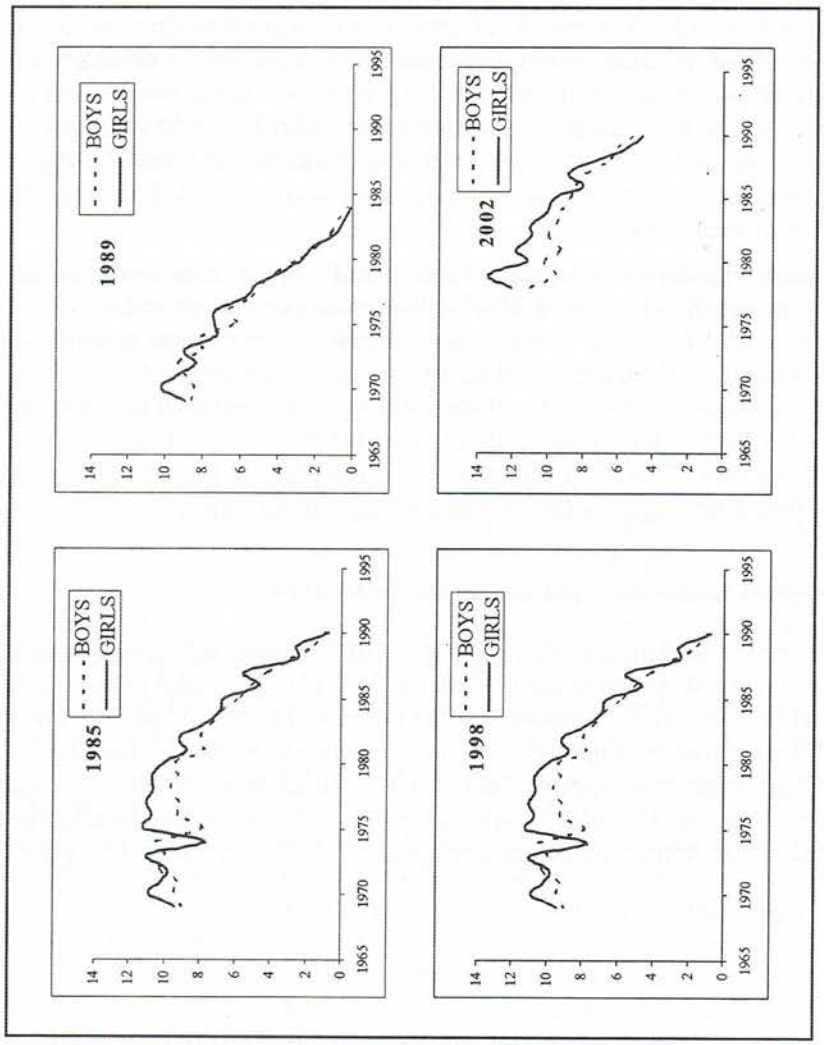

Figure 3. Average years in school completed by birth year of children of school age in our study villages

traditional belief that the eldest daughter in a Filipino family sacrifices for the benefit of her younger siblings by quitting school to either help in the domestic work and child care or join the labor market to help finance the schooling of both younger sisters and brothers.

A review of the literature indicates that birth-order and the gender composition of the siblings affect the schooling of children in other countries. In Taiwan, older sisters received a lower level of schooling because they dropped out of school to work and thus help in the education of younger siblings of either gender, or got married (Parish and Willis [1993]).[11] In the United States women with no sisters received, on the average, significantly more schooling than women with any sisters after controlling for household size (Butcher and Case [1994]).[12] Men's schooling, in contrast, was not systematically affected by the sex composition of their siblings.

Compared with the above-mentioned cases, the Philippine case seems unique. In brief, girls are slightly favored in schooling investments in secondary school but more so in tertiary school. Gender and birth-order effects appear to matter as shown by a significantly lower schooling attainment of other sons, who are either middle or youngest children. So far, there has been no consensus in the literature about whether birth-order effects really exist, and if they exist, whether they are positive or negative (Parish and Willis [1993]). The findings from the Philippine case may shed a new light on the literature on birth-order effects.

4. Theoretical framework and estimation procedure

In this section, we derive testable implications of the optimal schooling decisions by using a simplified version of the Levhari and Weiss [1974] model of household educational investments.[13] Suppose that the return to human capital investment in a child is measured by wage (W), which is a function of years of schooling (S), gender (FEM), other child-specific factors (CH), village-level variable (V), and an additive stochastic element (e), with $E(e) = 0$, which incorporates possibilities such as risk of job-mismatching after schooling. W can be represented simply as

$$W = f(S, FEM, CH, V) + e. \tag{1}$$

[11] Birth-order effects are important in intrahousehold allocation of nutrients as well. In India, parents generally favor older children and during the lean season, when food is scarce, parents follow a pure investment strategy which, together with the preference for earlier-born children, may expose less endowed later-born children to higher nutritional risks (Behrman [1988]).

[12] Hauser and Kuo [1998] challenged the findings of Butcher and Case [1994] using a more extensive and representative data set to show that age and gender composition of siblings do not systematically affect the schooling attainment of men and women in the United States. Regardless of age and gender, an additional child in the household significantly reduces the schooling attainment of the other siblings.

[13] A detailed mathematical solution to this model is available from the authors upon request.

Equation (1) is a variant of the so-called education production function (Hanushek [1995]). We assume that the education production function is concave in years of schooling so that the return to increments in schooling falls gradually.

4.1 The case of a perfect credit market

When a household can borrow and save money freely at an exogenous interest rate, we obtain the first-order condition as follows: $\partial f(S, FEM, CH, V)/\partial S = 1 + r$.[14] This equation indicates that a household with perfect access to credit will choose the level of schooling at which the net marginal productivity of schooling equals the non-stochastic market interest rate. Hence, we obtain a reduced-form equation of optimal schooling level (S^*),

$$S^* = S(FEM, CH, V, r). \tag{2}$$

Equation (2) indicates that when credit constraint is not binding, the separability between consumption and schooling investment decisions holds, and parental income does not affect schooling decisions.

4.2 The case of an imperfect credit market

Households in developing countries, especially the poor landless farm households, are more likely to be credit-constrained so that Equation (2) may not hold. Credit constraints of the households are driven by credit market imperfections resulting either from financial repression induced by the government (McKinnon [1973]) or from asymmetric information between lenders and borrowers (Stiglitz and Weiss [1981]). Under a binding credit constraint, households may adjust child schooling investment decisions to cope with income risks.

To explore this mechanism formally, we can derive a credit-constrained optimal schooling decision equation in a two-period framework, where the marginal rate of transformation of education production is equated to the marginal rate of substitution in consumption, i.e., $\partial f(S, FEM, CH, V)/\partial S = (\partial EU/\partial C_1)/(\partial EU/\partial C_2)$, where EU denotes the expected lifetime utility of the household and C_1 and C_2 are consumption in the first period and second period, respectively. Under credit market imperfections, the separability between consumption and schooling investment decisions breaks down and thus the household effectively faces an endogenous interest rate. Furthermore, the availability of investment funds, represented by transitory and permanent income, becomes important. Accordingly, under this non-separability condition, the reduced-form equation for schooling decision becomes

$$S^* = S(Y_P, Y_T, FEM, CH, V, r). \tag{3}$$

where Y_P and Y_T represent household permanent and transitory incomes, respectively.

[14] Note that we normalize the initial wage, i.e., $W(0) = 1$.

Comparing Equation (2) with Equation (3), we can investigate the existence of credit market imperfections. If the coefficients of Y_P and Y_T are equal to zero, credit market imperfections do not exist so that household income is not a crucially important determinant of child schooling. In contrast, if the coefficients of Y_P and Y_T are not statistically different from zero, then households face credit constraints so that parental income significantly affects child schooling. We expect that the coefficients of Y_P and Y_T are positive in the case of the rural Filipino households.

4.3 Estimation procedure

We estimate Equation (3) as a linear optimal schooling function as follows:

$$S^* = \alpha_0 + \alpha_1 \Pi Y + \beta_{FEM} FEM + \beta_{CH} CH + v + u_1, \quad (4)$$

$$Y = Y^P + Y^T, \quad (5)$$

where $Y^P = X^P \gamma$ and $E(Y^T) = 0$. In the estimation, we use progress in schooling (measured by incremental years of schooling completed between two adjacent survey years) to represent S^*. The α_s and β_s are regression parameters, Y is total household income which is the sum of permanent income (Y^P) and transitory income (Y^T), v represents village-fixed effects, and u_1 is an error term with $E(u_1)=0$. If we have a data set of M children from N households then S^*, v, and u_1 are $M \times 1$ vectors and Y_P and Y_T are $N \times 1$ vectors so that Equation (4) is an $M \times N$ matrix. Π is a term to denote the matching of a household-specific vector into a child-specific vector.[15] CH and FEM are $M \times T_1$ and $M \times T_2$ vectors of T_1 child variables and T_2 female dummy variable, respectively, while β_{CH} and β_{FEM} are $T_1 \times 1$ and $T_2 \times 1$ vectors of coefficients, respectively. X^P is an $M \times T_3$ matrix of T_3 variables determining household's permanent income, such as physical and human assets, and Y^T is a $T_3 \times 1$ vector of well-behaved errors which we consider as the transitory income, following Alderman [1996] and Paxson [1992].

Since household-level unobserved shocks (e.g., mother's sickness) affect both Y^T and u_1 then $cov(Y^T, u_1) \neq 0$. Accordingly, the OLS estimation of Equation (4) suffers from an endogeneity bias because it treats Y as an exogenous variable. If u_1 and ΠY^T follow a bivariate normal distribution with zero means, we can write u_1 conditional on ΠY^T,

$$u_1 = \alpha_3 \Pi Y^T + \varepsilon \quad (6)$$

where ε follows mean zero normal distribution and is independent of Y and ΠY^T (Amemiya [1978:1204]; Smith and Blundell [1986:679]).

However, S^* is censored with a value between zero and the maximum years of schooling attainable. Accordingly, we observe the following:

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[15] Note that M is larger than or equal to N. If each household has only one child, then $N=M$ and Π becomes an $N \times N$ identity matrix.

$$S = 0 \text{ if } S^* \leq 0, \tag{7}$$

$$S = S^* \text{if } 0 < S^* < S^U, \tag{8}$$

$$S = S^U \text{if } S^U \leq S^* \tag{9}$$

where S is the observed level of schooling and S^U is the maximum level of schooling attainable. Since the value of years of schooling is censored, we need to employ a model that can take into account the potential bias due to endogenous sample selection. Our approach is to employ a two-stage simultaneous equations Tobit model suggested by Smith and Blundell [1986]. The first stage is the ordinary least squares estimation of household-level income function shown in Equation (5). The second stage is to employ a two-limit Tobit estimation method and to estimate the individual-level schooling function considering Equations (7), (8), and (9), where the schooling function is simply a combination of Equations (4) and (5) with estimated coefficients:

$$S^* = \alpha_0 + \alpha_1 \Pi \hat{Y}^P + (\alpha_2 + \alpha_3) \Pi \hat{Y}^T + FEM\,\beta_{FEM} + CH\,\beta_{CH} + v + e, \tag{10}$$

where $\hat{Y}^P = X^P \hat{\gamma}_{OLS}$ with $\hat{\gamma}_{OLS}$ being the first-stage OLS estimators and $\hat{Y}^T = Y - \hat{Y}^P$ estimated from the first-stage regression of income equation. Alderman [1996], Alderman et al. [1997], and Paxson [1992] consider $\hat{Y}^P$ as an unbiased measure of household permanent income, while $\hat{Y}^T$ may be considered as household transitory income. Recalling the theoretical implications of Equations (2) and (3), we examine the existence of credit market imperfections by testing whether the values of coefficients of $\hat{Y}^P$ and $\hat{Y}^T$ in Equation (10), i.e., α_1 and $\alpha_1 + \alpha_3$, respectively, are equal to zero or not.

5. Results and discussion

We obtain $\hat{Y}^P$ and $\hat{Y}^T$ by regressing the base year household income on a set of household physical and human asset variables, namely: (1) size of landholdings by tenure; (2) use of MVs and availability of irrigation; (3) proportion of rice area under owner cultivation, leasehold tenancy and Certificate of Land Transfer combined, and share tenancy; (4) number of working members and their characteristics such as age, schooling and gender; and (5) village dummies. The estimation results will be examined later.

There is a wide variation in $\hat{Y}^P$: its standard deviation in thousand pesos is 12.7 in 1985 and 45.2 in 1998 (Table 3). We do not have an income function for 1989 because the data set does not provide income data. Average $\hat{Y}^P$ increased five times between 1985 and 1998. $\hat{Y}^T$ has a higher variance compared to $\hat{Y}^P$ and the value of $\hat{Y}^T$ may even be negative for poor households. The standard deviation of $\hat{Y}^T$ increased from 14.0 thousand pesos in 1985 to 73.3 in 1998.[16] These

[16] $\hat{Y}^P$ and $\hat{Y}^T$ are in nominal terms. The real values of $\hat{Y}^P$ and $\hat{Y}^T$ increase if paddy price is used as deflator but the real values decline if the consumer price index outside Manila is used as

Table 3. Permanent income and transitory income

Survey years	*1985*	*1989*	*1998*	*2002*
Permanent income[1]				
Mean ('000 Pesos per year)	18.1	n.a.	91.3	n.a.
Standard deviation	12.7	n.a.	45.2	n.a.
Transitory income				
Mean ('000 Pesos per year)	0.0	n.a.	0.0	n.a.
Standard deviation	14.0	n.a.	73.3	n.a.

"n.a." means not available.

US$1=Php20.90 in 1985 and US$1=Php54.99 in 1998.

findings suggest the decreasing importance of chronic poverty and the increasing importance of transient poverty among our sample households. Transitory incomes come primarily in the form of remittances, irregular wage income, gifts, and windfall gains. Hence, we hypothesize that the influence of $\hat{Y}^T$ on schooling investment is much less than the influence of $\hat{Y}^P$, especially in the earlier years when chronic poverty is more prevalent.

The dependent variable in the second-stage schooling regression function is the difference in years of schooling completed between two adjacent survey periods. The explanatory variables in the second-stage regression function are: (1) $\hat{Y}^P$; (2) $\hat{Y}^T$; (3) size of landholdings by tenure; (4) interaction term between $\hat{Y}^P$ and daughter dummy; (5) interaction term between $\hat{Y}^T$ and daughter dummy; (6) age of head; (7) squared term for age of head; (8) previous schooling; (9) gender and birth-order dummies such as eldest daughter, eldest son, and other sons (other daughter is the control); (10) father's and mother's schooling; (11) interaction term between daughter's dummy and father's and mother's schooling; (12) number of male and female children of school age; (13) dummy for year of birth; and (14) village dummies.

We run the regression functions separately for two adjacent survey periods in 1985-89 and 1998-02 where all the explanatory variables pertain to the base year. Our sample children are those who were available in two adjacent survey periods with the exclusion of those children who were included in the initial round of survey but were not included in the next round.

5.1 Explanatory variables

Before examining the estimation results, we discuss the hypothesized impacts of the following explanatory variables.

deflator. The discrepancy in the real values is due to the declining importance of rice in the consumer budget.

Permanent income and transitory income. A large number of studies have confirmed that the income elasticity of schooling is positive in many developing countries. (See Behrman and Knowles [1999, Appendix A]). Thus, for the rural Philippines, we expect to reject the null hypotheses, $\alpha_1 = 0$ and $\alpha_1 + \alpha_3 = 0$, which implies that credit market imperfections exist so that parental incomes play a significant role in child schooling.[17] The interaction term between permanent income and daughter dummy, and the interaction term between transitory income and daughter dummy aim to capture the gender bias associated with changes in different income components. If the interaction term has a positive coefficient, it means that daughters' schooling investments are more sensitive to permanent or transitory income than son's schooling investments.

Farm size. Farm size represents household access to the credit market because land is a major form of loan collateral in the rural communities. Owned land can be pawned in formal credit institutions while lands on usufruct rights such as CLT, leasehold tenancy, and share tenancy can be pawned to informal credit sources such as local moneylenders, relatives, and friends.

Interaction term between daughter dummy and permanent and transitory income. This represents the gender bias associated with the level of permanent and transitory income.

Age of head and its squared term. We included these variables to capture possible parental life cycle effects on schooling investments. For instance, priority for child schooling may be low at an earlier stage of the household life cycle when the head is younger and possess lower levels of income and resources.

Previous schooling. Completed years in school in the base year is a good measure of the human capital stock of each individual child in the initial period, which reflects individual endowments such as intelligence and ability as well as the desire to continue on in school (Jacoby and Skoufias [1997]; Sawada and Lokshin [2001]). Its effect on schooling progression, however, may be negative which may mean that parents are less willing to invest more in the schooling of the more educated children.

Gender and birth-order. The effects of gender and birth-order are captured by dummy variables (for four sets of gender and birth-order categories such as eldest daughter, eldest son, other sons and other daughters) assuming a value of either unity, if the child falls into the category, or zero otherwise. Sibling competition on educational resources may arise if credit constraint is binding: an additional year of schooling investment in a child leads to a decline in the optimal years of schooling investment in another child.

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[17] Wydick [1999] argued that the relationship between credit access and schooling investment may not be unequivocally positive. The positive impact of access to credit on child schooling can be mitigated when hired labor is not perfectly substitutable to child labor and when access to credit increases physical capitalization thereby increasing the return to child labor and the opportunity cost of schooling as in the case of small household enterprises in Guatemala.

Parents' schooling. Fathers' and mothers' completed years in school may represent the household-level stock of human capital brought into the household by the previous generation. We expect these variables to exert a nonnegative impact on the schooling progression of children (Deolalikar [1993]; Parish and Willis [1993]; Behrman et al. [1999]; Strauss and Thomas [1995:1928]).

Interaction term between daughter dummy and parents' schooling. This variable aims to measure the gender bias of parents associated with the resources they control.[18] The more educated mothers may prefer to send their daughters to school, if daughters' schooling is a complementary input in home production (Behrman et al. [1999]). Similarly, the more educated fathers may prefer to invest more on their sons' schooling, if the sons' schooling positively affects the father's labor productivity.

Number of male and female children of school age. The effects of these variables cannot be predicted a priori. According to Parish and Willis [1993], a larger number of brothers and sisters diminish household resources available to each child, thus leading to a lower schooling investment in all children regardless of gender. Schooling investments may be particularly low for children in large households with serious credit constraints (Jacoby [1994]). On the other hand, Hauser and Kuo [1998] find that the sex composition of the sibset does not explain much of the variations in (women's) schooling attainment.

Dummies for year of birth. We expect year of birth to have a nonnegative impact on current schooling attainment because of the effect of the birth cohort.

Village-fixed effects. Village-fixed effects capture village-specific unobserved heterogeneity such as the availability of, and distance to schools; access to urban labor markets and new agricultural technology; and type of production environment. We also expect that the inclusion of fixed effects will lessen the possible omitted variable bias.

5.2 Regression results

We first report the estimation results of the first-stage household income function (Table 4). As expected, farm size significantly increases income; and owner-cultivators, holders of CLTs, leasehold tenants, and share tenants have higher income compared to landless households (the control group). Although the presence of irrigation and the use of MVs improve rice yield, the impact on household income is not significant. Household income seems to be unaffected by the age and gender composition of working members. The ratio of working members with tertiary schooling, however, appears to have exerted a significant positive impact on income. It appears that working members with tertiary schooling

[18] Father's and mother's schooling are a good measure of bargaining power in the household. It is well documented in developing countries that increases in the relative resources controlled by women result in an expenditure pattern that enhances the welfare of the next generation (World Bank [2001: Ch. 4]). In Bangladesh, Ethiopia, Indonesia and South Africa, assets brought to marriage by women have a positive and significant effect on expenditure allocations on

have been heavily engaged in non-farm work requiring particular skills and knowledge. Among the villages, P1 had the highest income in 1985 and CL1 in 1998, while the isolated rainfed village, P3, had the lowest in both years.

As shown in Table 5, permanent income seems to have exerted a positive and significant impact on schooling progression even though its coefficient consistently declined from 1985-89 to 1998-02. This may indicate that, in more recent years, poor households fared relatively better in schooling investments vis-à-vis the rich households, which may partly reflect a decline in the liquidity constraints of poor households. Transitory income appears to have no significant impact on the schooling progression of children, thus indicating that transient poverty is not so much an important factor affecting child progress in school perhaps because of the presence of a strong community risk-sharing mechanism. Transitory income is highly correlated with remittances sent by children who have migrated and worked in the non-farm sector: the correlation coefficient between transitory income and remittances is 0.52 in 1985 and 0.46 in 1998. The impact of transitory income, however, is significantly smaller than that of permanent income. It seems evident that permanent income is the major source of educational funds.

Our null hypotheses, $\alpha_1 = 0$ and $\alpha_1 + \alpha_3 = 0$, are strongly rejected, indicating that the existence of credit market imperfections seriously impede the child schooling investments of Filipino households. These results are consistent with the theoretical implications of the education investments of credit-constrained households.

The coefficients of the interaction terms between daughter dummy and permanent income are negative and significant in 1998-02, implying that parents in more recent years had a higher propensity to send their sons to school in the face of increasing household permanent income. This behavior is consistent with parents' intention to restore gender equity considering that sons are less likely to receive schooling than daughters *ceteris paribus*. The insignificant coefficient of the interaction term between transitory income and daughter dummy seems to suggest the absence of gender bias in schooling as a coping device against insurance market imperfections.

Age of head and its squared term are not important in the schooling progression of school-aged children, indicating that life cycle effects are largely absent. The variable *completed years in school in the previous years* has a negative and significant impact on schooling progression after controlling for child age and household income. This finding seems to indicate that parents are less likely to invest in the schooling of those children who have already attained higher levels of schooling, suggesting the continuously increasing baseline hazard rate of schooling termination. In fact, there is a ceiling on the maximum desired level of child schooling which is 14 to 15 years in the case of the Philippines.

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education and children's clothing (Quisumbing and Maluccio [1999]). In Brazil, increases in income in the hands of women increase the budget share of education, health, and food (Thomas [1997]). In the rural Philippines, father's schooling (but not mother's schooling) has a positive and significant effect on the share of expenditures for schooling (Estudillo, Quisumbing and Otsuka [2001c]).

Table 4. Income determination function, 1985 and 1998

Explanatory Variables	*1985*	*1998*
MV x Irrigation[1]	2,580.80*	5,775.58
	(1.80)	(0.28)
Farm size by tenure:		
Ownership	9,836.63**	15,222.93*
	(6.05)	(1.88)
CLT-LH[2]	8,720.40**	22,073.49**
	(8.87)	(2.93)
Share tenancy	4,191.78**	20,075.30
	(2.02)	(1.18)
Proportion of landholding by tenure:		
Ownership	-3,593.35	7,356.45
	(-1.05)	(0.31)
CLT-LH[2]	-5,876.74**	9,912.30
	(-2.11)	(0.44)
Share tenancy	-7,612.59*	34,190.19
	(-1.92)	(1.00)
Number of working members	577.68	13,745.50**
	(0.90)	(3.04)
Proportion of working members:		
26 to 35 years old	4,036.09	50,805.12*
	(0.84)	(1.86)
36 to 45 years old	1,686.78	59,137.24**
	(0.44)	(1.99)
46 to 55 years old	1,407.00	46,927.14
	(0.35)	(1.40)
56 to 65 years old	2,400.72	53,738.92
	(0.52)	(1.57)

Table 4. Income determination function, 1985 and 1998 (continued)

Explanatory Variables	*1985*	*1998*
With secondary schooling	107.78	15,170.52
	(0.04)	(0.87)
With tertiary schooling	10,904.00**	59,440.61**
	(3.23)	(2.80)
Ratio of female working members	87,30.81*	-13,555.22
	(2.09)	(-0.55)
Dummy for Central Luzon Village 1	4,277.97	69,238.93**
	(1.38)	(2.58)
Dummy for Central Luzon Village 2	-2,999.03	41,381.45*
	(-0.96)	(1.64)
Dummy for Panay Island Village 1	7,195.49**	66,198.16**
	(2.24)	(2.36)
Dummy for Panay Island Village 2	1,024.50	22,718.04
	(0.35)	(1.04)
Constant	-224.70	-85,559.85*
	(-0.04)	(-1.93)
Number of observations	369.00	220.00
R-squared	0.45	0.27

Notes:

1 Interaction term between the proportion of rice area planted with modern rice varieties and proportion of rice area with irrigation

2 CLT refers to Certificate of Land Transfer and LH refers to leasehold tenancy.

Numbers in parenthesis are t-values.

Table 5. Determinants of changes in years of schooling completed[1]

Explanatory Variables	*1985-89*	*1998-02*
Permanent income ('00000 pesos)	3.68**	0.37
	(1.98)	(0.53)
Transitory income ('00000 pesos)	0.63	0.20
	(0.95)	(0.90)
Farm size by tenure:		
Area owned	0.07	0.74**
	(0.59)	(3.43)
CLT-LH[2]	0.00	0.31*
	(0.02)	(1.82)
Share tenancy	0.20*	0.06
	(1.87)	(0.18)
Daughter x Permanent income	-0.02	-0.12**
	(-0.17)	(-0.17)
Daughter x Transitory income	0.68	0.00
	(0.73)	(0.02)
Age of head	-0.00	-0.10
	(-0.11)	(-0.65)
Squared term for age of head	0.00	0.00
	(0.11)	(0.68)
Previous schooling:		
0 to 2 years	0.43	3.45**
	(0.84)	(3.23)
3 to 6 years	0.17	1.46**
	(0.43)	(2.42)
7 to 10 years	0.57*	1.11**
	(1.64)	(2.26)
Eldest daughter	0.27	0.02
	(1.14)	(0.06)
Eldest son	0.03	-0.96
	(0.06)	(-1.03)
Other son	-0.55	-1.52*
	(-1.11)	(-1.77)

Table 5. Determinants of changes in years of schooling completed[1] (continued)

Explanatory Variables	*1985*	*1998*
Father's education	-0.04	0.15*
	(-1.06)	(1.88)
Mother's education	0.08*	0.06
	(1.87)	(0.88)
Daughter x father's education	0.08	-0.21*
	(1.27)	(-1.95)
Daughter x mother's education	-0.05	0.05
	(-0.82)	(0.56)
Number of male children [3]	-0.03	0.00
	(-0.63)	(-0.03)
Number of female children [3]	-0.03	0.14
	(-0.64)	(1.26)
Dummy for Central Luzon Village 1	-0.71**	-0.85*
	(-2.15)	(-1.65)
Dummy for Central Luzon Village 2	-0.55**	0.40
	(-2.03)	(0.68)
Dummy for Panay Island Village 1	0.11	0.12
	(0.32)	(0.20)
Dummy for Panay Island Village 2	0.14	0.42
	(0.58)	(0.92)
Constant	1.12	-1.20
	(0.66)	(-0.27)
Log likelihood	-1,032.36	-358.43
Number of observations	646.00	226.00

Notes:

1 The dependent variable is the difference in years of schooling completed between two adjacent survey years.

2 CLT refers to Certificate of Land Transfer and lh refers to leasehold tenancy.

3 Number of male and female children who are of school age

Numbers in parenthesis are t-values.

Significant gender and birth-order biases in favor of daughters appear to be largely absent in 1985-89 but seem to have appeared in 1998-02 when the other sons completed, on the average, about 1.52 years less of schooling compared to the eldest daughter and other daughters. We find that this gender gap in completed years in school in favor of daughters was statistically significant in 1998-02. Previous studies have found that rural Filipino parents preferentially bequeath land to sons and invest more in the schooling of daughters (Quisumbing, Estudillo, and Otsuka [2004]; Quisumbing [1994]). It seems likely that parents rationally choose to send daughters to school because daughters have a comparative advantage in non-farm work, where schooling investment has a high pay-off. Indeed, schooling is more valuable to daughters who have a higher propensity to migrate out of the village to participate in non-farm labor market.

The findings in the Philippines are in contrast to the findings in many other developing countries, where it is generally observed that the schooling attainment of women is lower (King and Hill [1993]). Women's schooling may be an unattractive investment option to parents if women earn less than men (Kingdon [1998]), if women provide less old age support to parents (Stark and Lucas [1988]), and if parents lose the stream of benefits associated with schooling investment upon marriage as in the case of uxorilocal communities where women move out of their natal villages to join their husbands. On the contrary, there are no significant differences between male and female rates of return in the non-farm sector in the Philippines and daughters tend to send more remittances than sons (Estudillo, Quisumbing and Otsuka [2001b]) and are more likely to care for their aging parents.

School progression of children appears to be affected by the schooling of the father (who is the major earner), and the gender bias associated with parental schooling seems to be largely absent. The number of children of school age does not seem to matter much: the coefficients of the number of male and female children of school age are negative but are generally not significant. Progress in schooling is significantly lower in children in CL1 and CL2 compared to P3 (the control village) in 1985 but these differences appear to have largely disappeared in more recent years.

Dummies for year of birth (included in the regression run but are not shown in Table 5) show that progress in schooling increases steadily until the child reaches the age between 13 to 16 when the child reaches secondary school age, and then starts to decline thereafter. This pattern is particularly noticeable in 1985-89 but not so much in 1998-02. It is interesting that schooling progression seems to increase steadily with no visible peak in 1998-02 indicating that members of the later-born cohort are able to advance even to tertiary levels. Moreover, the later-born cohorts in the 1970s and 1980s appear to have progressed more in schooling than the earlier-born cohort.

Overall, our regression analysis suggests that permanent income significantly affects the schooling progression of children, and that the schooling progression of children, regardless of gender, has generally increased over time. Gender and birth-order bias in favor of daughters emerged and exerted a stronger influence on schooling investment decisions when the children reached tertiary school age.

6. Conclusions and future tasks

This study aimed to identify the determinants of the schooling progression of children as measured by completed years in school between two survey periods. We found among other things that there was an increase in the schooling progression of later-born children due to an increase in household income and the expansion of free public school systems. Gender biases were generally in favor of daughters, and these biases became stronger when most of the children reached tertiary school age.

We may conclude that schooling remains a superior good for most of the Filipino rural households since our results strongly reject the null hypothesis of zero income effects. This finding is consistent with the theoretical implications of the education investments of credit-constrained households. Permanent income positively and significantly affects the schooling progression of children, which strongly suggests that the Green Revolution and implementation of land reform as well as increased non-farm employment opportunities significantly increased schooling investments by increasing the permanent income of farm households. The impact of transitory income on child schooling progression appears largely absent, indicating that transitory poverty played a less significant role in child schooling investment decisions. High levels of income inequality and social class differentiation in the rural Filipino communities may be further exacerbated in the future, when the children from higher income households obtain higher levels of schooling and therefore reap the benefits associated with higher schooling.

One of our remaining tasks is to assess whether parental decision to invest more in daughters' schooling is a systematic response to the changes in relative rates of returns on male and female schooling. Our hypothesis is that the development of the non-farm sector in the Philippines is the single most important factor responsible for the differential increase in the rates of returns on schooling by gender. It seems more likely that parents invest more in the schooling of daughters because the rate of return on female schooling increases faster than the rate of return on male schooling in the non-farm sector. This hypothesis, however, needs to be tested rigorously in our future studies.

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