The Dynamics of School and Work in Rural Bangladesh[1]

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Abstract

This paper investigates the effect of work on the school progress of rural Bangladeshi children. We specify a dynamic switching model for the sequence of school and work outcomes up to the end of secondary school, where the switching in each school level is determined by the endogenous work history of the child up to that level. This approach allows us to evaluate the dynamic effects of work on school progress. We find that work has a negative and sizable effect on school progress and are able to measure this effect for different groups of children. Our results highlight the relevance of policies aimed at increasing school progress through reductions in child work and the importance of accopanying these policies by efforts to improve the adverse environment that working children face. We evaluate the dynamic effects of three policies: compulsory primary schooling, compulsory school entry at age six and universal access to secondary school. We find that these policies have a sizable effect on school progress and child labor.

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1 Introduction

Although labor force participation rates for school-age children (i.e. aged 5-14) in developing countries have been declining over time, recent International Labor Organization estimates (1996) show that child labor continues to be a very pervasive problem that is generally associated with low levels of educational attainment.

Bangladesh is a typical example of this pattern, particularly in rural areas. Recent estimates (Filmer, 1999) indicate that among children aged 15-19, 27.5 percent have never attended school. Among those who attended school, 36 percent started school later than 6 years of age (the official school entry age), 69.2 percent had reached secondary school, and less than 20 percent had completed secondary school. Furthermore, estimates based on the Child Labor Survey 1995-96 (Bangladesh Bureau of Statistics, 1996) indicate that 19 percent of children aged 5-14 are in the labor force, and child labor constitutes about 12 percent of the total labor force of Bangladesh.

This paper investigates the effect of work on the school progress of rural Bangladeshi children. We specify a dynamic switching model for the sequence of school and work outcomes for rural Bangladesh children up to the end of secondary school, where the switching in each school level is determined by the endogenous work history of the child up to that level. We extend the existing literature in a number of ways. First, to our knowledge this is the first paper in the context of a developing country to analyze the joint dynamics of school and work. Second, the dynamic structure of our model allows us to extend some of the static concepts from the program evaluation literature to a dynamic context. We find that work has a negative and sizable effect on school progress for the different groups of children considered. Furthermore, the effect of work becomes more negative the earlier in life an individual starts working. The magnitude of the effects of work on school progress makes policies aimed at increasing school progress through reductions in child work most relevant. The effectiveness of these policies would be greatly increased if they were accompanied by efforts to improve the adverse environment that working children face. Finally, we also evaluate the dynamic effects of three relevant policies: compulsory primary schooling, compulsory school entry at age 6 and universal access to secondary school. We find that these policies have a sizable effect in school progress.

The literature on child labor and schooling in developing countries has been rapidly expanding in recent years.[3] Most of the studies looking at child schooling focus on static measures (e.g. school enrollment in a particular year) with only a few papers looking at the dynamics of schooling (Lillard and Willis, 1994; Sawada and Lokshin, 2001). To our knowledge, all of the studies looking at child labor focus on static measures, such as work participation or hours of work in a particular year, or, at most, monthly variations within a year in these measures.

A number of studies analyze the school and work decisions simultaneously. Most of these studies consider the determinants of child labor and schooling, and then investigate the degree of substitution among them based on the correlation between observables and/or unobservables in the work and school equations.[4] Some studies examine the impact of work

[3] See Basu (1999) and Cigno et al. (2002) for surveys of the literature.

[4] See, for example, Canagarajh and Coulumbe (1997), Grootaert (1998), Skoufias (1994), Duryea and

on schooling indirectly, by considering the response of work and schooling to exogenous changes in the price of schooling as a result of school incentive programs.[5] Finally, a few papers have provided direct estimates of the effect of work on education "outputs" such as cognitive achievement (Heady, 2000) and education "inputs" such as school attendance and hours of study (Akabayashi and Psacharopoulos, 1999), years of schooling and grade progression (Psacharopoulos, 1997).

Some of the studies cited above do not account for the selection into work process. Furthermore, the studies that account for the endogeneity of work do so in an econometric framework that allows them to recover the average effect of work only.[6] From a policy perspective, it is also important to identify these children who are most affected by work so that informed policies can be developed.

The rest of the paper is organized as follows. Section 2 describes the data used in this study. Section 3 presents the dynamic model of school and work. Section 4 develops the framework for evaluating the dynamic effects of work on school progress. Section 5 presents the general results of the model, analyzes the dynamic effects of work and discusses the effects of a variety policies. Section 6 concludes and suggests some policy implications.

Arends-Kuenning (2003), and Ridao-Cano (2001).

[5] Examples are the Food-for-Education scheme in rural Bangladesh (Ravallion and Wodon, 2000) and Progresa in rural Mexico (Schultz, 2001).

[6] This is also true for the growing number of studies examining the effect of working while in high school on a variety of school outcomes in the U.S. See, for example, Eckstein and Wolpin (1999).

2 Data Description

The data for the analysis come from the 1996 Matlab Health and Socio-Economic Survey (MHSS), which covered 141 villages of Matlab, a region of rural Bangladesh. The MHSS collected extensive current and retrospective information on multiple domains from approximately 38,000 individuals in a sample of over 7000 households, and conducted a detailed community survey.[7]

The present analysis focuses on the school and work experiences, up to the end of secondary school, of individuals who were aged 15-25 at the time of the survey.[8] The sample used for the empirical analysis contains 2489 individuals, 113/684 of which were still in primary/secondary school at the time of the survey.

We choose to focus on the sequence of school and work outcomes up to the end of secondary school for two main reasons. First, we are mainly interested in the school and work experiences of children. To this extent, a child starting school at the official age of 6 will, in the absence of school delay, complete secondary school by age 15, the beginning of adulthood in Bangladesh. Second, we are mainly interested in the effect of work on the acquisition of basic skills needed in the labor market and in life, skills that are provided by basic education which is, in turn, delivered by primary and secondary education.[9]

The MHSS contains detailed information on education histories including the school entry

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[7] The data and documentation can be found at http://ftp.rand.org/software_and_data/FLS/mhss/.

[8] The lower age limit is set at 15 to guarantee that the information on the child is self-reported and to minimize school censoring. The upper age limit is set at 25 to minimize recollection errors and to maximize parental and household information.

[9] In addition, the number of individuals in the sample pursuing higher education is very small.

age, school exit age, grades attended and completed, and grade repetition. We concentrate our analysis of school outcomes in three "school" levels:

- **School entry:** the school outcome indicates whether a child enters school at each age, starting with age 5 (the first reported entry age) and continuing until age 14, beyond which the child is no longer of primary-school age and thus he or she is assumed to be no longer at risk of entering school.[10]

- **Primary school:** the school outcome indicates whether a child reached secondary school in each possible time interval, starting from 5 years, which is the minimum number of years required to reach secondary school from the time of school entry.[11]

- **Secondary school:** the school outcome is constructed as in the previous level, but for secondary school completion.[12]

The MHSS also collects retrospective information about the age or school level at which each individual started performing productive work and his or her work status while attending a specific school level. We use this information to construct the work status variable in each school level:

- **Work status before school entry:** an individual is considered to be working if he or she starts working at least one year before school entry.[13]

[10] We do not observe any children entering school after age 14.

[11] We choose to focus on whether the child who entered primary school reached secondary school, instead of whether he or she completed primary school, because the transition from the last grade of primary to the first grade of secondary is the single most important turning point in the Bangladeshi school system.

[12] See Appendix A for further details on the construction of the school and work variables and the treatment of censored observations.

[13] Since the school year starts in January, if the individual started working at the same age he or she entered school, he or she is considered not to have worked before school entry.

• **Work status while in primary and secondary school:** an individual is considered to be working in primary or secondary school if he or she performed productive work during that particular school level.

The work history in a given level is defined by the work status in that level and the work status in previous levels. Denote the three school levels as $k = \{e, p, s\}$, where e represents school entry, p represents primary school, and s represents secondary school and denote the work history up to k (inclusive) by H_k. All the children in our sample who start working in a given level continue to work thereafter. Hence, the set of possible work histories is

$$\begin{aligned} H_e &\in \{0,1\}; \; H_p \in \{(0,0),(0,1),(1,1)\} \\ H_s &\in \{(0,0,0),(0,0,1),(0,1,1),(1,1,1)\} \end{aligned}$$

Table 1 shows the number and proportion of children according to their schooling and work history. The proportion of working children is high at each level and increase with the school level. This is not surprising since, older children are more able to do work and also expected to contribute more to the household income. Very few of those who work at the entry level enter school. The high proportion of working children in the primary school level may be partly explained by the short duration of the school day in primary school, which allows children to combine school and work. However, working children may find themselves less able to learn as a result of exhaustion or insufficient time to complete their homework, which increases their chances of dropping out of school. Furthermore, this ability to combine school and work diminishes in secondary school, since the required school time is greater and the chances of having a secondary school nearby are lower.

Table 2 reports the transition rates associated to the school outcome at any school level and for any work history. Working children have a significantly lower probability of making progress in school than non-working children, and this probability is lower the earlier in life a child starts working.

3 A Dynamic Model of School and Work

Choices concerning continuing in school are inherently discrete, sequential in nature and correlated. The empirical framework is based on a schooling-transition model with individual heterogeneity (Lillard and Willis, 1994) augmented to incorporate the timing of school transitions and the decision to work. At each period the household decides on the schooling and work status of the child conditional on household characteristics, some of which may not be observed by the econometrician. The school and work decisions are made simultaneously but are better understood in the context of a two-stage decision making process. In the first stage, the household makes the schooling decision conditional on the working state for that period and the work history up that period. In the second stage, the indirect utilities generated by the potential school outcomes, defined for each possible work history, are compared and the child's working state for that period is chosen.

We develop a dynamic switching model for the sequence of school and work outcomes described in section 2, where the switching at each school level is determined by the endogenous work history up to that level. In particular, let t represent the period in which the school event in level $k = \{e, p, s\}$ is considered. Also, let the working status in each (t, k) be represented by $W_{tk} \in \{0, 1\}$, with 1 denoting work.

For each child i who has reached level k but has not experienced the school outcome by period t, we define $S_{tk}(H_k)$ as equal to 1 if school progress occurs at time t, and 0 otherwise. We assume that W_{tk} and $S_{tk}(H_k)$ are generated by the following latent index structure

$$
\begin{aligned}
W_{tki} &= \mathbf{1}\left[W^*_{tki} \geq 0\right] = \mathbf{1}\left[W^*_{tki}\left(t, Z_{ki}, \theta^w_i, \varepsilon^w_{tki}\right) \geq 0\right] \qquad (1) \\
S_{tki}\left(H_{ki}\right) &= \mathbf{1}\left[S^*_{tki}\left(H_{ki}\right) \geq 0\right] = \mathbf{1}\left[S^*_{tki}\left(t, X_{ki}, \theta^s_i, \varepsilon^s_{tki}; H_{ki}\right) \geq 0\right],
\end{aligned}
$$

where W^*_{tki} and $S^*_{tki}(H_{ki})$ represent net utilities;[14] Z_{ki}/X_{ki} represents the vector of observed (by the econometrician) characteristics affecting the school/work outcomes at k; θ^w_i/θ^s_i represents the unobserved (by the econometrician), individual-specific, propensity for work/schooling that is constant over time and common across work/school outcomes; (θ^w_i, θ^s_i) i.i.d. $F_\theta(\bullet)$; ε^w_{tki} represent level/period/individual i.i.d. shocks to work; and $\varepsilon^s_{t_k i}(H_{ki})$ represent state/level/period/individual i.i.d. shocks to schooling.

In particular, we consider the following convenient specification:

$$
W^*_{tki}\left(t, Z_{ki}, \theta^w_i, \varepsilon_{t_k i}\right) = \lambda_w\left(t; \beta^w_{k\lambda}\right) + \beta^w_{kz} Z_{ki} + \beta^w_{k\theta}\theta^w_i + \varepsilon^w_{tki} = W^*_{tki} + \varepsilon^w_{tki} \qquad (2)
$$

[14] Once a child starts working the work outcome becomes deterministic or equal to 1 with probability 1.

$$
\begin{aligned}
S^*_{tki}(t, X_{ki}, \theta^s_i, \varepsilon_{tki}; H_{ki}) &= \lambda_s\left(t; \beta^s_{k\lambda}(H_k)\right) + \beta^s_{kx}(H_k) X_{ki} + \beta^s_{k\theta}(H_k)\theta^s_i + \varepsilon^s_{tki}(H_k) \\
&= S^*_{tki}(H_k) + \varepsilon^s_{tki}(H_k), \qquad (3)
\end{aligned}
$$

where $\lambda_w(\cdot)$ and $\lambda_s(\cdot)$ are the baseline hazard functions for the work and school equations, $(\beta^w_{k\lambda}, \beta^w_{kz}, \beta^w_{k\theta})$ are defined for each school level and $(\beta^s_{k\lambda}(H_k), \beta^s_{kx}(H_k), \beta^s_{k\theta}(H_k))$ are specific to each school level and work history.[15] We assume (i) $(\varepsilon^w_{tki}, \varepsilon^s_{tki}(H_k))$ are mutually independent and identically distributed extreme value random variables, which implies logistic probabilities

$$
\begin{aligned}
\Pr\left(W_{tki} = \mathbf{1} | Z_{ki}, \theta^w_i\right) &= \Lambda\left(W^*_{tki}\right) \text{ and } \Pr\left(S_{tki}(H_k) = \mathbf{1} | X_{ki}, \theta^s_i\right) = \Lambda\left(S^*_{tki}(H_k)\right), \qquad (4) \\
\text{with } \Lambda(z) &= \exp(z)\left(1 + \exp(x)\right)^{-1}
\end{aligned}
$$

In addition, we assume (ii) (θ^w_i, θ^s_i) are independent of $\{(\varepsilon^w_{tki}, \varepsilon^s_{tki}(H_k)); k = e, p, s\}$, and both independent of $\{(X_{ki}, Z_{ki}); k = e, p, s\}$; (iii) $E(\theta^w) = E(\theta^s) = 0$, $Var(\theta^w) = Var(\theta^s) = 1$, $\beta^l_{k\theta}$ is finite for all k and $l \in \{w, s\}$ and $(\beta^w_{e\theta}, \beta^s_{e\theta}(0)) = (1, 1)$; (iv) $Supp(\beta^w_{k\theta}\theta^w_i + \varepsilon^w_{tki},\ \beta^s_{k\theta}(H_k)\theta^s_i + \varepsilon^s_{t_k i}(H_k)) \subseteq Supp(\beta^w_{kz} Z_{ki}, \beta^s_{kx}(H_k) X_{ki})$, and each component of $(\beta^w_{kz} Z_{ki}, \beta^s_{kx}(H_k) X_{ki})$ assume either arbitrarily large or arbitrarily small values; (v) $F_\theta(\bullet)$ is a discrete distribution with a finite and known number of mass points $\{\theta_m\}^M_{m=1}$, $\pi_m \geq 0$ is the probability associated with mass point $\theta_m = (\theta^w_m, \theta^s_m)$, and $\sum^M_{m=1} \pi_m = 1$ (Heckman and

[15] $\lambda_w(\cdot)$ only applies to the work equation in the entry level, after that we only observe an individual's working status in each school level but not the age at which he/she starts working.

Singer, 1984). Under these conditions identification of the model is a result of Theorem 4 and Theorem 5 in Cameron and Heckman (1998).[16]

In this framework, the contribution to the sample likelihood of observation i, conditional on θ_i, is

$$\begin{aligned}
P_i(\theta_i) &= \prod_{k\in\{e,p,s\}} \prod_{t\in T_k} \Pr(W_{tki}, S_{tki} | H_k, X_{ki}, Z_{ki}, \theta_i) \\
&= \prod_{k\in\{e,p,s\}} \prod_{t\in T_k} \Pr(S_{tki}(H_k) | X_{ki}, \theta_i^s) \Pr(W_{tki} | Z_{ki}, \theta_i^w)
\end{aligned}$$

where T_k represents the set of possible periods in school level k.[17] Finally, after integrating out the unobserved heterogeneity component, we obtain the following expression for the unconditional likelihood function for a sample of N individuals

$$L = \prod_{i=1}^{N} \int P_i(\theta_i) \, dF_\theta. \tag{5}$$

When the Heckman-Singer approach is considered, the integration term is substituted by a sum over the space of unobserved heterogeneity types.[18]

The original distribution of θ is very flexible. However, it still assumes that the same θ^s affects the working and non-working states. We also estimate the model under an alternative specification $\theta = (\theta^w, \theta_0^s, \theta_1^s)$, with θ_0^s and θ_1^s not necessarily the same, but possibly highly

[16] Abbring and van den Berg (2003) and Hansen, Heckman and Vytlacil (2000) also consider identification of related econometric models.

[17] After age 14 a child is no longer at risk of entering school. Thus, $T_e = \{5, ..., 14\}$, $T_p = T_s = \{5, ..., 10\}$.

[18] In this case, we assume three types for each element in θ. A Recent Monte Carlo analysis indicates that a small number of types works well (Baker and Melino, 2000).

correlated, and assume that θ is distributed a la Heckman-Singer. In this case, identification requires that $\beta_{e\theta} = (1, 1, 1)$. Finally, we also estimate the model for the case of $(\theta^w, \theta^s) \sim N(0, [1, 1, \rho])$.

As a result of the factor structure of the model, dependence between work/school outcomes occurs through observables and unobservables, θ^w/θ^s, while dependence between school and work outcomes arises from observables and the correlation between θ^w and θ^s. The structure of the model also allows for the school and work decisions in each level to be correlated and subject to selectivity as a result of school and work decisions in previous levels.

4 Evaluation of the Effect of Work on School Progress

This section presents a dynamic extension of the static program evaluation framework based on selection models.[19] The crucial feature of this framework is the presence of heterogenous responses to treatment among observationally equivalent individuals. In this context, the response to treatment is a random variable and a variety of treatment effects can be defined depending on the conditioning sets and the summary statics desired.

The econometric model developed in this paper can generate a rich set of dynamic treatment effects. Also, the model allows us to identify the groups of children that are most affected by the treatment, child work, and to assess the relative importance of observables and unobservables in understanding the selection into work and its effects on school progress.

[19] See Heckman et al. (1999) for a review of the program evaluation literature.

For each possible work history H_k in level k, let the school outcome of interest be represented by $S_k(H_k) \in \{0,1\}$. Also, let $\Delta_k\left(H_k^+, H_k\right) = S_k\left(H_k^+\right) - S_k(H_k)$ denote the effect on the school outcome in level k of the work history H_k^+ compared to an alternative "lower" work history H_k, for a given child and for any pair of possible work histories in level k. This person-specific effect is a counterfactual. For a given child, it compares the school outcome if he or she experienced the work history H_k^+ with the school outcome if he or she experienced the work history H_k. In our case, $\Delta_k\left(H_k^+, H_k\right)$ can take three values

1. $\Delta_k\left(H_k^+, H_k\right) = 1$, if the child experiences the school outcome in level k under the work history H_k^+, $S_k\left(H_k^+\right) = 1$, but not under the alternative work history H_k, $S_k(H_k) = 0$.

2. $\Delta_k\left(H_k^+, H_k\right) = 0$, if the child experiences the school outcome under both work histories, or if he or she does not experience the school outcome under any one of the two work histories.

3. $\Delta_k\left(H_k^+, H_k\right) = -1$, if the child experiences the school outcome under the work history H_k, but not under the work history H_k^+.

In the present context, we cannot estimate $\Delta_k\left(H_k^+, H_k\right)$ for any given person since we never observe the same individual under both work histories. Instead, we can consider population means or distributions of these variables. In this paper, we focus our attention on a variety of dynamic mean treatment parameters that differ in the conditioning set on which they are defined. In particular, we consider the dynamic versions of three familiar static mean treatment parameters: the *dynamic average treatment effect* (DATE), the *dynamic* *average treatment effect on the treated* (DTT), and the *dynamic average treatment effect on the untreated* (DTU). First, we consider the DATE,

$$DATE_k\left(H_k^+, H_k\right) = E\left(\Delta_k\left(H_k^+, H_k\right)\right),\ k = e, p, s. \tag{6}$$

In each school level k, this parameter represents the average difference between the school outcome $S_k\left(H_k^+\right)$, associated to the work history H_k^+, and the school outcome $S_k\left(H_k\right)$, associated with the work history H_k, computed over the whole population of children. The definition of DTT is similar to (6) after conditioning on the work history H_k^+,

$$DTT_k\left(H_k^+, H_k\right) = E\left(\Delta_k\left(H_k^+, H_k\right) \mid H_k^+\right), \tag{7}$$

with the average computed over the population of children who actually experienced the work history H_k^+. Finally, if instead we condition (7) on H_k, or any other possible work history at k different from H_k^+, we obtain alternative versions of the DTU.

These dynamic treatment effects are computed using simulations. More precisely, using the estimated model we simulate a sufficiently large sample.[20] Then, using the estimated model we also simulate the school outcomes under alternative predetermined work histories. The outcomes for any given pair of work histories are then compared either using the full sample (DATE) or specific subsamples (DTT and DTU). The estimated model can be used to determine the groups of individuals that select themselves in any possible work history.

[20] For each individual in the sample we generate a θ type based on the estimated distribution $F_\theta(\bullet)$. Likewise, we generate i.i.d. shocks to work, ε^w_{tki}, and schooling, $\varepsilon^s_{t_k i}(H_{ki})$.

Standard errors for the dynamic mean treatment effects are also computed by simulation.[21]

5 Results

The observable characteristics determining work and school choices include a set of child, parental, household and community characteristics relevant to the child in each school level.[22] We also include endogenous predetermined variables and policy variables. In particular, we include the school entry age in the primary and secondary school levels, and the number of primary school grade repetitions in the secondary school level. As regards policy variables, we include in the primary school level an indicator for whether the child was in primary school in or after 1992, the year in which compulsory primary education was introduced, and a gender-specific indicator for whether the child was in primary school when free tuition for girls in secondary school grades 6-8 was implemented (i.e. 1990). The last policy variable is also included in the secondary school level, where it indicates whether the child was in grades 6-8 when the policy was implemented.

The lack of sufficient variation in the data prevented us from estimating a separate equation for $S_{tp}(1,1)$. Instead we constrain the difference between $S_{tp}(1,1)$ and $S_{tp}(0,1)$ to a constant. Likewise, the only individual with work history $(1,1,1)$ contributing to the estimation sample in the secondary school level is aggregated with those with work history

[21] Similar to Heckman and Cameron (1998 and 2001), we first use the estimated asymptotic normal distribution of the vector of parameters to generate vectors of parameter values. We then compute the dynamic treatment effects under each of these vectors and calculate their standard deviation.

[22] We consider characteristics commonly used elsewhere in the literature on child labor and schooling. See Appendix B for details on these variables.

$(0,1,1)$ in equation $S_{ts}(0,1,1)$. Table 3 reports means and standard deviations of the model covariates by school level and work history.

To discriminate among competing models (including the one without unobserved heterogeneity), we use the likelihood ratio tests (LR) and the Bayesian Information Criterion (BIC).[23] Appendix C shows that the two models with a non-parametric specification of the unobserved heterogeneity compare favorably against the model with normal heterogeneity and the model without unobserved heterogeneity. Between the two non-parametric specifications, the LR test favors the more flexible three-factor model. However, using BIC the more parsimonious two-factor model is preferred. In addition, in contrast with the two-factor model, all of the probabilities associated with mass points are estimated very imprecisely in the three-factor model. Thus, for the remaining of the paper we focus the discussion on the results of the two-factor model.[24]

A. Parameter Estimates

Tables 4.1 through 4.3 report parameter estimates for the work and school equations at each school level and the estimated correlation between θ^w and θ^s. The parameters associated with unobserved heterogeneity are sizable and statistically significant. The presence of selection on unobservable characteristics in these data has a significant impact on the parameters associated to the model covariates, which are generally larger in magnitude and more statistically significant than in model without unobserved heterogeneity.

[23] The p-values of the LR tests are meant as heuristic guides only, and cannot be interpreted using the standard Chi-square tables as the models being compared are non-nested. BIC is, however, valid for discriminating between non-nested models.

[24] The results for the other models are available upon request from the authors.

Looking at the baseline hazards, we observe that the probability of working before school entry increases with age, while the probability entering school follows an inverted u-curve. At each school level, the probability of school progress decreases as the child accumulates additional school delay. In general, the observable characteristics that make an individual more likely to work also make him or her less likely to advance in school, for any work history. Likewise, the observable characteristics that make an individual more likely to succeed at a particular school level also make him or her more likely to succeed in subsequent levels. This indicates the presence of selection into work and school on the basis of observable characteristics.

Child characteristics: Delaying school entry age increases the probability of working during primary school and, specially, secondary school. However, conditional on the work history, the school entry age only has a significantly negative effect on the probability of reaching secondary school for those who did not work during primary school. To the extent that work reduces the likelihood of school progress, these results show that school entry age has an indirect negative effect on schooling. Grade repetition in primary school increases the probability of working during secondary school. Conditional on the work history, grade repetition reduces the probability of completing secondary school, but only significantly so for those who started working during secondary school. For those who started working earlier grade repetition has an indirect negative effect on secondary school completion.

Girls are significantly less likely to work in all levels except in primary school. This gender difference in the propensity to work is particularly strong in secondary school.[25] Also, non-working girls, the largest group of girls, are significantly less likely to succeed in school at any school level. Hence there is a gender gap in education among the non-working children but the gap seems to disappear among the working children after school entry.

If a child was in primary school after the compulsory schooling law was in place, his or her chances of working during primary school decrease significantly, while his or her chances of reaching secondary school increase, but the effect is only significant in the non-working state. The policy of free tuition for girls in secondary school had no effect on the decision to work in primary school. The policy has a positive effect in school progress for boys and girls in the working state. In the non-working state the effect is also positive but significant only for girls. If the child was in secondary school, grades 6-8, after the free tuition policy was introduced, the chances of working are lower, specially among boys. The policy also has a positive effect on secondary school completion, the effect is significant in most cases.

Parental and household characteristics: Only the father's education significantly reduces the probability of working in primary school. The education of either parent increases the probability of entering school and reaching secondary school under all work histories, although the effect of mother's education is larger in all cases. The effect of mother's education is always significant, but the effect of father's education only has a significant effect among non-working children. This differential effect of education by gender of the

[25] As noted in section 2, our definition of work refers to productive work only, and thus ignores household chores, which are most likely to be performed by girls.

parent may suggest that women have a higher preference for child schooling than men do.[26]

Household wealth, as indicated by household assets or the ownership of a modern latrine, significantly reduces the probability of working in all but the primary level and significantly increases the probability of school progress, for any work history. Apart from its income effect, household wealth may play an important role as a cushion against economic shocks in the absence of well-developed capital markets (Jacobi and Skoufias, 1997). In all but the entry level, the ownership of at least one of two household productive assets significantly increases the probability of work, particularly the ownership of a non-farm business. Likewise, in all but the secondary school outcome for children who were working before entering secondary school, the ownership of at least one of two household productive assets significantly increases the probability of experiencing the school event. Controlling for farm ownership, the probability of work increases in households that cultivate land.

The number of older siblings has a negative effect on work, but this effect is only significant at the secondary level, while the number of younger siblings increases the probability of work before school entry but decreases the probability of work in secondary school. Conditional on work history, the effect of the number of older siblings on schooling is always positive whenever significant, while the effect of the number of younger siblings is significantly negative in the secondary level among those who start working in that level, but significantly positive among working children in the primary level.

[26] Parental education can potentially influence the allocation of children's time directly, mainly through income and preferences, and indirectly through its effect on the bargaining power of the mother relative to that of the father (Ridao-Cano, 2001).

Village characteristics: The presence of a primary school in the village has no significant effect on work or school progress.[27] In contrast, the presence of a secondary school has a significant effect on work and school progress. Thus, the presence of a secondary school nearby seems to facilitate the combination of school and work activities. The presence of health-related infrastructure in the village has a significantly negative effect on work in the secondary level but significantly positive in the primary level. The benefits on schooling seem to be particularly strong at the entry and primary levels.

A more diversified village economy (as indicated by the presence of some form of industry) has no significant effect on work, but does generally have a consistently positive effect on schooling throughout the three school levels. The capital of Matlab provides access to credit institutions, health facilities, schools and employment opportunities. Villages further away from the capital of Matlab have a higher incidence of child work in the primary level, and consistently lower school transition and completion rates.

B. The Effect of Work on School Progress

Table 5 reports the simulated mean effects of work on school progress. As work in the entry level may refer to any age prior to the school entry age, in our simulation we have assumed that if the child starts working before entering school it does so at age 5.

The DATE is found to be negative and sizable in all levels and for any pair of work histories. The greater the difference in work intensity between two work histories the larger the impact on school progress. Thus, on average work reduces the likelihood of school

[27] This is not surprising given the fact that most children in the sample lived in a village with a primary school by the time they were 6.

progress in each school level. Also, the earlier the exposure to work the more negative its effect on school progress. For example, if work begins in primary school the probability of reaching secondary school is reduced by 10.73 percent, while if work begins before school entry this probability is reduced by 33.20 percent.

In all three school levels, the DTT is less negative than the DATE for any pair of work histories involving work at the entry level, except the one in which the sequence being compared is no work up to secondary school (inclusive). When comparing children that work before school entry with the whole population of children, our model predicts that children who worked before school entry are less affected by this work history, particularly in the entry and primary school levels. The opposite is true when work begins in primary or secondary school.

We now focus our discussion on the DTU for the group of children who select into the less work-intensive sequence being compared. The difference in all three school outcomes between a more work-intensive and a less work-intensive work history is in most cases more negative for those who select into the less work-intensive history (i.e. the untreated population) as compared with those who select into the more work-intensive sequence (i.e. the treated population) or with the entire population. This is particularly so when the comparison group includes children who began working before school entry. However, the effect of work when it begins in secondary school is slightly more negative for the treated population than for the untreated population.

It is worthwhile to compare the simulated treatment effects with the non-parametric mean differences of Table 2. In both cases, more work results in worse school outcomes. However, there are systematic differences in the magnitudes, which indicates the importance of controlling for selection.

In conclusion, the results indicate that in most cases the “treated” populations have combination of observable and unobservable characteristics that make them less likely to benefit from a less demanding work history. This is particularly so the more work-intensive the treatment history is. In particular, work appears to have a smaller effect for working children than for non-working children and, within working children, the longer a child has been exposed to work the smaller the impact of work. The exception to this pattern involves children whom started working in secondary school.

C. The Relation Between Selection and School Outcomes

This section examines the contribution of observable and unobservable characteristics to the differences between DTT and DTU. Table 6 presents the distribution of the unobserved propensity for schooling, θ^s, by school level and work history. Not surprisingly, the distribution of θ^s shifts to the right for higher school levels as individuals with low θ^s are screened out. Overall, the extent of cream-screening is larger among working children than among non-working children. This is because, working children usually have a low observed propensity for schooling, $\beta_x^s X$, relative to non-working children, so they tend to continue schooling only if they also have a high θ^s.

Table 7 reports, for each school level, the correlations between the values of the unobservables in the work equation, $U_k^w = \beta_{k\theta}^w \theta^w + \varepsilon^w$, and those in the school equations in each working state, $U^s = \beta_\theta^s \theta^s + \varepsilon^s$, as well as the correlations between the observed propensity to work, $\beta_{kz}^w Z$, and $\beta_{kx}^s X$ in each working state.[28] In the entry level, the higher the unobserved propensity to work the lower the unobserved propensity to enter school, particularly in the non-working state. In terms of observables, the higher the propensity to work the lower the propensity to enter school, particularly in the working state. Altogether, it appears that selection on unobservables is stronger than selection on observables in explaining why children who work before school entry would benefit less from not working than non-working children, i.e. they are more likely to be of type $(S_e(1) = 0,\ S_e(0) = 0)$.

In the primary school level, among those who did not work before school entry, the higher the unobserved propensity to work the higher the propensity to reach secondary school, particularly in the working state. In terms of observables, a higher propensity to work is associated with a lower probability of school progress, particularly in the non-working state. Hence selection on observables and unobservables reinforce each other in explaining why those children who start working in primary school would benefit less from not working than non-working children, i.e. they more likely to be of type $(S_p(0,1) = 1,\ S_p(0,0) = 1)$. In the secondary school level, among those who did not work in primary school, a high propensity to work is associated with an equally high propensity to reach secondary school in either working state. However, working children have observable characteristics that make them less likely to complete secondary school, particular in the working state. This explains why working children are more likely to benefit from not working in secondary school than

[28] The distribution of observables and unobservables is determined by the group of children in each working-schooling state.

non-working children.

Summarizing, the extent of cream-screening across school transitions is larger for working children than for non-working children. Thus, working children that remain in school tend to have a higher unobserved propensity for schooling than non-working children. This tends to make the negative effect of work smaller for those who start working in primary school relative to non-working children in the primary level, and for all working children relative to non-working children in the secondary level. However, working children are subject to greater selection than non-working children because they face a worse environment in terms of observable characteristics.

Thus, studies that ignore this selection process and just focus on a particular school level would underestimate the benefits of policies designed to reduce child work, as we would observe that a significant number of working children are able to make it through school without such a policy. However, if we were to expose working children to the same environment that non-working children face, we would not observe the systematic differences in selection patterns outlined above, and thus we would most likely observe similar negative effects of work for both groups of children.

These findings have important policy implications. First, any assessment of policies to reduce child work in primary school or secondary school must be based on a full understanding of the nature of the selection process across school transitions. Second, the magnitude of the effects of work on school progress makes policies aimed at increasing school progress through reductions in child work most relevant. Third, the effectiveness of these policies would be greatly increased if they were accompanied by efforts to improve the adverse environment that working children face.

D. Policy Simulations

Motivated by the previous policy implications, we simulate the dynamic effects of three policies. First, we evaluate the effect of the compulsory primary schooling policy introduced in 1992. Second, we consider a policy that makes school entry compulsory at age 6. Third, we evaluate a policy that makes access to a secondary school universal. In each case we compare the effects of the policy against the outcomes in the unrestricted model. The first two policies are aimed at increasing school progress directly, as well as indirectly by reducing child work. The third policy is aimed at increasing school progress directly by improving the school environment.

As Table 8 shows, the compulsory primary schooling policy had a significant impact on the probability of reaching secondary school, which is partly explained by its sizable effect on work during primary school. Making school entry compulsory at age 6 would significantly decrease the probability of working in primary school and secondary school, but its effect on schooling would only be sizable in the primary school level. The availability of secondary schools would have a beneficial effect on schooling, particularly in the entry level. In all three school levels, the benefits of this policy would be mainly accrued by working children, particularly those who started working younger, which highlights the importance of policies aimed at improving the adverse environment that working children face.

6 Conclusions

This paper investigates the effect work on the school progress of rural Bangladeshi children. We find that work has a negative and sizable effect on school progress in each school level. The effect of work on school progress becomes more negative the earlier in life an individual is exposed to work. School progress appears to be more negatively affected by work for non-working children, if they were to work, than for working children. This is partly due to the fact that working children are subject to greater selection than non-working children, which is in turn explained by the fact that working children face a worse environment, as measured by their observable characteristics, than non-working children. However, if we were to expose working children to the same environment as non-working children, we would most likely observe similar negative effects of work for both groups of children.

The magnitude of the effect of work on school progress makes policies aimed at increasing school progress through reductions in child work most relevant. The effectiveness of these policies would be greatly increased if they were accompanied by efforts to improve the adverse environment faced by working children. We also evaluate the dynamic effects of three policies. The compulsory primary schooling policy introduced in 1992 had a significant impact on the probability of reaching secondary school, and a sizable effect on work during primary school. Compulsory school entry at age 6 would significantly decrease the probability of working in primary and secondary school. The availability of secondary schools would affect schooling positively, specially among working children. This highlights the importance of policies aimed at improving the adverse environment often faced by working children.

References

Abbring H. J. and G. J. van den Berg, 2003. The Nonparametric Identification of Treatment Effects in Duration Models. Forthcoming in: Econometrica.

Akabayashi, H., and G. Psacharopoulos, 1999. The Trade-Off Between Child Labor and Human Capital Formation: A Tanzanian Case Study. *Journal of Development Studies* 35, 120-140.

Baker, M. and A. Melino (2000). Duration Dependence and Nonparametric Heterogeneity: A Monte Carlo Study. Journal of Econometrics 96, 357-393.

Bangladesh Bureau of Statistics, 1996. *Report on National Sample Survey of Child Labor in Bangladesh 1995-1996*. BBS, Dhaka.

Basu, K., 1999. Child Labor, Cause, Consequence and Cure, with Remarks on International Labor Standards. *Journal of Economic Literature* 37, 1083-1119.

Cameron, S.V., and J.J. Heckman, 1998. Life Cycle Schooling and Dynamic Selection Bias: Models and Evidence for Five Cohorts of American Males. *Journal of Political Economy* 106, 262-333.

Canagarajah, S., and H. Coulumbe, 1997. Child Labor and Schooling in Ghana. *World Bank Policy Research Working Paper* 1844, the World Bank, Washington, D.C.

Cigno A., F.C. Rosati and Z. Tzannatos, 2002. Child Labor Handbook. *Social Protection Discussion Paper* 206, the World Bank, Washington, D.C.

Duryea, S., and M. Arends-Kuenning, 2003. School Attendance, Child Labor and Local Labor Market Fluctuations in Urban Brazil. *World Development* 31, 1165-1178.

Eckstein, Z., and K.I. Wolpin, 1999. Why Youths Drop out of High School: The Impact of Preferences, Opportunities, and Abilities. *Econometrica* 67, 1295-1339.

Filmer, D., 1999. Educational Attainment and Enrollment Profiles: A Resource Book based on an Analysis of Demographic and Health Survey Data. Mimeo, Development Research Group, The World Bank.

Grootaert, C., 1998. Child Labor in Cote d'Ivoire: Incidence and Determinants. *World Bank Policy Research Working Paper* 1905, the World Bank, Washington, DC.

Hansen, K. Heckman J. J. and Vytlacil, E., 2000. Dynamic Treatment Effects. Working paper, The University of Chicago.

Heady, C., 2000. What is the Effect of Child Labor on Learning Achievement? Evidence from Ghana. *Innocenti Working Paper* 79, UNICEF, Innocenti Research Center, Florence, Italy.

Heckman, J., R. LaLonde, and J. Smith, 1999. The Economics and Econometrics of Training Programs. Forthcoming in: O. Ashenfelter and D. Card, eds., *Handbook of Labor Economics*, Volume III, North Holland, Amsterdam.

ILO, 1996. *Child Labor: Targeting the Intolerable*. Report VI, Part 1, ILO, 85th Session, Geneva.

Jacobi, H.G., and E. Skoufias, 1997. Risk, Financial Markets, and Human Capital in a Developing Country. *Review of Economic Studies* 64, 311-335.

Lillard, L.A., and R.J. Willis, 1994. Intergenerational Educational Mobility: Effects of Family and State in Malaysia. *Journal of Human Resources* 29, 1126-66.

Psacharopoulos, G., 1997. Child Labor Versus Educational Attainment: Some Evidence from Latin America. *Journal of Population Economics* 10, 377-386.

Ravallion, M., and Q. Wodon, 2000. Does Child Labor Displace Schooling? Evidence on Behavioral Responses to an Enrollment Subsidy. *Economic Journal* 110, C158-C175.

Ridao-Cano, C., 2001. Child Labor and Schooling in a Low Income Rural Economy. Working Paper 01-16, Department of Economics, University of Colorado at Boulder.

Rosenzweig, M.R., and R. Evenson, 1977. Fertility, Schooling, and the Economic Contribution of Children in Rural India: An Econometric Analysis. *Econometrica* 45, 1065-1079.

Sawada, Y., and M. Lokshin, 2001. Household Schooling Decisions in Rural Pakistan. Working Paper 2541, the World Bank, Washington, DC.

Schultz, T.P., 2001. School Subsidies for the Poor: Evaluating the Mexican Progresa Poverty Program. Discussion Paper 834, Economic Growth Center, Yale University.

Skoufias, E., 1994. Market Wages, Family Composition and the Time Allocation of Children in Agricultural Households. *Journal of Development Studies* 30, 335-360.

Table 1. Children by Work History in Each Level

	Unadjusted for censoring		Adjusted for censoring	
	Count	Percent	Count	Percent
School entry				
$H_e = 1$	329	13.22	329	13.22
$H_e = 0$	2160	86.78	2160	86.78
Total	2489	100.00	2489	100.00
Primary school				
$H_p = (1,1)$	24	1.23	24	1.24
$H_p = (0,1)$	546	27.94	546	28.33
$H_p = (0,0)$	1384	70.83	1357	70.42
Total	1954	100.00	1927	100.00
Secondary school				
$H_s = (1,1,1)$	5	0.39	5	0.48
$H_s = (0,1,1)$	272	21.13	272	26.08
$H_s = (0,0,1)$	351	27.27	351	33.65
$H_s = (0,0,0)$	659	51.20	415	39.79
Total	1287	100.00	1043	100.00

Notes: H_e, H_p, and H_s represent the work history in the entry, primary and secondary school levels, respectively. The work history in each level includes the work status in that level as well as the work status in previous levels. For example, $H_p = (0,1)$ represents the work history in the primary school level of those children who did not work before school entry but worked during primary school.

Table 2. Estimated Transition Rates Associated to Each School Outcome by Work History

	Estimate	Std. Err.	Comparison	Difference	LR test: $\chi^2(1)$
School entry					
(1) $H_e = 1$	0.073	0.014	(1) Vs (2)	-0.821	723.58 (0.000)
(2) $H_e = 0$	0.893	0.007			
Transition to secondary school					
(3) $H_p = (1,1)$	0.222	0.089	(3) Vs (4)	-0.283	3.21 (0.073)
(4) $H_p = (0,1)$	0.505	0.022	(3) Vs (5)	-0.513	14.86 (0.000)
(5) $H_p = (0,0)$	0.735	0.012	(4) Vs (5)	-0.231	96.20 (0.000)
Secondary school completion					
(6) $H_s = (0,1,1)$	0.176	0.028	(6) Vs (7)	-0.076	3.85 (0.050)
(7) $H_s = (0,0,1)$	0.252	0.029	(6) Vs (8)	-0.139	22.00 (0.000)
(8) $H_s = (0,0,0)$	0.315	0.022	(7) Vs (8)	-0.063	7.71 (0.005)

Notes: See notes to Table 1. There is only one case with $H_s = (1,1,1)$ contributing to the estimation sample (see text for details), which we aggregate with $H_s = (0,1,1)$. LR test corresponds to the likelihood ratio test for equality of transition rates (p values in parentheses).

Table 3. Means and Standard Deviations of Characteristics by Work History

	$H_e = 1$	$H_e = 0$	$H_p = (0,1)$	$H_p = (0,0)$	$H_s = (0,1,1)$	$H_s = (0,0,1)$	$H_s = (0,0,0)$
	Mean (Stdv)	Mean (Stdv)	Mean (Stdv)	Mean (Stdv)	Mean (Stdv)	Mean (Stdv)	Mean (Stdv)
Girl	0.39 (0.49)	0.49 (0.50)	0.45 (0.50)	0.47 (0.50)	0.33 (0.47)	0.43 (0.50)	0.44 (0.50)
Age	19.99 (3.21)	19.29 (3.05)	19.42 (3.07)	19.32 (2.98)	21.19 (2.52)	21.15 (2.70)	21.07 (2.40)
School entry age			8.01 (1.67)	7.50 (1.49)	7.57 (1.54)	7.00 (1.32)	7.05 (1.40)
Grade repetitions in primary					0.25 (0.85)	0.06 (0.33)	0.06 (0.31)
Compulsory school policy			0.27 (0.45)	0.27 (0.45)			
Free tuition policy			0.45 (0.50)	0.43 (0.49)	0.63 (0.48)	0.53 (0.50)	0.62 (0.49)
Free tuition policy * girl			0.20 (0.40)	0.21 (0.41)	0.22 (0.41)	0.21 (0.41)	0.26 (0.44)
Mother's education	0.48 (1.29)	1.35 (2.35)	1.08 (2.05)	1.69 (2.56)	1.59 (2.40)	2.21 (2.62)	2.13 (2.94)
Father's education	1.37 (2.65)	3.58 (3.73)	3.35 (3.56)	4.15 (3.80)	4.17 (3.63)	4.93 (3.43)	5.23 (4.10)
Household assets missing	0.22 (0.41)	0.16 (0.37)	0.17 (0.37)	0.15 (0.36)	0.13 (0.34)	0.25 (0.43)	0.18 (0.38)
Log(household assets)[1]	10.24 (1.05)	10.92 (1.12)	10.95 (1.05)	11.05 (1.11)	11.34 (0.91)	11.13 (1.14)	11.45 (1.06)
Modern latrine	0.10 (0.30)	0.28 (0.45)	0.30 (0.46)	0.32 (0.47)	0.37 (0.49)	0.36 (0.48)	0.42 (0.49)
Cultivating household	0.71 (0.45)	0.74 (0.44)	0.82 (0.39)	0.73 (0.44)	0.80 (0.40)	0.71 (0.46)	0.68 (0.46)
Owns farm land	0.61 (0.49)	0.78 (0.42)	0.84 (0.37)	0.80 (0.40)	0.90 (0.30)	0.87 (0.33)	0.86 (0.35)
Owns non-farm business	0.38 (0.48)	0.43 (0.49)	0.51 (0.50)	0.42 (0.49)	0.59 (0.49)	0.46 (0.50)	0.41 (0.49)
Older siblings	2.07 (1.86)	2.50 (2.09)	2.53 (1.95)	2.51 (2.21)	2.65 (1.83)	2.28 (2.17)	2.66 (2.37)
Younger siblings	1.14 (0.93)	1.00 (0.83)	1.28 (1.05)	1.23 (0.97)	1.66 (1.42)	1.80 (1.31)	1.78 (1.50)
Village outside Matlab[2]	0.11 (0.32)	0.09 (0.28)	0.08 (0.28)	0.09 (0.29)	0.05 (0.21)	0.17 (0.38)	0.13 (0.34)
Tubewell in village	0.77 (0.42)	0.78 (0.42)	0.84 (0.37)	0.82 (0.39)	0.84 (0.37)	0.85 (0.35)	0.85 (0.36)
Health facility in village	0.006 (0.08)	0.40 (0.49)	0.70 (0.46)	0.70 (0.46)	0.77 (0.42)	0.77 (0.42)	0.84 (0.36)
Industry in village	0.13 (0.34)	0.15 (0.35)	0.40 (0.49)	0.38 (0.49)	0.54 (0.50)	0.49 (0.50)	0.50 (0.50)
Primary school in village	0.64 (0.48)	0.75 (0.43)	0.74 (0.44)	0.77 (0.42)			
Secondary school in village	0.01 (0.10)	0.25 (0.43)	0.27 (0.45)	0.33 (0.47)	0.26 (0.44)	0.32 (0.47)	0.32 (0.47)
Distance to Matlab capital	6.38 (5.36)	5.82 (4.49)	6.48 (5.23)	5.42 (4.19)	7.53 (6.52)	5.03 (3.88)	5.36 (4.31)
Number of individuals	329	2160	533	1339	138	183	333

Notes: Based on weighted data. Samples account for censoring (see text for details) so that the individuals in each sample are those used in the estimation. (1) Mean defined for non-missing observations. (2) Means of village characteristics defined for children whose village of residence in each level was in Matlab, since only those villages were surveyed. $H_p = (0,1)$ also includes the 19 individuals with $H_p = (1,1)$, while $H_s = (0,1,1)$ also includes the only individual with $H_s = (1,1,1)$.

Table 4.1. Dynamic Switching Model of School and Work: School Entry Level

	Work equation		School equations			
	W_{te}		$S_{te}(0)$		$S_{te}(1)$	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
Intercept	-6.259	-4.606	-6.465	-13.466	-1.518	-0.062
Baseline hazard (1)	2.868	3.085	1.688	13.547	9.040	1.892
Baseline hazard (2)	3.314	3.610	2.883	23.174		
Baseline hazard (3)	3.878	4.318	3.613	27.967		
Baseline hazard (4)	6.975	8.216	3.595	25.613		
Baseline hazard (5)	5.368	6.137	4.011	27.003		
Baseline hazard (6)	7.588	8.876	3.048	14.854		
Baseline hazard (7)	7.053	8.145	2.859	12.310		
Baseline hazard (8)			1.053	2.470		
Girl	-1.022	-5.046	-0.401	-5.187	1.017	0.489
Age	0.010	0.359	0.021	1.600	-1.486	-2.879
Mother's education	0.027	0.385	0.151	8.644	1.781	2.387
Father's education	0.038	1.032	0.086	7.848	1.082	2.105
Household assets missing	-2.207	-2.253	0.658	1.482	14.386	0.779
Log(household assets)	-0.244	-2.630	0.063	1.603	0.967	0.545
Modern latrine	-0.053	-0.198	0.599	7.441	7.984	2.392
Cultivating household	0.241	1.176				
Owns farm land	0.183	0.966	0.544	6.062	-2.458	-1.105
Owns non-farm business	0.015	0.089	0.120	1.665	5.595	2.621
Older siblings	-0.061	-1.279	-0.014	-0.758	1.031	2.331
Younger siblings	0.170	1.890	-0.010	-0.232	-0.409	-0.278
Village outside Matlab	0.211	0.566	0.466	2.617	-7.980	-1.089
Tubewell in village	-0.112	-0.532	0.141	1.593	-0.400	-0.186
Health facility in village	-0.628	-0.754	1.113	13.028	5.740	1.281
Industry in village	-0.133	-0.513	0.231	2.162	6.681	3.180
Primary school in village	-0.186	-1.026	0.121	1.368	-1.520	-0.722
Secondary school in village	-0.695	-1.026	0.701	7.395	7.732	1.466
Distance to Matlab capital	-0.007	-0.365	-0.044	-5.244	-0.349	-0.679
q_w	1.000					
q_s			9.602	3.432	1.000	
$Corr(q_w, q_s)$	-0.315					
Log-L	-8527.370					

Notes: The specification of the baseline hazard in each equation is given by the variation in the data. For equation W_{te}, baseline(1) through baseline(7) refer to work ages 7 through 13, while the reference is ages < 7. For equation $S_{te}(0)$, baseline(1) through baseline(7) refer to school entry ages 6 through 12, baseline(7) refers to ages 13 and 14, and the reference is age = 5. For equation $S_{te}(1)$, baseline(1) refers to school entry ages between 10 and 14, while the reference is ages < 10.

Table 4.2. Dynamic Switching Model of School and Work: Primary School Level

	Work equation		School equations					
	W_{tp}		$S_{tp}(0,0)$		$S_{tp}(0,1)$		$S_{tp}(1,1)$	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
Intercept	-3.064	-2.479	-8.188	-5.788	-11.728	-3.646	-13.628	-3.649
Baseline hazard (1)			-4.077	-22.866	-3.037	-11.709		
Girl	-0.046	-0.249	-0.667	-3.114	-0.073	-0.159		
Age	-0.022	-0.662	0.212	5.118	0.255	2.782		
School entry age	0.290	4.357	-0.176	-2.655	-0.006	-0.053		
Compulsory school policy	-0.511	-2.425	1.363	5.509	0.489	1.095		
Free tuition policy	-0.014	-0.063	0.363	1.380	1.262	2.595		
Free tuition policy * girl	-0.019	-0.075	0.822	2.802	0.245	0.425		
Mother's education	-0.041	-1.331	0.164	4.413	0.401	4.282		
Father's education	-0.040	-2.115	0.137	5.459	0.072	1.872		
Household assets missing	-0.552	-0.684	2.928	3.096	1.085	0.617		
Log(household assets)	-0.101	-1.444	0.342	4.061	0.228	1.517		
Modern latrine	0.087	0.639	0.590	3.659	1.630	4.372		
Cultivating household	0.434	2.494						
Owns farm land	0.390	2.116	0.541	2.818	0.741	1.662		
Owns non-farm business	0.510	3.864	0.294	1.982	0.896	2.658		
Older siblings	-0.034	-1.070	-0.013	-0.356	0.238	2.763		
Younger siblings	-0.004	-0.059	0.028	0.369	0.427	3.078		
Village outside Matlab	0.424	1.226	1.451	3.597	-1.844	-2.151		
Tubewell in village	0.061	0.351	0.653	3.406	-0.319	-0.803		
Health facility in village	0.406	2.568	1.014	5.570	0.596	1.689		
Industry in village	-0.075	-0.539	0.339	2.056	0.369	1.207		
Primary school in village	0.152	0.910	-0.262	-1.398	-0.069	-0.191		
Secondary school in village	-0.167	-1.101	-0.094	-0.545	1.097	2.819		
Distance to Matlab capital	0.049	3.317	-0.041	-2.197	-0.040	-1.280		
q_w	-0.823	-2.699						
q_s			0.836	3.723	1.901	4.408		

Notes: For all school outcome equations, baseline(1) refers to 6 or more years to reach secondary school, while the reference is 5 years.

Table 4.3. Dynamic Switching Model of School and Work: Secondary School Level

	Work equation		School equations					
	W_{ts}		$S_{ts}(0,0,0)$		$S_{ts}(0,0,1)$		$S_{ts}(0,1,1)/S_{ts}(1,1,1)$	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
Intercept	-4.354	-0.296	-37.013	-5.096	-50.748	-4.011	-36.176	-3.323
Baseline hazard (1)			-2.765	-5.174	-1.294	-2.265	-3.389	-4.767
Girl	-9.689	-2.563	-4.354	-4.026	-0.752	-0.533	-1.316	-1.059
Age	-0.697	-1.593	0.503	2.424	0.794	2.695	0.731	2.332
School entry age	6.351	3.487	0.326	1.299	-0.364	-1.007	0.091	0.274
Grade repetitions in primary	6.384	3.597	-0.374	-0.501	-4.411	-2.092	-1.714	-1.625
Free tuition policy	-10.921	-2.437	-1.100	-0.944	6.688	4.202	1.322	0.899
Free tuition policy * girl	10.239	2.448	5.988	4.217	-6.281	-3.302	0.909	0.626
Mother’s education	-0.033	-0.174	1.057	6.031	1.438	4.373	0.448	1.825
Father’s education	-0.078	-0.388	0.550	4.597	-0.070	-0.443	0.008	0.069
Household assets missing	-10.366	-0.898	12.162	2.604	14.424	1.635	10.265	1.679
Log(household assets)	-3.330	-2.411	1.433	3.728	1.929	2.387	1.103	2.058
Modern latrine	1.651	1.450	-0.704	-1.138	1.732	1.750	-0.707	-0.856
Cultivating household	24.740	3.887						
Owns farm land	2.762	1.577	2.540	2.397	2.638	2.146	-0.489	-0.441
Owns non-farm business	13.604	4.022	1.615	2.567	0.281	0.353	0.193	0.241
Older siblings	-2.997	-3.338	0.398	2.529	0.283	1.156	-0.406	-1.552
Younger siblings	-1.248	-2.036	0.216	0.970	-1.016	-2.076	0.250	0.964
Village outside Matlab	-8.244	-1.529	-0.611	-0.384	4.517	2.186	4.220	1.410
Tubewell in village	-6.867	-1.875	-0.953	-0.989	1.675	1.239	1.493	1.272
Health facility in village	-7.986	-2.821	-0.864	-1.009	1.818	1.569	2.517	2.050
Industry in village	4.436	1.742	6.149	5.177	-1.587	-1.534	1.927	2.289
Secondary school in village	7.856	2.945	3.548	3.812	-0.018	-0.013	2.417	2.344
Distance to Matlab capital	-0.439	-1.423	-0.360	-3.744	-0.005	-0.053	-0.234	-2.097
q_w	-34.930	-3.490						
q_s			5.923	6.690	7.123	4.314	2.810	2.903

Notes: For all school outcome equations, baseline(1) refers to 6 or more years to complete secondary school, while the reference is 5 years. There is only one case in $S_{ts}(1,1,1)$ that is thus aggregated with $S_{ts}(0,1,1)$.

Table 5. Dynamic Effects of Work on School Progress

	DATE	DTT	DTU
School entry			
$H_e = 1$ Vs $H_e = 0$	-0.2592 (0.042)	-0.1080 (0.046)	-0.2818 (0.046)
Transition to secondary school			
$H_p = (1,1)$ Vs $H_p = (0,1)$	-0.2247 (0.060)	-0.1347 (0.093)	-0.2984 (0.071)
$H_p = (1,1)$ Vs $H_p = (0,0)$	-0.3320 (0.060)	-0.1899 (0.093)	-0.4165 (0.070)
$H_p = (0,1)$ Vs $H_p = (0,0)$	-0.1073 (0.037)	-0.1197 (0.051)	-0.1369 (0.043)
Secondary school completion			
$H_s = (1,1,1)$ Vs $H_s = (0,1,1)$	-0.0395 (0.017)	-0.0289 (0.034)	-0.0966 (0.039)
$H_s = (1,1,1)$ Vs $H_s = (0,0,1)$	-0.0961 (0.048)	-0.0798 (0.066)	-0.1789 (0.088)
$H_s = (1,1,1)$ Vs $H_s = (0,0,0)$	-0.2474 (0.046)	-0.2781 (0.073)	-0.4746 (0.072)
$H_s = (0,1,1)$ Vs $H_s = (0,0,1)$	-0.0566 (0.046)	-0.1037 (0.086)	-0.1113 (0.081)
$H_s = (0,1,1)$ Vs $H_s = (0,0,0)$	-0.2079 (0.048)	-0.3458 (0.081)	-0.4149 (0.072)
$H_s = (0,0,1)$ Vs $H_s = (0,0,0)$	-0.1513 (0.038)	-0.3137 (0.083)	-0.2764 (0.066)

Notes: Standard errors in parentheses.

Table 6. Distribution of q_s Across School Levels by Work History

	School entry			
	$H_e = 1$	$H_e = 0$		
Low type	27.61	4.89		
Middle type	68.80	65.53		
High type	3.60	29.58		
	Primary school			
	$H_p = (1,1)$	$H_p = (0,1)$	$H_p = (0,0)$	
Low type	6.97	1.69	4.84	
Middle type	70.29	59.51	63.71	
High type	22.74	38.80	31.45	
	Secondary school			
	$H_s = (1,1,1)$	$H_s = (0,1,1)$	$H_s = (0,0,1)$	$H_s = (0,0,0)$
Low type	3.87	0.49	0.22	5.45
Middle type	52.23	43.42	54.02	62.29
High type	43.90	56.09	45.75	32.27

Note: Numbers are percentages.

Table 7. Selection into Work by School Level

Unobservables		Observables	
School entry			
$Corr[U_e^w, U_e^s(1)]$	-0.0735	$Corr[b_{ez}^w Z_e, b_{ex}^s X_e(1)]$	-0.4201
$Corr[U_e^w, U_e^s(0)]$	-0.1495	$Corr[b_{ez}^w Z_e, b_{ex}^s X_e(0)]$	-0.3100
Primary school			
$Corr[U_p^w, U_p^s(0,1)]$	0.094	$Corr[b_{pz}^w Z_p, b_{px}^s X_p(0,1)]$	-0.2320
$Corr[U_p^w, U_p^s(0,0)]$	0.054	$Corr[b_{pz}^w Z_p, b_{px}^s X_p(0,0)]$	-0.3786
Secondary school			
$Corr[U_s^w, U_s^s(0,0,1)]$	0.3050	$Corr[b_{sz}^w Z_s, b_{sx}^s X_s(0,0,1)]$	-0.3592
$Corr[U_s^w, U_s^s(0,0,0)]$	0.3010	$Corr[b_{sz}^w Z_s, b_{sx}^s X_s(0,0,0)]$	-0.1026

Table 8. Policy Simulations

Policy 1: No compulsory primary schooling									
School level	Primary	Secondary							
School effect	-0.1934	-0.0229							
Work effect	0.0909	0.0499							
Policy 2: School entry at 6 years of age									
School level	Primary	Secondary							
School effect	0.0776	0.0054							
Work effect	-0.1609	-0.1876							
Policy 3: Secondary school availability									
School level	Entry		Primary			Secondary			
Work History	(1)	(0)	(1,1)	(0,1)	(0,0)	(1,1,1)	(0,1,1)	(0,0,1)	(0,0,0)
School effect	0.3989	0.0531	0.2558	0.1022	-0.0149	0.1903	0.1264	0.0059	0.0657

APPENDIX A
Construction of the Dependent Variables of the Model

School outcomes

The school entry outcome only considers entry up to age 14 (inclusive), beyond which the child is no longer of primary-school age and thus he or she is assumed to be no longer at risk of entering school. Individuals still attending a primary or secondary school only contribute to the estimation sample for that level if they could not have experienced the schooling event in 5 years. For those individuals still attending primary/secondary school, the school outcome looks at each of the years in which the child could have not reached/completed secondary school, being this observation censored after the last year in which the child could not have reached/completed secondary school.

A few points are worth noting. First, the information on the timing of the school events in the primary and secondary school levels is based on the number of repetitions in each level. School delay may also occur as a result of school interruptions. School interruptions may occur before or after completing a grade. In the former case, school interruptions imply grade repetition, although it is likely that some children may not consider those as repetitions. We can get information on school interruptions for the whole period a child was in school but not by school level. For this reason we choose to focus on grade repetition as our measure of school delay. Second, the maximum time to reach/complete secondary school in the sample is 10 years. Third, the school outcome in the primary/secondary school level for individuals who dropped out of school before reaching/completing secondary school is zero for all years considered. Fourth, the consideration of the timing of school events allows us to make use of the information on censored observations that otherwise could not be used. This is particularly important when we estimate the effect of work on schooling, as part of the reason why some children are still in school may lie in the lack of adequate school progress, which may in turn be affected by their work status. If this is the case, then the estimated effects of work on the probability of reaching/completing secondary school may be biased downward to the extent that a significant proportion of these children will never reach/complete secondary school.

Work outcomes

In our sample, all the children who start working in a given level continue working in subsequent levels, that is work is deterministic (i.e. it is 1 with probability 1) in a given level for those who started working in previous levels. For this reason, we do not consider these individuals when estimating the work equation for that level.

It is assumed that if the individual is attending the last grade of the school level considered and reports no work, then he or she is no longer at risk of working during that level, while he or she is considered to be at risk if attending some other grade in that level. Individuals still attending a school level that contribute to the estimation sample do so in the work history reported at the time of the survey.

APPENDIX B
Construction of Model Covariates

Child characteristics that are common to the three levels include sex and age at the time of the survey. Parental characteristics include years of schooling of the mother and the father of the child. Household level variables have several dimensions. Household demographics are summarized by the number of younger siblings and the number of older siblings when the child was 6 years of age, for the entry level, and at the time the child started primary and secondary school, for the primary and secondary levels, respectively. Household productive assets are summarized by whether the household had farm land and non-farm business assets at the time of the survey(for children living with their parents) and either the time of the survey if parents are alive or the time of death if parents are dead (for children living separately). While the amount of land owned or the value of non-farm business assets are likely to change over time, it is less likely that whether the household owns some of these assets changes over time.

Household wealth is summarized by the current value of non-productive assets, such as homestead land, precious metals and savings. In this case, looking at whether the household owns any asset, or a particular asset such homestead land, is not applicable as all households own some kind of asset and most own homestead land. An indicator for whether the household has a modern latrine (i.e. septic or slab latrine) is also included to supplement the household wealth information and as a proxy for the health environment that the child was exposed to during school. This information refers to the time of the survey for children living with their parents and to the time right before leaving the parental home for children living on their own.

Finally, a variety of village level variables are included, such as the presence of a tubewell for drinking water, presence of a modern health facility, village economy diversification (i.e. presence in the village of any mill, factory or workshop), distance to the capital of Matlab, and the presence of primary and secondary schools. Village level variables refer to the period when the child was 6 years of age (for the entry level), and the period prior to completion of or drop out from primary and secondary school (for the primary and secondary levels, respectively). The indicators for the presence of a primary and secondary school in the village are included in the entry and primary levels, but only the latter is included in the secondary level.

The work equations include, in addition, an indicator of whether the household cultivated land (own land, rented or sharecropped) around the time the child was 6 years of age (for the entry level), and around the time the child was in primary and secondary school (for the primary and secondary levels, respectively). This variable is constructed on the basis of the current cultivation status of the household, and the retrospective information on parental occupation.

APPENDIX C
Model Comparison

Table A. Likelihood Ratio Tests and Bayesian Information Criterion

Model	Log-L	Parameters	BIC rank
(1) No heterogeneity	-8586.15	239	3
(2) Normal heterogeneity	-8601.82	248	4
(3) Non-parametric (2 factors)	-8527.37	257	1
(4) Non-parametric (3 factors)	-8512.37	275	2
Likelihood ratio tests			
(1) Vs (2)	NA		
(1) Vs (3)	$\chi^2(18) = 117.56$ (0.000)		
(1) Vs (4)	$\chi^2(36) = 147.57$ (0.000)		
(2) Vs (3)	$\chi^2(9) = 148.91$ (0.000)		
(2) Vs (4)	$\chi^2(27) = 178.91$ (0.000)		
(3) Vs (4)	$\chi^2(18) = 30.00$ (0.000)		

Notes: BIC rank goes from best to worst. Values in parentheses are p-values.

(NOT FOR PUBLICATION)

APPENDIX D
Model Without Unobserved Heterogeneity

Table D.1. School Entry Level

	Work equation		School equations			
	W_{te}		$S_{te}(0)$		$S_{te}(1)$	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
Intercept	-6.353	-5.205	-5.348	-13.823	-5.782	-0.998
Baseline hazard (1)	2.916	3.151	1.421	12.145	1.516	0.725
Baseline hazard (2)	3.420	3.743	2.304	19.984		
Baseline hazard (3)	4.006	4.479	2.773	23.238		
Baseline hazard (4)	6.983	8.275	2.578	19.839		
Baseline hazard (5)	5.375	6.184	2.844	20.562		
Baseline hazard (6)	7.410	8.741	1.877	9.642		
Baseline hazard (7)	6.766	7.892	1.643	7.377		
Baseline hazard (8)			-0.132	-0.315		
Girl	-1.005	-5.873	-0.298	-4.834	0.672	0.904
Age	0.005	0.193	0.024	2.317	-0.383	-2.932
Mother’s education	0.077	1.299	0.116	7.942	0.207	0.979
Father’s education	0.039	1.306	0.069	7.673	0.126	0.977
Household assets missing	-1.620	-1.999	0.293	0.823	6.982	1.237
Log(household assets)	-0.191	-2.480	0.033	1.039	0.552	1.100
Modern latrine	0.058	0.254	0.513	7.812	1.787	2.078
Cultivating household	0.176	1.030				
Owns farm land	0.234	1.497	0.404	5.670	0.011	0.010
Owns non-farm business	0.031	0.207	0.082	1.399	0.479	0.586
Older siblings	-0.063	-1.560	-0.008	-0.514	0.214	1.322
Younger siblings	0.156	2.067	-0.003	-0.089	0.373	1.139
Village outside Matlab	0.190	0.611	0.392	2.698	-2.399	-1.286
Tubewell in village	-0.101	-0.571	0.177	2.455	-0.512	-0.676
Health facility in village	-0.716	-0.865	0.935	13.379	2.838	1.279
Industry in village	-0.111	-0.502	0.257	3.030	1.581	2.273
Primary school in village	-0.125	-0.831	0.010	0.144	-0.072	-0.093
Secondary school in village	-0.777	-1.201	0.523	6.686	2.144	1.246
Distance to Matlab capital	-0.008	-0.518	-0.033	-4.914	-0.031	-0.385
Log-L	-8586.153					

Notes: See notes to table 4.1.

Table D.2. Primary School Level

	Work equation		School equations					
	W_{tp}		$S_{tp}(0,0)$		$S_{tp}(0,1)$		$S_{tp}(1,1)$	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
Intercept	-1.458	-1.678	-5.281	-5.221	-2.944	-1.973	-3.137	-1.926
Baseline hazard (1)			-4.217	-25.905	-3.407	-16.024		
Girl	-0.015	-0.086	-0.507	-2.791	0.365	1.212		
Age	-0.029	-0.965	0.200	5.583	0.131	2.582		
School entry age	0.196	4.386	-0.350	-6.683	-0.356	-4.408		
Compulsory school policy	-0.497	-2.633	1.232	5.557	0.385	1.215		
Free tuition policy	-0.040	-0.198	0.332	1.403	0.667	1.977		
Free tuition policy * girl	-0.025	-0.109	0.742	2.807	-0.076	-0.193		
Mother’s education	-0.055	-2.013	0.128	3.848	0.186	3.723		
Father’s education	-0.038	-2.211	0.101	4.944	0.030	1.049		
Household assets missing	-0.759	-1.046	2.355	2.833	0.164	0.132		
Log(household assets)	-0.111	-1.761	0.281	3.837	0.121	1.143		
Modern latrine	0.036	0.295	0.469	3.292	0.814	3.631		
Cultivating household	0.321	2.108						
Owns farm land	0.313	1.924	0.336	2.104	0.125	0.473		
Owns non-farm business	0.433	3.790	0.257	1.923	0.459	2.318		
Older siblings	-0.034	-1.178	-0.010	-0.303	0.166	2.971		
Younger siblings	0.002	0.027	0.011	0.152	0.289	3.039		
Village outside Matlab	0.242	0.792	1.128	3.348	-1.353	-2.232		
Tubewell in village	0.085	0.539	0.614	3.568	0.119	0.455		
Health facility in village	0.289	2.156	0.776	5.189	-0.115	-0.505		
Industry in village	-0.064	-0.508	0.277	1.875	0.101	0.494		
Primary school in village	0.030	0.206	-0.350	-2.093	-0.124	-0.485		
Secondary school in village	-0.226	-1.658	-0.271	-1.770	0.451	1.939		
Distance to Matlab capital	0.041	3.224	-0.027	-1.715	-0.013	-0.587		

Notes: See notes to table 4.2.

Table D.3. Secondary School Level

	Work equation		School equations					
	W_{ts}		$S_{ts}(0,0,0)$		$S_{ts}(0,0,1)$		$S_{ts}(0,1,1)/S_{ts}(1,1,1)$	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
Intercept	5.665	3.478	-7.302	-2.924	-10.644	-2.949	-22.623	-3.405
Baseline hazard (1)			-4.401	-11.189	-3.373	-8.629	-3.658	-5.900
Girl	-0.389	-1.296	-1.334	-3.041	0.051	0.091	-0.046	-0.053
Age	-0.099	-1.766	0.299	3.166	0.303	2.561	0.556	2.633
School entry age	0.078	1.060	-0.339	-2.984	-0.626	-3.593	-0.577	-2.658
Grade repetitions in primary	0.343	1.486	-0.236	-0.568	-2.675	-1.845	-1.792	-1.917
Free tuition policy	-0.922	-2.678	-0.438	-0.865	2.207	3.237	1.291	1.161
Free tuition policy * girl	0.288	0.819	2.456	4.526	-1.732	-2.327	0.124	0.112
Mother's education	-0.042	-1.214	0.328	5.688	0.238	3.110	-0.035	-0.288
Father's education	0.011	0.419	0.014	0.372	0.028	0.475	-0.023	-0.300
Household assets missing	-2.698	-2.322	0.091	0.052	4.545	1.791	9.879	2.470
Log(household assets)	-0.315	-3.112	0.155	1.061	0.559	2.530	1.013	2.911
Modern latrine	0.076	0.418	0.034	0.124	0.199	0.507	-0.699	-1.249
Cultivating household	0.223	0.995						
Owns farm land	-0.232	-0.855	0.247	0.655	-0.373	-0.722	-0.100	-0.135
Owns non-farm business	0.534	2.924	0.144	0.516	-0.141	-0.394	0.220	0.409
Older siblings	-0.077	-1.616	0.167	2.432	0.132	1.467	-0.294	-1.849
Younger siblings	0.005	0.076	0.024	0.226	0.177	1.237	0.383	1.934
Village outside Matlab	-0.677	-1.494	0.818	1.047	0.494	0.538	2.763	1.506
Tubewell in village	-0.130	-0.503	0.300	0.734	0.132	0.212	1.795	2.117
Health facility in village	-0.626	-2.589	-0.364	-0.945	0.129	0.289	0.323	0.512
Industry in village	0.279	1.376	1.111	3.423	1.050	2.393	1.193	2.083
Secondary school in village	0.014	0.073	0.648	2.116	-1.678	-3.389	1.304	2.133
Distance to Matlab capital	-0.030	-1.334	0.040	1.143	0.050	1.083	-0.094	-1.657

Notes: See notes to table 4.3.

(NOT FOR PUBLICATION)

APPENDIX E
Model with Normal Heterogeneity

Table E.1. School Entry Level

	Work equation		School equations			
	W_{te}		$S_{te}(0)$		$S_{te}(1)$	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
Intercept	-6.338	-4.621	-5.463	-11.643	-5.109	-0.902
Baseline hazard (1)	2.751	2.971	1.669	13.447	1.421	0.704
Baseline hazard (2)	3.189	3.479	2.824	22.857		
Baseline hazard (3)	3.728	4.141	3.521	27.378		
Baseline hazard (4)	6.858	8.016	3.456	24.642		
Baseline hazard (5)	5.277	5.970	3.881	25.946		
Baseline hazard (6)	7.489	8.609	2.910	14.005		
Baseline hazard (7)	6.946	7.861	2.696	11.408		
Baseline hazard (8)			0.831	1.921		
Girl	-1.025	-4.881	-0.387	-5.104	0.626	0.824
Age	0.005	0.165	0.015	1.196	-0.387	-2.910
Mother's education	0.041	0.574	0.158	8.961	0.253	1.138
Father's education	0.030	0.808	0.102	9.325	0.149	1.128
Household assets missing	-2.034	-2.021	-0.250	-0.561	6.693	1.240
Log(household assets)	-0.228	-2.378	-0.033	-0.830	0.520	1.078
Modern latrine	-0.020	-0.072	0.554	6.921	1.841	2.127
Cultivating household	0.240	1.160				
Owns farm land	0.151	0.765	0.575	6.481	0.138	0.176
Owns non-farm business	0.027	0.151	0.129	1.766	0.530	0.673
Older siblings	-0.079	-1.624	0.025	1.351	0.256	1.548
Younger siblings	0.161	1.756	0.018	0.429	0.350	1.046
Village outside Matlab	0.185	0.488	0.394	2.217	-2.341	-1.234
Tubewell in village	-0.149	-0.695	0.203	2.327	-0.431	-0.551
Health facility in village	-0.542	-0.642	0.998	12.000	3.063	1.394
Industry in village	-0.190	-0.716	0.227	2.201	1.707	2.352
Primary school in village	-0.159	-0.864	0.023	0.264	-0.081	-0.104
Secondary school in village	-0.730	-1.062	0.725	7.617	2.285	1.376
Distance to Matlab capital	-0.006	-0.304	-0.043	-5.014	-0.040	-0.499
q_w	1.000					
q_s			0.600	1.052	1.000	
$Corr(q_w, q_s)$	-0.964	-1.923				
Log-L	-8601.824					

Notes: See notes to table 4.1.

Table E.2. Primary School Level

	Work equation		School equations					
	W_{tp}		$S_{tp}(0,0)$		$S_{tp}(0,1)$		$S_{tp}(1,1)$	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
Intercept	-1.824	-2.020	-19.571	-6.995	-17.316	-4.314	-12.724	-2.833
Baseline hazard (1)			-2.486	-8.607	0.047	0.090		
Girl	-0.003	-0.015	-0.254	-0.570	2.865	1.733		
Age	-0.035	-1.109	0.311	3.869	0.457	2.250		
School entry age	0.247	4.846	-0.068	-0.616	-0.740	-2.329		
Compulsory school policy	-0.527	-2.729	3.515	4.768	-1.527	-1.067		
Free tuition policy	-0.029	-0.138	0.563	1.039	7.596	4.805		
Free tuition policy * girl	-0.058	-0.246	0.986	1.585	-7.804	-2.984		
Mother's education	-0.048	-1.722	0.341	4.749	2.663	5.403		
Father's education	-0.030	-1.696	0.544	6.048	0.518	3.833		
Household assets missing	-0.873	-1.179	5.230	2.085	-22.619	-3.117		
Log(household assets)	-0.125	-1.926	0.658	2.938	-1.488	-2.771		
Modern latrine	0.043	0.344	1.057	2.998	8.292	4.851		
Cultivating household	0.327	2.104						
Owns farm land	0.358	2.140	2.350	4.221	4.623	3.446		
Owns non-farm business	0.456	3.892	1.665	3.058	1.942	2.083		
Older siblings	-0.027	-0.924	0.048	0.493	3.688	4.875		
Younger siblings	0.012	0.211	0.144	1.028	4.773	4.853		
Village outside Matlab	0.262	0.840	4.323	3.963	-10.937	-4.083		
Tubewell in village	0.089	0.556	1.946	4.160	-0.574	-0.977		
Health facility in village	0.344	2.466	2.868	5.935	1.993	3.088		
Industry in village	-0.057	-0.444	0.626	1.717	8.110	5.104		
Primary school in village	0.016	0.104	-0.599	-1.843	-7.615	-4.165		
Secondary school in village	-0.176	-1.254	-0.219	-0.662	11.766	4.502		
Distance to Matlab capital	0.039	3.037	-0.184	-3.848	-0.258	-2.317		
q_w	-0.326	-1.737						
q_s			4.754	7.026	16.593	5.420		

Notes: See notes to table 4.2.

Table E.3. Secondary School Level

	Work equation		School equations					
	W_{ts}		$S_{ts}(0,0,0)$		$S_{ts}(0,0,1)$		$S_{ts}(0,1,1)/S_{ts}(1,1,1)$	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
Intercept	7.544	3.233	-30.685	-2.553	-38.910	-4.543	-28.497	-2.950
Baseline hazard (1)			-2.799	-4.635	-0.597	-0.860	-3.644	-5.743
Girl	-0.395	-1.136	-7.802	-2.764	1.525	1.789	-0.027	-0.030
Age	-0.088	-1.372	0.454	1.923	0.418	1.636	0.626	2.528
School entry age	-0.071	-0.665	0.764	1.823	0.339	1.454	-0.337	-1.154
Grade repetitions in primary	0.006	0.019	4.764	2.823	-0.321	-0.199	-1.641	-1.691
Free tuition policy	-0.917	-2.240	-2.841	-2.277	4.713	3.797	1.577	1.272
Free tuition policy * girl	0.257	0.640	10.199	2.830	-8.518	-5.888	-0.082	-0.071
Mother's education	-0.087	-1.864	1.728	3.197	2.072	4.230	0.098	0.568
Father's education	-0.024	-0.739	0.527	3.101	0.725	3.884	0.010	0.116
Household assets missing	-2.725	-2.002	-6.200	-1.470	-0.662	-0.399	9.165	2.075
Log(household assets)	-0.323	-2.655	-0.130	-0.356	0.471	3.028	0.990	2.566
Modern latrine	0.038	0.187	1.082	1.724	1.142	1.499	-0.457	-0.733
Cultivating household	0.216	0.863						
Owns farm land	-0.361	-1.133	1.526	1.574	1.063	1.825	0.163	0.205
Owns non-farm business	0.407	1.902	2.924	2.946	1.333	2.033	0.363	0.609
Older siblings	-0.106	-1.818	1.078	2.786	1.159	3.331	-0.216	-1.150
Younger siblings	-0.008	-0.098	0.218	0.973	0.669	2.684	0.446	1.939
Village outside Matlab	-0.798	-1.495	0.341	0.153	-0.192	-0.073	3.183	1.589
Tubewell in village	-0.155	-0.527	-0.258	-0.318	3.475	2.219	1.954	2.089
Health facility in village	-0.861	-2.615	2.156	1.905	-0.048	-0.044	0.511	0.721
Industry in village	0.308	1.322	2.302	3.118	2.517	2.582	1.531	2.222
Secondary school in village	-0.088	-0.382	2.732	3.274	0.986	0.866	1.773	2.187
Distance to Matlab capital	-0.021	-0.799	0.091	1.275	-0.448	-2.982	-0.093	-1.529
q_w	0.928	1.461						
q_s			8.041	3.463	10.760	4.526	1.219	1.141

Notes: See notes to table 4.3.

APPENDIX F
Model with Three-Factor Non-Parametric Heterogeneity

Table F.1. Entry Level

	Work equation		School equations			
	W_{te}		$S_{te}(0)$		$S_{te}(1)$	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
Intercept	-6.484	-4.556	-6.530	-12.244	-4.955	-0.847
Baseline hazard (1)	2.902	3.109	1.732	13.504	1.544	0.729
Baseline hazard (2)	3.383	3.620	2.938	22.990		
Baseline hazard (3)	3.970	4.257	3.658	27.340		
Baseline hazard (4)	7.064	7.604	3.617	23.751		
Baseline hazard (5)	5.477	5.646	4.017	23.978		
Baseline hazard (6)	7.734	7.526	3.088	13.117		
Baseline hazard (7)	7.231	6.736	2.881	10.736		
Baseline hazard (8)			1.118	2.236		
Girl	-1.039	-4.675	-0.382	-4.638	0.815	0.983
Age	0.023	0.688	0.026	1.830	-0.402	-2.906
Mother’s education	0.051	0.680	0.137	7.529	0.192	0.849
Father’s education	0.055	1.325	0.086	7.600	0.112	0.825
Household assets missing	-2.322	-2.086	0.512	1.024	6.449	1.165
Log(household assets)	-0.251	-2.397	0.052	1.171	0.497	1.004
Modern latrine	0.008	0.012	0.647	7.597	1.711	1.935
Cultivating household	0.227	1.073				
Owns farm land	0.275	1.193	0.518	5.471	0.059	0.074
Owns non-farm business	0.052	0.248	0.133	1.584	0.498	0.618
Older siblings	-0.056	-0.966	-0.011	-0.603	0.257	1.547
Younger siblings	0.159	1.688	0.016	0.352	0.328	0.935
Village outside Matlab	0.205	0.527	0.494	2.620	-2.404	-1.251
Tubewell in village	-0.132	-0.593	0.183	1.864	-0.450	-0.557
Health facility in village	-0.580	-0.691	1.214	10.569	3.497	1.536
Industry in village	-0.147	-0.548	0.275	1.783	1.707	2.298
Primary school in village	-0.211	-1.092	0.040	0.282	-0.168	-0.205
Secondary school in village	-0.823	-1.188	0.607	5.999	1.837	1.089
Distance to Matlab capital	-0.015	-0.705	-0.035	-2.629	-0.027	-0.332
q_w	1.000					
q_s			1.000		1.000	
$Corr(q_w, q_{s0})$	-0.103					
$Corr(q_w, q_{s1})$	-0.732					
$Corr(q_{s0}, q_{s1})$	0.132					
Log-L	-8512.369					

Notes: See notes to table 4.1.

Table F.2. Primary School Level

	Work equation		School equations					
	W_{tp}		$S_{tp}(0,0)$		$S_{tp}(0,1)$		$S_{tp}(1,1)$	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
Intercept	-2.149	-1.756	-6.942	-4.236	-14.742	-1.996	-10.914	-1.323
Baseline hazard (1)			-4.152	-22.125	-0.531	-0.893		
Girl	-0.012	-0.057	-0.613	-2.909	0.484	0.489		
Age	-0.027	-0.793	0.200	5.176	0.671	2.697		
School entry age	0.226	3.509	-0.221	-2.298	-1.705	-4.388		
Compulsory school policy	-0.497	-2.375	1.286	5.360	2.483	1.489		
Free tuition policy	-0.059	-0.249	0.294	1.183	5.494	2.349		
Free tuition policy * girl	-0.017	-0.057	0.804	2.857	-4.262	-1.295		
Mother’s education	-0.070	-2.278	0.144	3.712	1.502	5.156		
Father’s education	-0.040	-2.070	0.121	4.543	0.046	0.371		
Household assets missing	-0.737	-0.926	2.535	2.865	-9.388	-2.206		
Log(household assets)	-0.110	-1.602	0.301	3.822	-0.527	-1.529		
Modern latrine	0.067	0.484	0.585	3.366	7.395	5.546		
Cultivating household	0.350	2.120						
Owns farm land	0.375	2.063	0.445	2.332	3.284	3.464		
Owns non-farm business	0.488	3.850	0.295	2.059	4.333	2.907		
Older siblings	-0.045	-1.414	-0.015	-0.431	0.736	3.726		
Younger siblings	-0.016	-0.253	0.026	0.359	-0.325	-1.046		
Village outside Matlab	0.425	1.139	1.345	3.261	0.283	0.086		
Tubewell in village	0.175	0.985	0.645	3.464	5.059	3.732		
Health facility in village	0.332	2.006	0.955	4.415	0.631	0.557		
Industry in village	-0.104	-0.757	0.294	1.897	-1.308	-2.031		
Primary school in village	0.151	0.908	-0.304	-1.723	1.267	0.620		
Secondary school in village	-0.175	-1.161	-0.197	-1.192	5.619	2.975		
Distance to Matlab capital	0.049	3.372	-0.025	-1.478	-0.214	-2.441		
q_w	-0.759	-4.548						
q_s			0.545	1.304	10.192	6.189		

Notes: See notes to table 4.2.

Table F.3. Secondary School Level

	Work equation		School equations					
	W_{ts}		$S_{ts}(0,0,0)$		$S_{ts}(0,0,1)$		$S_{ts}(0,1,1) / S_{ts}(1,1,1)$	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
Intercept	6.251	0.555	-34.584	-2.481	-47.513	-3.747	-23.346	-1.020
Baseline hazard (1)			-2.686	-3.033	-0.466	-0.690	-3.658	-5.303
Girl	-7.434	-3.412	-13.077	-3.630	-2.580	-1.611	-0.033	-0.017
Age	-0.308	-0.978	0.747	1.086	0.356	1.351	0.576	1.134
School entry age	2.943	3.552	0.146	0.207	-1.374	-2.680	-0.582	-2.272
Grade repetitions in primary	3.312	2.782	-1.361	-0.898	-10.947	-3.210	-1.847	-0.248
Free tuition policy	-13.039	-3.702	-3.653	-1.665	5.092	3.116	1.382	0.532
Free tuition policy * girl	15.685	4.099	17.978	3.160	-4.585	-2.475	0.082	0.038
Mother’s education	-1.614	-4.127	1.507	3.691	1.511	4.451	-0.040	-0.050
Father’s education	0.616	3.333	0.368	1.478	0.213	1.182	-0.024	-0.123
Household assets missing	-18.705	-2.712	-4.380	-0.309	12.966	1.468	10.216	2.130
Log(household assets)	-2.188	-3.132	0.278	0.312	1.895	2.407	1.044	2.875
Modern latrine	1.117	1.387	1.729	1.862	-2.476	-1.974	-0.715	-0.142
Cultivating household	3.730	2.008						
Owns farm land	-1.346	-0.677	6.655	1.355	5.560	3.038	-0.089	-0.043
Owns non-farm business	7.635	3.854	3.089	2.999	3.360	2.925	0.213	0.067
Older siblings	-1.853	-3.775	0.576	2.132	0.002	0.005	-0.299	-1.427
Younger siblings	0.281	0.741	0.020	0.067	-1.268	-2.153	0.393	0.938
Village outside Matlab	1.638	0.519	2.872	1.594	8.144	2.982	2.796	0.709
Tubewell in village	4.741	2.484	-0.881	-0.581	1.002	0.724	1.812	0.452
Health facility in village	-2.516	-2.399	2.575	2.089	5.541	3.777	0.308	0.200
Industry in village	-0.821	-0.784	2.757	2.511	-2.914	-2.436	1.220	1.744
Secondary school in village	7.211	3.832	2.503	2.573	-2.380	-1.924	1.322	0.320
Distance to Matlab capital	0.390	2.647	0.363	2.860	-0.025	-0.172	-0.095	-1.515
q_w	-15.387	-4.260						
q_s			10.208	1.822	17.157	4.488	-0.081	-0.004

Notes: See notes to table 4.3.