Ramadan School Holidays as a Natural Experiment: Impacts of Seasonality on School Dropout in Bangladesh

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ABSTRACT School academic calendar not accommodating the agricultural cycles may hamper the educational outcomes and may leads to dropouts for agrarian economies. In Bangladesh, the *Aman* paddy harvesting season typically coincides with the annual final exam schedules of schools in December. However, in the year 2000, Ramadan school vacation was in December which forced schools to pre-pone their final exam schedules in November, which was the month before the harvest begins. "Ramadan 2000" is a natural experiment that reduced the labour demand for children during the exam period. Using household level panel data of 2000 and 2003, and after controlling for various unobservable variations including individual fixed effects, aggregate year effects, and subdistrict-level year effects, this paper finds evidence of statistically significant impacts of seasonal labour demand on school dropout in Bangladesh among the children from agricultural households. The results shown in this paper can provide foundation for reconsidering the school calendar that is consistent with agrarian calendar and seasonal local labor market conditions.
KEYWORDS: Dropout, child labor, seasonal labor demand, school calendar, Ramadan
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1 Introduction

Bangladesh is aiming to achieve the two Millennium Development Goals (MDGs) related to education by 2015, one of which is to ensure the primary education for all school-aged children (6-10 years). The Government of Bangladesh has taken a few initiatives which have reportedly increased the net enrollment rates (NER) for the primary school-age children. For instance, the net enrolment rate of primary school was about 60% in 1990, which has gradually increased by an additional 20% points within a decade (BBS and UNICEF, 2000; Chowdhury et al., 2002) and the latest statistics shows that the NER has reached 88.4% in 2008 (UN, 2011). However, base line survey conducted by the Department of Primary Education (DPE) of Bangladesh reveals that the primary education dropout rates in both Government Primary Schools (GPS) as well as Registered Non-Government Primary Schools (RNGPS) have increased from 33% in 2002 to 47.2% in 2006 and an alarming 50.5% in 2007 (DPE, 2008, 2009). This means that almost half of the students who enrolled in class 1 will not be able to finish their primary education, indicating a loss of resources which is termed as a 'colossal waste' (pg. 59) by an independent watch dog group of MDGs in Bangladesh (PFM, 2008).

The dropout is even more wasteful if it is caused by market imperfections. Dropout is a part of school enrollment decisions, and the recent enrollment literature has mainly focused on the impacts of two market imperfections, namely, credit constraints and imperfect substitution of family and hired labor in conjunction with land market imperfections. This strand of literature estimates cross effects of income shocks and market imperfections, as in Jacoby and Skoufias (1997) who contrasted differential schooling implications of income shocks on small and large farm households. Beegle et al. (2006) use self-reported crop loss and show they increase child labor and decrease enrollment, and poorer households run down asssets while wealthier increase borrowing. Jacoby (1994) has shown that children from households with more durables are less likely to fall behind in school, and splitting households based on likelihood of borrowing magnifies the results. Child labor in relation to labor and land market imperfections, together with credit constrainedness, are examined in Bhalotra and Heady (2003). As land can have both wealth effects (luxry axiom a là Basu and Van, 1998) and increased marginal labor product effects, the sign of estimate on land can go either way. Using cross-sectional data from Ghana and Pakistan, authors find positive impacts of land on child labor, indicating labor and land market imperfections.

Other works have maintained Walrasian equilibrium framework and examined the role of technological and price changes on schooling. Rosenzweig and Evenson (1977) find negative estimates of child schooling on child wage and yield variations. Foster and Rosenzweig (1996) estimate the effects of persistent change in productivity on schooling after the Green Revolution, and find higher schooling in areas with more rapid yield growth. Foster and Rosenzweig (2004) show that such impacts are different between landed and landless households. Rosenzweig (1990) finds, by simple difference-in-differences comparison, that schooling growth rates are higher for areas under Green Revolution than other areas, despite real wage growth rates were higher in the former.

As will be discussed in the later section, our paper seeks to understand the schooling impacts of change in labor demand or child wage rates. So it is considered to be following the traditional Walrasian equilibrium framework in that regard. On the other hand, what we will be estimating is the impacts of qualifying exam period coinciding with the paddy harvest season. If it is a pure price effect that prompts children to dropout, then the wage increase must be large enough to offset the future income losses from discontinued schooling. As returns to schooling is considered to be high, estimated impacts should be understood as a composite of wage change and credit constrainedness. In this regard, we are following the market imperfection strand of the literature.

Previous literature focused on dropout has identified many potential factors which is crucial in triggering the process of school dropout in developing countries. These factors could be broadly classified as individual, household, school and government specific along with natural disasters driven elements. Individual specific issues that affect dropout are mainly ill-health, under-nutrition (Glewwe and Jacoby, 1995; Alderman et al., 2001) and lack of motivation (Hunt, 2008). Household levels factors are mainly poverty (Hunter and May, 2003), child labor (Sabates et al., 2010), migration (Hunt, 2008) and parental illiteracy (UNESCO, 1984), attitude and death (Case and Ardington, 2006). A notable number of papers have reported negative impacts of traditional beliefs and religiosity as well as adolescent marriage and pregnancy on girls education and dropout (Colclough et al., 2000; Dunne et al., 2005; Cardoso and Verner, 2006; Bandyopadhyay and Subrahmanian, 2008; Grant and Hallman, 2008; Hossain, 2010, to name a few). Other discussed factors are teacher absenteeism (Banerjee and Duflo, 2006), school location and distance, poor quality educational provision (Harbison and Hanushek, 1992), natural disaster and rehabilitation (DPE, 2009).

One rarely studied cause of dropout is the seasonal labor demand in the agricultural sector. Poor rural children from agricultural households are often needed by their families for labor purposes, especially during the peak harvesting seasons. Seasonal labor demand is known to lead to high dropout rates in rural areas (Hadley, 2010). The situation gets even critical when the peak harvesting season coincides with school exam schedules.

Since independence, schooling system in Bangladesh follows the English calender year as the academic calender without accommodating the agrarian calender. As a consequence, seasonal agricultural labor demand regularly hampers poor agricultural household children which leads to extended absenteeism from school. This absenteeism becomes crucial when it affects the final exam preparation, because progression to the next class is usually given on the basis of satisfactory results of the annual examination held at the end of each academic year (BANBEIS, 2007).

Unfortunately, the typical exam period in primary and secondary schools usually coincides with the peak harvesting of wet season paddy called *Aman*. *Aman* has the largest coverage in terms of area and has the second highest yield in Bangladesh. *Aman* is usually harvested during the period of late November to early January, and the labor demand for the harvesting reaches its peak during December. During the harvesting season poor households can not afford to hire external labor to help them with the harvesting procedure. As a result, children from agricultural households get engaged in harvesting and spend less time in preparing for the final exams, which might result in failing and eventually dropping out of the schools. Moreover, children involved in harvesting procedure face frequent injuries which also hamper their exam preparation.

With publication of a handful of anecdotal papers (Ardt et al., 2005; CAMPE, 2004, 2008; DPE, 2009), importance of seasonal labor impacts on dropout is widely acknowledged by practitioners.[*1] However, academic literature, with an exception of Sabates et al. (2010), has paid a relatively sparse attention, and such impacts are rarely examined. This is partly due to difficulty in finding valid instrumental variables to be used in rigorous assessment, because local seasonal labor demand or local productivity shocks are not readily observable.

The aim of this paper is to rigorously identify the impacts of seasonal labor demand on school enrollment choices. Our assessment takes an advantage of the overlap between peak seasonal labor demand period and exam period. An ideal way to conduct such impact evaluation research is to employ a randomized control trial (RCT). However, implementing a RCT in this context, assigning different exam schedules to different individuals, will be difficult and costly, as it must randomize at school levels which necessitates a large scale operation. Instead of a RCT, this paper utilizes Ramadan holidays as a natural experiment that shifted the exam period ahead of peak seasonal labor demand period.

Bangladesh is predominantly a muslim country and during the time of Ramadan, schools are closed for holidays to accommodate Ramadan activities for children. Since Islamic months follow the lunar calendar, the schedule of Ramadan drifts each solar year by 11 to 12 days. Interestingly, in the year of 2000, Ramadan was celebrated during the month of December, as a result schools had to pre-pone their final exam schedules in November which did not overlap with the peak seasonal labor demand period for *Aman* paddy. Three years later, due to shifting Ramadan period, Ramadan in 2003 was celebrated during November. Schools were closed in November, all the final exams were scheduled in December which entirely overlapped with the Aman harvesting season. This makes year 2003 as an ideal candidate for counterfactual of Ramadan in 2000, and data from both years will provide outcomes of a natural experiment that reduced the labor demand for children during the exam period. This paper uses 2000-2003 longitudinal data set to estimate the impact of such overlapping seasonal labor demand and academic calender on school dropout in Bangladesh.

Consistent with our assumption that children from agricultural households are more affected than children from non-agricultural households by increased agricultural labor demand in 2003, we find evidence that more children from agricultural households have dropped out by 2003 than children from non-agricultural households. Enrollment rates also decrease between 2000 and 2003 as one progresses through school, but they decrease more for agricultural households. This tendency remains unchanged after we control for variations at various levels. Our estimates confirmed our hypothesis that rescheduling exam period off the peak seasonal labor demand period decreases dropouts (increases enrollment).

In the next section, we will show how we can systematically consider about enrollmemt/dropout decisions using a simple dynamic model. In Section 3, we present identification strategy, discuss potential confounding factors and our ideas on how we can separate them in the estimation. In Section 4, we use descriptive statistics to examine data and explain about how we select samples. Section 5

[*1] In a recent comprehensive study to find the reasons for rising dropout in Bangladesh, (DPE, 2009) reports that after poverty, child labor is the second most frequently cited cause of dropout. Since poverty and child labor go simultaneously in Bangladesh, academic calender not facilitating the seasonal labor demand may also has contributed to the rising rate of dropout.

gives estimated results and Section 6 concludes our analysis.

2 Model

It is a simple task to describe impacts of reduced seasonal labor demand, as a consequence of Ramadan coinciding with exam period in 2000, in a theoretical model. Consider an individual living for 2 periods. In the first period, she faces a trade-off in choosing the optimal hours l in schooling over work $1-l$. If she chooses to go to school for l hours, she receives an income according to production function $h(1-l)$, and her second period income y increases at rate $e(l) > 0$ with $e(0) = 1$. We let a multiplicative term $\frac{1}{1+aD}$ with $a > 0$ which measures the productivity change to enter production, where in off-harvest seasons D takes the value of 1, and 0 otherwise. Rewriting $\frac{1}{1+aD} = m$, individual's problem is:

$$\begin{aligned} \max_{\{c_1,c_2,l\}} \quad & u(c_1) + \beta u(c_2) \\ \text{s.t.} \quad & mh(1-l) = c_1 + s \\ & e(l)y + Rs = c_2 \end{aligned} \tag{1}$$

where we denoted c_t as period t consumption, $\beta \in (0, 1]$ as a discount factor, s as saving, y as second period base income, and $R > 0$ as an interest rate factor. Upon substitution, this is equivalent to:

$$\max_{\{s,l\}} \quad u[mh(1-l) - s] + \beta u[e(l)y + Rs]$$

First order conditions (FOCs) are, assuming positive saving:

$$\begin{aligned} -u'(c_1) + \beta R u'(c_2) &= 0, \\ -mh'(1-l)u'(c_1) + \beta e'(l) y u'(c_2) &= 0. \end{aligned}$$

The second FOC shows that individuals equate marginal utility loss of income in the period 1 due to schooling to marginal utility gain due to increased income in the second period. Substituting the first FOC into the second FOC, we have[*2]:

$$e'(l) = \tfrac{R}{y} mh'(1-l). \tag{2}$$

If there is a uniform market wage rate w, then at the equilibrium without any factor market imperfection, we must have $w = mh'(1-l)$. Then the above becomes

$$e'(l) = \tfrac{R}{y} w. \tag{3}$$

Let us assume that the return to schooling e and production h are strictly concave functions. Assume also that regularity conditions $\lim_{l\to 0} e'(l) = \infty$ and $\lim_{l \to 0} h'(1-l) = \bar{h} > 0$ hold.[*3] Then, we know that there

[*2] We can alternatively rewrite (2) as:

$$g(l) = \tfrac{R}{y} m, \qquad g(l) \overset{\text{def}}{=} \tfrac{e'(l)}{h'(1-l)}, \; g' < 0.$$

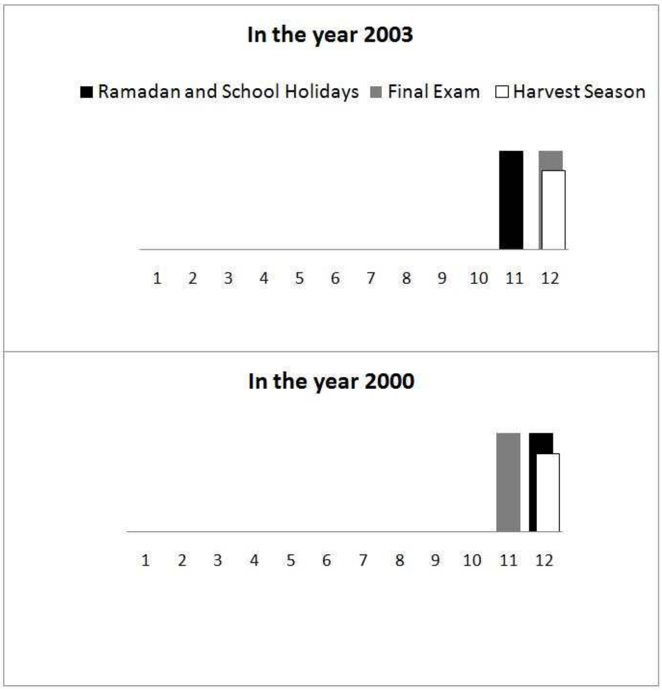
Taking an inverse function will show that l^* is a nonlinear function in arguments of RHS functions to which later approximate by log-linearization. In the case of (3), this is equivalent to a wage rate decrease. Log-linearization of this gives

$$l \simeq= l^* + a_1(R - R^*) + a_2(y - y^*) + (m - m^*),$$

which gives the basis for the estimation equation.

[*3] These assure $l^* > 0$ to exist. Given that almost everyone goes to school to some extent, and Government of Bangladesh introduced compulsory primary education in 1991, these conditions are not a bad description of reality.

Figure 1: Ramadan, Exam Period, and Harvest Period in 2000 and 2003



exists $l^* > 0$ that satisfy FOCs, because LHS of (2) is increasing while RHS is decreasing in l. When $D = 1$ and $m < 1$, the marginal productivity of labor gets smaller and l^* becomes larger.

The impact of having Ramadan during the harvest season is equivalent to a decrease in productivity or wage rates in this model. Harvest season coincides with year-end exam period 2003. In 2000, however, Ramadan holiday was during the harvest season. This led schools to pre-pone the exams to before the harvest begins. Hence the individuals faced a lower marginal labor productivity/wage during the exam period in 2000 than in 2003. This can be expressed as having lower values for m. If we compare between agricultural and non-agricultural households, we will be able to identify Ramadan impact on enrollment if $\Delta m_{ag} \geqslant \Delta m_{nonag}$ where $\Delta m \equiv m_{2003} - m_{2000}$.

Noting that passing the exam is critical to the future increase in incomes, individuals' future incomes crucially depend on the hours spent for the exam before and during the exam period. As the individuals face lower wage rates, it allowed them to concentrate their efforts in exam preparation, or to choose a larger l^*.

3 Identification Strategy

As noted, Ramadan driven school holidays in 2000 forced schools to pre-pone the exam to November, when *Aman* harvest has not begun. In Figure 1, schematic explanation of timing is given. In 2000, exam period and harvest period did not overlap. In 2003, Ramadan and school holidays preceded the period when exams and harvest took place concurrently. For students (and their parents) who were preparing for the exams, this implies that they were facing lower wage rates or smaller seasonal labor demand during the exam period of 2000 than in 2003. It is this variation we utilize to identify the impacts of smaller labor demand during the exam period.

By taking log-linear approximation of (2), the base estimation equation can be written as:

$$y_{i,t} = \boldsymbol{\beta}'\mathbf{x}_{it} + \gamma r_{i,t} D_i + \delta r_{i,t} + v_i + e_{i,t}, \tag{4}$$

where $y_{i,t} = 0, 1$ is a binary variable indicating enrollment for an individual i at period t, $\mathbf{x}_{i,t}$ is a set of exogenous covariates, $r_{i,1} = 1$, $r_{i,2} = 0$ is a dummy variable for Ramadan coinciding with harvest seasons, $D_i = 0, 1$ is a dummy variable for agricultural households, v_i is an individual effect, and $e_{i,t}$ is an error term.

In (4) we are approximating l^* with enrollment continuation binary variable $y_{i,t}$. As we do not observe production function h nor wage rate w during exam period, we take $r_{i,t}D_i$ as a proxy of decreased labor productivity or decreased agricultural wage rates during exam period that agricultural households faced in 2000. The coefficient δ of year 2000 dummy $r_{i,t}$ picks up all other effects in 2000 and γ measures enrollment differential in 2000 of agricultural households relative to non-agricultural households.

$\mathbf{x}_{i,t}$ includes all other relevant variables that affect second period base incomes y and effective interest rate R that an individual faces. These are in general functions of parental characteristics and wealth levels. So we will incorporate variables such as head education levels and land holding. These variates may also enter home production processes h, so the interpretation of estimates on them can be either or all of future income, effective interest rate, and current production inputs. As it is not our main focus, we will not try to derive structural interpretation of these estimates.

In general $\mathcal{E}[\mathbf{x}_{i,t}v_i] \neq \mathbf{0}$ or $\mathcal{E}[D_i v_i] \neq 0$, so we demean both sides to eliminate individual effects v_i:

$$\begin{aligned} y_{i,t} - \bar{y}_i &= \boldsymbol{\beta}' \left(\mathbf{x}_{it} - \bar{\mathbf{x}}_{it}\right) + \gamma r_{i,t} D_i + \delta r_{i,t} + e_{i,t} - \bar{e}_{i,t}, \\ &\text{or,} \\ \tilde{y}_{i,1} &= \boldsymbol{\beta}'\tilde{\mathbf{x}}_{i1} + \gamma D_i + \delta + \tilde{e}_{i,1}, \\ \tilde{y}_{i,2} &= \boldsymbol{\beta}'\tilde{\mathbf{x}}_{i2} + \tilde{e}_{i,2}, . \end{aligned} \tag{5}$$

where we denoted $\tilde{A}_{i,t} = A_{i,t} - \bar{A}_i$.

As we are interested in the impacts of off-harvest exam period, or lowered wage rates, on enrollment, we need to compare individual's outcome with credible counterfactual. With the panel data in the absence of any random variations affecting the magnitude of labor demand that individuals face, the most credible strategy is to use the difference-in-differences (DID) estimator by assuming a group of individuals faced smaller labor demand than the others. We assume children from agricultural households faced relatively larger reduction in labor demand in 2000 than children from non-agricultural households. This is based on a presumption that children of agricultural households have stronger ties with agricultural community and have more un-ignorable experiences in agricultural production. From employers' perspectives, children from agricultural households tend to have better expertise in agricultural production and thus are more employable during the harvesting season. In addition, we note that non-agricultural households face peak labor demand, if any, different than harvesting season (for example during the time of new year celebration).

The basic idea of our identification strategy is to use DID and compare enrollment status between individuals, who are otherwise similar in their observed characteristics, of agricultural and non-agricultural households, and between 2003 and 2000. By taking deviations from individual means, we can control for any time-invariant traits of individuals that may affect school enrollment.

There are a few issues to consider in validating DID identification strategy. The first issue is our key identification assumption that individuals from agricultural households are more strongly affected by the agricultural labor demand than individuals from non-agricultural households. Even if γ is statistically significant, it can be that agricultural households share unobservable characteristics that result in higher dropout rates in 2003 than non-agricultural households. However, one must note that we are controlling for individual fixed-effects. Thus the remaining unobservable characteristics we have to worry about are time-varying ones. The most likely candidate is plausibility of particularly large agricultural labor demand in 2003. It is possible that, even if there was no impact of Ramadan 2000 on enrollment, the good harvest in 2003 induced higher dropout rates for agricultural households relative to non-agricultural households, making 2000 enrollment large relative to 2003.

To test this idea, it is ideal to use paddy productivity in the regressor. However, the data set focuses on schooling and puts sparse attention on production-related information. As a proxy to paddy productivity variability, we include year 2003 dummy and interaction terms of location (thana[*4]) dummies and year 2003 dummy, although these variable captures all other time-variant causes that affect enrollment. While an imperfect measure, we note that national production of *Aman* does not differ much between these two seasons, 11249 thousand metric tons in 2000 and 11520.5 thousand metric tons in 2003, a 2.4 per cent change.

Second, it is arguable that our identification strategy cannot separately identify Ramadan impacts from any event peculiar to 2003 that is unrelated to productivity shocks. An example is having a holiday season before the exam period. This happened in 2003 but not in 2000. This can harm learning for children whose learning environment is disadvantageous. So it is possible that it is not Ramadan impact that our interaction term between agricultural household and year 2003 dummies are picking up, but the impacts of having holidays before the exams that are specific to agricultural households. The latter impact may penalize enrollment, because learning environment in agricultural households are expected to be poorer, even after we control for observable wealth measures such as land holding, non-land assets, and official poverty status.

To examine if such interpretation holds, we will add parental education variables to regressors. If home learning environment differs and affects enrollment, it should also affect how the children spend their holidays before the exam in 2003. So children from more learning-conducive home, which is supposedly positively correlated with parental education, should increase the chance of enrollment. As maternal education can play a key role in home learning (Behrman et al., 1999), we include both parents' education variables in our regressions. In doing so, we had to reduce the sample size as we needed to exclude single-parent households.

Third involves the subtlties on how ages affect enrollment status. As a general trend in the low income areas, enrollment rates decrease as one progresses in school. So we will need to control for baseline dropout rates for each cohort. One way to achieve this is to use individual deviation from cohort mean. Assuming individuals in the same cohort faces the same dropout distribution, then taking deviation from the cohort mean will control for baseline dropout rates for the cohort. So the base model changes to

$$y_{i,c,t} = \boldsymbol{\beta}'\mathbf{x}_{i,c,t} + \gamma r_{i,c,t} D_{i,c} + v_{i,c} + e_{i,c,t}, \tag{6}$$

[*4] A thana is an administrative unit for subdistricts.

This gives cohort means by year as:

$$\begin{aligned}\bar{y}_{c,1} &= \boldsymbol{\beta}'\bar{\mathbf{x}}_{c,1} + \gamma\bar{D}_c + \bar{v}_c + \bar{e}_{c,1},\\ \bar{y}_{c,2} &= \boldsymbol{\beta}'\bar{\mathbf{x}}_{c,2} + \bar{v}_c + \bar{e}_{c,2},\end{aligned}$$

Using the original FE model, cohort demeaned estimation equations are:

$$\begin{aligned}y_{i,c,1} - \bar{y}_{c,1} &= \boldsymbol{\beta}'\left(\mathbf{x}_{i,c,1} - \bar{\mathbf{x}}_{c,1}\right) + \gamma\left(D_{i,c} - \bar{D}_c\right) + \left(v_{i,c} - \bar{v}_c + e_{i,c,1} - \bar{e}_{c,1}\right),\\ y_{i,c,2} - \bar{y}_{c,2} &= \boldsymbol{\beta}'\left(\mathbf{x}_{i,c,2} - \bar{\mathbf{x}}_{c,2}\right) + \left(v_{i,c} - \bar{v}_c + e_{i,c,2} - \bar{e}_{c,2}\right).\end{aligned}$$

Individual mean for these is:

$$\bar{y}_{i,c} - \bar{y}_c = \boldsymbol{\beta}'\left(\bar{\mathbf{x}}_{i,c} - \bar{\mathbf{x}}_c\right) + \gamma\tfrac{1}{2}\left(D_{i,c} - \bar{D}_c\right) + \left(v_{i,c} - \bar{v}_c + \bar{e}_{i,c} - \bar{e}_c\right),$$

or

$$\tilde{y}_{i,c} = \boldsymbol{\beta}'\tilde{\mathbf{x}}_{i,c} + \gamma\tfrac{1}{2}\tilde{D}_{i,c} + \left(\tilde{v}_{i,c} + \tilde{e}_{i,c}\right),$$

where we denoted $\tilde{A}_{i,c} = \bar{A}_{i,c} - \bar{A}_c$ with slight abuse of notation. Demeaning individual means will give:

$$\begin{aligned}y_{i,c,1} - \bar{y}_{c,1} - \tilde{y}_{i,c} &= \boldsymbol{\beta}'\left[\mathbf{x}_{i,c,1} - \bar{\mathbf{x}}_{i,c} - \left(\bar{\mathbf{x}}_{c,1} - \bar{\mathbf{x}}_c\right)\right] + \gamma\tfrac{1}{2}\left(D_{i,c} - \bar{D}_c\right) + \left(e_{i,c,1} - \bar{e}_{i,c} - \left(\bar{e}_{c,1} - \bar{e}_c\right)\right),\\ y_{i,c,2} - \bar{y}_{c,2} - \tilde{y}_{i,c} &= \boldsymbol{\beta}'\left[\mathbf{x}_{i,c,2} - \bar{\mathbf{x}}_{i,c} - \left(\bar{\mathbf{x}}_{c,2} - \bar{\mathbf{x}}_c\right)\right] + \gamma\tfrac{1}{2}\left(-\left(D_{i,c} - \bar{D}_c\right)\right) + \left(e_{i,c,2} - \bar{e}_{i,c} - \left(\bar{e}_{c,2} - \bar{e}_c\right)\right).\end{aligned}$$

Note:

$$\begin{aligned}\left.\overline{r_{i,t}D_{i,c}}\right|_t &= \tfrac{1}{2}D_{i,c}, & \left.\overline{r_{i,1}D_{i,c}}\right|_{i|c} &= \bar{D}_c,\\ \left.\overline{r_{i,2}D_{i,c}}\right|_{i|c} &= 0, & \left.\overline{r_{i,t}D_{i,c}}\right|_{i|c} &= \tfrac{1}{2}\bar{D}_c,\end{aligned}$$

we have

$$\ddot{y}_{i,c,t} = \boldsymbol{\beta}'\ddot{\mathbf{x}}_{i,c,t} + \gamma\ddot{d}_{i,c,t} + \ddot{e}_{i,c,t},$$

where we denoted $\ddot{A}_{i,c,t} = A_{i,c,t} - \bar{A}_{i,c} - (\bar{A}_{c,t} - \bar{A}_c)$ and $d_{i,c,t} = r_{i,t}D_{i,c}$. Note that we have got rid of all fixed effects from our estimation equation.

In sum, under the full set of controls, we control for time-invariant individual characteristics, time-variant aggregate unobservables, time-variant thana-level unobservables, and cohort effects. We also confirmed that national paddy production does not show a significant increase in 2003 relative to 2000. If there is anything else that systematically prompted individuals to drop out only from agricultural households at individual level in 2003, such as household-level productivity shocks that are uncorrelated with aggregate productivity shocks and household time-invariant unobservables, we are not controlling them. This is the extent of credibility that our analysis conveys.

4 Data, Definitions, and Descriptive Statistics

Data set we use is a panel collected in 2000 and 2003 in rural Bangladesh as FFE-CEF by International Food Policy Research Institute (IFPRI). It surveyed 469 households from 47 villages to investigate the impacts of Food-For-Education (FFE) programs on school enrollment. From these households, the total of 2597 individuals were surveyed.

In our analysis, we will compare agricultural households against non-agricultural households in their enrollment trends. An agricultural household is defined as a household with at least one member

Table 1: Enrollment Rates per Age

		5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	all
2000	all	12.70 (63)	63.00 (100)	80.36 (112)	84.82 (112)	83.33 (108)	92.00 (125)	89.58 (96)	84.91 (106)	71.43 (98)	67.09 (79)	52.38 (63)	60.87 (46)	38.10 (42)	38.24 (34)	0.00 (13)	0.00 (33)	69.11 (1230)
	a	7.69 (39)	61.40 (57)	75.93 (54)	83.82 (68)	83.61 (61)	91.55 (71)	84.75 (59)	82.46 (57)	68.25 (63)	65.91 (44)	54.55 (44)	54.17 (24)	50.00 (28)	31.58 (19)	0.00 (8)	0.00 (26)	66.20 (722)
	n	20.83 (24)	65.12 (43)	84.48 (58)	86.36 (44)	82.98 (47)	92.59 (54)	97.30 (37)	87.76 (49)	77.14 (35)	68.57 (35)	47.37 (19)	68.18 (22)	14.29 (14)	46.67 (15)	0.00 (5)	0.00 (7)	73.23 (508)
2003	all	10.91 (55)	46.88 (64)	68.35 (79)	87.30 (63)	84.31 (102)	92.79 (111)	83.33 (114)	75.93 (108)	69.77 (129)	71.11 (90)	55.14 (107)	34.02 (97)	26.25 (80)	25.40 (63)	13.04 (46)	2.44 (41)	59.38 (1349)
	a	10.71 (28)	41.67 (36)	60.00 (40)	82.50 (40)	80.70 (57)	96.23 (53)	80.00 (70)	75.41 (61)	70.67 (75)	64.15 (53)	47.37 (57)	30.16 (63)	26.67 (45)	20.45 (44)	4.17 (24)	0.00 (27)	55.50 (773)
	n	11.11 (27)	53.57 (28)	76.92 (39)	95.65 (23)	88.89 (45)	89.66 (58)	88.64 (44)	76.60 (47)	68.52 (54)	81.08 (37)	64.00 (50)	41.18 (34)	25.71 (35)	36.84 (19)	22.73 (22)	7.14 (14)	64.58 (576)
change	all	1.79	16.12**	12.00*	−2.48	−0.98	−0.79	6.25	8.98*	1.66	−4.02	−2.76	26.85***	11.85	12.84	−13.04**	−2.44*	9.73***
	a	−3.02	19.74*	15.93	1.32	2.90	−4.68	4.75	7.05	−2.41	1.76	7.18	24.01*	23.33*	11.12	−4.17*	0.00	−10.71***
	n	9.72	11.54	7.56	−9.29	−5.91	2.94	8.66	11.16	8.62	−12.51	−16.63	27.01**	−11.43	9.82	−22.73	−7.14	−8.65***

Source: Compiled from original IFPRI data before dropping observations.
Notes: 1. Numbers in first parenthesis are number of observations of each cell.
2. $*$, $**$, $* * *$ indicate significance levels at 10%, 5%, 1%, respectively.
3. Column under "All" indicates simple group means.
4. Rows headed by 'a' indicates agricultural households, 'n' indicates non-agricultural households.

Table 2: Enrollment Rates per Cohort in 2000

		5	6	7	8	9	10	11	12	13	14	15	16	17	all
2000	all	12.70	63.00	80.36	84.82	83.33	92.00	89.58	84.91	71.43	67.09	52.38	60.87	38.10	72.78
	a	7.69	61.40	75.93	83.82	83.61	91.55	84.75	82.46	68.25	65.91	54.55	54.17	50.00	70.55
	n	20.83	65.12	84.48	86.36	82.98	92.59	97.30	87.76	77.14	68.57	47.37	68.18	14.29	75.88
2003	all	87.30	84.31	92.79	83.33	75.93	69.77	71.11	55.14	34.02	26.25	25.40	13.04	2.44	61.77
	a	82.50	80.70	96.23	80.00	75.41	70.67	64.15	47.37	30.16	26.67	20.45	4.17	0.00	57.85
	n	95.65	88.89	89.66	88.64	76.60	68.52	81.08	64.00	41.18	25.71	36.84	22.73	7.14	67.22
change	all	74.60***	21.31***	12.43***	−1.49	−7.40	−22.23***	−18.47***	−29.77***	−37.41***	−40.84***	−26.98***	−47.83***	−35.66***	11.01***
	a	74.81***	19.30**	20.30***	−3.82	−8.20	−20.88***	−20.60**	−35.09***	−38.09***	−39.24***	−34.10***	−50.00***	−50.00***	−12.71***
	n	74.82***	23.77***	5.18	2.28	−6.38	−24.07***	−16.22**	−23.76***	−35.96***	−42.86***	−10.53	−45.45***	−7.15	−8.66***

Source: Compiled from original IFPRI data before dropping observations.
Notes: 1. Numbers in first parenthesis are number of observations of each cell.
2. $*$, $**$, $* * *$ indicate significance levels at 10%, 5%, 1%, respectively.
3. Column under "All" indicates simple group means.
4. Rows headed by 'a' indicates agricultural households, 'n' indicates non-agricultural households.

reporting its main income source or main occupation as agriculture, or a household owning agricultural plots. We also used a narrower definition if the household head reports his/her main income source or self-reported occupation is agriculture. Different definitions are highly correlated with each other and estimated results turned out to be similar. So we will use income source, self-reported occupation, and ownership of agricultural plots as definition of agricultural households. We will interact the agricultural household dummy with the year 2003 dummy to see if we observe a positive correlation with drop out (indicating smaller drop out rates in 2000 for agricultural households).

In Tables 1, 2, three-year trends in enrollment rates for each age group and cohort using original panel data are reported, respectively. While per age group differences do not show any consistent pattern, per cohort differences show two things: First, children are more likely to stop enrollment within three years as they become older. Second, as shown in Table 2, it is generally the agricultural households who report larger drops in enrollment rates. The overall reduction in enrollment rates between 2000 and 2003 is 12.71% points for agricultural households while it is 8.66% points for non-agricultural households. This seemingly small difference between two groups of households can be greater than they may look, because we are dealing with limited dependent variables whose values are less likely to decrease from lower levels. For example, a decrease from 68.25% to 30.16% is a 38.09 point or a 55.81% reduction, while 77.14% to 41.18% is a 35.96 point or 46.62% reduction. These two findings give some vindication to our supposition that children from agricultural households may have been affected more strongly by reduced labor demand in 2000. While this is all suggestive, we need to employ a more elaborate estimation technique than descriptive statistics to rigorously identify the impacts of Ramadan in 2000.

Given our focus on primary and secondary schooling, we will set age limits on the sample we use in our empirical analysis. In Bangladesh, school age officially starts from six. However, some parents choose to start earlier.[*5] Considering the small chance of working as a harvest laborer, and the fact shown in Table 2 that most individuals younger than age 10 cohort in 2000 do not drop out by 2003, we will use only age 11 and older. We have used other cut off ages (10 and 12) and the results are similar and follows a statistically predicted pattern (See page 16).

Setting the upper-bound age for our sample is not as simple as the lower-bound. High schools officially end at the age of sixteen, but due to late start and repetition, many children stay in high schools at ages older than sixteen. As the public primary schools accept up to age ten for class 1, and the fact that many children start enrolling at schools late, there are many children who may be considered as "adults" if judged only with their age, still going to school nonetheless. Thus we will have many individuals included in our sample who have already finished schooling if we set a uniform upper-bound for age at twenty three, say.

Fortunately, the data has information on the year of first enrollment. We will use the expected year of finishing high school as our primary criteria to exclude adults from our sample. We will allow for a three year margin to factor in class repetition. So any individual whose expected year of graduation is 2000 or later will be included in our sample. At the same time, it is unrealistic to assume a twenty eight year old individual to be in class 10. So we will combine another cutoff at age twenty five in wave 1 (2000). So the upper-bound of age is set by the interaction of two conditions: an individual with expected year of graduation is no earlier than 2000, and ages below twenty five in 2000.

Under these conditions, it turns out that the eldest individual in our sample is twenty one in 2000. There are originally 2597 individuals in the original panel data, of which 881 individuals fit into age limits (between 7 and 25) and expected graduation after 2000. We have excluded individuals whose highest education level in wave 2 (2003) is Play-School, Madrasa, Bachelor or higher degrees, in which we dropped 24, 1, and 18 individuals, respectively. This leaves us with 838 individuals, and after imposing lower age limit of 11 years and older, we drop 388 individuals and total number of individuals in our sample becomes 450.

Drop out in this paper is defined as an individual who was enrolled in 2000 but not in 2003. The drop out indicator takes the value of 1 in 2003 if it satisfies the definition of drop out, 0 otherwise. The drop out indicator takes the value of 0 for all individuals in 2000. So if we take a cluster deviation from its mean (i.e., taking deviation from individual mean), an individual who dropped out has the values -.5 and .5 in 2000, 2003, respectively, while non-drop outs have all zero's.[*6] If there is an enrollment enhancing effect in Ramadan of 2000, then the year dummy for 2003 will be positive in drop out regressions. If its impact is limited to agricultural households, then the interaction term between year

[*5] At the same time, judging from discrepancy of information between two waves of data, there is a good chance that parents may say "yes" to enrollment without understanding the question was asking about primary school, not preschool.

[*6] So the drop out indicator assumes the exactly the same values as the enrollment dummy when we take within-cluster deviations, except that the signs are opposite.

Table 3: Reported Reasons for Stop Going to School by Consumption Quartiles

quartile	group	financial	not accepted	school environ	not want to, others	distance	sickness	marriage	NA	total
1	non-goers 2000	0.68	0.02	0.27	0.00	0.00	0.00	0.00	0.02	41
1	non-goers 2003	0.55	0.00	0.01	0.10	0.00	0.00	0.01	0.33	114
1	drop outs 2003	0.60	0.00	0.01	0.09	0.00	0.00	0.01	0.28	75
2	non-goers 2000	0.57	0.00	0.23	0.09	0.09	0.00	0.00	0.03	35
2	non-goers 2003	0.36	0.00	0.04	0.19	0.01	0.00	0.00	0.41	81
2	drop outs 2003	0.44	0.00	0.04	0.12	0.02	0.00	0.00	0.38	50
3	non-goers 2000	0.57	0.00	0.26	0.04	0.00	0.09	0.00	0.04	23
3	non-goers 2003	0.28	0.00	0.00	0.24	0.00	0.01	0.04	0.42	78
3	drop outs 2003	0.25	0.00	0.00	0.26	0.00	0.02	0.04	0.44	57
4	non-goers 2000	0.22	0.11	0.44	0.00	0.11	0.00	0.00	0.11	9
4	non-goers 2003	0.10	0.03	0.03	0.20	0.00	0.03	0.02	0.58	60
4	drop outs 2003	0.12	0.04	0.02	0.19	0.00	0.04	0.02	0.58	52
ag HH	group	financial	not accepted	school environ	not want to, others	distance	sickness	marriage	NA	total
yes	non-goers 2000	0.60	0.02	0.24	0.06	0.06	0.00	0.00	0.02	63
yes	non-goers 2003	0.33	0.00	0.02	0.17	0.00	0.01	0.02	0.44	204
yes	drop outs 2003	0.31	0.01	0.02	0.19	0.01	0.01	0.03	0.43	145
no	non-goers 2000	0.62	0.02	0.33	0.00	0.00	0.00	0.00	0.02	42
no	non-goers 2003	0.42	0.01	0.01	0.19	0.00	0.01	0.01	0.36	123
no	drop outs 2003	0.49	0.01	0.01	0.13	0.00	0.01	0.00	0.35	86

Source: Compiled from IFPRI data.
Notes: 1. Numbers are all ratios except totals.
2. "ag HH" indicates agricultural households. See main text for definition of agricultural households.
3. Non-goers are individuals who were not enrolled in respective period.
4. Drop outs are individuals who were enrolled in 2000 but not in 2003.

Table 4: Tabulation of Agricultural vs. Consumption Quartiles (%)

ag HH/quartile	1	2	3	4	NA	rowtotal (persons)
yes	23.68	23.4	20.06	32.87	0	718
no	25.47	24.84	30.27	18.37	1.04	958

Source: Compiled from IFPRI data.
Notes: 1. Consumption quartiles are based on households, not individuals.
2. "ag HH" indicates agricultural households. See main text for definition of agricultural households.

2003 and agricultural household dummy variables should have a positive estimate, but not necessarily on year 2003 dummy *per se*. In a sense, enrollment enhancing impacts of Ramadan 2000, if any, increase the drop out probability, because one needs to be enrolled in the earlier years to be dropped out in the later years. Enrollment indicator is a mirror image of drop out indicator, taking the value of 1 if enrolled to school, 0 otherwise.

The data set reports reasons for stop going to school, which are given in Table 3. As the data also have household consumption information, we summarized the reported reasons for dropping out by per household member consumption quartiles in the top table. We have summarized the reported reasons by agricultural or non-agricultural households in the bottom table. In the top table, drop out rates are higher for lower per member consumption quartiles, and their reasons for dropping out are more concentrated in financial difficulty while upper quartile individuals give non financial reasons such as not fitting well or marriage. This suggests that we need to control for household wealth in analyzing school enrollment decisions.

In the bottom table of Table 3, there is no significant difference in terms of reported reasons by agricultural and non-agricultural households. This is because each row conditions on not enrolled to schools, and the proportions of two bottom and top quartiles, which report similar reasons within each group, do not differ much for agricultural and non-agricultural households, as seen in Table 4 where we tabulated agricultural/non-agricultural households against consumption quartiles.

As Bangladesh is known for proactive education policies, one needs to take education support pro-

Table 5: Tabulation of Enrollment against Program Membership (2000)

enrollment	A non-member	FFW	IFS-FFA	Primary stipend	RRMP	Secondary stipend	VGD
yes	7	180	5	190	164	187	109
no	329	2	0	1	0	0	0

Source: Compiled from IFPRI data.
Notes: 1. Compiled from ages 6 - 21 in 2000.
2. Apprebiations for prorgams are: FFW (Food-For-Work), IFS-FFA (Integrated Food Security - Food For Asset Creation), PRMP is , VGD (Vulnerable Group Development).

grams into account when analyzing enrollment behavior. It turns out that most of non-enrollers do not have membership to any of the listed support programs. Table 5 shows tabulation for education support program membership against enrollment status in 2000 for children between six and twenty one years old. The table shows a clear correlation between membership and enrollment. It is difficult to assess causality as we cannot control for actual targeting rules being used by various institutions, but the table suggests it is essential to control for program membership in the estimation.

To conclude this section, we summarize relative advantages of our identification strategy over a more conventional, more structural approach. In theory, the investigation we undertake can be done using exogenous random variation, rainfall recorded at closest weather stations possibly interacted with household characteristics, in instrumenting the observed productivity. However, the latter approach suffers from several drawbacks.[*7] First, the research question under the structural approach is the magnitude of labor supply elasticity of school going children in response to labor demand variations. However, this is not the question policy makers are asking. Rather, they ask, "does rescheduling of exam period away from harvesting seasons increase enrollment?" Our identification strategy gives a straight answer as it has internal validity for the question being asked, while the estimation of labor supply elasiticity does not. Knowledge of labor supply elasticity provides a scope for external validity, but it comes with a cost that we must use additional assumptions when we translate it to the projected impacts of exam period rescheduling. Second, in the absence of explict randomization, researchers often lack valid and strong enough instruments for productivity. Rainfall, a candidate instrument under a more structual approach can be a weak instrument. This is because rainfall is often recorded at weather stations covering spatially wide areas. There is an inherent "basis risk" in the use of recorded rainfall for instruments for productivity, if geographical information is not provided additionally. In addition, even under the same rainfall, impacts on yield may differ across plots by alteration in elevation and drainage availability, even after controlling for observable differences in farmer characteristics.

[*7] it requires that contribution of other inputs needs to be identified simultaneously. If any time-variant inputs are omitted, this is likely to result in underestiamtion of γ. Under positive shocks, households will increase inputs, but having such information omitted from data will lead to overestimation of positive shocks as it includes contribution of unobserved inputs. Converse is true for negative shocks. This will inflate the variability of estimated shocks, reducing its impacts on enrollment decisions. This can cause the same problem under our approach, but its extent is less severe. This is because we are estimating on common shocks whose size is, if grouping of household is done correctly, not going to be affected... we are using the same shocks on everyone for agricultural households. This is because all agricultural households follow the same agricultural calendar, and timing of harvest labor demand is the same. In a more structural approach, we use estimated productivity shocks which are heterogenous and unobservable in nature, and naturally more error ridden.

5 Estimation Results

In Table 6, estimated results on drop out are shown. First column (1) is the most basic specification where we control for individual characteristics, participation to various education support programs including cash transfer programs, year effect, and land and non-land assets. The covariates used for individual characteristics are age and sex. As we estimate fixed-effect models, sex is interacted with year 2003 dummy. Other household characteristics, agricultural household dummy, per member land holding, and non-land asset values, are also interacted with year 2003 dummy. We have also used other covariates suggested by the theoretical model, such as poverty status, household head's educational attainment, GPS-measured distance to schools, anthropometric measures, but none of them turned out to be statistically significant and have been dropped from estimation for Table 6 (See Tables 12, 13). Column (2) uses children other than sons and daughters of household head ("extended household" specification). In columns (3) and (4), we subtracted cohort means, while using nuclear household and extended household data, respectively. Columns (5) to (8) use the same sample and demeaning as in columns (1) to (4), except the regressors include gender of children. In columns (9) and (10), we also use thana*2003 interaction terms to control for thana-level productivity shocks.

From Table 6, we see that estimates on agricultural household dummy has positive impacts on drop out probability. Point estimates range from 10% points to 12% points, and all estimates are statistically significant at 1% level.

Table 7 shows the results for enrollment. As enrollment is conceptually a mirror image of drop outs, we see that the results to be similar except that signs are opposite. As in the drop outs, program membership to education support programs have large impacts on enrollment. Estimates show that girls have lower enrollment prospects in rural Bangladesh, because, firstly, back in 2000 and 2003, employment opportunities which require higher education were limited except in a narrowly defined garment industry (Paul-Majumder and Begum, 2000; World-Bank, 2008), and secondly, in a patrilineal society like rural Bangladesh, parents may find it financially unrewarding to invest on girls as they will marry off and will not provide as much old age supports as boys (Chowdhury and Bairag, 1990; Fraser, 2010). Per member land holding shows positive estimates, indicating that any deterring impacts of family labor demand, due to imperfect substitutability between family and hired labor, if any, are overturned by wealth effects on enrollment. Estimates on non-land assets are positive, also indicating wealth effects. Agricultural household dummies are all negative, indicating that enrollment probabilities of children from agricultural households dipped more severely in 2003 than children from non-agricultural households.

Figure 2 gives an overview of robustness check we conducted. All figures show point estimates and their 95% confidence intervals. Before going into details, we will glance the results: In all figures, relative positions of point estimates are similar (e.g., 5 gives lowest, 4 or 10 gives highest, with slightly sloping upwards between 1-4 and 5-10), indicating similar patterns in point estimates to the same set of changes in regression specifications. So between-specification estimation result changes, as one moves from 1 to 10, are correlated changes across figures.

The differences between each figure are that, first, change in the mean levels of point estimates

Table 6: Linear Dropout Probability Fixed-Effect Model

variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(Intercept)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
age	−0.075	−0.082			−0.125	−0.132*				
	(0.085)	(0.084)			(0.077)	(0.076)				
age2	0.008***	0.008***			0.009***	0.009***				
	(0.001)	(0.001)			(0.001)	(0.001)				
year 2003	−0.495**	−0.491**			−0.562***	−0.557***				
	(0.219)	(0.219)			(0.188)	(0.187)				
program membership	−0.603***	−0.603***	−0.592***	−0.594***	−0.647***	−0.648***	−0.637***	−0.638***	−0.643***	−0.644***
	(0.032)	(0.031)	(0.034)	(0.034)	(0.031)	(0.030)	(0.034)	(0.033)	(0.034)	(0.033)
interaction with 2003										
agricultural household	0.120***	0.110***	0.118***	0.107***	0.130***	0.120***	0.123***	0.114***	0.102***	0.105***
	(0.038)	(0.037)	(0.038)	(0.037)	(0.036)	(0.036)	(0.037)	(0.036)	(0.039)	(0.038)
sex (female = 1)					0.181***	0.181***	0.179***	0.177***	0.184***	0.181***
					(0.037)	(0.036)	(0.037)	(0.037)	(0.038)	(0.037)
per member land holding	−4.940***	−4.426***	−3.466*	−2.864	−6.947***	−6.556***	−5.537***	−5.041**	−6.211**	−6.298***
	(1.402)	(1.398)	(2.078)	(1.852)	(1.534)	(1.474)	(2.137)	(1.975)	(2.720)	(2.298)
nonland asset (1,000,000 Tk)	−5.696***	−5.428***	−5.802***	−5.534***	−5.115***	−4.886***	−5.151***	−4.893**	−5.020***	−4.895***
	(1.974)	(1.981)	(2.031)	(2.030)	(1.896)	(1.898)	(1.939)	(1.937)	(1.894)	(1.906)
extended family members	no	yes	no	yes	no	yes	no	yes	no	yes
area dummies * 2003	no	no	no	no	no	no	no	no	thana	thana
cohort demeaned	no	no	yes	yes	no	no	yes	yes	yes	yes
n	417	446	410	438	417	446	410	438	410	438

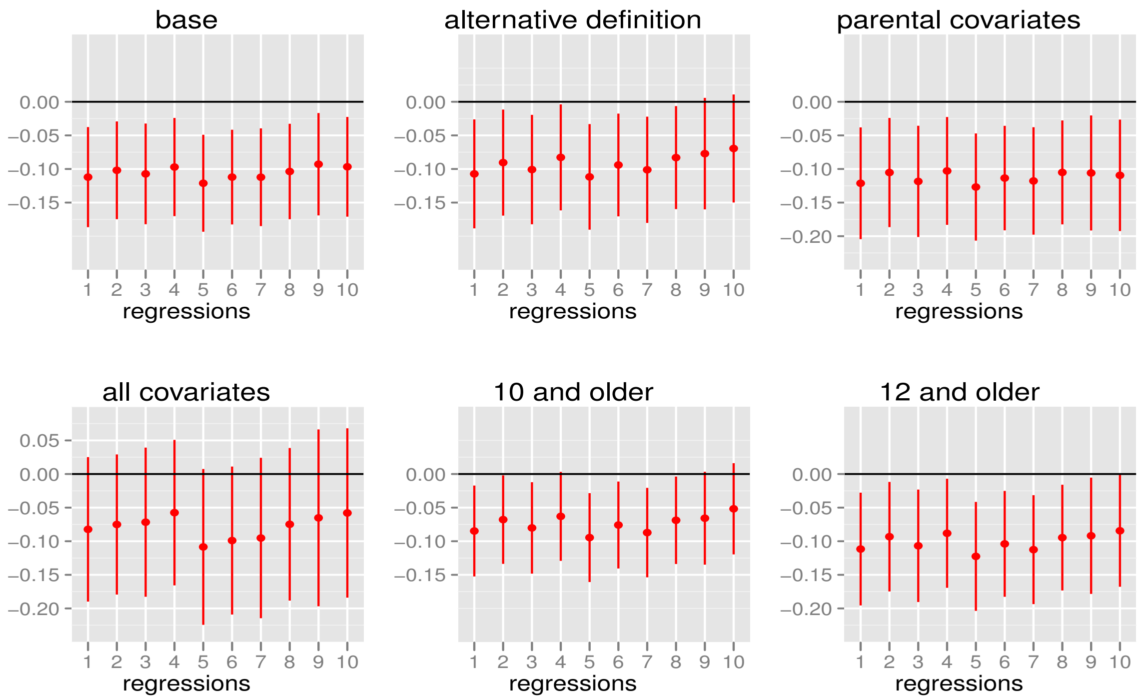
Source: Compiled from IFPRI data.
Notes: 1. Location dummies are omitted from the table for brevity.
2. ∗, ∗∗, ∗ ∗ ∗ indicate significance levels at 10%, 5%, 1%, respectively, using cluster robust standard errors.

Table 7: Linear Enrollment Probability Fixed-Effect Model

variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(Intercept)	0.000	0.000	0.000*	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
age	0.005	0.012			0.053	0.060				
	(0.102)	(0.101)			(0.102)	(0.101)				
age2	−0.008***	−0.008***			−0.009***	−0.009***				
	(0.002)	(0.001)			(0.002)	(0.001)				
year 2003	0.743***	0.738***			0.807***	0.802***				
	(0.287)	(0.284)			(0.282)	(0.279)				
program membership	0.614***	0.614***	0.607***	0.609***	0.656***	0.657***	0.650***	0.651***	0.657***	0.658***
	(0.033)	(0.031)	(0.035)	(0.034)	(0.032)	(0.031)	(0.035)	(0.034)	(0.034)	(0.034)
interaction with 2003										
agricultural household	−0.112***	−0.102***	−0.107***	−0.097***	−0.121***	−0.112***	−0.112***	−0.104***	−0.093**	−0.097**
	(0.038)	(0.037)	(0.038)	(0.037)	(0.037)	(0.036)	(0.037)	(0.036)	(0.039)	(0.038)
sex (female = 1)					−0.174***	−0.174***	−0.172***	−0.170***	−0.176***	−0.173***
					(0.037)	(0.037)	(0.038)	(0.037)	(0.038)	(0.037)
per member land holding	4.670***	4.168***	3.186	2.606	6.595***	6.215***	5.173**	4.696**	5.816**	5.939***
	(1.399)	(1.401)	(2.050)	(1.838)	(1.527)	(1.475)	(2.110)	(1.959)	(2.616)	(2.242)
nonland asset (1,000,000 Tk)	6.070***	5.798***	6.185***	5.932***	5.513***	5.277***	5.560***	5.316***	5.490***	5.369***
	(2.012)	(2.014)	(2.068)	(2.059)	(1.950)	(1.946)	(1.990)	(1.979)	(1.930)	(1.935)
extended family members	no	yes	no	yes	no	yes	no	yes	no	yes
area dummies * 2003	no	no	no	no	no	no	no	no	thana	thana
cohort demeaned	no	no	yes	yes	no	no	yes	yes	yes	yes
n	417	446	410	438	417	446	410	438	410	438

Source: Compiled from IFPRI data.
Notes: 1. Location dummies are omitted from the table for brevity.
2. ∗, ∗∗, ∗ ∗ ∗ indicate significance levels at 10%, 5%, 1%, respectively, using cluster robust standard errors.

Figure 2: Robustness Check on $\hat{\gamma}$



Source: Estimated by authors using IFPRI data.

Notes: 1. Fixed effect linear probability models. All regressands are enrollment. Regression specifications are:

	extended family	gender * 2003	area * 2003	cohort demeaned
1.	no	no	no	no
2.	yes	no	no	no
3.	no	no	no	yes
4.	yes	no	no	yes
5.	no	no	no	no
6.	no	yes	no	no
7.	yes	yes	thana	no
8.	no	yes	no	yes
9.	yes	yes	no	yes
10.	no	yes	thana	no

2. Base refers to Table 7 results (number of observations for specification 1 is $n = 417$). Alternative regression uses agricultural household definition as head's report (Table 9, $n = 417$). Parental covariates uses parental covariates (Table 11, $n = 361$). All covariates use all other covariates including distance and anthropometric measures interacted with year 2003 dummy (Table 13, $n = 204$). 10 and older uses sample of children 10 years and older (Table 15, $n = 518$). Analogously for 12 and older (Table 17, $n = 336$).

3. Points indicate point estimates, and line indicates 95% confidence intervals based on cluster robust standard errors.

(but not individual deviations from mean), and second, widths of confidence intervals. One advantage of an overview like Figure 2 is that it gives an idea what factors are changing the estimates. From comparison of each figure, one visually grasps that a systematic change of point estimate means in response to specifications, and that widths of confidence intervals are indeed a function of sample size. We observe that wider confidence intervals which cross the horizontal line at zero in "all covariates" figure is due to much smaller sample size of 204 where we have 417 in "base".[*8]

Table 8 and Table 9 give estimates using an alternative definition for agricultural households, where we restrict only heads' self-reports to be eligible in definition. Estimated results do not change much, both qualitatively and quantitatively, except that estimate of γ become smaller in absolute values, as

[*8] In "all covariates" specifications, mean of "all covariates" point estimates is larger than "base" specifications, but individual deviation from the mean remains similar. Confidence intervals are twice as wide as in "base" specifications, where the former includes 0. As we will see below, increases in point estimates in "all covariates" are due to addition of covariates with negative correlations with agriculture * 2003 dummy, like anthropometrics and head education variables, and the loss in precision is due to more than 50% reduction in sample size.

both definitions are highly correlated.

As discussed in the section 3, there are two lingering issues in identification. First, we may be picking up impacts of time-varying productivity shocks that may have increased labor demand in 2003. Although the aggregate production of *Aman* is not very different between two waves of data, it is possible that regional variation may still exist. To best control the productivity differences, we used year 2003 dummy for aggregate productivity shocks, and thana*2003 interaction terms for time-variant thana-level productivity shocks. This is shown in specification (8) and (9) in both Tables 6, 7, and all point estimates attenuate by about 1% point, but stay statistically significant.

Second, our identification strategy cannot separately estimate seasonal labor demand impacts from any event peculiar to 2003 that is unrelated to productivity shocks, such as having holidays prior to exam period. To control for possible differences in home learning environment, we added to regressors parental education variables. Tables 10, 11 show the estimated results. Surprisingly, paternal secondary education reduces enrollment. This may be because more educated fathers, after controlling for household wealth, may have stronger ties with potential employers, or own more agricultural machinery which increases per area marginal labor productivity. Maternal secondary education has positive impacts on enrollment, but does not affect point estimates of γ. Most estimates of γ stay statistically significant and show the expected signs.

As a part of further robustness check, we include other possible covariates, such as height and weight of children from respective age means, official poverty status, and GPS-measured distance to schools. Tables 12, 13 show the estimated results. As there are many missing observations in anthropometric information, sample size is more than halved that may affect statistical power. It turns out that most of estimates of added covariates are statistically insignificant, although, probably due to much smaller sample size, estimates of γ also become statistically insignificant in most specifications. Anthropometric measures have expected signs, taller heights and heavier weights will induce more drop outs, suggesting that brawl can be a deterrent to schooling in 2003.

If we use a lower age cut off, it will leave more younger children in the sample. Then it is reasonable to expect a smaller proportion of individuals to be distracted with their schooling by harvest labor, leading to attenuated estimates of γ. Increased sample size may improve standard errors, so the changes in significance levels can go either way. This is indeed the case in Tables 14, 15 where we show estimated results using a new age cut off at ten or older. All point estimates become smaller, but estimates remain statistically significant, because standard errors are smaller. In contrast, if we set the cut off at twelve and older, the contrary should occur. This is what we observe in Tables 16, 17. We have greater point estimates but also greater standard errors. As net results, estimates in Tables 16, 17 become statistically significant at smaller p-values, which provides another indication of robustness.

6 Conclusion

The issue of seasonality is quite important and needs to be addressed properly to have effective public policies. Adjustments in institutional design are necessary for developing countries which are predominantly agrarian economies and are frequently affected by seasonality. To our surprise, seasonally adjusted policies outside the context of food security and disaster management are rare. This paper seeks to address the impact of seasonal labor demand on school enrollment and drop out in Bangladesh. The school calender for both primary and high schools in Bangladesh is not seasonally adjusted to local agriculture. This can increase drop out by forcing children to trade-off between education and work, especially during the peak harvesting season. To identify the impacts of seasonal labor demand on dropout, we employed Ramadan vacation in the year of 2000 as a natural experiment. In 2000, Ramadan driven school vacation coincided with the original annual exam period of December. This forced schools to pre-pone their final exam schedules in November, which was the month before the harvest begins. As a consequence, labor demand during the annual examination period in year 2000 was smaller. Comparing this phenomenon with year 2003, by employing longitudinal data, we found positive and significant impacts of seasonal labor demand on drop out for the rural agricultural households in Bangladesh.

There are arguably ample factors other than seasonality that are limiting educational attainment and increasing the dropout in Bangladesh. However, adjusting the school calendars with local agrarian calendars will at least reduce the dilemma faced by the children from the agricultural households and implementing such adjustment is almost costless for Bangladesh. Countries like Japan, Brazil, Colombia and The Gambia have implemented seasonally adjusted education policies in the past, and their impacts are told favorably, if anecdotally. Even in Bangladesh, non-formal education providers, which are mainly Non Government Organizations (NGOs), have also taken steps to adjust school calendars with seasonality. For instance, schools run by BRAC, a leading NGO for example, has already undertook seasonally-adjusted school calendar in Bangladesh.

We have used household level panel data to rigorously assess the impacts of having the exams in off-harvesting seasons. Our identification strategy using DID estimators relied on several assumptions: First, differential impacts exist between agricultural and non-agricultural households. This is likely to hold, as non-agricultural households face peak labor demand, if any, different than harvesting season (for example during the time of new year celebration). Second, from employers' perspectives, children from agricultural households tend to have better expertise in agricultural production and thus are more employable during the harvesting season. Third, impacts of having holidays immediately before the exam period can be partly captured by parental education that are assumed to proxy the home learning environment. While these proxies are never perfect, they will control certain aspects of learning environment at the home. Given these considerations, we expect the results of our empirical analysis to have high credibility.

We have shown that estimated results robustly point that schooling of children from agricultural households have benefitted from Ramadan holidays in 2000 relative to children from non-agricultural households. Results survived after extensive specification search, where we used various wealth, anthropometric, locational measures, official program membership, official poverty status, and we have also controlled for cohort effects. The results shown in this paper can provide foundation for reconsidering the school calendar that is consistent with seasonal local labor market conditions.

Table 8: Linear Dropout Probability Fixed-Effect Model, Alternative Agricultural Household Definition

variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(Intercept)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
age	−0.081 (0.085)	−0.087 (0.084)			−0.130* (0.077)	−0.136* (0.076)				
age2	0.008*** (0.001)	0.008*** (0.001)			0.009*** (0.001)	0.009*** (0.001)				
year 2003	−0.488** (0.219)	−0.482** (0.218)			−0.551*** (0.188)	−0.544*** (0.186)				
program membership	−0.597*** (0.032)	−0.598*** (0.031)	−0.588*** (0.034)	−0.590*** (0.034)	−0.640*** (0.031)	−0.641*** (0.030)	−0.632*** (0.034)	−0.633*** (0.033)	−0.638*** (0.034)	−0.639*** (0.033)
interaction with 2003										
agricultural household	0.117*** (0.037)	0.102*** (0.036)	0.113*** (0.037)	0.097*** (0.036)	0.121*** (0.035)	0.108*** (0.035)	0.114*** (0.036)	0.100*** (0.035)	0.091** (0.037)	0.089** (0.036)
sex (female = 1)					0.177*** (0.037)	0.177*** (0.036)	0.176*** (0.037)	0.175*** (0.037)	0.182*** (0.038)	0.178*** (0.037)
per member land holding	−5.101*** (1.399)	−4.519*** (1.412)	−3.720* (2.026)	−3.057* (1.841)	−7.007*** (1.510)	−6.553*** (1.464)	−5.711*** (2.076)	−5.168*** (1.953)	−6.439** (2.713)	−6.522*** (2.329)
nonland asset (1,000,000 Tk)	−5.784*** (1.970)	−5.486*** (1.980)	−5.847*** (2.025)	−5.548*** (2.026)	−5.205*** (1.896)	−4.946*** (1.898)	−5.191*** (1.936)	−4.906** (1.936)	−5.009*** (1.894)	−4.853** (1.908)
extended family members	no	yes	no	yes	no	yes	no	yes	no	yes
area dummies * 2003	no	no	no	no	no	no	no	no	thana	thana
cohort demeaned	no	no	yes	yes	no	no	yes	yes	yes	yes
n	417	446	410	438	417	446	410	438	410	438

Source: Compiled from IFPRI data.
Notes: 1. Location dummies are omitted from the table for brevity.
2. *, **, *** indicate significance levels at 10%, 5%, 1%, respectively, using cluster robust standard errors.

Table 9: Linear Enrollment Probability Fixed-Effect Model, Alternative Agricultural Household Definition

variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(Intercept)	0.000 (0.000)	0.000 (0.000)	0.000** (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000* (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
age	0.011 (0.102)	0.016 (0.100)			0.058 (0.102)	0.063 (0.100)				
age2	−0.008*** (0.001)	−0.009*** (0.001)			−0.009*** (0.001)	−0.009*** (0.001)				
year 2003	0.735** (0.287)	0.730*** (0.283)			0.795*** (0.281)	0.790*** (0.277)				
program membership	0.608*** (0.033)	0.610*** (0.031)	0.603*** (0.035)	0.606*** (0.035)	0.650*** (0.032)	0.651*** (0.031)	0.645*** (0.035)	0.647*** (0.034)	0.653*** (0.035)	0.654*** (0.034)
interaction with 2003										
agricultural household	−0.108*** (0.037)	−0.094*** (0.036)	−0.101*** (0.037)	−0.086** (0.036)	−0.112*** (0.036)	−0.099*** (0.035)	−0.102*** (0.036)	−0.089** (0.035)	−0.081** (0.038)	−0.080** (0.037)
sex (female = 1)					−0.170*** (0.038)	−0.170*** (0.037)	−0.169*** (0.038)	−0.168*** (0.037)	−0.174*** (0.038)	−0.171*** (0.037)
per member land holding	4.809*** (1.400)	4.239*** (1.418)	3.402* (2.006)	2.760 (1.831)	6.638*** (1.509)	6.195*** (1.469)	5.314*** (2.058)	4.788** (1.942)	6.001** (2.616)	6.117*** (2.277)
nonland asset (1,000,000 Tk)	6.150*** (2.010)	5.848*** (2.013)	6.221*** (2.063)	5.938*** (2.055)	5.594*** (1.950)	5.328*** (1.946)	5.592*** (1.987)	5.321*** (1.977)	5.470*** (1.930)	5.321*** (1.936)
extended family members	no	yes	no	yes	no	yes	no	yes	no	yes
area dummies * 2003	no	no	no	no	no	no	no	no	thana	thana
cohort demeaned	no	no	yes	yes	no	no	yes	yes	yes	yes
n	417	446	410	438	417	446	410	438	410	438

Source: Compiled from IFPRI data.
Notes: 1. Location dummies are omitted from the table for brevity.
2. *, **, *** indicate significance levels at 10%, 5%, 1%, respectively, using cluster robust standard errors.

Table 10: Linear Dropout Probability Fixed-Effect Model, Parental Education

variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(Intercept)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
age	−0.081	−0.084			−0.134*	−0.135*				
	(0.088)	(0.088)			(0.078)	(0.077)				
age2	0.007***	0.008***			0.008***	0.008***				
	(0.002)	(0.002)			(0.002)	(0.002)				
year 2003	−0.470**	−0.480**			−0.450*	−0.468**				
	(0.231)	(0.232)			(0.232)	(0.234)				
program membership	−0.617***	−0.617***	−0.609***	−0.610***	−0.669***	−0.672***	−0.662***	−0.667***	−0.669***	−0.673***
	(0.035)	(0.033)	(0.037)	(0.036)	(0.034)	(0.032)	(0.036)	(0.036)	(0.035)	(0.035)
interaction with 2003										
agricultural household	0.128***	0.111***	0.126***	0.109***	0.134***	0.120***	0.126***	0.112***	0.110**	0.113***
	(0.042)	(0.041)	(0.042)	(0.041)	(0.040)	(0.039)	(0.040)	(0.039)	(0.043)	(0.042)
sex (female = 1)					0.186***	0.194***	0.188***	0.195***	0.194***	0.200***
					(0.041)	(0.040)	(0.041)	(0.040)	(0.041)	(0.040)
spouse sex (female = 1)					−0.084	−0.083	−0.096	−0.103	−0.187	−0.177
					(0.130)	(0.134)	(0.137)	(0.142)	(0.149)	(0.151)
head primary	0.045	0.036	0.043	0.034	0.027	0.019	0.026	0.019	0.025	0.015
	(0.043)	(0.043)	(0.044)	(0.044)	(0.043)	(0.042)	(0.044)	(0.043)	(0.043)	(0.043)
head secondary	0.105**	0.117**	0.099*	0.111**	0.095*	0.114**	0.093*	0.110**	0.104**	0.128**
	(0.053)	(0.051)	(0.054)	(0.052)	(0.051)	(0.050)	(0.052)	(0.051)	(0.053)	(0.051)
head spouse primary	0.007	0.013	0.005	0.012	0.027	0.027	0.023	0.026	0.028	0.025
	(0.045)	(0.045)	(0.046)	(0.045)	(0.045)	(0.044)	(0.045)	(0.044)	(0.044)	(0.043)
head spouse secondary	−0.019	−0.007	−0.017	−0.004	−0.017	−0.011	−0.016	−0.008	−0.011	−0.012
	(0.047)	(0.046)	(0.049)	(0.047)	(0.046)	(0.044)	(0.047)	(0.045)	(0.046)	(0.045)
per member land holding	−5.111***	−4.366***	−3.792*	−2.812	−7.196***	−6.553***	−5.867**	−4.983**	−6.624**	−6.192**
	(1.654)	(1.697)	(2.208)	(1.982)	(1.780)	(1.755)	(2.314)	(2.113)	(2.875)	(2.423)
nonland asset (1,000,000 Tk)	−5.874***	−5.811***	−6.159***	−6.037***	−5.445***	−5.380***	−5.622***	−5.486***	−5.631***	−5.682***
	(2.025)	(2.012)	(2.084)	(2.060)	(1.949)	(1.930)	(1.984)	(1.955)	(1.914)	(1.898)
extended family members	no	yes	no	yes	no	yes	no	yes	no	yes
area dummies * 2003	no	no	no	no	no	no	no	no	thana	thana
cohort demeaned	no	no	yes	yes	no	no	yes	yes	yes	yes
n	722	768	710	756	722	768	710	756	710	756

Source: Compiled from IFPRI data.
Notes: 1. Location dummies are omitted from the table for brevity.
2. *, **, * * * indicate significance levels at 10%, 5%, 1%, respectively, using cluster robust standard errors.

Table 11: Linear Enrollment Probability Fixed-Effect Model, Parental Education

variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(Intercept)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
age	−0.006	−0.003			0.045	0.045				
	(0.109)	(0.107)			(0.111)	(0.110)				
age2	−0.008***	−0.008***			−0.009***	−0.009***				
	(0.002)	(0.002)			(0.002)	(0.002)				
year 2003	0.785**	0.795**			0.747**	0.764**				
	(0.319)	(0.313)			(0.340)	(0.338)				
program membership	0.631***	0.630***	0.626***	0.627***	0.680***	0.683***	0.677***	0.682***	0.686***	0.689***
	(0.036)	(0.034)	(0.038)	(0.037)	(0.035)	(0.033)	(0.038)	(0.037)	(0.037)	(0.036)
interaction with 2003										
agricultural household	−0.121***	−0.105**	−0.118***	−0.103**	−0.127***	−0.114***	−0.118***	−0.105***	−0.106**	−0.109***
	(0.042)	(0.041)	(0.042)	(0.041)	(0.041)	(0.040)	(0.041)	(0.039)	(0.044)	(0.042)
sex (female = 1)					−0.176***	−0.184***	−0.178***	−0.186***	−0.185***	−0.191***
					(0.042)	(0.040)	(0.042)	(0.040)	(0.041)	(0.040)
spouse sex (female = 1)					0.099	0.097	0.123	0.129	0.223	0.212
					(0.130)	(0.134)	(0.139)	(0.144)	(0.151)	(0.152)
head primary	−0.055	−0.045	−0.053	−0.045	−0.038	−0.030	−0.037	−0.030	−0.036	−0.026
	(0.043)	(0.043)	(0.045)	(0.044)	(0.043)	(0.043)	(0.044)	(0.043)	(0.044)	(0.043)
head secondary	−0.121**	−0.132***	−0.111**	−0.123**	−0.112**	−0.130***	−0.105**	−0.123**	−0.118**	−0.142***
	(0.054)	(0.051)	(0.055)	(0.052)	(0.052)	(0.050)	(0.053)	(0.051)	(0.054)	(0.052)
head spouse primary	−0.005	−0.010	−0.001	−0.008	−0.024	−0.024	−0.020	−0.022	−0.024	−0.020
	(0.046)	(0.045)	(0.046)	(0.045)	(0.046)	(0.045)	(0.046)	(0.044)	(0.045)	(0.044)
head spouse secondary	0.013	0.001	0.009	−0.002	0.011	0.004	0.008	0.000	0.005	0.007
	(0.048)	(0.047)	(0.049)	(0.048)	(0.046)	(0.045)	(0.047)	(0.046)	(0.046)	(0.045)
per member land holding	4.758***	4.020**	3.460	2.494	6.729***	6.100***	5.419**	4.550**	6.127**	5.731**
	(1.654)	(1.714)	(2.161)	(1.962)	(1.772)	(1.760)	(2.259)	(2.083)	(2.734)	(2.367)
nonland asset (1,000,000 Tk)	6.112***	6.044***	6.339***	6.224***	5.709***	5.637***	5.837***	5.707***	5.964***	6.003***
	(2.062)	(2.046)	(2.134)	(2.104)	(2.004)	(1.981)	(2.048)	(2.013)	(1.977)	(1.955)
extended family members	no	yes	no	yes	no	yes	no	yes	no	yes
area dummies * 2003	no	no	no	no	no	no	no	no	thana	thana
cohort demeaned	no	no	yes	yes	no	no	yes	yes	yes	yes
n	722	768	710	756	722	768	710	756	710	756

Source: Compiled from IFPRI data.
Notes: 1. Location dummies are omitted from the table for brevity.
2. $*$, $**$, $***$ indicate significance levels at 10%, 5%, 1%, respectively, using cluster robust standard errors.

Table 12: Linear Dropout Probability Fixed-Effect Model, All Covariates

variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(Intercept)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
age	−0.104	−0.122			−0.021	−0.034				
	(0.113)	(0.117)			(0.079)	(0.077)				
age2	0.005**	0.005**			0.005**	0.005**				
	(0.002)	(0.002)			(0.002)	(0.002)				
year 2003	−0.254	−0.259			−0.577***	−0.600***				
	(0.301)	(0.316)			(0.164)	(0.160)				
program membership	−0.670***	−0.667***	−0.652***	−0.649***	−0.663***	−0.661***	−0.649***	−0.646***	−0.660***	−0.659***
	(0.051)	(0.049)	(0.051)	(0.049)	(0.052)	(0.050)	(0.052)	(0.050)	(0.051)	(0.048)
interaction with 2003										
agricultural household	0.105**	0.098**	0.106**	0.099**	0.114**	0.106**	0.116**	0.106**	0.076	0.068
	(0.050)	(0.050)	(0.051)	(0.050)	(0.051)	(0.051)	(0.051)	(0.051)	(0.055)	(0.055)
sex (female = 1)	0.193*	0.229**	0.154***	0.163***	0.242**	0.276***	0.167***	0.174***	0.247***	0.273***
	(0.105)	(0.103)	(0.056)	(0.054)	(0.107)	(0.104)	(0.057)	(0.055)	(0.082)	(0.079)
height deviation	0.008	0.007	0.007	0.006	0.008*	0.008*	0.007	0.006	0.004	0.004
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
weight deviation	0.003	0.003	0.003	0.004	0.002	0.002	0.003	0.004	0.004	0.005
	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)
head primary	−0.009	−0.013	−0.024	−0.025	−0.003	−0.006	−0.015	−0.016	−0.012	−0.023
	(0.056)	(0.055)	(0.055)	(0.054)	(0.057)	(0.056)	(0.057)	(0.056)	(0.058)	(0.058)
head secondary	0.064	0.037	0.039	0.014	0.074	0.045	0.049	0.019	0.095	0.049
	(0.063)	(0.063)	(0.065)	(0.064)	(0.066)	(0.066)	(0.068)	(0.067)	(0.073)	(0.071)
per member land holding					−3.945**	−4.095**	−2.756	−2.946	−3.626	−4.825*
					(1.955)	(1.940)	(1.870)	(1.835)	(2.538)	(2.464)
poverty (=1 if BPL)					−0.003	0.015	0.005	0.022	−0.016	0.022
					(0.068)	(0.067)	(0.068)	(0.067)	(0.074)	(0.073)
GPS distance					−0.040	−0.042	−0.042	−0.043	−0.081	−0.077
					(0.067)	(0.065)	(0.067)	(0.065)	(0.078)	(0.077)
extended family members	no	yes	no	yes	no	yes	no	yes	no	yes
area dummies * 2003	no	no	no	no	no	no	no	no	thana	thana
cohort demeaned	no	no	yes	yes	no	no	yes	yes	yes	yes
n	408	432	406	430	398	422	398	422	398	422

Source: Compiled from IFPRI data.
Notes: 1. Location dummies are omitted from the table for brevity.
2. $*$, $**$, $***$ indicate significance levels at 10%, 5%, 1%, respectively, using cluster robust standard errors.

Table 13: Linear Enrollment Probability Fixed-Effect Model, All Covariates

variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(Intercept)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
age	0.001	0.018			−0.107	−0.093				
	(0.148)	(0.151)			(0.138)	(0.140)				
age2	−0.005**	−0.006**			−0.005**	−0.006**				
	(0.002)	(0.002)			(0.002)	(0.002)				
year 2003	0.619	0.625			1.002***	1.026***				
	(0.446)	(0.457)			(0.383)	(0.392)				
program membership	0.683***	0.680***	0.674***	0.672***	0.676***	0.674***	0.672***	0.668***	0.681***	0.678***
	(0.052)	(0.050)	(0.052)	(0.051)	(0.053)	(0.051)	(0.053)	(0.051)	(0.051)	(0.049)
interaction with 2003										
agricultural household	−0.092*	−0.085*	−0.089*	−0.082	−0.105**	−0.096*	−0.104**	−0.094*	−0.069	−0.062
	(0.051)	(0.051)	(0.053)	(0.051)	(0.052)	(0.051)	(0.052)	(0.051)	(0.056)	(0.055)
sex (female = 1)	−0.174	−0.212**	−0.148***	−0.157***	−0.230**	−0.264**	−0.160***	−0.168***	−0.252***	−0.277***
	(0.107)	(0.105)	(0.057)	(0.055)	(0.108)	(0.105)	(0.058)	(0.056)	(0.082)	(0.079)
height deviation	−0.008	−0.008	−0.007	−0.006	−0.009*	−0.009*	−0.007	−0.006	−0.003	−0.003
	(0.005)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
weight deviation	−0.004	−0.004	−0.004	−0.005	−0.002	−0.002	−0.005	−0.005	−0.008	−0.009
	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
head primary	−0.010	−0.006	0.002	0.003	−0.018	−0.014	−0.008	−0.006	0.005	0.015
	(0.057)	(0.056)	(0.057)	(0.056)	(0.058)	(0.057)	(0.058)	(0.057)	(0.058)	(0.058)
head secondary	−0.088	−0.061	−0.067	−0.041	−0.104	−0.073	−0.082	−0.050	−0.114	−0.067
	(0.064)	(0.065)	(0.067)	(0.066)	(0.069)	(0.068)	(0.071)	(0.069)	(0.074)	(0.072)
per member land holding					3.962**	4.115**	2.949	3.135*	3.861	5.034**
					(1.992)	(1.974)	(1.895)	(1.859)	(2.540)	(2.481)
poverty (=1 if BPL)					0.025	0.006	0.019	0.001	0.016	−0.022
					(0.074)	(0.072)	(0.075)	(0.073)	(0.075)	(0.074)
GPS distance					0.052	0.053	0.051	0.052	0.086	0.082
					(0.069)	(0.067)	(0.067)	(0.066)	(0.077)	(0.076)
extended family members	no	yes	no	yes	no	yes	no	yes	no	yes
area dummies * 2003	no	no	no	no	no	no	no	no	thana	thana
cohort demeaned	no	no	yes	yes	no	no	yes	yes	yes	yes
n	408	432	406	430	398	422	398	422	398	422

Source: Compiled from IFPRI data.
Notes: 1. Location dummies are omitted from the table for brevity.
2. $*$, $**$, $***$ indicate significance levels at 10%, 5%, 1%, respectively, using cluster robust standard errors.

Table 14: Linear Dropout Probability Fixed-Effect Model, Ages 10 and Older

variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(Intercept)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
age	−0.041	−0.047			−0.072	−0.075				
	(0.077)	(0.076)			(0.070)	(0.069)				
age2	0.008***	0.008***			0.008***	0.008***				
	(0.001)	(0.001)			(0.001)	(0.001)				
year 2003	−0.551***	−0.540***			−0.606***	−0.589***				
	(0.202)	(0.200)			(0.177)	(0.176)				
program membership	−0.552***	−0.552***	−0.543***	−0.543***	−0.601***	−0.596***	−0.593***	−0.589***	−0.598***	−0.595***
	(0.029)	(0.027)	(0.031)	(0.030)	(0.029)	(0.028)	(0.031)	(0.031)	(0.031)	(0.031)
interaction with 2003										
agricultural household	0.087**	0.070**	0.084**	0.066**	0.097***	0.078**	0.091***	0.072**	0.069**	0.055
	(0.034)	(0.033)	(0.034)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.035)	(0.034)
sex (female = 1)					0.164***	0.149***	0.166***	0.150***	0.167***	0.151***
					(0.034)	(0.033)	(0.035)	(0.034)	(0.035)	(0.034)
per member land holding	−5.431***	−4.901***	−3.929*	−3.339	−6.991***	−6.424***	−5.696**	−5.033**	−6.736**	−6.514**
	(1.558)	(1.490)	(2.353)	(2.120)	(1.646)	(1.549)	(2.344)	(2.172)	(2.908)	(2.570)
nonland asset (1,000,000 Tk)	−3.719**	−3.483*	−3.778**	−3.553*	−3.037	−2.917	−3.019	−2.891	−2.597	−2.622
	(1.850)	(1.836)	(1.889)	(1.866)	(1.880)	(1.859)	(1.894)	(1.866)	(1.958)	(1.927)
extended family members	no	yes	no	yes	no	yes	no	yes	no	yes
area dummies * 2003	no	no	no	no	no	no	no	no	thana	thana
cohort demeaned	no	no	yes	yes	no	no	yes	yes	yes	yes
n	518	560	511	552	518	560	511	552	511	552

Source: Compiled from IFPRI data.
Notes: 1. Location dummies are omitted from the table for brevity.
2. *, **, *** indicate significance levels at 10%, 5%, 1%, respectively, using cluster robust standard errors.

Table 15: Linear Enrollment Probability Fixed-Effect Model, Ages 10 and Older

variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(Intercept)	0.000	0.000	0.000*	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
age	−0.023	−0.018			0.006	0.008				
	(0.094)	(0.092)			(0.094)	(0.092)				
age2	−0.008***	−0.008***			−0.008***	−0.008***				
	(0.001)	(0.001)			(0.001)	(0.001)				
year 2003	0.784***	0.773***			0.836***	0.820***				
	(0.264)	(0.259)			(0.262)	(0.257)				
program membership	0.566***	0.565***	0.559***	0.560***	0.613***	0.607***	0.608***	0.603***	0.613***	0.610***
	(0.030)	(0.028)	(0.032)	(0.031)	(0.030)	(0.029)	(0.032)	(0.031)	(0.032)	(0.031)
interaction with 2003										
agricultural household	−0.085**	−0.068**	−0.080**	−0.063*	−0.095***	−0.076**	−0.087***	−0.069**	−0.066*	−0.052
	(0.035)	(0.034)	(0.035)	(0.034)	(0.034)	(0.033)	(0.034)	(0.033)	(0.035)	(0.035)
sex (female = 1)					−0.155***	−0.142***	−0.157***	−0.142***	−0.158***	−0.143***
					(0.035)	(0.034)	(0.035)	(0.034)	(0.035)	(0.034)
per member land holding	5.152***	4.631***	3.674	3.098	6.631***	6.074***	5.352**	4.704**	6.448**	6.254**
	(1.549)	(1.486)	(2.333)	(2.107)	(1.637)	(1.546)	(2.328)	(2.160)	(2.817)	(2.506)
nonland asset (1,000,000 Tk)	3.863**	3.620*	3.922**	3.698*	3.216*	3.084	3.202	3.070	2.759	2.786
	(1.913)	(1.894)	(1.943)	(1.914)	(1.948)	(1.922)	(1.951)	(1.918)	(2.005)	(1.972)
extended family members	no	yes	no	yes	no	yes	no	yes	no	yes
area dummies * 2003	no	no	no	no	no	no	no	no	thana	thana
cohort demeaned	no	no	yes	yes	no	no	yes	yes	yes	yes
n	518	560	511	552	518	560	511	552	511	552

Source: Compiled from IFPRI data.
Notes: 1. Location dummies are omitted from the table for brevity.
2. *, **, *** indicate significance levels at 10%, 5%, 1%, respectively, using cluster robust standard errors.

Table 16: Linear Dropout Probability Fixed-Effect Model, Ages 12 and Older

variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(Intercept)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
age	−0.090	−0.097			−0.161	−0.170				
	(0.171)	(0.166)			(0.159)	(0.154)				
age2	0.008***	0.008***			0.009***	0.009***				
	(0.002)	(0.002)			(0.002)	(0.002)				
year 2003	−0.465	−0.471			−0.470	−0.475				
	(0.494)	(0.480)			(0.450)	(0.435)				
program membership	−0.659***	−0.659***	−0.647***	−0.647***	−0.688***	−0.687***	−0.675***	−0.675***	−0.680***	−0.681***
	(0.035)	(0.033)	(0.038)	(0.037)	(0.033)	(0.032)	(0.037)	(0.036)	(0.036)	(0.036)
interaction with 2003										
agricultural household	0.117***	0.098**	0.114***	0.094**	0.128***	0.109***	0.120***	0.101**	0.099**	0.091**
	(0.043)	(0.041)	(0.043)	(0.041)	(0.041)	(0.040)	(0.041)	(0.040)	(0.044)	(0.042)
sex (female = 1)					0.179***	0.179***	0.178***	0.176***	0.179***	0.180***
					(0.040)	(0.039)	(0.040)	(0.040)	(0.041)	(0.040)
per member land holding	−4.287***	−3.766***	−2.913	−2.298	−6.404***	−5.988***	−5.055**	−4.530**	−5.144*	−5.379**
	(1.432)	(1.393)	(2.089)	(1.851)	(1.559)	(1.492)	(2.119)	(1.959)	(2.649)	(2.362)
nonland asset (1,000,000 Tk)	−7.181***	−7.267***	−7.257***	−7.338***	−6.227***	−6.338***	−6.220***	−6.304***	−6.398***	−6.624***
	(2.028)	(2.014)	(2.086)	(2.062)	(2.006)	(1.989)	(2.063)	(2.036)	(1.988)	(1.971)
extended family members	no	yes	no	yes	no	yes	no	yes	no	yes
area dummies * 2003	no	no	no	no	no	no	no	no	thana	thana
cohort demeaned	no	no	yes	yes	no	no	yes	yes	yes	yes
n	336	359	329	351	336	359	329	351	329	351

Source: Compiled from IFPRI data.
Notes: 1. Location dummies are omitted from the table for brevity.
2. ∗, ∗∗, ∗ ∗ ∗ indicate significance levels at 10%, 5%, 1%, respectively, using cluster robust standard errors.

Table 17: Linear Enrollment Probability Fixed-Effect Model, Ages 12 and Older

variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(Intercept)	0.000	0.000	0.000**	0.000	0.000	0.000	0.000**	0.000	0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
age	0.099	0.105			0.167	0.176				
	(0.170)	(0.165)			(0.158)	(0.153)				
age2	−0.008***	−0.008***			−0.009***	−0.010***				
	(0.002)	(0.002)			(0.002)	(0.002)				
year 2003	0.480	0.485			0.484	0.489				
	(0.491)	(0.477)			(0.447)	(0.432)				
program membership	0.669***	0.668***	0.660***	0.660***	0.696***	0.695***	0.687***	0.687***	0.692***	0.693***
	(0.036)	(0.034)	(0.039)	(0.038)	(0.034)	(0.033)	(0.038)	(0.037)	(0.037)	(0.036)
interaction with 2003										
agricultural household	−0.112***	−0.093**	−0.107**	−0.088**	−0.123***	−0.104***	−0.113***	−0.095**	−0.092**	−0.084**
	(0.043)	(0.042)	(0.043)	(0.041)	(0.041)	(0.040)	(0.041)	(0.040)	(0.044)	(0.042)
sex (female = 1)					−0.174***	−0.174***	−0.172***	−0.171***	−0.174***	−0.175***
					(0.040)	(0.039)	(0.041)	(0.040)	(0.041)	(0.041)
per member land holding	4.123***	3.608***	2.732	2.133	6.180***	5.770***	4.807**	4.299**	4.932*	5.187**
	(1.424)	(1.390)	(2.068)	(1.837)	(1.553)	(1.491)	(2.102)	(1.947)	(2.642)	(2.357)
nonland asset (1,000,000 Tk)	7.786***	7.860***	7.905***	7.990***	6.859***	6.956***	6.900***	6.987***	7.055***	7.283***
	(2.069)	(2.057)	(2.105)	(2.082)	(2.071)	(2.055)	(2.103)	(2.076)	(2.029)	(2.015)
extended family members	no	yes	no	yes	no	yes	no	yes	no	yes
area dummies * 2003	no	no	no	no	no	no	no	no	thana	thana
cohort demeaned	no	no	yes	yes	no	no	yes	yes	yes	yes
n	336	359	329	351	336	359	329	351	329	351

Source: Compiled from IFPRI data.
Notes: 1. Location dummies are omitted from the table for brevity.
2. ∗, ∗∗, ∗ ∗ ∗ indicate significance levels at 10%, 5%, 1%, respectively, using cluster robust standard errors.

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