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Abstract

This paper investigates the determinants of child labor and schooling in a low income rural economy, while focusing on the role of the intrahousehold distribution of power. To this end, a collective model of the time allocation of school-age farm children is developed and empirically tested using data from rural Bangladesh. The model works particularly well in characterizing school attendance and full time work. The results indicate that mothers have a higher preference for child schooling than fathers. This difference is identified by changes in factors that affect the time allocation of children only through the relative bargaining power of mothers. This result has important implications for policies directed at women.

JEL CLASSIFICATION: D12, I21, J13, J22, O15

KEYWORDS: Child labor and schooling, intrahousehold distribution of power, collective models

1 Introduction

Although labor force participation rates for school-age children have been declining over time, recent ILO estimates (1996) show that worldwide approximately 120 million children (aged 5-14) do full time paid work, a figure that goes up to 250 million if part-time work is included. Child labor is particularly pervasive in poor countries, where it is generally accompanied by low levels of educational achievement.

What has increased in contemporary times is the awareness of, and concern for, working children, both at national and supranational levels. The universal perception of child labor as a "problem" stems from its believed harmful effects on the health and intellectual development of children, which may condemn these children (and the countries or regions where they live in) to perpetual poverty. However, there is wide disagreement on how to tackle the problem of child labor, which stems from lack of awareness of the causes of child labor and the consequences of banning it through legislation or enacting compulsory schooling.

In recent years, however, there has been a rapidly expanding literature on child labor, surveyed in Grootaert and Kanbur (1995), and Basu (1999). This renewed academic interest in child labor has been motivated by the evidence on the incidence of child labor, awareness of its long-run negative impact on development, and realization that simply banning child labor is unlikely to eradicate this phenomenon and may even be counterproductive. This research has been facilitated by the increasing availability of good and more representative data on child employment. This literature, however, has in general provided few theoretical insights, and has emphasized more ad-hoc empirical analysis.

Almost all theoretical models of child labor and schooling have been developed within a unitary household framework, that is, taking the household as the unit of analysis. The "unitary" model has been recently criticized because of its weak theoretical foundations (Chiappori, 1992), its inability to be used to perform intra-household welfare analysis (Apps and Rees, 1988), and its empirical failure in both developed and developing countries (see Berhman, 1997, for a review). Furthermore, in the context of developing countries, Haddad *et al.* (1997) argue that using a unitary model of the household as a guideline for policy prescriptions may lead to serious policy failures when, for example, the effect of public transfers differs depending on who within the household gets the transfer.

These criticisms have lead to the development of two types of models that explicitly recognize the role of individual preferences within the household unit, namely, bargaining models and collective models. These two approaches differ though in what it is assumed about the intra-household decision process. In contrast with bargaining models, the collective model leaves the decision rule unspecified and only assumes that the decision process, whatever its true nature, leads to Pareto efficient outcomes, and thus can be viewed as a generalization of some bargaining models.

Furthermore, contrary to the bargaining approach, the collective setting imposes restrictions on household demands that are empirically testable. Finally, and most importantly, in contrast with the unitary approach, the collective model opens up a new set of policies aimed at affecting household allocation outcomes, namely policies targeted to specific individuals within the household. All this makes the collective approach particularly well-suited for the

study of child labor and schooling, and a promising framework from which to derive policies to reduce the incidence of child labor and increase child schooling.

This paper looks at the factors determining the allocation of children's time in a low income rural economy, focusing on the role of the intrahousehold distribution of power. To this extent, a collective household model of the time allocation of school-age farm children is developed and empirically tested using data from rural Bangladesh. The theoretical model yields a system of demand equations for the allocation of children's time to farm work and school, which is then used to construct a bivariate probit model for the work and school participation choices.

The results show that the model works particularly well in characterizing school attendance and full time work. Among the novel results is the rejection of the unitary representation of preferences, and the validation of the Pareto efficiency assumption imposed by the collective model. More precisely, it appears that mothers have a higher preference for child schooling than fathers. This difference is mainly revealed by changes in factors that affect the time allocation of children only through the relative bargaining power of mothers, such as credit from group-based credit programs. Thus, the results suggest that mothers use their increased power within the household to allocate more resources to child schooling.

These results suggest a new set of policy instruments that can be used to reduce the incidence of child labor and increase child schooling such as the promotion of credit programs targeted to the poor (particularly women), education programs for adults (particularly women), and improved access of women to the non-agricultural rural sector. Other policies

suggested by the results are the promotion of family planning programs and agricultural modernization.

The rest of the paper is organized as follows Section 2 reviews the theoretical and empirical literature on child labor and schooling. Section 3 develops a simple collective household production model. Section 4 describes the data used for analysis. Section 5 presents a bivariate probit model for the work and school participation choices. Section 6 reports the estimation results and presents the tests of the collective model. Section 7 concludes and suggests some policy implications.

2 A Review of Theoretical and Empirical Approaches to the Study of Child Labor and Schooling

Following Becker's general household production framework, several models that explicitly account for the economic contribution of children have been developed. Much of this work is based on Rosenzweig and Evenson (1977), who model decisions associated with child investment (i.e. fertility, child labor, and schooling) simultaneously within a static unitary household framework. These models generally highlight the relationship between fertility and time allocation decisions through the shadow wage of children.

Another class of static models with single household preferences but within a general equilibrium framework was first developed by Basu and Van (1998). This type of models go beyond the standard household setting and consider a labor market with multiple equilibria

as regards child labor. Child labor exists in equilibrium if the economy is very unproductive. Two basic assumptions underlie this type of model. First, children only work when it is necessary for the subsistence of the household (*Luxury Axiom).* Second, child labor is a substitute for adult labor from the perspective of firms (*Substitution Axiom*).

In their general equilibrium two period model, Baland and Robinson (1998) show that child labor arises as a result of the lack of parental control over their children's income when adults, thus making it difficult to enforce intergenerational contracts.

Some work has been done in extending the unitary household approach to include time and uncertainty dimensions. Jacobi and Skoufias (1997), for example, present a stochastic dynamic model in which child labor arises as an insurance mechanism against shocks in the absence of complete financial markets.

Very few theoretical models go beyond the unitary approach to household decision making in studying child labor and schooling. Moehling (1995) considers bargaining between a parent and a child, whereas Behrman *et al.* (1999) considers bargaining between the mother and the father.

The conventional empirical strategy has been a binary model for the school or work choice versus everything else (e.g. Patrinos and Psacharopoulus, 1997). These studies explicitly or implicitly assume an inverse relationship between school and work. However, in many settings, a sizable group of children combine school and work, and some children are neither in school nor reported to be working. Studies that make use of continuous time allocation information on either work hours or school hours suffer from a similar problem (e.g. Ray,

1999).

Few studies have jointly analyzed school and work as different but interdependent choices. Canagarajah and Coulumbe (1997) make use of a bivariate probit model for the school and work choices in Ghana. Grootaert (1998) makes use of a sequential multivariate probit model for Cote d'Ivoire, where children are grouped into four mutually exclusive categories: school only, school and work, work only, and domestic work (or leisure) only. Finally, using data from rural India, Skoufias (1994) estimates a simultaneous system of continuous time allocation equations, distinguishing between market, home, school, and leisure activities.

3 A Collective Household Production Model

3.1 A Review of Collective Models

Collective models of household behavior recognize the role of individual preferences, and assume that the intra-household decision process leads to Pareto efficient outcomes. However, the true nature of this process is left unspecified. The efficiency assumption is justified by the fact that the household setting is a clear example of a 'repeated' game with symmetric information, and hence it is plausible to suppose that household members find mechanisms to support efficient outcomes.

If allocations are Pareto efficient, then household decisions can be modelled as a two stage process. In the first stage, individuals pool their income and reallocate it among themselves according to some sharing rule, which is determined by the relative bargaining

power of household members, and fully summarizes the intra-household decision process. In the second stage, each household member maximizes his or her own utility given their income shares.

The collective model has been developed in the context of consumption goods (Browning and Chiappori, 1998), labor supply (e.g. Chiappori, 1992), and household production (e.g. Chiappori, 1997). Only a few collective models consider public goods such as children (e.g. Bourguignon, 1999). Each of these models yields a specific set of testable restrictions on household outcomes which, if satisfied, allow the identification of the sharing rule, individual preferences, and (if present) the household production function. There are only a few empirical studies based on the collective model.[2] The results from these studies generally support the collective model.

3.2 The Model

The model that I present below combines household production and the public good features of child schooling within a collective setting where the mother and the father are allowed to have different preferences as regards child schooling but where, for simplicity, all children are treated equally.[3]

Consider a prototypical farm household consisting, at a particular point in time, of a

[2] See, for example, Blundell et al. (1998) and Chiappori et al. (1998) in the context of developed countries, and Thomas et al. (1999) and Quisumbing and Maluccio (1999) in the context of developing countries.

[3] This model abstracts from possible strategic interactions between parents and children through intergenerational transfers.

couple, n_p pre-school children, and n_s school-age children.[4] Preferences of each spouse are defined over own and spouse's consumption of a composite consumption good (c_m and c_f),[5] and the human capital level of each school-age child (h_s), and represented by well-behaved individual-specific utility functions of the form

$$u_i = u_i(c_m, c_f, h_s; z_i), \quad i = m, f \tag{1}$$

where z_i represents observable and unobservable individual, household and community characteristics affecting tastes and therefore utility.[6] The production of h_s is governed by the following linear homogenous production function

$$h_s = h(l_{ss}, b; s) \tag{2}$$

where l_{ss} is the time spent by each school-age child on his or her human capital production;[7] b are purchased school goods allocated to school-age child c, with unit market price p_b; and s represents a vector of technological shifters such as health environment at home and in the community, and school quality. Each additional unit of human capital is assumed to require an additional unit of b.

[4] We can think of a period in this model as the time span from birth of a child until the child is of school-age. The number of pre-school children, n_p, can be thought as the fertility outcome for each period, which is assumed to be exogenous in this model but not in the empirical analysis.

[5] Preferences are thus 'caring'. The composite good includes direct consumption of the farm good as well as purchased market goods. The subscript m refers to the mother and f to the father.

[6] At an individual level, for example, the education and age of the parent may affect how much he or she values child schooling.

[7] Hence forth we call this school time, although it comprises both time in school and study time.

Farm output is determined by a linear homogenous production function

$$y = y(l_{ym}, l_{yf}, n_s l_{ys}; h_m, h_f, k, \tau) \tag{3}$$

where k represents farm scale; τ represents the level of agricultural technology;[8] h_i, $i = m, f$, represents the human capital level of parent i which is a positive function of his or her education, experience and health; l_{yi} is the time spent by parent i in farm production; and l_{ys} is the time devoted by each school-age child to farm production. The above specification allows for the marginal product to vary across different individuals due to differences in human capital and farm activity performed, but assumes that there are returns to human capital in farm production only for parents.

Parents and school-age children can participate in the wage labor market, earning a competitive wage per unit of time that is a positive function of the stock of human capital in the case of parents $w_i(h_i)$, and a competitive fixed wage w_s in the case of school-age children. w_s is the appropriate opportunity cost of child school time even if a child works exclusively in the household farm provided the child labor market is perfectly competitive. However, the thinness of the child labor market in rural Bangladesh makes w_s a unrepresentative measure of the shadow child wage.[9] Therefore, it is assumed that all child labor takes the form of own farm work. Thus the household budget constraint can be written as

[8] Farm scale and agricultural technology are assumed to be fixed at least in the short-run, and hence exogenous to the time allocation decision.

[9] Only 2.5% of the working children in my sample participate in the wage labor market. The same is true to a lesser extent for women: only 6.5% of the working mothers work for wages.

$$c + p_n(n_p + n_s) + p_b(n_s h_s) = m + p_y y + w_m(h_m) l_{wm} + w_f(h_f) l_{wf} \tag{4}$$

where c is total parental consumption of the composite good, whose price is normalize to one; p_y is the exogenously-given unit price of farm output; p_n is the fixed cost associated with raising a pre-school and school-aged child, including the cost of child consumption; l_{wi} is the time spent by i in wage employment; and m is household non-labor income.

Each pre-school child requires a fixed amount of child care time t_p, which is normalized to one. Of this time, a fixed proportion α can only be performed by the mother (e.g. breast-feeding). The remaining $(1 - \alpha)$ is performed by school-age children in equal shares (i.e. $(1 - \alpha)/n_s$ per school-age child). I take leisure of children and parents as exogenous, and hence L, the total time endowment for each individual, is fixed. Thus, the time constraints for the mother, father, school-age children are, respectively,

$$L = \alpha n_p + l_{ym} + l_{wf} \tag{5}$$

$$L = l_{yf} + l_{wf} \tag{6}$$

$$L = [(1 - \alpha)/n_s] n_p + l_{ss} + l_{ys} \tag{7}$$

Chiappori (1998) shows that for all Pareto efficient allocations there exists some λ such that the household optimization program is

$$\max U = \lambda u_m + (1-\lambda)u_f \quad 0 \leq \lambda \leq 1 \;\; \textit{subject to} \tag{8}$$

$$c + p_n(n_p + n_s) + p_b(n_s h_s) = m + p_y y + w_m(h_m) l_{wm} + w_f(h_f) l_{wf}$$

$$y = y(l_{ym}, l_{yf}, n_s l_{ys}; h_m, h_f, k, \tau); \;\; h_s = h(l_{ss}, b; s)$$

and the time constraints in (3.5) through (3.7). λ is some distribution function summarizing the decision process, that is, describing how household income gets divided up between the mother and the father (i.e. the sharing rule). This weight also has a very intuitive interpretation as an indicator of the relative bargaining power of the mother, which in general is a function of individual incomes and prices, as well as those individual, household, and community characteristics that are associated with the relative bargaining power of the women. In this model, assuming no cross-sectional variation in prices, this weight is represented by a continuously differentiable function $\lambda = \lambda(z_m, z_f, h_m, h_f, d)$, where d is to be defined below. The value of λ determines the particular location of the solution to the household problem on the Pareto frontier.

A solution to the above optimization problem yields a system of demand equations for children and parental time by activity, consumption of the composite good for each parent, and human capital of each school-age child. Those corresponding to the allocation of children's time to school and work activities, assuming no cross-sectional variation in prices and α, can be represented as

$$l_{js} = l_{js}(n_p, n_s, s, z_m, z_f, h_m, h_f, k, \tau, m, \lambda), \quad j = s, y \tag{9}$$

and substituting for the weight yields the reduced-form representation

$$l_{js} = l_{js}(n_p, n_s, s, z_m, z_f, h_m, h_f, k, \tau, m, d), \quad j = s, y \tag{10}$$

Note that apart from the weight λ, the demand functions are identical to those that would be derived from a unitary model. In fact, conditional on λ, the demand functions must satisfy the usual properties derived from the unitary model. Treating λ as endogenous leads to a series of Slutsky-like conditions and testable restrictions on the data.

To this extent, a crucial issue in the design of empirical tests of unitary and collective models is to find factors that affect the final outcome (e.g. l_{js}) only through λ, i.e. the so called distribution factors (Bourguignon, Browning and Chiappori, 1995), which are represented in this model by the vector d. Most studies use the distribution of exogenous household income (total or non-labor) in the design of the tests.

Doubts about the exogeneity of total and non-labor income have lead other researchers to use alternative measures of relative power, such as assets brought to marriage (Thomas *et al.*, 1999) or what MacElroy (1990) calls 'extra-environment parameters' (EEP), that is, variables that affect the opportunities of spouses outside marriage and can therefore influence relative bargaining power.[10]

[10] Chiappori et al. (1998), for example, make use of the relative sex ratio as a proxy for the situation in the marriage market.

In the unitary model distribution factors play no role on outcomes,[11] whereas the collective model predicts they do, but imposes restrictions on how they do it. More precisely, the Pareto efficiency assumption embodied in the collective model constrains the ratio of the effects of two distribution factors to be independent of the outcome, that is, to be the same for all 'goods', regardless of whether those are private or public. In the context of the present model and for two distribution factors, d_1 and d_2, this can be illustrated by the equality

$$\pi_{12,s} = \frac{(\partial l_{ys}/\partial d_1)}{(\partial l_{ys}/\partial d_2)} = \frac{(\partial l_{ys}/\partial \lambda)(\partial \lambda/\partial d_1)}{(\partial l_{ys}/\partial \lambda)(\partial \lambda/\partial d_2)} = \pi_{12,y} \tag{11}$$

The intuition behind this result is simple. Distribution factors affect outcomes only through λ, which in turn only affects the location on the Pareto frontier. Since λ is unidimensional (i.e. the same for l_{ss} and l_{ys}), this implies that the ratio of the effects of d_1 and d_2 on l_{ss} is the same as that on l_{ys}.

3.2.1 Comparative Statics

To guide the informal comparative statics analysis below, consider the marginal rate of substitution between school time and parent $i's$ consumption from (3.8)

$$\frac{\lambda\left[\frac{\partial u_m}{\partial h_s}\frac{\partial h_s}{\partial l_{ss}}\right] + (1-\lambda)\left[\frac{\partial u_f}{\partial h_s}\frac{\partial h_s}{\partial l_{ss}}\right]}{\lambda\left[\frac{\partial u_m}{\partial c_i}\right] + (1-\lambda)\left[\frac{\partial u_f}{\partial c_i}\right]} = p_y n_s \frac{\partial y}{\partial l_{ss}} + p_b n_s \frac{\partial h_s}{\partial l_{ss}} \equiv \omega_s \tag{12}$$

[11] In the unitary model, for example, all that matters is total income and not its intra-household distribution (i.e. income pooling hypothesis).

Thus the shadow price of each child's school time, ω_s, has two components. The first term is the opportunity cost of school time in terms of the value of the farm product foregone (i.e. shadow child wage), and the second term captures the direct costs of schooling.

An increase in the number of pre-school children (n_p) has a negative income effect on school time since it 'uses up' household resources by increasing the total cost of raising children. This effect may be reinforced by the increased need for complementary income from children. On the other hand, a greater number of pre-school children puts pressure on child care time, thus reducing the time available for both school and work.[12] Thus, overall we can expect child care and farm work to increase at the expense of school time following an increase in n_p.

An increase in the number of school-age children (n_s) has both an income and a substitution effect. As regards income, more school-age children leads to higher farm income but it also increases the cost of raising children. On the other hand, a rise in n_s increases ω_s by increasing the direct cost of schooling, although this effect may be partially offset by the reduction in the marginal farm product of each child. Finally, an increase in n_s reduces the child care time of each pre-school child, and hence increases the time available for school and work. Overall, we can expect school time to decrease and work to increase.

An increase in the area of operated land (k) has a positive income effect and a negative substitution effect on demand for school time. The income effect is likely to be strong in the case of rural Bangladesh given the combination of low land to labor ratios and very low

[12] However, to the extent that child care and farm work can easily be combined (see Cain, 1977, for evidence on that), this reduction in time available will mainly affect schooling time.

levels of agricultural productivity. The substitution effect results from the increase in the value of the marginal product of children.[13] As a result, given the strong income effect, an increase in k is likely to increase school time at the expense of farm work.

The introduction of labor-saving agricultural technologies (τ) through, for example, irrigation and the adoption of high-yielding variety (HYV) seeds, increases farm productivity so it has a positive income effect on school time. On the other hand, these technologies reduce the marginal product of children, thus decreasing the opportunity cost of school time (Levy, 1985). The latter results in decreased child farm work and increased demand for school time . These technologies may also increase the returns to education in agriculture, thus increasing the demand for school time (Foster and Rosenzweig, 1996). Hence higher τ is expected to increase schooling and reduce child work.

An increase in the education level of either parent (as an argument of h_i) affects the demand for school time through the budget constraint, preferences, and the weighting function. First, the increase in education has a positive income effect both through farm income and wages. Likewise, to the extent that returns to education are higher in the wage labor market than on the farm, the parent would reallocate labor to wage employment away from the farm, hence potentially increasing the marginal farm product of the other spouse and school-age children.[14] Second, through preferences, an increase in the spouse's educa-

[13] The effect of land on the allocation of children's time was first analyzed by Rosenzweig and Evenson (1977).

[14] The estimation of a farm income equation and a land productivity equation revealed significant returns to education in farm production. However, the estimation of gender-specific wage equations corrected for participation in wage employment revealed that education does in fact reduce the likelihood of participation in wage employment of both men and women, and has no significant effect on wages conditional on participation. These results suggest that part of the rationale of parents for investing in children's education is the

tion would increase the demand for school time to the extent that a more educated parent prefers more educated children. Finally, through the weighting function, an increase in the education level of one parent will increase his or her relative bargaining power, which would translate into higher demand for child schooling to the extent that this parent has a higher preference for child schooling than the other parent.[15] Thus, the total effect of an increase in h_i on the demand for school time is a composite of direct effects (mainly through income and preferences) and an indirect effect through λ (i.e. bargaining effect) which cannot be identified separately.

Finally, differences in parental preferences for child schooling can be identified by examining the effect of distribution factors (d), since those factors only affect the demand for school time through λ. For example, it is hypothesized that a shift in the distribution of household resources in favor of the mother increases her relative bargaining power, which will only translate into higher (lower) demand for school time to the extent that the mother has a higher (lower) preference for child schooling than the father.

4 Data Description

The data for the empirical analysis comes from the 1995 survey of 5,062 households in eight villages evenly distributed in the *thanas* of Madhupur and Chandina, and representative of

belief that they will become better farmers, and discard the possibility of a substitution effect of parental education on the demand for school time. These results can be obtained from the author upon request.

[15] Or a lower demand for school time if he or she has a lower preference for child schooling than his or her spouse.

the major rice cropping patterns in Bangladesh across the *amon* (winter), *aus* (summer) and *boro* (early summer) seasons.[16]

This survey was part of an extensive ESCOR project directed by Dr. Martin Greeley.[17] The most distinctive feature of the survey for the present study is the information on the primary, secondary, and residual occupation of all household members, including children. The latter information forms the basis for the analysis of the allocation of children's time.

In Bangladesh, children between the ages of six and fourteen are considered to be of school-age. Using these age cutoffs, the final sample of school-age children is 6,958, of whom 90.57% are sons and daughters of the household head, while the others are offspring of other members of the household (mostly of sons and daughters of the household head in extensive-type of families).

The survey does not contain information on the number of hours spent in each activity, but information on whether the child performs the activity as well as discrete information on the time intensity with which an activity is performed (i.e. whether an activity is the child's primary, secondary or residual occupation). Likewise, the data set does not provide information on domestic activities such as child care, and hence it does not distinguish between domestic work and leisure, which are both treated as "non work and non school" activities.

Based on the available information, a useful first inspection of the data is to group children

[16] As a result this sample is not representative of rural Bangladesh, nor representative of Madhupur and Chandina. For a review of the state of child labor in Bangladesh, see Bangladesh Bureau of Statistics (1996).

[17] Institute of Development Studies, Sussex University, UK.

into 4 mutually-exclusive categories: children attending school as their primary activity, and not reporting any work as secondary occupation: "school only"; children attending school and reporting work: "school and work"; children not attending school and reporting work: "work only"; and children reporting no work or schooling: "residual".

Table 1 shows this categorization. A substantial proportion of children perform some kind of work (75%), mostly own farm work (92.8%), and the majority in combination with school (58.8%).[18]Thus, for the whole sample, full time work shows a remarkable and troublesome prevalence (30.9%). Surprisingly, there are not substantial differences between boys and girls, except for the higher proportion of girls in the "school and work" category.

Table 2 characterizes these groups of children by selected child, parental and household characteristics. The "school only" and "school and work" groups display similar characteristics, except for the higher holdings of crop land of the "school only" group. On the other hand, the "work only" and "residual" groups are similarly more disadvantaged in terms of household socioeconomic characteristics, although those in the residual category are younger on average. The latter may indicate two things. First, these "residual" children may be too young to go to school (77% are 6 or 7 years old). However, we do observe in the sample 6 and 7 years olds attending school (16.3% of all 6-7 year olds). Second, these children belong to very poor households that cannot afford school nor can they afford to have the child without doing any work, yet these children are too young for their work to be of significance for the household and hence worth reporting.

[18] Of those children combining school and work, all but two report school as their primary activity.

The explanatory variables used for the empirical analysis of the time allocation of school-age children are close measures of the covariates in (3.10). The vector of preference shifters (z_i) is represented by education and age of parent i as well as the religion of the household the parent belongs to (i.e. whether the household is Muslim). I use education, age, and health status of parent i to represent his or her human capital level (h_i). As regards the number of school-age children (n_s), I distinguish between boys and girls. Since households may have adults (aged 15 or older) other than the parents, I have also included the number of other adults distinguishing by gender. The measure of non-labor income used is the sum of the total amount received by the household as rents from land operator of share-out land, for mortgage-out or cash-out, and as remittances from permanent migrants.

As regards farm scale (k), not all households in the sample cultivate land, so I distinguish between access to crop land (i.e. whether household cultivates some land), and the actual area cultivated by the household. Agricultural technology (τ) is represented by the extent of irrigation, irrigation technology (i.e. traditional versus non-traditional) and ploughing technology (i.e. power versus animal and manual). The adoption of high-yielding variety crops (HYV), which has been the main source of technical change associated with the green revolution in Bangladesh (particularly rice varieties), has been accompanied by the growth in irrigation practices which HYV are dependent on. Hence in the absence of information about HYV, irrigation serves as good proxy for their adoption.

I use two types of distribution factors. The first one is a measure of the degree of mobility of the mother, an issue of big relevance in Bangladesh where the Muslim practice

of *purdah* secludes women at home. This information is proxied by a dummy variable for whether the mother travelled outside of the village in 1994. The main distribution factor, however, is the amount of credit borrowed from local group-based credit programs in 1994, distinguishing between the father's credit and the mother's credit. The Grameen Bank is the most prevalent of these programs in the villages considered, comprising 27.4% of all program participants.[19] These programs provide small-scale production credit and other services to the poor. Many of these programs specifically target women based on the view that women are more likely to be credit constrained than men, have restricted access to the wage labor market, and have an inequitable share of power in household decision-making. Another important characteristic of these programs is that they provide credit to groups of people not to individuals themselves, and then use peer monitoring as a substitute for collateral. Membership to a group and to an organization adds non-monetary dimensions to these credits that may positively influence a person's power to affect household decisions such as access to kin and other social networks, discipline, self-steem, and self-confidence. Furthermore, many of these programs have explicit empowerment objectives which go beyond economic means to include legal awareness, political participation, and use of contraception (Schuler *et al.* 1997). The validity of mother's credit and father's credit as distribution factors relies on the adequate control for labor and non-labor household income (or rather its determinants in the case of labor income), which I do in my model.

[19] With loan recovery of over 90%, the Grameen Bank has been touted as among the most successful credit programs for the poor, and its model for group lending has been used for delivering credit in over 40 countries.

The empirical model also includes characteristics of the child such as age and gender. In the absence of direct measures of school availability/quality and, in general, relevant community characteristics, this information is summarized by village dummies. Finally, although not present in the theoretical model, I have included a dummy variable for whether the household has experienced a major financial crisis in the last five years. This variable is included for two reasons. First, it captures unanticipated negative changes in income, and hence allows me to better control for income when examining the effect of parental credit. Second, it is also intended to capture the possible role of child labor as an insurance mechanism against economic shocks in the absence of other means of credit and insurance.

Finally, given that there are only 47 households where the mother is not present I restrict the sample to households where both the father and the mother are present (3185 households comprising 6543 school-age children). This also allows me to focus more the analysis on issues of distribution of power within the household. Table 3 lists, defines and gives means and standard deviations of all the variables for the final estimation sample.

5 Empirical Strategy

5.1 A Bivariate Probit Model of the School and Work Choices

Consider the following linear empirical counterpart of the system of time allocation equations in (3.10) corresponding to school and work activities [20]

[20] Suppressing observation subscripts for notational convenience.

$$l_s^* = X'\beta_s + \varepsilon_s \tag{13}$$

$$l_w^* = X'\beta_w + \varepsilon_w \tag{14}$$

where X is the vector of covariates in (4.11), ε_s and ε_w represent unobserved (to the econometrician) variation in l_s^* and l_w^* (mostly preference and technological shifters), and l_s^* and l_w^* are the "optimal" time (e.g. hours) in school and work respectively as generated by the collective household model above, which we do not observe. What we observe, though, is whether the child participates in school and/or work activities

$$l_s = 1 \; if \; l_s^* > 0, \; 0 \; otherwise \tag{15}$$

$$l_w = 1 \; if \; l_w^* > 0, \; 0 \; otherwise \tag{16}$$

Thus children are observed either doing the activity (which corresponds to a positive optimization outcome, i.e. interior solution), or not doing it (corresponding to a negative or zero optimization outcome, i.e. a corner solution because of the non-negativity constraint).[21] To complete the specification of the empirical model, the error terms ε_s and ε_w are assumed

[21] It is likely that parents do not report their children as working if the number of hours worked is low. As long as this threshold level of hours of work (μ_w) is the same for all households, (5.4) would be simply replaced by $l_w = 1$ if $l_w^* > \mu_w$, 0 otherwise, without affecting the results. However, if some parents deliberately misreport (i.e. they do not report the child to be working even when hours worked by the child is above μ_w), the resulting coefficient estimates are inconsistent (see Hausman *et al.* 1998). Despite its potential relevance, this issue will not be further explored in this paper.

to be distributed as

$$\begin{bmatrix} \varepsilon_s \\ \varepsilon_w \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_s^2 & \rho\sigma_s\sigma_w \\ & \sigma_w^2 \end{bmatrix} \right)$$

This is a bivariate probit model of the school and work choices where the error terms of the two processes, ε_s and ε_w, are allowed to be correlated, in the same spirit as the seemingly unrelated regression model (SUR). After imposing the standard normalization restriction for identification (i.e. $\sigma_s = \sigma_w = 1$), this model can be estimated by Full Information Maximum Likelihood (FIML). By allowing l_s^* and l_w^* to be jointly dependent through the error processes we gain precision in our estimates over the estimation of two univariate probits separately (to the extent that ρ is significant), as well as insight into the degree of substitution between school and work.

5.2 Endogeneity of Fertility and Credit

Another important econometric issue in the present context concerns the endogeneity of the number of pre-school children (our measure of the fertility outcome for the 6 year period, n_p), and parental credit from NGOs. There is an extensive literature on how fertility and time allocation decisions are jointly determined. In this case, it is possible that some of the unobserved components in l_s^* and l_w^* (i.e. ε_s and ε_w) may be related to fertility, which would bias the estimated effect of n_p. Likewise, credit program participation and credit amount is endogenous to parental labor supply, which is endogenous to the household problem.

Standard Instrumental Variable (IV) methods do not guarantee consistency in the context of non-linear models like the bivariate probit model.

A method for obtaining a consistent estimator in this context was first developed by Smith and Blundell (1986) for continuously observed endogenous regressors, and subsequently extended to censored regressors by Datt and Ravallion (1994). Let the regressor suspected of endogeneity be z. The method assumes a linear relationship between the errors in the school and work equations and the error of the model generating z (say ν), which then allows, after substitution, to express l_s^* and l_w^* as functions of z and ν. The latter is in turn replaced by the predicted residuals ($\widehat{\nu}$) from the model generating z. This method then provides a consistent estimate of the effect of z, and the significance of the coefficient estimate on $\widehat{\nu}$ provides an exogeneity test.

This method requires, just as the standard IV method does, at least one instrument to identify the effect of z. For parental credit, a potential instrument is village participation in any credit program. However this variable is collinear to the village dummies included in the bivariate probit model. Consequently, I use instead a measure of the past credit history of the parent -the number of loans taken prior to 1994- as an instrument in the appropriate parental credit equation.[22] I also use variables that determine program eligibility such as the number of cattle and ponds owned by the household, but identification does not rely on those.[23] Given the censored nature of credit and the difference between credit program

[22] The very few cases where this variables had positive values for both spouses precluded the inclusion of number of past loans of one spouse on the credit equation for the other spouse.

[23] These variables can potentially affect the time allocation outcome as well. However, those turned out to be highly insignificant in the time allocation model and thus were exluded from the final specification of the bivariate probit model.

participation and credit demand decisions, the credit equations are estimated using the FIML Heckman procedure.[24]

In the case of the fertility outcome, however, I lack valid identifying instrument, so the above method cannot be applied. The (second-best) strategy followed here is that of using the residuals from an estimated fertility equation as noisy estimate of the stochastic component of the fertility outcome.[25] These residuals are correlated with realized fertility (i.e. n_p), but not with the time allocation choices net of X.[26] These residuals can thus be used to instrument n_p in the bivariate probit model. The fertility outcome is estimated using both OLS and Poisson.[27]

6 Results

6.1 General results of the Bivariate Probit Model of the School and Work Choices

The results of the bivariate probit model, reported in Table 4, are generally consistent with the predictions of the collective model, although those corresponding to the work equation are less clear.[28] The estimated correlation between the errors in the school and work equations is negative and statistically significant, indicating that school time and work time are generally

[24] The results of the credit equations are reported in the Appendix.
[25] See Foster and Roy (1995) for a similar approach.
[26] Even if these residuals are still correlated with ε_s and ε_w, there is more exogenous variation in these residuals than in n_p.
[27] The results of the equation for the fertility outcome are reported in the Appendix.
[28] All models in the results section include village dummies, but those are not reported in the tables.

substitutes.[29]

The effect of the age of the child on schooling has the standard concave shape, a pattern that is surprisingly repeated, to a lesser extent, in the work equation.[30] Being a school-age girl increases the chances of both attending school and working relative to being a boy, although the effect on work doubles (statistically) the effect on schooling, suggesting that girls are more likely to combine school and work than boys.[31]

Exogenous increases in the number of pre-school children have a strong negative effect on schooling, and an even stronger positive effect on work participation.[32] This result may suggest that additional pre-school children raise the cost of raising children, and increase the need to use child labor to complement household income, work that is easily combined with the increased demand for child care time.

The presence of other school-age children in the household has a negative impact on a child's school attendance but no effect on work participation, with no statistically significant difference by gender of the child. The net economic contribution of children is likely to be positive, especially that of boys, so the negative effect on schooling mainly reflects the increased shadow price of school time arising from increased competition for schooling

[29] In particular, unobserved child, parental and household characteristics that increase time allocated to one activity tend to reduce the time allocated to the other.

[30] This may be due to the influence of the residual group of children, who are on average younger than the other groups of children.

[31] Interestingly enough, the estimated fertility equation shows that a couple with school-age girls is more likely to want additional children, which may suggest that girls are viewed by parents as less efficient mechanism for transferring resources across time than boys. These additional pre-school children in turn significantly reduce schooling and increase child work.

[32] These are the predicted residuals from the OLS fertility model. The results are basically the same when using the residuals from the Poisson fertility model.

resources.[33] Although this paper does not explicitly attempt to identify gender differences, the results of estimating the time allocation model for boys and girls separately shows that intra-sibling competition only occurs within sexes.

Only the presence of adult males increases school attendance and decreases work participation of children. This result may suggest that additional males not only bring additional income but also reduce the marginal product of children, and the need for child labor. The gender difference is consistent with the higher economic contribution of male adults.

If the child belongs to a household that cultivates some land, his or her chances of attending school are lower, whereas his or her chances or working are higher, a result that is consistent with the theoretical prediction that the marginal product of children in households operating land is higher than that in households with no crop land. Controlling for crop land availability, the area of operated land has a strong positive effect on child schooling, but no effect on child work. The latter mainly reflects the strong income effect of land in rural Bangladesh, where land is the main determinant of household well-being (Ridao-Cano, 1999).

As regards agricultural technology, the fact that some crop land is irrigated increases school attendance and reduces work participation of children, which is consistent with positive income and substitution (through reduced marginal product) effects on the demand for school time.[34]

[33] The estimation of a farm income equation revealed that the economic contribution of school-age children, particularly boys, is far from negligable. These results can be obtained from the author upon request.

[34] Other measures of agricultural technology that positively affect farm output and productivity, such as the percentage of irrigated land, irrigation technology, and ploughing technology, had a highly insignificant effect on the time allocation of children, and were thus exluded from the final specification.

Non-labor income increases child schooling but has no effect on child work participation. On the other hand, children belonging to households that have been hit by some economic shock in the past experience lower school attendance, which supports the view that in the absence of well-functioning capital markets, households adjusts to unexpected shocks by withdrawing their children from school. This effect is likely to be higher in the case of poor households because of their limited access to credit, but also in households whose income is too concentrated on agricultural activities since those activities are more prone to negative economic shocks such as floods or droughts.

Both the education of the father and the mother increase child schooling, although the effect of mother's schooling is statistically higher than that of father's schooling. On the other hand, only the education of the mother significantly reduces child work. Having discarded the possible substitution effect of parental education on the demand for school time, parental education can potentially influence child schooling directly, through income and preferences, and indirectly through the relative bargaining power of the mother. Even assuming equal effects on farm income, the differences in the effect of parental education on the time allocation of children may suggest that mothers have a higher preference for child schooling than fathers. This prediction holds even if education does not affect the distribution of power within the household, in which case the interpretation of the above result would be that educated mothers have a higher preference for child schooling than equally educated fathers. The effect of maternal education gets however reinforced if her education does affect her relative bargaining power.

The age of the mother has a positive impact on child schooling, whereas that of the father has the opposite effect. Neither parent's age affects work participation. Parental age has the same potential effects as parental education. In this case, however, the substitution effect on school time may be important in the case of mother's age, since the likelihood of participating in the wage labor market increases with her age, as well as her wage conditional on participation.[35] On the other hand, parental age has a positive effect on farm income. Even assuming equal effect on farm income, and accounting for the negative effect of father's age on wages, the remarkable difference in the effect of parental age may suggest again that mothers have a higher preference for child schooling than fathers.

Having a healthy mother or father reduces in turn the likelihood of child work, but has no effect on school attendance. On the other hand, children from Muslim households (most households) are less likely to attend school and more likely to work than children from households professing other religions.

This difference in parental preferences for child schooling is further confirmed by the significance of the distribution factors included in the model. Mother's mobility increases child schooling, but has no effect on child work. The coefficient estimate on predicted residuals from the model for female NGO credit is significantly different from zero in the school equation, indicating that the hypothesis of exogeneity of female credit is rejected. Mother's credit has a positive effect on child schooling, but no effect on child work. On the other hand, in the case of father's credit, the hypothesis of exogeneity cannot be rejected,

[35] The wage equation for mothers, however, is not estimated very precisely.

and father's credit has no significant effect on the time allocation of children.[36]

6.2 Tests of the Collective Model

Panel A in Table 5 shows that the three distribution factors are jointly significant in the school equation, but not in the work equation. However, mobility, mother's credit and father's credit are jointly significant when considering the two equations together. These results reject the unitary representation of preferences.

Having rejected the unitary model we can then test whether the Pareto efficiency assumption of the collective model holds, which amounts to testing whether the ratio of the coefficients on any pair of distribution factor is constant across equations. As a practical matter, however, a value of a ratio approaches infinity as the parameter estimate in the denominator goes to zero, and so tests based on ratios tend to lack power (Thomas *et al.*, 1999). Thus I have transformed the test as $\beta_{d_1,s} * \beta_{d_2,w} - \beta_{d_2,s} * \beta_{d_1,w} = 0$ for any two distribution factors d_1 and d_2. Panel B in Table 5 shows that for all pairs the Pareto efficiency assumption cannot be rejected, which gives support to the collective representation of preferences. These results, however, must be interpreted with caution in view of the imprecision of some of the parameter estimates.[37]

[36] This result, however, has to be interpreted with caution since only 121 fathers out of 3185 participate in these credit programs.

[37] However, it is worth noting that the above results are not mere statistical coincidences. For the purpose of proving the collective model further in this context, I also estimated a seemingly unrelated reduced-form model of the fertility outcome and human capital of children, as measured by years of schooling completed. The results (available upon request) show a strong substitution between child schooling and fertility, higher maternal preference for child schooling, as well as a preference of mothers for smaller families, and a preference of fathers for bigger families. Finally, for all pairs of distribution factors the Pareto efficiency assumption cannot be rejected.

6.3 Work and School Intensities

To gain further insight into the process generating the allocation of children's time, this section makes use of the discrete information on the time intensity with which school and work activities are performed, that is, whether work/school is the primary or secondary activity of the child.

Using this information, I estimated a bivariate probit for work intensity (i.e. work being the primary activity versus work being the secondary activity) with selection into work. Since, as mentioned earlier, all children but two in the "school and work" group report school as the primary activity, this model basically looks at differences between the "work only" and "school and work" groups. The coefficient estimates, presented in Table 6, are more in accordance with our theoretical predictions and are very similar, with the sign reversed, to those of the school equation in the bivariate probit model of the school and work choices. Thus, for example, mother's credit increases the likelihood of school attendance and reduces the likelihood of full time work. This indicates that the "work only" and "school and work" groups are very different, and that it is really full time work that directly conflicts with schooling, in the sense of precluding school attendance.[38]

Using the same information, I also estimated a bivariate probit for school intensity (i.e. "school only" versus "school and work") with selection into school attendance. In this case, I do not make use of the discrete time intensity information, since all children but two in the "school and work" group report school as the primary activity. Thus the idea

[38] For this very reason, this type of child labor is what Blunch and Verner (2000) call harmful child labor.

here is that those children who only attend school may devote more time to school-related activities (particularly study time) than those children combining school and work. The results, reported in Table 7, show that only a few variables are significant in distinguishing these two groups of children, and are more in line with those of the work equation in the bivariate probit of the school and work choices (with the signs reversed). Although only full time work precludes school attendance, some work while in school may have a negative impact on human capital accumulation.[39]

The results of the above two models, along with the similarity between the "work only" and residual groups,[40] indicate that the weaker results of the work equation in the bivariate probit of the school and work choices are explained by the lack of substantial differences between the "school only" and "school and work" groups, and between the "residual" and "work only" groups. More importantly, these results also indicate that the model works particularly well in characterizing school attendance and full time work. In particular, distribution factors such as female credit play a key role in explaining school attendance and full time work.

[39] In the absence of longitudinal or retrospective information I cannot address this issue directly. However, preliminary results (available upon request) based on a simple human capital model that controls for the endogeneity of school intensity, suggest that children combining school and work have on average fewer years of education than those only attending school.

[40] A probit of 'work only' versus the residual category (available upon request) showed very little difference between these two groups.

7 Conclusion

In this paper I have attempted to shed some further light on the determinants of child labor and schooling in a low income rural economy, focusing on the role of the intrahousehold distribution of power. To this end, a collective household model of the time allocation of school-age farm children is developed and empirically tested using data from rural Bangladesh. The theoretical model yields a system of demand equations for the allocation of children's time to farm work and school, which is then used to construct a bivariate probit model for the work and school participation choices. Finally, an attempt is made to further characterize children by the time intensity with which work and school activities are performed.

The results show that the model works particularly well in characterizing school attendance and full time work. Among the novel results is the rejection of the unitary representation of preferences, and the validation of the Pareto efficiency assumption imposed by the collective model. More precisely, it appears that mothers have a higher preference for child schooling than fathers. This difference is identified by changes in factors that affect the time allocation of children only through the relative bargaining power of mothers, such as credit from group-based credit programs. This difference is further revealed by comparing the effect of other parental attributes that affect time allocation both directly and indirectly such as education and age. Thus, the results suggest that mothers use their increased power within the household to allocate more resources to child schooling.

As mentioned earlier, one of the advantages of the collective model over the unitary model is that, provided it holds, it opens up a new set of policy instruments that can be

used to reduce the incidence of child labor (particularly full time work) and increase child schooling, namely policies targeted at specific individuals within the household.

The results in this paper suggest that efforts to promote credit programs targeted to the poor, particularly women, should continue. In particular, Table 8 shows that a 10% increase in female credit increases the probability of a child going to school by 11% (conditional on working) and 10% (conditional on not working), whereas it decreases the probability of full-time work by 10%.[41]

These credit programs are important since they provide access to credit to the poor who otherwise would resort to child labor as an insurance mechanism against economic shocks.[42] Furthermore, by targeting women more heavily, child schooling would improve both directly (since mothers have a higher preference for child schooling than fathers) and indirectly through lower fertility (since mothers prefer smaller families than fathers).[43] Finally, these programs have an explicit training and educational component that should be promoted in addition to specific education programs for adults, especially for women, in the light of the strong effect of parental education (particularly women's education) on the time allocation of children.[44]

The results also suggest that, given the strong effect of the number of pre-school chil-

[41] At the means of the data, a 10% increase in female credit corresponds to 79 Taka. See Table 8 for selected marginal effects of other policy-related variables.

[42] The promotion of these programs should be accompanied by efforts to promote the development of formal credit and insurance markets.

[43] For the effect maternal credit on child nutritional status in Bangladesh see Pitt *et al.* (1998). For its role on the fertility transition in Bangladesh see Schuler *et al.* (1997).

[44] Behrman *et al.* (1999) show that there are also important returns to maternal education in the production of child schooling through home teaching.

dren on the time allocation of children, the family planning programs already in place in some parts of Bangladesh should be extended and strengthened.[45] On the other hand, the government should continue to promote technological change in agriculture, since these new technologies appear to increase child schooling by reducing the marginal product of children and increasing the returns to schooling in agriculture.[46] Likewise, agricultural modernization should be accompanied by additional efforts to develop a non-agricultural rural sector and improved access of women to this sector.

Finally, the results make clear that measures like banning child labor or imposing compulsory schooling are likely to have a counterproductive effect on child schooling through reduced household welfare and thus child well-being. More promising policies are those that specifically affect parental incentives to send their children to school such as better and closer-to-home schools, higher returns to education in agriculture and elsewhere, as well as policies that reduce the shadow price of schooling such as the ongoing Food-for-Education program or the already mentioned adoption of labor-saving agricultural technologies.[47]

[45] Foster and Roy (1997) find a strong positive effect of these programs on child schooling through reduced fertility.

[46] See Foster and Rosenzweig (1996).

[47] Ravallion and Wodon (1999) examine the effect of the Food-for-Education program on child labor and schooling in Bangladesh.

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Table 1. Categories of Child Activities

	All		Girls		Boys	
	Count	Percent	Count	Percent	Count	Percent
Residual	734	10.55	319	9.51	415	11.52
Work only	2149	30.89	1010	30.10	1139	31.62
School and work	3062	44.01	1582	47.14	1480	41.09
School only	1013	14.56	445	13.26	568	15.77
Total	6958	100	3356	100	3602	100

Table 2. Characteristics of Children by Activity (Means and Standard Deviations)

	School only	School & work	Work only	Residual
Child's age	8.91 (2.18)	10.42 (2.22)	10.18 (2.56)	6.99 (1.35)
Child's years of schooling	2.17 (1.56)	2.96 (1.89)	0.49 (1.30)	0.15 (0.51)
Household income p.c., in 100 Taka	60.63 (58.59)	61.44 (106.33)	39.89 (49.97)	40.69 (34.75)
Size of crop land, in 10 decimals	23.03 (31.98)	19.08 (24.57)	10.76 (19.11)	11.36 (16.98)
Father's years of schooling	3.54 (4.31)	3.34 (4.20)	1.03 (2.48)	1.45 (3.01)
Mother's years of schooling	1.90 (2.76)	1.65 (2.65)	0.38 (1.38)	0.60 (1.72)
Number of 0-5 aged children	0.92 (0.97)	0.98 (0.91)	1.00 (0.91)	0.97 (0.84)
Number of 6-14 aged children	2.46 (1.10)	2.52 (1.07)	2.50 (1.04)	2.47 (1.11)

Table 3. Definition, mean and standard deviation of variables

	Definition	Mean	STD
Age	Age of the child	9.72	2.49
Sex	1 if the child is a girl, 0 otherwise	0.48	0.50
Edum	Mother's years of schooling	1.22	2.38
Agem	Mother's age	36.06	8.31
Healthm	1 if mother in good health, 0 otherwise	0.86	0.35
Eduf	Mother's years of schooling	2.59	3.88
Agef	Father's age	44.52	9.89
Healthf	1 if father in good health, 0 otherwise	0.82	0.38
Mobility	1 if mother travelled outside village in '94, 0 otherwise	0.76	0.43
Creditm	Log(1+mother's credit, in Taka)	1.28	3.00
Loanm	Number of loans taken by mother prior to 1994	0.45	1.86
Creditf	Log(1+father's credit, in Taka)	0.30	1.57
Loanf	Number of loans taken by father prior to 1994	0.25	1.95
Land	1 if househol operates land, 0 otherwise	0.76	0.43
Cropland	Log(1+size of crop land, in decimals)	3.74	2.29
Irrigation	1 if household irrigates crop land, 0 otherwise	0.58	0.49
NLI	Log(1+non labor income, in Taka)	3.00	4.28
Shock	1 if household experienced major crisis, 0 otherwise	0.27	0.44
Children05	Number of 0-5 aged children	1.01	0.91
Girls614	Number of 6-14 aged girls	0.75	0.81
Boys614	Number of 6-14 aged boys	0.79	0.85
Males	Number of male adults	0.80	1.11
Females	Number of female adults	0.58	0.85
Muslim	1 if Muslim household, 0 otherwise	0.91	0.29
Kangai	1 if household resides in Kangai, 0 otherwise (reference)	0.25	0.43
Keshora	1 if household resides in Keshora, 0 otherwise	0.11	0.32
Hossainpur	1 if household resides in Hossainpur, 0 otherwise	0.10	0.30
Darora	1 if household resides in Darora, 0 otherwise	0.10	0.30
Jatabari	1 if household resides in Jatabari, 0 otherwise	0.14	0.35
Biprabari	1 if household resides in Biprabari, 0 otherwise	0.01	0.12
Teki	1 if household resides in Teki, 0 otherwise	0.08	0.27
Pirojpur	1 if household resides in Pirojpur, 0 otherwise	0.20	0.40

Table 4. Bivariate probit of the school and work choices (N=6543)

	School equation		Work equation	
Variable	Coefficient	t-ratio	Coefficient	t-ratio
Intercept	-5.672	-17.55	-4.441	-12.72
Age	1.194	19.27	0.902	13.11
Age^2	-0.056	-18.25	-0.032	-9.24
Sex	0.099	2.89	0.183	4.76
Edum	0.093	8.48	-0.026	-2.60
Agem	0.013	2.94	-0.004	-0.90
Healthm	-0.032	-0.60	-0.163	-2.68
Eduf	0.060	9.60	-0.007	-1.11
Agef	-0.017	-4.73	-0.0002	-0.07
Healthf	0.005	0.10	-0.237	-4.10
Mobility	0.115	2.87	-0.062	-1.34
Creditm	0.028	2.52	0.009	0.75
Rcreditm	-0.041	-2.71	0.007	0.44
Creditf	-0.022	-1.26	0.008	0.39
Rcreditf	0.029	1.28	-0.004	-0.15
Rchildren05	-0.071	-3.35	0.126	5.05
Girls614	-0.069	-3.16	0.023	0.94
Boys614	-0.085	-4.04	0.013	0.56
Males	0.036	1.71	-0.046	-2.10
Females	-0.013	-0.54	-0.007	-0.25
Land	-0.492	-4.54	0.246	2.00
Cropland	0.183	8.24	-0.024	-0.97
Irrigation	0.110	2.17	-0.194	-3.41
NLI	0.030	6.70	0.0002	0.03
Shock	-0.177	-4.62	-0.039	-0.90
Muslim	-0.260	-3.60	0.545	7.66
ρ	-0.230	$\chi^2(1) = 75.2$ (0.000)		
Log-L	-6372.7	$\chi^2(64) = 2551.5$ (0.000)		

T-ratios are based on robust standard errors. Rcreditm and Rcreditf are the predicted residuals from the Heckman model for mother's and father's credit respectively [e.g. Rcreditm = creditm-E(creditm), where E(creditm) = P(creditm>0)*E(creditm | creditm>0)]. Rchildren05 are the predicted residuals from the OLS fertility model. $\chi^2(1)$ is the value of the Wald test statistic for $\rho = 0$.

Table 5. Tests of unitary preferences and Pareto efficiency

Panel A. Tests of unitary preferences	
School equation	$\chi^2(3) = 17.54$ (0.000)
Work equation	$\chi^2(3) = 2.44$ (0.486)
Full model	$\chi^2(6) = 19.82$ (0.003)
Panel B. Tests of Pareto efficiency	
(Creditm, Mobility)	$\chi^2(1) = 1.89$ (0.169)
(Creditf, Mobility)	$\chi^2(1) = 0.02$ (0.881)
(Creditf, Creditm)	$\chi^2(1) = 0.36$ (0.549)

Significance levels in parenthesis. Tests of unitary preferences are Wald test of joint significance. Tests of Pareto efficiency are non-linear Wald tests of equality of the ratio of effects of each pair of distributional factors across the school and work equations.

Table 6. Bivariate probit for work intensity with selection into work (N=6543)

	Work intensity		Work participation	
Variable	Coefficient	t-ratio	Coefficient	t-ratio
Intercept	4.194	5.99	-4.433	-12.60
Age	-0.934	-7.97	0.902	13.00
Age^2	0.045	8.58	-0.032	-9.17
Sex	-0.151	-3.66	0.185	4.83
Edum	-0.091	-6.78	-0.026	-2.58
Agem	-0.015	-2.86	-0.004	-0.89
Healthm	0.055	0.92	-0.164	-2.69
Eduf	-0.068	-9.15	-0.006	-1.05
Agef	0.022	5.10	-0.0006	-0.15
Healthf	0.045	0.80	-0.236	-4.05
Mobility	-0.122	-2.67	-0.060	-1.30
Creditm	-0.026	-2.04	0.009	0.77
Rcreditm	0.040	2.34	0.006	0.37
Creditf	0.027	1.46	0.008	0.38
Rcreditf	-0.028	-1.09	-0.004	-0.14
Rchildren05	0.090	3.55	0.124	4.98
Girls614	0.032	1.27	0.026	1.05
Boys614	0.079	3.26	0.015	0.65
Males	-0.037	-1.48	-0.046	-2.07
Females	0.006	0.22	-0.006	-0.24
Land	0.503	3.96	0.241	1.95
Cropland	-0.183	-7.00	-0.023	-0.95
Irrigation	-0.143	-2.39	-0.191	-3.33
NLI	-0.032	-6.06	0.0003	0.06
Shock	0.153	3.45	-0.037	-0.85
Muslim	0.302	3.39	0.543	7.57
ρ	0.082	$\chi^2(1) = 0.19$ (0.660)		
Log-likelihood	-5513.6	$\chi^2(32) = 720.6$ (0.000)		

The estimated correlation between the work intensity probit and the work participation probit, ρ, is not significant, indicating that there is no selection bias.

Table 7. Bivariate probit for school intensity with selection into school (N=6543)

	School intensity		School attendance	
Variable	Coefficient	t-ratio	Coefficient	t-ratio
Intercept	3.264	4.37	-5.679	-17.49
Age	-0.705	-5.34	1.196	19.23
Age^2	0.025	3.87	-0.056	-18.22
Sex	-0.241	-4.91	0.101	2.94
Edum	0.025	2.11	0.093	8.40
Agem	0.002	0.28	0.013	2.82
Healthm	0.190	2.48	-0.033	-0.62
Eduf	-0.004	-0.43	0.060	9.56
Agef	0.005	0.96	-0.017	-4.58
Healthf	0.347	4.46	0.003	0.07
Mobility	0.030	0.48	0.113	2.82
Creditm	-0.018	-1.17	0.030	2.62
Rcreditm	-0.001	-0.10	-0.042	-2.77
Creditf	0.018	0.68	-0.022	-1.30
Rcreditf	-0.005	-0.16	0.030	1.34
Rchildren05	-0.079	-2.58	-0.072	-3.45
Girls614	-0.058	-1.82	-0.070	-3.17
Boys614	0.013	0.43	-0.087	-4.09
Males	0.051	1.92	0.035	1.70
Females	0.021	0.67	-0.013	-0.52
Land	-0.215	-1.31	-0.488	-4.49
Cropland	0.005	0.16	0.181	8.17
Irrigation	0.105	1.44	0.112	2.22
NLI	-0.006	-0.90	0.030	6.70
Shock	0.036	0.60	-0.178	-4.63
Muslim	-0.438	-5.40	-0.266	-3.65
ρ	-0.029	$\chi^2(1) = 0.04$ (0.848)		
Log-likelihood	-5369.3	$\chi^2(32) = 654.8$ (0.000)		

The estimated correlation between the work intensity probit and the work participation probit, ρ, is not significant, indicating that there is no selection bias.

Table 8. Selected marginal effects of some policy-related variables

A. School and work choices		
	$P[y_s \mid y_w = 1]$	$P[y_s \mid y_w = 0]$
Edum	3.6 (8.93)	2.9 (8.39)
Creditm	1.1 (2.59)	1.0 (2.62)
Rchildren05	-2.3 (-2.76)	-1.6 (-2.18)
Irrigation	3.6 (1.78)	5.9 (1.41)
	B. Work intensity	C. School intensity
	$P[y_{wi} \mid y_w = 1]$	$P[y_{si} \mid y_s = 1]$
Edum	-3.4 (-7.54)	0.8 (2.06)
Creditm	-1.0 (-2.07)	-0.5 (-0.98)
Rchildren05	3.3 (3.49)	-2.3 (-2.75)
Irrigation	-5.3 (-2.29)	3.3 (1.41)

Marginal effects are evaluated at the means of the variables, and represent percentage changes in the relevant probability resulting from a unit increase in the relevant variable (1% increase in the case of credit). The number in parenthesis are t-ratios. $\mathrm{P}[\mathrm{y}_{si} \mid \mathrm{y}_s = 1]$ and $\mathrm{P}[\mathrm{y}_{wi} \mid \mathrm{y}_w = 1]$ are the the probability of attending school with no work conditional on going to school, and the probability of working full-time condtional on working, respectively, which are equal to their unconditional counterparts due to the absence of selection bias. The effect of irrigation is obtained by comparing the relevant probability when there is irrigation with that with no irrigation, with the other variables held at their sample means. The effects of irrigation on $\mathrm{P}[\mathrm{y}_w \mid \mathrm{y}_s = 1]$ and $\mathrm{P}[\mathrm{y}_w \mid \mathrm{y}_s = 0]$ are -0.055 (-3.02) and -0.069 (-2.93) respectively.

APPENDIX

Table A.1. Parental log-credit equations corrected for participation

	Mother				Father			
	Credit		Participation		Credit		Participation	
Variable	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio
Intercept	8.781	38.31	-2.933	-5.37	10.278	14.83	-2.933	-5.37
Edum	0.042	2.44	0.004	0.18	-0.006	-0.24	0.033	1.24
Agem	0.005	0.93	0.068	2.36	-0.016	-1.20	0.006	0.48
$Agem^2$			-0.001	-2.66				
Healthm	0.180	1.67	-0.146	-1.32	-0.0005	-0.003	0.204	0.91
Eduf	0.020	2.26	-0.024	-1.89	0.005	0.26	-0.014	-0.74
Agef	-0.010	-2.05	0.002	0.28	-0.006	-0.53	-0.019	-1.91
Healthf	-0.175	-2.02	0.075	0.67	0.269	0.93	0.120	0.45
Mobility	-0.021	-0.38	0.143	1.62	-0.170	-1.53	-0.103	-0.83
Girls614	0.055	1.79	0.005	0.11	0.062	0.87	0.049	0.69
Boys614	0.073	2.14	0.008	0.17	0.069	0.94	0.086	1.28
Males	0.018	0.45	-0.034	-0.71	0.223	2.84	-0.017	-0.24
Females	-0.013	-0.28	0.079	1.25	-0.085	-0.78	0.035	0.43
Land	-0.591	-4.01	0.832	4.31	-0.585	-1.57	0.354	1.07
Cropland	0.151	4.27	-0.170	-4.18	0.174	2.87	0.006	0.09
Irrigation	-0.006	-0.06	0.042	0.40	0.020	0.11	0.267	1.34
Cattle			-0.096	-3.23			-0.099	-2.13
Pond			-0.149	-1.96			-0.247	-1.82
NLI	0.010	0.92	-0.046	-4.18	-0.014	-0.83	0.013	0.84
Shock	-0.018	-0.33	0.053	0.67	-0.053	-0.52	0.203	1.52
Muslim	-0.167	-0.89	-0.404	-2.77	-0.206	-0.57	-0.227	-0.55
Loanm	0.061	6.41	0.692	5.47				
Loamf					0.007	0.74	0.431	4.78
Log-L	-1149.6				-339.4			
$\chi^2(23)$	250.74	(0.000)			334.82	(0.000)		

The number of credit participants is 514 mothers and 121 fathers. The estimated correlation between the credit and the participation equation is -0.652 [$\chi^2(1) = 41.52$ (0.000)] for mothers and -0.675 [$\chi^2(1) = 18.32$ (0.000] for fathers. The number of cattle and ponds and $agem^2$ were highly insignificant in explaining the amount of credit, so they were excluded from the credit equation. Both equations include village dummies to account for village participation in credit programs and possible differences among participants.

Table A.2. Equation for the fertility outcome (N=3185)

	OLS		Poisson	
Variable	Coefficient	t-ratio	Coefficient	t-ratio
Intercept	2.605	10.71	1.107	3.64
Edum	-0.035	-4.73	-0.039	-4.86
Agem	-0.053	-3.97	-0.023	-5.23
$Agem^2$	0.0004	2.38		
Healthm	-0.001	-0.03	-0.032	-0.69
Eduf	-0.012	-2.52	-0.011	-2.22
Agef	-0.011	-3.46	-0.012	-3.49
Healthf	0.031	0.73	0.021	0.49
Mobility	-0.099	-2.97	-0.092	-2.87
Girls614	0.079	4.18	0.071	4.07
Boys614	-0.010	-0.50	-0.016	-0.80
Males	0.034	1.85	0.016	0.93
Females	0.199	8.61	0.173	7.97
Land	-0.012	-0.13	0.003	0.04
Cropland	0.012	0.73	0.010	0.61
Irrigation	-0.002	-0.06	-0.003	-0.09
NLI	-0.003	-0.93	-0.004	-1.06
Shock	-0.005	-0.14	0.001	0.03
Muslim	0.433	8.08	0.426	6.75
R^2	0.22		Log–L = 3715.8	
			$\chi^2(32) = 654.8$ (0.000)	