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Allocation of Child's Time for Schooling in Rural Ethiopia: Does Households' Participation in Off-farm Activities Matter?

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Abstract

Using panel data collected over the course of three rounds, the study seeks to investigate the factors that influence households' need for their children to attend school, concentrating primarily on off-farm activities as a primary explanatory variable of interest. The study used propensity score matching with a difference-in-difference estimator. The data is gathered from children whose ages are below 15 and their households in rural Ethiopia. The findings show that the net effect of a household's participation in off-farm activities on a child's schooling was negative. The rationale behind this result is that household participation in off-farm activities increases the demand for child labor, which decreases a child's time spent in school and studying. Other factors such as household size, the age of the head, farm income, and livestock ownership significantly affected a child's schooling. A household's participation in off-farm activities is influenced by the head's age, access to credit, assistance, household size, the mean schooling of a male and female, shocks, and livestock ownership. According to the study, incentivizing households to educate their children rather than substituting child labor for adult labor should be considered. Adoption of labor-saving technologies may encourage children to attend school by decreasing the desire for child labor. By fostering the livestock industry, rural families can be strengthened, and a comprehensive family planning strategy should be considered.

Keywords: Child schooling, off-farm activities, propensity score matching, difference-in-difference, rural Ethiopia

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Introduction

Education plays a key role in the process of economic development, particularly in developing nations. It is essential for improving income, health, and reducing poverty in rural areas specifically (Ayalew, 2005; Hannum & Buchmann, 2005). To improve education in Ethiopia, the Education Sector Development Program (ESDP) was introduced in 1997. After implementing these programs, the educational sector has registered admirable results. For instance, the gross enrollment rate in the first cycle increased from 83% to 140.8%, and in the secondary cycle increased from 30.8% to 74.4 % (MOE, 2016/17). In a primary school, the completion rate increased from 47.8% to 54.1% at national level.

Despite the aforementioned achievements, the education sector in Ethiopia still faces several problems, such as unevenly distributed of access to education in rural and urban areas, a decline in learning outcomes for children, high dropout rates, etc. (Woldehanna and Gebremedhin, 2016; Woldehanna and Araya, 2016; EDHS, 2016). About 40% of the country's adult populations were illiterate; among them, 57% of rural women have no formal education, compared with 16% of urban women (EDHS, 2016). The proportion of children who cannot read anything increased from 12.89% to 18.29% in rural areas and 6.09% to 7.93% in urban areas in the years from 2006 to 2013 (Woldehanna and Gebremedhin, 2016). Over three million pupils of primary school age were out of school (UNICEF, 2012). The proportion of children who dropped out of school at age 12 was 7.07% and 3.05% for younger and older cohort children[2], respectively in rural area, and 1.56% and 2.03%, respectively in urban areas (Woldehanna and Araya, 2016). About 19.59% and 24.5% of Young Lives and non-Young Lives children were repeated. Moreover, 65.24% and 74.27% of young and old cohort children in rural areas, respectively, and 39.09% and 49.75% of young and older children in urban areas, respectively, reached the age of 12 years.

Therefore, it is important to investigate both demand side and supply side factors that determines household demand for child schooling. Demand side factors affectting demand for child schooling include houehold income/wealth, household size, child's birth order, shocks, household educational status, occupation (farm and/or off-farm activities), employment opportunity, the

2. Children born in 2001-02 are called the 'Younger Cohort' and in 1994-95 called 'Older Cohort' (Woldehanna and Araya, 2016).

direct and indirect cost of sending a child to school, and household demand for child labor[3] (Admassu & Kassahun, 2011; Admassie, et al., 2007). On the other hand, the supply side factors affecting demand for child schooling are availablity of schools, size of classes, pupil teacher ratio, distance to schools, and proportion of female teachers.

The empirical literature shows both a substitution and an income effect of households' participation in off-farm activities on child's schooling. Studies by Admassu and Kassahun (2011) and Tansel (2002) revealed that households' participation in off-farm activities on child's schooling has a substitution effect. According to their finding, households' participation in off-farm activities increases demand for child labor, which impedes child time allocation to school and studying. Child labor substituted for adult labor for domestic work such as cooking food, fetching water, and carrying their young; farm activities: keeping livestock; and collecting fire wood. On the contrary, other studies such as Huisman & Smits (2009) and Woldehanna (2010) show the income effect of household's participation in off-farm activities on child schooling. Household livelihood diversification in off-farming activities generates additional income to the household, which solves income constraint that prevents households from investing in their children's education. Households send their children to school if the income effect dominates.

The existing literature on the effect of household participation in off-farm activities on child schooling did not address the potential endogeneity problem in estimation (Admassu & Kassahun, 2011; Huisman & Smits, 2009). Other studies did not use comprehensive measurements for schooling (Subha et al., 2013; Glick & Sahn, 2000; Beegle et al., 2003). The study by Abafita and Kim (2015) relies on cross-sectional data that does not capture the impact of changing socio-economic environments on schooling.

This study contributes to the existing literature on child schooling in the following ways: First, it investigates the effect of households' participation in off-farm activities on child schooling by using propensity score matching (PSM) combined with difference in difference (DID) estimation to control for both observed and unobserved heterogeneity. Second, as outcome variables of interest in this study, more comprehensive schooling measurements such as grade completions, delay to start formal education, ever attendance of formal education, current enrollment, and basic

[3] For the definition of child labor, refer Woldehanna, et al. (2017)

literacy skill are used. Third, the study is based on a comprehensive data set that covers three rounds of panel data from the Ethiopian Socio-economic Survey (ESS). Therefore, the study answers the following research questions: What are the determinants of household participation in off-farm activities in rural Ethiopia? Does households' participation in off-farm activities have a substitution effect or an income effect on a child's schooling?

Data and Methodology

Data and Variables:

The data used for this study is obtained from the three rounds of the Ethiopian Socio-economic Survey (ESS), which is panel data collected by the Ethiopian Central Statistical Agency (CSA) in collaboration with the World Bank Living Standards Measurement Study (LSMS) team as part of the Integrated Surveys on Agriculture (ISA) program project. The ESS is a countrywide representative and large sample size, with over 5,000 households from rural and urban areas, and is more compatible with the objective of this study.

The survey employed two-stage probability sampling. At the first stage, enumeration areas (EAs) were selected. A total of 433 EAs were selected based on a probability proportional to the size of the total EAs in each region. For the rural, small, and large areas, 290, 43, and 100 EAs, respectively, were selected. The second stage of sampling involved the selection of households from each EA. For rural EAs, a total of 12 households were sampled from each EA, of these, 10 households were randomly selected from those involved in farming or livestock activities. Another two households were randomly selected from all other non-agricultural households in the selected rural EA (those not involved in agriculture or livestock). From the small and large towns, 12 and 15 households, respectively, were selected randomly from each enumeration area with no stratification. The first round of the survey conducted in 2011/12 covers only rural areas and small urban areas. By adding samples from large town areas, the second round and the third round were conducted in 2013/14 and in 2015/16, respectively.

Table 1a

Definition and Measurements of Variables

Category	Variable	Definition and measurement
Children's schooling	Ever attendance	1 if child ever attended formal education, 0 otherwise
	Enrolment status	1 if child currently in school, 0 otherwise
	Highest grade	Highest grade completed by child in years
	Delay to start primary school	Age in year – (7 + grade attainment); note that in Ethiopia, the official entrance age of child is 7 to start primary school.
	Basic literacy skill	1 if child can read and write by any language, 0 otherwise
Household head characteristics	Sex	1 if the household head is female, 0 otherwise
	Age	Age of household head in year
	School years	Formal education of household head; highest grade level completed
Household wide characteristics	Household size	Total number of household member
	School years	Mean of highest years of schooling all members of male and females
	Age	Age of children (in years)
Household asset	Land owned	Size of land holding by household (measured in hectares)
	Livestock owned	Livestock owned by household at the end of the period in Tropical Livestock Units (TLU)
Household income	Farm real income	Total income from farm per year (measured in birr)

Table 2b

Definition and Measurements of Variables

Shocks (1 if household faced)	Idiosyncratic shock	Death of household member, illness of household member, loss of off-farm jobs of household member, involuntary loss of house/farm, displacement (due to Gov. dev project), Great Loss/Death of Livestock and fire)
	Covariate shock	Drought, flood, landslides/avalanches, heavy rains preventing work, other crop damage, price fall of food items, price raise of food item, increase in price of inputs, theft/robbery and other violence, local unrest/violence
Community	Credit	Household access to formal credit, dummy variable (1, if yes; = 0, otherwise)
	Assistance	Dummy variable, taking 1 if at least one of the household members receive assistance from government and non-governmental organizations such as productive safety nets program (PSNP, do not include PSNP labor activities), free food, food-for-work programme or cash for-work programme, inputs-for work programme, and others); 0, otherwise

Methodology:

In this study, the probit model is used to identify determinants of households' decisions to participate in off-farm activities, and DID combined with the PSM model is used to investigate the impact of households' participation in off-farm activities on child schooling. The PSM controls for observable differences between participant and non-participant households in off-farm activities, but it does not control for unobserved heterogeneity. To address this shortcoming of the PSM impact estimator, the DID impact evaluation technique was employed on the data balanced via the PSM; it eliminates unobservable heterogeneity.

Model 1: Off-farm participation decision model

In this section, a non-linear probability model is employed to identify determinants of households' decisions to participate in off-farm activities following Rosenbaum & Rubin (1983) and Shahidur R., et al. (2010). In a study by Verbeek (2012), a probit model was employed to examine the decision to participate in off-farm activities. Similar to the logit model, the probit model is used to predict the probability of households' participation in off-farm activities, but the probit model is based on a standard normal distribution function instead of logistic functions. The Probit model assumes that participation in off-farm activities is determined by a continuous latent variable Y*, which satisfies:

$$Y^* = X'\beta + \varepsilon_i \quad \ldots\ldots (1)$$

Although Y is not observed, we do observe

$$Y = \begin{cases} 1 \text{ if } Y^* > 0 \\ 0 \text{ otherwise} \end{cases} \quad \ldots\ldots (2)$$

Equation (2) shows decision of a household to remain engaged in off-farm activities in both 2013/14 and 2015/16, or either one of the two. Given the latent models in equations 1 and 2, and specifying $\Pr(Y = 1|X) = F(X\beta)$ to be the cumulative distribution conditional on X, it yields participation in off-farm activities in period one (2013/14) and period two (2015/16) as follows:

$$\Pr(D_i, 2013/14,\ 2015/16 = 1) = \Pr(X'_i\beta + \varepsilon_i > 0)$$

$$= \Pr(-\varepsilon_i < X'\beta)$$

$$\Pr(D_i, 2013/14, 2015/16 = 1) = F(X'_{i_{2011/12}}) \quad \ldots\ldots (3)$$

In equation (3), F (.) is the cumulative normal density function, which yields in the probit estimation. The dependent variable represents the probability that household i participate in period one and/or period two conditional on $X'_{i_{2011/12}}$. The dummy variable (D_i, 2013/14, 2015/16) equals one if household i participated in at least one, either in 2013/14 and/ or 2015/16 and zero, otherwise. The probability of participation in period one and/ or period two is the function of observable variables X_i in 2011/12. The variable X_i includes sex and age of head, mean schooling of male and female, highest grade completed by head, household size, farm income, livestock owned, plot of land owned, idiosyncratic and covariate shocks, credit, and assistance. β and ε_i are the coefficients of explanatory variables and the error term, respectively.

Model 2: Modeling the effect of household participation in off-farm activities on child schooling

Following Nguyen (2012) and Nguyen & Grote (2015), the study employed PSM combined with DID estimation. The PSM matches participated and non-participated households based on the propensity score, which is conditional on households' socio-demographic characteristics, shocks, and community level characteristics. To satisfy the conditional independent assumption, a propensity score is calculated from 2011/12 households' data, using probit estimation. The propensity scores are the predicted probability of households' participation in off-farm activities, conditional on pre-treatment characteristics, X in 2011/12. Pre-treatment characteristics of household covariates such as the mean schooling of male and female in the household, the head's schooling, sex of household the head, credit access, receiving assistance from government and non-government agencies, idiosyncratic shocks, and covariate shocks were included in the estimation. Covariates, X, that affects the likelihood of households' engagement in off-farm activities.

$$P\,(Yi) = \Pr(D_i, 2013/14,\ 2015/16\ = 1)|Xi_{2011/12}\,) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where, D_i determines whether households are participated or not; $D_i = 1$ if households participated, 0 otherwise. Based on matched data in equation (4), DID estimation is carried out, which quantify the impact of household participation in off-farm activities on child schooling. In other words, after generation of the propensity score for household level data, DID regressions are estimated for individual children data. Suppose Y_{1i} and, Y_{0i} denote child schooling corresponding to the state of household participation $D_i = 1$ and $D_i = 0$, respectively.

We can then measure the impact of household participation on the schooling of an individual child i as follows:

$\Delta i = Y_{1i} - Y_{0i}$ …… (5)

Equation (5) states that the difference in the schooling of a child belonging to participant and non-participant household. To quantify the effect of participation in off-farm activites on child schooling, the study estimated average treatment effect of the population (ATE), average treatment effect of the treated (ATT), and average treatment effect on not treated (ATNT) in 2015/16. ATE modeled as follows:

$ATE = \Delta Y_i = E[Y_{1i}] - E[Y_{0i}]$ …….. (6)

Equation (6) implies the average treatment effect. We can compute ATE conditional on covariates, X, as follows:

$ATE_X = \Delta Y_i|X = E[Y_{1i}|X] - E[Y_{0i}|X]$…..…….…….. (7)

In equation (7), it is impossible to estimate the impact of participation in off-farm activites on each child's schooling because we cannot know the counterfactual outcomes. One can not observe Y_{1i} and Y_{0i} in the same child i. For child belonging to participant household, we can observe only Y_{1i} and for child belonging to non-participant househld, we can observe only Y_{0i}. To evaluate the impact, we introduce participated and non-participated household.

$$ATE_X = \Delta Y_i|X = \overbrace{\langle E[Y_{1i}|X, D_i = 1] - E[Y_{1i}|X, D_i = 0]\rangle}^{\text{Educational outcome for the child belonging to participant household over time}} - \underbrace{\langle E[Y_{0i}|X, D_i = 1] - E[Y_{0i}|X, D_i = 0]\rangle}_{\text{Educational outcome for the child belonging to non-participant household over time}}$$

…… (8)

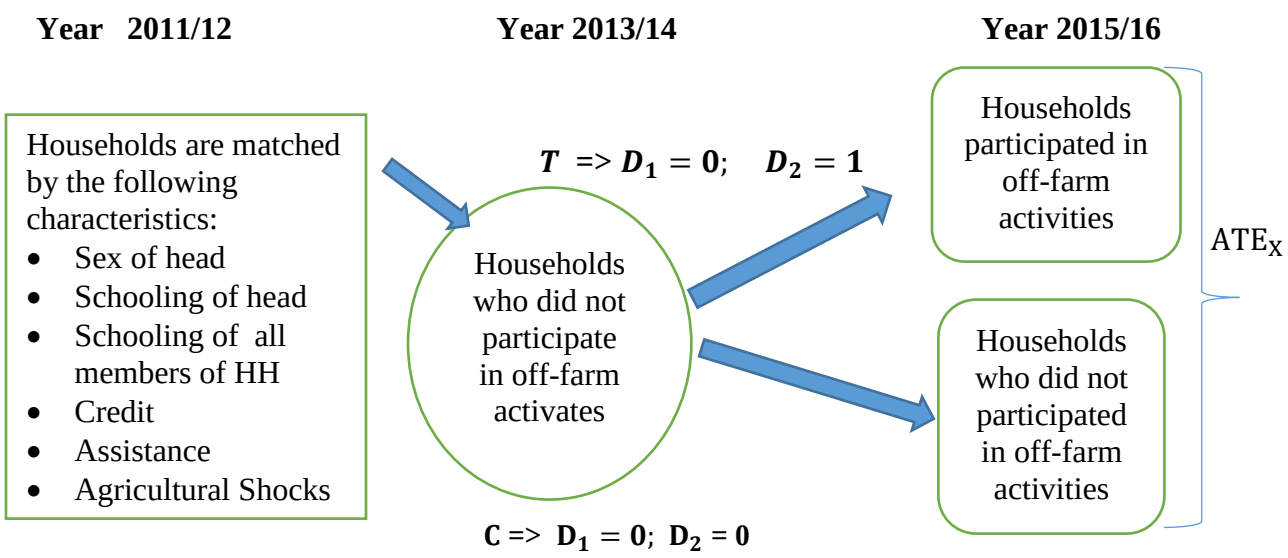
Where ATE_X is the sum of average treatment effect on treated and $ATNT_X$ average treatment effect on non-treated, conditional on covariates. Thus, equation (8) can be rewritten as follows:

$ATE_X = \Pr(D_1 = 0|X, D_2 = 1)ATT_X + \Pr(D_1 = 0|X, D_2 = 0))ATNT_X$……...…….…. (9)[4]

[4] see Eq. A1 for more explanation in the appendix

Figure 1

Theoretical Model of the PSM-DID Estimation



Results and Discussion

Descriptive Statistics

In this section, we present the descriptive statistics of variables of interest. Table 2 shows the outcomes of child schooling (the first five variables) and explanatory variables, which affect household participation in off-farm activities. The result shows that 64% of the children attended formal education on average; it implies that many school aged children were bot attending formal education in rural areas. But the proportion of children attending formal education has increased from 61% to 66% in the years from 2011/12 to 2015/16.

About 92% of children were enrolled during the study period. Only 46% of children in the sample have a basic literacy skill (can read and write); the figure increased from the year 2011/12 to 2015/16. It indicates low quality of education in rural areas since more than half of children (54%) had no basic literacy skill. Therefore, it is important to consider both the distribution of educational access and the quality of education. On average, the highest grade completed was 1.37 years; the figure increased from the year 2011/12 to 2015/16. On average, child delayed about 0.55 years to

start primary school; it means that the average age of child start primary school is 7.55 years. However, the delay to start primary school increased from the year 2011/12 to 2015/16.

The majorities of rural households were male-headed; only 17% of a household were a female headed in the sample. The age of head on average was 45.44 years. The average household size was six, and the size was more or less similar between the years 2011/12-2015/16. The mean schooling of a male and female in the household was 1.66 and 1.46 years, respectively. The mean years of schooling for a female was higher than the mean years of schooling for a male in the year 2015/16; the result reveals that the current education system is giving attention to females in rural Ethiopia. On average, the highest grade completed by the household head was 1.77 years.

The average age of the children in the sample was 9.44 years. On average, 24% of children participated in off-farm activities; the participation rate was high in the year 2011/12 (32 %). The rationale for demand for child labor is that poor households send their children to work instead of school to support their households with income. About 29% and 19 % of households received credit and assistance, respectively. The proportion of households experienced idiosyncratic and covariate shocks is 23% and 43%, respectively. The households' average annual income from farm activities was Br. 743.29. The average land size and livestock owned by the households was 1.7 hectares and 3.7 livestock in TLU, respectively.

Table 2

Descriptive Statistics

Variable	Pooled	2011|12	2013/14	2015/16
	Mean	Mean	Mean	Mean
Ever attendance (1 = attended)	0.64	0.61	0.65	0.66
Enrollment status (1 = enrolled)	0.92	0.93	0.92	0.93
Basic skill (1= read and write)	0.46	0.43	0.46	0.49
Highest grade completed	1.37	1.24	1.38	1.49
Delay to start primary school	0.55	0.48	0.58	0.59
Sex head (1 = F)	0.17	0.17	0.18	0.17
Credit (1 = borrowed)	0.29	0.28	0.32	0.28
Assistance (1= received)	0.19	0.19	0.14	0.24
Head's age	45.44	44.92	45.38	45.98
Child's age	9.44	9.23	9.46	9.62
Child labor in off-farm (1 = participated)	0.24	0.32	0.21	0.20
Household size	6.61	6.57	6.63	6.63
Mean schooling of male	1.66	1.72	1.90	1.38
Mean schooling of female	1.46	1.12	1.23	2.04
Head's schooling	1.77	1.65	1.65	1.99
Idiosyncratic shocks (1 = Experienced)	0.23	0.23	0.15	0.32
Covariate shocks (1 = Experienced)	0.43	0.42	0.31	0.55
Farm earning, real	743.29	878.18	838.93	519.6
Livestock owned in TLU	3.70	3.24	3.54	4.31
Plot of land	1.70	1.87	1.65	1.58

Source: Authors' computation based on 2011/12, 2013/14, and 2015/16 ESS data

Table 3 shows the proportion of households' participation status in off-farm activities in the three rounds. On average, 27% of households were participated in our sample within three rounds. The proportion of household participated in off-farm activities is almost the same within the three rounds.

Table 3

Variation of Household's Participation in Off-Farm Activities in The Three Rounds

Participation rate	Survey round			
	2011/12	2013/14	2015/16	Average in three periods
Non-participated	3,093	3,218	3,303	3,205
Percentage (%)	72.69	71.93	73.74	73
Participated	1,162	1,256	1,176	1,198
Percentage (%)	27.31	28.07	26.26	27
Total	4,255	4,474	4,479	4,403
Percentage (%)	100	100	100	100

Source: Authors' computation based on 2011/12, 2013/14, and 2015/16 ESS data

Determinants of households' participation in off-farm activities

Table 4 presents the factors that affect households' participation in off-farm activities in rural Ethiopia. The probit regression results reveal that credit access, assistance, size of the household, the mean schooling of the male and female positively and significantly affect households' participation in off-farm activities; whereas age of the head, covariate shocks, and livestock owned in TLU have negative and significant effects.

Having access to credit increases the probability of participation in off-farm activities by 3.6% compared to having no access to credit, holding other factors constant. The result is similar to the previous study by Abebe (2010). The probability of participation is higher by 3% for households that receive assistance. This makes it likely that access to credit and assistance will solve the liquidity problem in rural areas, and thereby increase the probability of participation in off-farm activities.

Consistent with other studies (Woldenhannaa & Oskam, 2001; Amare & Belaineh, 2013), the study found a negative relationship between the age of the household head and the likelihood of participation in off-farm activities. This may be related to asset/wealth holding; young headed households hold a small amount of assets, particularly land and farm inputs, compared to older households. Therefore, young headed households diversify their livelihood into off-farm activities.

Also, as age increases, the income effect may dominate, and households may demand more leisure and reduce time allocation to off-farm activities at a later age.

Related to household size, having one more household member increases the likelihood of households' participation in off-farm activities by 1%, holding another factors constant. The result is similar with Musa & Kumilachew (2018). This is may be related with large household size have more time endowment to allocate in off-farm activities. The coefficient of mean schooling for males and females is positive; it indicates the probability of participation in off-farm activities increases when members of households are more educated. This may be related to the fact that a higher educated household member may participate more in off-farm income generating activities, particularly professional jobs.

The probability of participation in off-farm activities decreases by 2.1% for a household who faced covariate shocks. This may be related with occurrences of shock exacerbate financial liquidity problem which hinders the participation. Similar with the previous studies (Adugna, 2009; Yishak, 2017), household's who have more livestock in TLU participate less in off-farm activities. This may be related to the fact that households who have more livestock allocate more time to livestock management and husbandry; and are therefore less likely to engage in off-farm work.

Table 4

Determinants of Household Participation in Off-Farm Activities

	Panel data		
Variables	Coef.	dy/dx	Std. Err.
Sex of head (1 = F)	-0.091	-0.013	0.015
Credit (1 = borrowed)	0.250	0.036	0.008*
Assistance (1 = received)	0.209	0.030	0.010*
Head's age	-0.018	-0.003	0.000*
Child's age	0.000	0.000	0.002
Household size	0.071	0.010	0.003*
Mean schooling of male	0.077	0.011	0.003*
Mean schooling of female	0.049	0.007	0.003*
Head's schooling	0.006	0.001	0.002
Farm earning, real in real	0.021	0.003	0.002
Idiosyncratic shocks (1 = faced)	0.063	0.009	0.009
Covariate shocks (1 = faced)	-0.146	-0.021	0.008*
Livestock owned in TLU	-0.043	-0.006	0.002*
Plot of land	0.009	0.001	0.001
Cons.	-1.407		0.226
Sigma _u	1.956		0.077
rho	0.793		0.013
Number of observations		11,166	
Number of groups		6,137	
Wald chi2(14)		134.7	
Prob > chi2		0.000	

Note: * shows statistically significant variables at 1% level of significance.

Source: Authors' computation based on 2011/12, 2013/14, and 2015/16 ESS data

The impact of households' participation in off-farm activities on child schooling

Table 5 presents the impact of household participation in off-farm activities on child schooling. The average treatment on treated (ATT), the average treatment on not treated (ATNT), and the average treatment on the whole sample (ATE) were estimated. Households that participated and did not participated in off-farm activities were balanced based on covariates such as the mean schooling of a male and female in the household, the head's schooling, the sex of the household head, credit access, receiving assistance from the government and non-government agencies, idiosyncratic shocks, and covariate shocks, and the balancing test was met (see Table A1 in the appendix).

The results from PSM-DID regression show that households' participation in off-farm activities negatively affects child schooling, implying that the substitution effect dominates the income effect. This result is similar to the findings of previous studies such as Admassu and Kassahun (2011) and Tansel (2002). Unlike previous studies, the present study addressed the endogeneity problem. The rationale behind this result is that household participation in off-farm activities may increase demand for child labor for domestic works such as cooking food, fetching water, carrying their young, keeping livestock, collecting firewood, and farm activities. An increase in a child's time spent on domestic and farm work hinders a child's schooling by reducing time spent on schooling and studying. Moreover, for poor households, the immediate needs of income generated by children outweigh future benefits of schooling; therefore, poor households use child labor in off-farm activities instead of sending their children to school.

Children belonging to households that participated in off-farm activities completed fewer grade levels than children belonging to non-participant households. Children belonging to the household did not participate in off-farm activities are less likely to delay to start primary school. A higher proportion of children belonging to a household who did not participate in off-farm activities attended formal education and are currently enrolled. A higher proportion of children from households that did not participate in off-farm activities have basic literacy skills (read and write in any language).

The highest grade completed by children belonging to households that participated in off-farm activities was lower by 0.245 years on average as compared to children belonging to households that did not participate. The average delay to start primary school for children belonging to non-participant households was lower by 0.105 years on average as compared to children belonging to non-participant households. The proportion of children belonging to non-participant households is higher by 18.3% and 20.1% in formal education attendance and current enrollment, respectively. In the whole sample, the proportion of children who are currently enrolled in school decreased by 58.5% when households participated in off-farm activities. The proportions of children who have basic literacy skills (read and write in any language) from households that did not participate were higher by 11.6%.

Corresponding with the estimation of the impact of a household's participation in off-farm activities, other factors that determine child schooling were estimated. The finding shows that household size and the age of the household head negatively and significantly affected child schooling, whereas farm income and ownership of livestock in TLU positively and significantly affected child schooling. The age of a child has an inconsistent effect.

Table 5

DID with Matching Estimates of Impact of Household Participation on Off-Farm Activities

Variables	Highest grade completed	Delay to start Primary school	Ever attended formal education	Current enrollment status	Basic literacy skill
	Coef.	*Coef.*	*Coef.*	*Coef.*	*Coef.*
ATT	-0.245***	0.191	0.092	0.128	0.155
ATNT	0.029	-0.105***	0.183*	0.201***	0.116**
ATE	0.137	-0.144	0.037	-0.585***	-0.211
Head's age	-0.005***	0.008**	-0.008*	-0.005	-0.005**
Child's age	0.514*	0.437*	0.199*	-0.122*	0.251*
Household size	-0.090*	0.117*	-0.057*	-0.036	-0.033**
Farm earning, real in ln	-0.020	0.014	0.036***	-0.007	0.029***
Livestock owned in TLU	0.012	-0.017	0.002	0.060*	0.016**
Plot of land	0.005	-0.006	0.003	-0.004	0.013
_cons	-2.652	-4.689	-0.825	3.067	-2.258
Number of obs.	3,025	3,012	2,985	1,437	2,988
F test	F (9, 1977) = 153.79	F (9, 1973) = 89.78			
Wald chi2(9)			255.31	40.32	419
P- value	0.000	0.000	0.000	0.000	0.000

Source: Authors' computation based on 2011/12, 2013/14, and 2015/16 ESS data

Note: *, ** and ***, shows statistically significant variables at 1%, 5% and 10% level of significance, respectively. In all the estimations, we specified the standard error to be robust standard errors.

Conclusion and Policy Implications

The study investigated the effects of households' participation in off-farm activities on child schooling and identified the determinants of household participation in off-farm activities in rural Ethiopia using three round panel data sets from the ESS. The findings from the PSM-DID estimation show that households' participation in off-farm activities has a negative effect on child schooling. The rationale for this result is that household participation in off-farm activities may induce the substitution of child labor for adult labor at home and in farm activities, which impedes child schooling. Other factors, such as household size and the age of the household head, also negatively affected child schooling. On the other hand, income from farm activities and livestock owned in a tropical livestock unit (TLU) positively affected child schooling. The results from the probit estimation show that household size, the mean schooling of male and female members of the household, and access to credit and assistance positively affected household participation in off-farm activities. Whereas age and sex of the head, livestock owned in TLU, and covariate shocks negatively affected household participation in off-farm activities.

Based on the findings, the study has the following implications: first, providing incentives such as cash transfers, free supplies of education materials, such as pens, exercise books, and school uniforms, and school feeding for children belonging to participant households, particularly those belonging to poor households. Second, encouraging the adoption of labor-saving technologies and promoting the livestock sector to empower rural households is suggested. Third, family planning policies should be implemented widely because family size has a negative impact on schooling.

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Appendix

Table A1: Descriptive statistics of variables

	Pooled					**2011|12**				
Variable	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max	Obs
Ever attendance (1 = attended)	0.64	0.48	0	1	13,088	0.61	0.49	0	1	4,183
Enrollment status (1 = enrolled)	0.92	0.26	0	1	8,374	0.93	0.26	0	1	2,534
Basic skill (1= read and write)	0.46	0.50	0	1	13,089	0.43	0.49	0	1	4,183
Highest grade completed	1.37	1.84	0	9	13,208	1.24	1.77	0	8	4,255
Delay to start primary school	0.55	2.15	-3	7.33	13,164	0.48	2.27	-3	7.33	4,245
Sex head (1 = F)	0.17	0.38	0	1	13,180	0.17	0.38	0	1	4,230
Credit (1 = borrowed)	0.29	0.46	0	1	13,208	0.28	0.45	0	1	4,255
Assistance (1= received)	0.19	0.39	0	1	13,180	0.19	0.39	0	1	4,227
Head's age	45.44	12.21	13	98	13,120	44.92	12.29	17	97	4,228
Child's age	9.44	2.72	5	14.75	13,208	9.23	2.81	5	14.33	4,255
Child labor in off-farm (1 = participated)	0.24	0.43	0	1	13,208	0.32	0.46	0	1	4,255
Household size	6.61	2.08	1	17	13,206	6.57	2.00	2	14	4,255
Mean schooling of male	1.66	1.82	0	17	13,030	1.72	1.81	0	15	4,189
Mean schooling of female	1.46	1.73	0	16	13,102	1.12	1.40	0	14	4,243
Head's schooling	1.77	2.95	0	18	13,124	1.65	2.80	0	16	4,230
Idiosyncratic shocks (1 = Experienced)	0.23	0.42	0	1	13,208	0.23	0.42	0	1	4,255
Covariate shocks (1 = Experienced)	0.43	0.49	0	1	13,208	0.42	0.49	0	1	4,255
Farm earning, real	743.29	3507.28	0	162499	13,208	878.18	5807.41	0	162499	4,255
Livestock owned in TLU	3.70	4.23	0	87.14	13,208	3.24	4.14	0	87.14	4,255
Plot of land	1.70	3.82	0	126.48	13,208	1.87	4.74	0	77.05	4,255
	2013|14					**2015|16**				

Variable	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max	Obs
Ever attendance (1 = attended)	0.65	0.48	0	1	4427	0.66	0.47	0	1	4478
Enrollment status (1 = enrolled)	0.92	0.28	0	1	2863	0.93	0.25	0	1	2977
Basic skill (1= read and write)	0.46	0.50	0	1	4428	0.49	0.50	0	1	4478
Highest grade completed	1.38	1.84	0	9	4474	1.49	1.89	0	9	4479
Delay to start primary school	0.58	2.11	-3	7	4461	0.59	2.08	-3	7	4,458
Sex head (1 = F)	0.18	0.38	0	1	4472	0.17	0.38	0	1	4,478
Credit (1 = borrowed)	0.32	0.47	0	1	4474	0.28	0.45	0	1	4,479
Assistance (1= received)	0.14	0.35	0	1	4474	0.24	0.43	0	1	4,479
Head's age	45.38	12.11	17	97	4430	45.98	12.20	13	98	4,462
Child's age	9.46	2.67	5	14	4474	9.62	2.66	5	14.75	4,479
Child labor in off-farm (1 = participated)	0.21	0.41	0	1	4,474	0.20	0.40	0	1	4,479
Household size	6.63	2.09	1	16	4474	6.63	2.14	1	17	4,477
Mean schooling of male	1.90	1.94	0	17	4,378	1.38	1.65	0	15	4,463
Mean schooling of female	1.23	1.51	0	15	4,462	2.04	2.05	0	16	4,397
Head's schooling	1.65	2.86	0	18	4,432	1.99	3.16	0	17	4,462
Idiosyncratic shocks (1 = experienced)	0.15	0.36	0	1	4474	0.32	0.47	0	1	4,479
covariate shocks (1 = f experienced)	0.31	0.46	0	1	4474	0.55	0.50	0	1	4,479
farm earning, real	838.93	1586.5	0	33530.62	4474	519.6	1,284.51	0	17560	4,479
Livestock owned in TLU	3.54	4.15	0	65.18	4474	4.31	4.31	0	45.92	4,479
Plot of land	1.65	3.97	0	126.48	4474	1.58	2.45	0	47.391	4,479

Source: Authors' computation based on 2011/12, 2013/14, and 2015/16 ESS data

Table A 2: A Formal test of balance before and after matching

Covariates	**Enrollment status**		**Basic literacy skill**		**Absence from school**	
	Standardized differences	Variance ratio	Standardized differences	Variance ratio	Standardized differences	Variance ratio

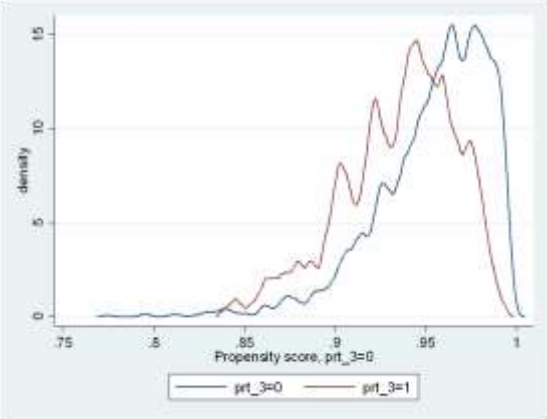
	Raw	Matched	Raw	Matched	Raw	Matched	Raw	Matched	Raw	Matched	Raw	Matched
sex of head (= F)	0.03	0.03	1.07	1.06	0.03	0.02	1.07	1.05	0.03	0.02	1.07	1.03
credit (1= borrowed)	-0.18	-0.02	0.81	0.98	-0.18	-0.03	0.81	0.97	-0.18	-0.07	0.81	0.92
assistance	-0.09	0.05	0.85	1.08	-0.09	0.03	0.85	1.05	-0.09	0.09	0.85	1.15
mean schooling of male	0.01	-0.02	0.88	0.78	0.01	-0.02	0.88	0.76	0.01	-0.03	0.89	0.79
mean schooling of female	-0.09	0.04	0.93	1.15	-0.09	0.03	0.93	1.14	-0.09	0.03	0.92	1.08
head's schooling	0.26	-0.01	1.08	0.79	0.26	-0.02	1.08	0.78	0.26	-0.05	1.09	0.76
idiosyncratic shocks	-0.15	0.00	0.81	1.00	-0.15	0.00	0.81	1.01	-0.15	-0.03	0.81	0.96
covariate shocks	-0.22	-0.02	0.90	0.99	-0.22	-0.03	0.90	0.99	-0.21	-0.03	0.90	0.99
Total obs.	2103	4206			2,101	4,202			2077	4,154		
Treated obs	98	2103			98	2,101			98	2,077		
Control obs	2,005	2,103			2,003	2,101			1979	2,077		

Covariates	**Enrollment status**				**Basic skill**			
	Standardized differences		Variance ratio		Standardized differences		Variance ratio	
	Raw	Matched	Raw	Matched	Raw	Matched	Raw	Matched
sex of head (= F)	0.17	0.26	1.32	1.43	0.03	0.02	1.07	1.04
credit (1= borrowed)	-0.14	0.12	0.88	1.10	-0.18	-0.08	0.81	0.91
assistance	0.17	0.19	1.30	1.29	-0.09	0.10	0.85	1.16
mean schooling of male	-0.15	-0.03	0.78	0.71	0.01	-0.02	0.89	0.82
mean schooling of female	-0.08	-0.24	1.06	0.96	-0.09	0.04	0.92	1.10
head's schooling	0.21	-0.02	1.11	0.92	0.26	-0.05	1.09	0.77
idiosyncratic shocks	-0.16	0.26	0.80	1.29	-0.15	-0.03	0.81	0.96
covariate shocks	-0.11	0.32	0.98	1.00	-0.21	-0.03	0.90	0.99
Total obs.	1,127	2,254			2,079	4,158		
Treated obs	43	1,127			98	2,079		
Control obs	1,084	1,127			1,981	2,079		

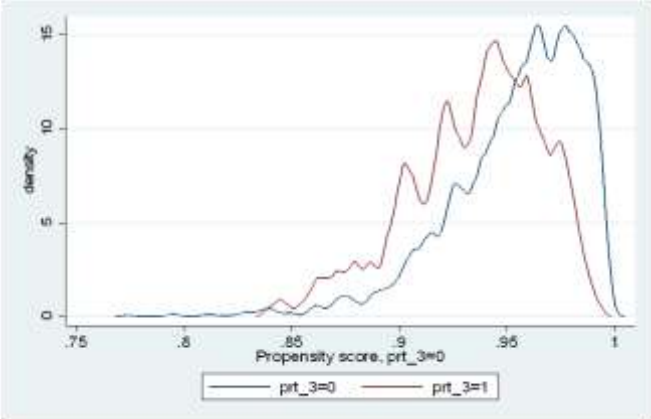
Source: Authors' computation based on 2011/12, 2013/14, and 2015/16 ESS data.

Figure A1: Overlap between participants before and after matching for main results

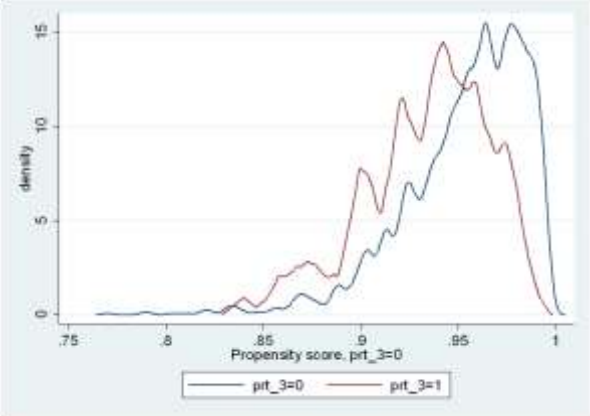
Highest grade completed



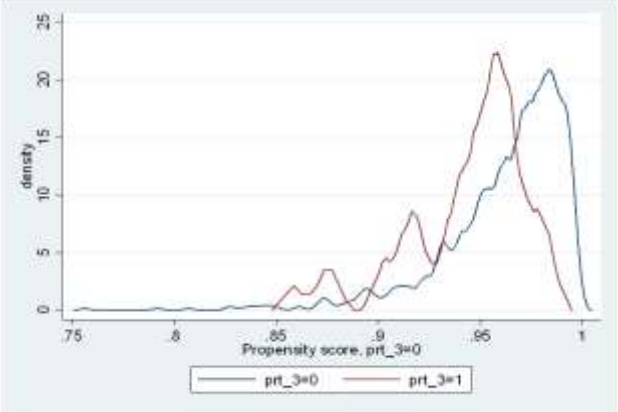
Delay to start primary school



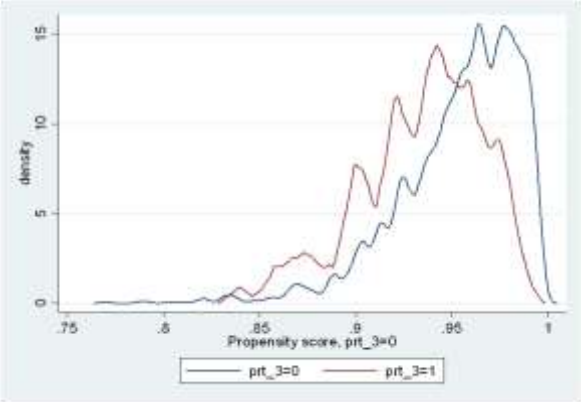
Ever attendance



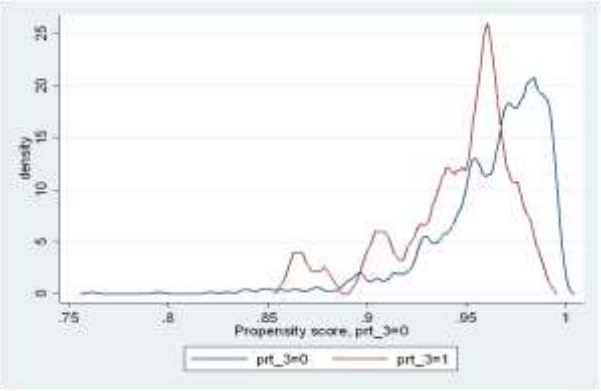
Enrollment status



Basic literacy skill



Absence from school



Source: Authors' computation based on 2011/12, 2013/14, and 2015/16 ESS data.

Eq. A1: Estimation of ATE_X , ATT_X , and $ATNT_X$

Assume that D_1 and D_2 denote the binary variables of the participation in off-farm activities status in the period one (2013/14) and period two (2015/16), respectively. Let Y_{1iF} and Y_{0iF} denote the potential child schooling belonging to participant household and non-participant household in off-farm activities, respectively in period one. Further, let Y_{1iS} and Y_{0iS} denote the potential child schooling belonging to participant household and non-participant household, respectively in period two. The average treatment effect as follows:

$ATE_X = Pr(D_2 = 1)\, ATT_X + Pr(D_2 = 0)\, ATNT_X$ ..……..…….…… (1)

In order to identify ATE_X, let us first compute ATT_X as follows:

$ATT_X = E[Y_{1i} | X, D_2 = 1] - E[Y_{0i} | X, D_2 = 1]$ ……...……... (2)

Equation (2) shows average treatment effect on treated, the difference between mean schooling of children belonging to participant household ($Y_{1i} | X, D_2 = 1$), and their counterfactual (expected educational outcome of child belonging to household participated had did not treated, $E[Y_{0i} | X, D_2 = 1]$). We rewrite equation (2) as follows:

$ATT_X = Pr(D_1 = 0 | X, D_2 = 1)(E[Y_{1iS} | X, D_1 = 0, D_2 = 1] - E[Y_{0iS} | X, D_1 = 0, D_2 = 1])$ (3)

In equation (3), $E[Y_{0iS} | X, D_1 = 0, D_2 = 1]$ is not observable. To identify ATT, again rewrite the above equation as the following:

$ATT_X = Pr(D_1 = 0 | X, D_2 = 1)\, E\, \{[Y_{1iS} | X, D_1 = 0, D_2 = 1] - E[Y_{0iS} | X, D_1 = 0, D_2 = 0]\}$-$\{E[Y_{0iF} | X, D_1 = 0, D_2 = 1] - E[Y_{0iF} | X, D_1 = 0, D_2 = 0]\}$ ……..…… (4)

Note, households participated in 2015/16 only match with household do not participated in both periods (2013/14 and 2015/16.

To identify ATE_X, we additionally need to calculate $ATNT_X$. It can be calculated as follows:

$ATNT_X = E[Y_{1iS} | X, D = 0] - E[Y_{0iS} | X, D = 0]$ …….……..….... (5)

$ATNT_X$ in second period (2015/16) as follows:

$ATNT_X = [Y_{1iS} | X, D_2 = 0] - E[Y_{0iS} | X, D_2 = 0]$

$ATNT_{(X)} = Pr(D_1 = 0 | X, D_2 = 0)\, \langle E\, \{[Y_{1iS} | X, D_1 = 0, D_2 = 1] - E[Y_{0iS} | X, D_1 = 0, D_2 = 0]\rangle - E[Y_{0iF} | X, D_1 = 0, D_2 = 1]$- $E[Y_{0iF} | X, D_1 = 0, D_2 = 0]\}$…… (6)

Therefore, from equation (6 and 13), we identify $ATE_{(X)}$ estimated by $ATT_{(X)}$ and $ATNT_{(X)}$ weighted by Pr ($D_2 = 1$) and Pr ($D_2 = 0$) in equation (1).

The matching to estimate ATNT in equation (6): households did not participated in off-farm activities in both periods are matched with households participated in off-farm activities in 2015/16 only.