ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

THE IMPACT OF HOUSEHOLD PARTICIPATION IN OFF-FARM INCOME GENERATING ACTIVITIES ON CHILDREN EDUCATIONAL OUTCOMES IN RURAL ETHIOPIA

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BY

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Acronyms and Abbreviations

ATE-Average Treatment Effect

ATT-Average Treatment Effect on Treated

ATNT-Average Treatment Effect on Non-treated

CARA- Constant Absolute Risk Aversion

CIA-Conditional Independent Assumption

CSA- Central Statistical Agency

DID-Difference-in-Difference

EA-Enumeration Area

EDHS- Ethiopian Demographic and Health Survey

ERHS-Ethiopian Rural Household Survey

ESDP-Education Sector Development Program

ESS- Ethiopian Socio-Economic Survey

FGT- Foster, Greer, and Thorbecke

IV- Instrumental Variable

LSMS-ISA- Living Standards Measurement Study- Integrated Surveys on Agriculture

MOE- Ministery of Education

MRP-Marginal Revenue of Product

PAP-FAM-Pan Arabic Project for Family Health

PPP-Purchasing Power Parity

PPVT-Peabody Picture Vocabulary Test

PSM- Propensity Score Matching

SNNP- Southern Nations, Nationalities, and Peoples

TLU- Tropical Livestock Unit

UNICEF- United Nations Children's Fund

US- United States

WMS-Welfare Monitoring Survey

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Abstract

This study investigates the impact of household participation in off-farm income generating activities on children's educational outcomes in rural Ethiopia. The analysis uses Ethiopian Socio-economic survey panel data collected in three periods (i.e. 2011/12, 2013/14, and 2015/16). Propensity Score Matching in combination with Difference-in-Difference (PSM-DID) estimator was applied to estimate effects. The results from probit model suggest that credit, household size, mean schooling of males and female, government and non-governmental assistance, children's labor and age positively affected household's participation in off-farm activities. Whereas, sex and age of head, livestock owned in TLU, covariate shocks and farm earning negatively affected off-farm participation. The results from matching with difference-in-difference suggests that household participation in off-farm activities had a negative impact on children's educational outcomes such as highest grade completed, current enrollment and basic literacy skill of children. Household's exit from off-farm activities significantly reduced proportion of children who absent from school and increased proportion of children who ever attended formal education. Household's off-farm participation affects children's educational outcomes through increasing demand of child labor in off-farm work. Higher proportion of children participated in off-farm activities who lives with participated household's compared to their counterparts. In addition, it may increase demand of children's work in farm for boys and home work for girls. The study suggests that incentivizing households for schooling their children instead of using their time on off-farm activities should be considered. Incentives such as cash transfer, free supply of educational materials such as pens, exercise books, school uniforms, cloths during a big holidays such as New Year and Christmas should be given to children belonging to participant households. In addition, Empowering rural households in obtaining sufficient income through promoting livestock sector, expanding modern agricultural systems such as irrigation system, encouraging cash crops production, and providing modern inputs such as improved seed and fertilizers, and tractors need to be considered. Family planning policy should be worked widely as the family size has negative impact on educational outcomes.

Key words: Off-farm participation, Educational outcomes, Propensity Score Matching, Difference-in-Difference, Rural Ethiopia

Chapter One: Introduction

1.1. Background of the study

Capital is needed for economic development in both developed and developing countries. Countries investment on both human and physical capital to increase their stock is essential. Human capital plays a vital role in economic development in a country as it enhances the productivity of labor (Hannum & Buchmann, 2005). Education plays a key role in the process of economic development in a given country; it is essential for improving income, health, and reducing poverty at large by improving the livelihood and building a food-secure world; and it also encourages democratic political system (Ayalew, 2005; Hannum & Buchmann, 2005). To improve education in Ethiopia, Education Sector Development Program (ESDP) was introduced during 1997. After implementing these programs, the educational sector has registered admirable results. According to MOE (2016/17) report, between the year 2000/01 and 2016/17 gross enrollment rate in first cycle (grade 1-4) increased from 83 percent to 140.8 percent. The gross enrolment in secondary cycle (grade 5-8) increased from 30.8 percent to 74.4 percent. This almost doubled Ethiopia's gross enrolment rates. Also, primary completion rate increased from 47.8 percent to 54.1 percent at national level. Despite these achievements, the education sector still faces several problems.

The foregoing studies show that studying on children's educational outcomes needs identifying a wide range of factors which affect a children schooling decisions by households (Admassu & Kassahun, 2011; Appleton, 1991; Admassie, Delelegn and Abebaw, 2007). According to their investigation it is important to investigating the demand sides in addition to the supply side factors which affects the schooling decision. After identifying the reasons for demand and supply side constraints, it will be possible to decide on appropriate policies to remedy that situation. According to them, demand side factors are houehold income or wealth, household size, child's birth order, economic shocks, household educational status, occupation (farm and/or off-farm activities), employment opportunity, direct cost of schooling and indirect costs such as opportunity cost of sending the child to school. And the supply side factors are the availablity of school, school quality measured by the size of class, pupil teacher ratio, distance to school, and proportion of female teachers.

Studies show that household occupation combined with other factors, particularly the head's participation in off-farm activities affect children's educational outcomes. Some studies have found negative effect of participation in off-farm activities on child educational outcomes (Admassu & Kassahun, 2011; Appleton (1991); Tansel, 2002). Others, in contrary, found its positive effect (Huisman & Smits, 2009). Households expand their income into farm activities and off-farm activities to diversify their source of income and to secure income (or consumption) for their household members (Adugna, 2009). Studies imply that because of several agricultural shocks, farming as a main source of income has failed to guarantee enough livelihood for most rural farm households in developing countries, particularly in Sub-Saharan Africa (Losch et al., 2011; Oyakhilomen & Kehinde, 2016; Stifel, 2010). And it is needed to expand the household sources of income to overcome the uncertainty of farm income and improve the economic well-being in rural areas. Stimulating the off-farm economy is one measurement that is considered an important step forward.

Adugna (2009) found 35 percent and 23.6 percent participation rate of rural households in off-farm activities in rural Ethiopia in 1994 and 1997, respectively. Bezu et al. (2012) reported about 50 percent of households participated in off-farm activities in rural Ethiopia in 2012. A study by Yishak (2017) found that 57.7 percent of rural households combine agriculture with off-farm activities in Wolaita Zone, Southern Ethiopia. Amare & Belaineh (2013) found that about 84 percent of the households involve in non-farm activities and only 16 percent did not involve in Eastern Hararghe Zone in Oromia region, Ethiopia. Some other studies explored the impact of household income on child educational outcomes, and found the positive effect (Abafita & Kim, 2015; Shahidur, Gayatri & Hussain, 2010). They revealed that children from a richer household have a higher probability of having educational outcomes than those from poorer household. Even if the above studies analyze the effect of participation in off-farm activities on educational outcomes implicitly, one should note here that household's participation in off-farm activities have a positive effect on children's educational outcomes by generating income to the household. However, income-based poverty alleviation policy, particularly expansion of off-farm activities in rural areas may have negative impact on children's educational outcomes through increasing the demand for child's labor[1].

[1] For the definition of child labor, refer Woldehanna, Gebremedhin and W. Araya (2017).

1.2. Statement of the problem

About 80 percent of population of Ethiopia lives in rural areas, where subsistence agriculture is the main source of livelihood (EDHS, 2016). A study by Birhan and Tesfahun (2017) found that 30.7 percent of the rural population lives below threshold level of poverty and 54 percent of population are potential to enter into poverty in next year (vulnerable to poverty) in Ethiopia by using 1.24 US$ PPP per adult per day. This figure implies that poverty is more widespread in rural areas as compared to its share in total population.

Although several efforts have been made to increase coverage and fair access of education in Ethiopia, access to education is unevenly distributed between rural and urban areas; it's much lower in rural areas than urban areas. About 40 percent of the country's adult population was illiterate (EDHS, 2016). Among them, 57 percent of rural women have no formal education as compared with 16 percent of urban women. Over three million of primary school age children were out of school (UNICEF, 2012). According to Woldehanna and Gebremedhin (2016) learning outcomes of children in Ethiopia was declined. And there was a wide gap of learning outcomes between children lives in rural areas and urban areas. For instance, on average, children cannot read anything in mother language in rural areas was 12.89 percent as compared with urban areas which were 6.09% in 2006. The percentage of children who cannot read anything was increased in 2013 and gap widen between children lives in rural and urban areas which was 18.29 percent and 7.93%, respectively. The Peabody Picture Vocabulary Test (PPVT) score for children who live in rural areas has declined, but it was increased to children who live urban areas between 2006 and 2013.

Woldehanna and Araya (2016) revealed that dropout from school, repetion and overage at school were the challenges that the educational sector in Ethiopia faces. For instance, the proportion of children who dropped from school at age of 12 was 7.07 % and 3.05 % for younger and older cohort children[2], respectively in rural area, and 1.56% and 2.03 in urban areas. About 19.59 percent and 24.5 percent of Young Lives and non-Young Lives children were repeated. Also, 65.24 percent and 74.27 percent of young and old cohort children at age of 12, respectively overaged in rural

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

area. About 39.09 percent and 49.75 percent of young and older children who live at urban area, respectively were overaged at age of 12. One should note from this result that there is a poor educational outcomes in general, and the problem is severe in rural areas.

A few studies have been taken on the effect of household's participation in off-farm activities on children's educational outcomes (Admassu & Kassahun, 2011; Appleton, 1991; Tansel, 2002). These studies revealed a negative effect of household head's participation in off-farm activities on children's educational outcomes. According to there findings, parents do not send their child to school if the percieved current contribution of children in off-farm activities overweighs future return from schooling. In addition, their participation in off-farm activity needs additional labor including child labor and this impede children's schooling. One should note that it may not be necessary to stimulate schooling of children by targeting household's income levels, particularly promoting off-farm activities expansion in as a way to improve the income of households. In contrary to the above studies, Huisman & Smits (2009) found positive effect of household's participation in off-farm activites on children enrollment at primary school in developing countries. According to their findings, the increment of head of household participation in upper off-farm[3] activities leads to increase in the proportion of children who currently enrolled.

Other studies explored the impact of household income on children's educational outcomes (Behrman & Knowles, 1999; Glick & Sahn, 2000; Abafita & Kim, 2015; Subha, John, & John, 2013). They found positive effect of parental income on children's educational outcomes using different educational outcomes measurements. Glick & Sahn (2000) found positive effect of household's income on grade attainment and current enrollment of girls in Guinea. In addition, it reduces the probability that teenage girls will leave school. But, household's income has insignificant effect on schooling of boys. Abafita and Kim (2015) found household income, measured by per capita consumption expenditure, has significant positive impacts on children's ever attendance and current enrollment in rural Tigray region, Ethiopia. But household income has insignificant effect on highest grade attainment and relative to expected grade attainment level by children. Woldehanna et al. (2017) and Beegle et al. (2003) examined the effect of child work on child's educational outcomes. They found that child work had a negative effect on child's educational outcomes. Other studies have focused on the effect of participation in off-farm

[3] Upper off-farm activities such as professional works and other activities yields higher return.

activities on poverty in rural areas and found its negative effect (Muhammad, et al., 2018; Sosina et al., 2012; Marrit & Kumbib, 2006).

Few studies conducted on the effect of household's off-farm participation on children's educational outcomes, they have no consistence results. In addition, their studies did not control for the endogeneity problem (for instance, Admassu and Kassahun, 2011; Huisman and Smits, 2009; Tansel, 2002). Some of the existing studies examined the impact of household income on child educational outcomes (for example, Behrman and Knowles, 1999). And their studies did not predict the direct impact of off-farm activities on child schooling. Some of the studies rely on cross-sectional data that does not capture the impact of changing socio-economic environment on educational outcomes (for example, Abafita and Kim, 2015). Most of the existing studies did not use the comprehensive measurements for educational outcomes (for instance, Subha et al., 2013; Glick & Sahn, 2000; Beegle et al., 2003, Huisman & Smits, 2009; Tansel, 2002). They focused only on current enrollment and grade attainment to measure educational outcomes. Therefore, present study address all the aforementioned gaps in the previous study by using comprehensive measurements for educational outcomes such as grade completions, delay to start primary school, attendance of formal education, basic literacy skill, current enrollment, and absence from school for enrolled students as outcome variables of interest. In addition, to address endogeneity in estimations propensity score matching combined with difference-in-difference was used.

1.3.Objective of the study

1.3.1. General objective

The objective of the study is to examine the impact of household participation in off-farm income generating activities on children's educational outcomes in rural Ethiopia.

1.3.2. Specific objectives

- ✓ To examine the impact of household participation in off-farm activities on children's current enrollment and attending formal education in rural Ethiopia.
- ✓ To investigate the impact of household participation in off-farm activities on highest grade completion and delay to start primary school by children in rural Ethiopia.
- ✓ To explore the impact of off-farm participation on children's basic literacy skill and absent from school in rural Ethiopia

- ✓ To assess determinants of household participation in off-farm activities in rural Ethiopia.

1.4. Significance of study

Before programmatic targeting of education particularly children's education through quantity and quality, it should be carefully identified. The impact of household participation in off-farm activities on children's educational outcomes has been central in policy setting, particularly integrated rural development programs setting out to solve income constraints of households. Finding the impact of household's participation in off-farm activities on a children's educational outcomes may be useful to policymakers. The appropriate identifying of the effect of participation in off-farm activities on schooling is important to properly design income based welfare policy in rural areas, specifically in terms whether it minimizes the schooling of children by increasing demand for child labor or enhancing and smoothing the income of households and consequently improve the educational outcomes of their children. As the first study explicitly modelling the impact of household participation in off-farm activities on children's educational outcomes, this study paves the way to conduct further investigation in this area.

1.5.Scope and limitations of the study

Identifying the factors that affect educational outcomes is a wide in scope. Therefore, this study has examined the impact of one of the demand side factors on educational outcomes. In addition to this, the study does not take into account other measurements to educational outcomes such as Peabody Picture Vocabulary Test, repetition, dropout from school, examination results for primary & secondary education. Therefore, this study is limited in examining the impact of household participation in off-farm activities on children's educational outcomes in rural Ethiopia.

1.6. Organization of the study

The rest of the paper is as follows. Literature review is discussed in section 2. Data and Methodology are presented in section 3. Section 4 describes results and discussion. Finally, in section 5, conclusions and policy implications is presented.

Chapter Two: Literature Review

2.1. Theoretical literature review

2.1.1. Theories of investment in human capital

Several theories deal with investment on human capital. In this section, we rely only on a limited number of theories, relevant for our study. Schultz (1961) argued that human capital is important to economic growth. It is impossible to realize modern agricultural as well as industrial economic growth without considering human capital. Similar to physical capital, human capital such as skills and knowledges are the product of investment. Present-day investment on human capital yields return in the future. The difference in human capital investment creates the difference in stock of human capital among countries. There is growth rate in national income which is greater than the growth rate of land, physical capital and times spent. Also different individuals who have identical background in sex, race and age receive different amount. He argued this variation was the result of unequal investment in human capital.

According to his theory, magnitude of investment of human capital is measured by the spending made to produce human capital. Investment on human capital includes cost on formal education, forgone cost when one student stays at school full time[4], searching cost to get job, on-the-job training (this cost may be covered by the employer or by the employee depend up on the type of training), investment on health which increases the strength and stamina as well as the life expectancy which consequently increases the return of investment on human capital, study program for adults which are not provided by the firm such as extension program to the farmers which increases the knowledge and skill of farmers. Schultz noted that the tax laws, professional associations, governmental bodies, imperfect capital laws for funding investment on human capital such as lack of long-term private as well as public loan to students, discrimination such as racial, religious and others, lack of modern sectors[5] for internal migration from farm work to off-farm

[4] One can note in here that the opportunity cost of sending children to school is higher in rural areas, particularly for children living with poor families.

[5] Schultz argues that wide availability of modern sector promote investment on human capital, because this sector needs higher educational attainment and rewards better return.

work, lack of employment opportunity to the educated adults and low earning of educated adults are detrimental to investment on human capital[6].

Becker (1962) developed the theory on the investment in human capital. According to his theory, investment in human capital takes at different forms and this investment influences future earnings. Becker stated that the variation of income between countries and peoples within the country is not explained by physical capital only but also explained by human capital differences. The difference in the level of investment in human capital generates the variation in stock of human capital and return from it. He explained investment in human capital as followed: on-the-job training (he gave particular attention to this investment, on-the-job training itself classified as specific training, and general training.), schooling, investment in health (this investment improves both physical and emotional health.) and investment in information[7].

According to Wilson (2001)**,** family backgrounds, neighborhood, and school quality affect both the returns to education that an individual can expect to receive and utility costs and benefits of acquiring education. He argues that individuals make their education choices on the basis of expected earnings and costs. And they are taken to be utility maximizers who choose to invest in human capital if the expected utility from human capital investment is greater than the expected utility from not investing on it, subject to their perceptions of the expected income returns to, and the utility worth of alternative levels of schooling. According to his theory individuals optimize at the point where the marginal transformation of schooling for income (return to schooling) equals marginal rate of substitution of education consumption. In other words, the individual continues to get schooling until marginal utility benefits equal the marginal utility costs.

The standard theory of educational investment model by Sawada and Lokshinb (1999)**,** featured human capital investment model under uncertainty in the context of rural areas. This model expressed a formal model of household's optimal schooling behavior. This model uses two

[6] Also this problem is common in developing countries like Ethiopia, in Ethiopia over 80 percent of populations livelihood is based on subsistence agriculture and a very few modern sectors available in urban areas that does not meet the excess supply of labor, particularly youths unemployed.

[7] Becker argues that information about economic system, consumption, and production possibility, also information about the political-social system could significantly increase real income. For instance, information about prices charged by different sellers allows the buyer to buy from cheapest; information about wage (also working environments) offered by different firms would enable the employee to work for firm who are paying higher wage and having good environment. In addition, workers search for job, and incur search cost and this is one of investment on information.

assumptions of optimal behavior; a household decides the intertemporal allocation of resources so as to maximize the expected total lifetime utility of the household, and they make decision also on the allocation of educational resources among children given the overall resource constraint of the household. In developing countries, incomes are typically low and varying (because of bad weather condition such as drought or flood thereby affecting yield and price, results varying farm income which is the main source of household's livelihood.), therefore, there is a significant impact on human capital investment. Basically, risk, uncertainty, and constraints on insurance and credit impact deprived households' investment on children's schooling and consumption choices in developing economies.[8]

Assume k children eligible for education in a given household, and households' decision made on consumption, C, and education for child i, E_i. The household chooses whole consumption C_t and education for children E_{it} as to maximize the household's total expected utility with concave instantaneous utility function, U f(.) given all existing information at the beginning of period t, π_t. Therefore, household maximize the expected discounted value of a time separable utility function as follows:

$$\text{Max } E\left\{\sum_{n=0}^{T-t} \Upsilon^t U(C_{t+n}) + \Upsilon^{T+1} W(A_{t+1},\ H^c_{iT+1,}\ B_{iT+1}) | \pi_t\right\} \quad \ldots\ldots (1)$$

$$\{C_t E_{it}\} \quad i = 1, 2, 3 \ldots k$$

$$\text{s.t} \quad A_{t+1} = [A_t + Y_t(H^P) + \sum_{i=1}^{n} w(1 - E_{it}) - C_t](1 + r_t) \quad \ldots\ldots (2)$$

$$H^C_{it+1} = H^C_{it} + \sum_{i=1}^{n}\left\{f(E_{it,} q_{it}) + e_{it}\right\},\ i=1, 2 \ldots k \quad \ldots\ldots (3)$$

$$A_t + M_t(H^P) + \sum_{i=1}^{n} w(1 - E_{it}) + B \geq C_t \quad \ldots\ldots (4)$$

$$B \geq 0,\ H^P,\ A_0,\ B_0 \text{ are given, } A_T \geq 0 \quad \ldots\ldots (5)$$

Where Υ implies the discount factor, $B_{iT+1}$is bequest that household leave as inheritance to his child, π_t is an available information on early asset holding and the entire history of household characteristics. Equation (1) shows households maximize collected expected utility which is subject to total consumption C_t , salvage value of the final stock of the children's human capital, and financial bequest on given information available at time t. Equation (2) shows household's intertemporal budget restriction. Household's spending resources on consumption to each period are composed of assets (A), combined household income (M) which is the sum of households'

[8] This problems commonly affect children's education in Ethiopia particularly in rural areas (Woldehanna and Hagos, 2012; Admassie, Delelegn and Abebaw, 2007).

human capital (H^P) and entire children income $(\sum_{i=1}^{n} w\,(1 - E_{it}))$ with w_i being the children-specific wage rate.[9] Note that entire time endowment of children is standardized to 1; E_{it} is the total time that the children devote on their education, and 1- E_{it}, is the entire time that the children devote on work. Equation (3), second constraint shows the human capital accumulation equation. The human capital production function, f (.), contains the variable q, which represents gender gap, school supply side factors, and subjective factors. The variable q is a function of a time-invariant gender indicator variable which takes 1 if the child is female and 0, otherwise. Moreover, there is stochastic element e, which includes probabilities such as risk of job-mismatching after schooling. The model assume that the stochastic element related to the human capital accumulation have the following property; E $(e_{it}|\pi_t) = 0$, for all i.

Equation (4), third constraint represents the potentially binding credit constraint where B is a maximum amount of credit available to a household. In this equation household total income is equal or greater than their expenditure on the consumption good. This stochastic programming model has n+1 state variables: physical assets, A, and children human assets, $H_{i,}^{c}$., i = 1, 2, ⋯, n. Let us identify the functional forms of household's utility and human capital production functions. Assume that household has constant absolute risk aversion (CARA) utility function. The utility function can be expressed as follows:

$U(C_t) = \bar{a} - \frac{1}{a} \exp(-aC_t)$ …….……. (6)

Whereas, α denotes the positive coefficient of absolute risk aversion. Moreover, assume that we have exponential human capital production function. And it can be specified in the following:[10]

$f(e_{it}, q_{it}) = q_{it}[\mu_0 - \mu_1 \exp(-e_{it})]$ ……. (7)

Where, μ_0 and μ_1 are greater than zero; $f_s > 0$ *and* $f_{ss} < 0$

Given that household's human capital affects permanent income, let $M_t^{p}(H^P)$ and M_t^{T} represents permanent and transitory components, respectively of household's income.

$M_t\left(H^P\right) = M_t^{p}(H^P) + M_t^{T}$……..…… (8)

$E_t(M_t) = M_t^{p}(H^P), \quad E_t(M_t^{T}) = 0$

Further assumption, $M_t \sim N(M_t^{p}(H^P), \delta_t^{2})$- that is household follow an augmented permanent income function:

[9] The model assumes that a children's schooling does not change the children wage rate immediately, and accumulated human capital, H^P, is reflected in income after the children becomes an adult.

[10] For an alternative specification of the human capital production function, see Sawada (1999).

$M_t^P(H^P) = \beta H_t^P + s(H^P)$ ..... (9)

In equation (9), the first term in the right hand side denotes that human capital adjusted time-trend of income with parameter β. The second term, s (.), is a general non-linear function that defines the form of households' human capital specific wage profile. This problem can be solved by two different ways. First, using the functional form of equation (7), the optimal schooling decision rule then approximately becomes,

$E^*_{it} = X_{it}\,\Upsilon^N + E^*_{it-1}$, ∀ i ..... (10)

Where $X_{it}\,\Upsilon^N$ defined as

$X\Upsilon^N = g_{it} - r_{t-1}$ ..... (11)

Where g denotes the growth rate of q, which indicates return to education and subjective factors, and X is a matrix of proxy variables for g and r. Equation (10) is a linear difference equation for the optimal schooling decision, E*. In this equation optimal level of schooling is a function of gender-specific elements, availability and quality of school, and the market interest rate. Secondly, household faces imperfect credit market (they constrained from borrowing), the household effectively experiences an endogenous shadow interest rate, which is given by the marginal rate of substitution of consumption over time. Under credit market imperfections, the separability between consumption and schooling investment decisions fails to hold. At the optimum, marginal rate of transformation of educational investment is equal with marginal rate of substitution of household's consumption;[11]

$$\frac{\partial f/\partial E_{it}}{\partial f/E_{it-1}} = \Upsilon E_{t-1}\left[\frac{\partial U/\partial C_t}{\partial U/C_{t-1}}\right], \forall i \text{ .....} (12)$$ [12]

Under functional form of equation (7), reduced schooling decision can be represented by the following linear difference equation:

$E^*_{it} = X_{it}\,\Upsilon^c + E^*_{it-1} + \varepsilon_{it}$, ∀ i, ... (13)

ε_{it} , implies that the expected error of household's income (M_t) is equal to zero. There may be probability of serial correlation of this expectation error exist. Variable X comprises trends in return to education and household specific-subjective factors of educational investments, educational resource competition among children's, ownership, and accumulation of both human

[11] Separability among different children's schooling decisions does not hold.

[12] For the full derivation of the first-order conditions, see Sawada and Lokshinb (1999).

and physical assets, and an ex post comprehension of temporary income of parents and saving of households for safety.

2.1.2. Theoretical models of off-farm work choice by households

Several models have been developed on household decision of labor supply to off-farm activities. In this section, we only focus on some of the relevant theoretical models. Schultz (1975) expresses that individuals consciously reallocating their resources in response to changes in economic situations. He claims that the return from economic activities reshapes the allocation of resource on the activities. Individual's supply their labor for hire or self-employed are reallocating their labor in response to changes in the return from the work they do. In other words, individuals allocate their time on a farm and off-farm activities in response to changes in return from a farm and off-farm work.

Polzn and Macdonald (1971) developed marginal analysis model of labor supply on off-farm activities. The model is classical optimizing process as a frame-work for the examination of the allocation of time between a farm and off-farm work by household. The model was based on the assumption of labor in a farm work is subjected to diminishing returns and off-farm labor market, labor is paid a constant return per unit of time. The model points that optimum division of time by households takes place at the point where the marginal revenue product of farm work (MRP_F) is just equal to the net wage paid in off-farm sector (W_{off}). Off-farm laborers were assumed wage takers in this model. Also, the net wage clearly allows for the expenditures per labor unit, typically in terms of travel time and distance, experienced in working off-farm sectors. This model suggests that an increase in wage paid in off-farm sector or a reduction of farm income would lead to extra labor supply in off-farm work. An increase in the marginal revenue product (MRP_F) from farm work will lead to a decrease in equilibrium off-farm work. This model restated the theory of demand for labor facing the worker in farm and off-farm work, but had nothing to about how much time was allocated between a farm work, off-farm work, and leisure. Therefore, in order to solve the shortcoming of marginal analysis; Bollman (1979) developed the kinked demand curve analysis.

Kinked demand curve for labor supply model (Bollman 1979) was based on the assumptions of labor supply decision is made by individual.[13] The model assumes perfect market situation[14]. In addition, workers in off-farm activities were assumed wage takers. The demand for labor in off-farm work is the function of the expected wage (which itself is the function of skill and cost of commuting). The cost of commuting is negatively related to demand of labor in off-farm work, whereas skill is positively related to demand of labor in off-farm work. Demand of labor in farm work is the function of the price of farm worker's labor in farm work, price of all other farm inputs (including hired labor and unpaid household labor) and price of output. The price of farm worker's labor in a farm work is negatively related to demand of labor in farm work; result of this, farm workers experiences downward sloping demand for labor in farm work. Supply of labor is a function of the price of the consumption good, the price of the worker's leisure and non-earned income. The slope of labor supply is upward. The optimal allocation of labor in a farm and off-farm activities occurs at the point where the marginal return from a farm and off-farm are equal.

Mathematically

Utility is a function of consumption good and leisure, and which is expressed in the following;

$U = U(C, L_T - L_f - L_{off})$ …….. (1)

Where C, consumption; L_T is total time endowment to the individual; L_f is time spent on farm work and; L_{off} is time spent on off-farm activities. Additionally, leisure, $L_e = L_T - L_f - L_{off}$.

Individual's income is received from farm work $M(X, L_f)$, income from off-farm work ($w_{off}. L_{off}$). And also non-earned income from off-farm activities is represented by N_{off}. Output (Q) is the function of labor in farm work, L_f, and all other farm inputs including hired labor and unpaid household labor (X). Individuals spend their income on consumption good. The constraint of the utility if specified as follows:

$P_C. C \leq P_Q. Q(X, L_f) + w_{off}. L_{off} + N_{off}$ …… (2)

Where, P_C is the price for consumption good, w_{off} is the wage of off-farm work.

$L = U(C, L_T - L_f - L_{off}) + \lambda\left[\left(P_Q. Q(X, L_1) + w_{off}. L_{off} + N_{off} - P_C. C\right) + \mu L_{off}\right]$..... (3)

[13] The model was based on one-period, individual-utility, and individual-budget constraint.

[14] The model assumes that goods bought and sold by the same price, and information is free and costless, products produced by the farmers are identical and there is no seasonality of the demand for the worker's labor on the farm, farmers allocate their time on farm or off-farm works and both self-employed and hired labor exist.

Where μ is the Lagrangian multiplier on the "boundary" constraint indicating the labor supply in off-farm may be zero (i.e. households' labor may be fully supplied in farm work). It is the utility foregone by not being able to hire labor (L_{off}) as a perfect substitute for worker's labor (L_f) in farm production. A Lagrangian multiplier, λ shows that change in utility due to a change in the constraint. It represents the marginal utility of income. The equilibrium solution of labor supply in farm and off-farm is as follows:

$P_Q Q_{Lf} = w_{off}$ ..... (4)[15]

Equation (4) indicates that the value of marginal unit of farm work ($P_Q Q_{Lf}$) and off-farm work (w_{off}) are equal.

Alternatively, $\frac{\partial U_{Le}}{\partial P_Q Q_{L_L}} = \frac{U_{Le} - \mu}{w_{off}} = \frac{U_c}{P_C}$ ..... (5)

Equation (5) indicates the equilibrium condition, the ratio of the marginal utility of leisure to the marginal price of work must be equal for both farm and off-farm work and must be equal to the ratio of the marginal utility from the consumption good with respect to its price. But, kinked demand curve for labor model does not take into account the combined decision of supply of labor by household's members in both farm and off-farm activities. The problem in kinked demand curve for labor model was solved by Huffman (1980).

Huffman (1980)**,** developed supply of labor model based on assumption of labor supply decision is made by combined decision of farm household members[16]. Moreover, the model assumes that labor supply decisions of farm household members are viewed as the result of household's utility maximization subject to constraints on household's time endowment (which is reallocated on farm work, off-farm work and leisure), income (income from farm work, off-farm work and from other sources), farm production (which is determined by the household member's labor in farm work, purchased other inputs, and indirectly by education, research and extension service by development agents, household members' age and schooling, and household size). Also off-farm worker were assumed wage takers from off-farm work. Total labor supply of a household member is a function of wage in off-farm work, the price of farm output and inputs other than the household member's labor, the price of consumption goods, other household income, household size, and

[15] For full mathematical derivation see Appendix A8

[16] The model was built on the assumption of a household utility, household budget constraint and two-commodity model with goods and leisure.

age, education, extension and time endowments. Household's decisions on off-farm work are made at the same time with choices on farm inputs, including household members' labor in farm work, and on purchased household consumption goods. In other words, off-farm labor supply is the function of wage of off-farm work, price of farm output and inputs, price of consumption goods, other household income, household members' age, education and household size, agricultural research and extension and household members total time endowment. At equilibrium, time allocation of marginal values of a household's member's time at farm work, at leisure, and at off-farm work are equal. At the equilibrium, off-farm labor demand and supply are equal; off-farm labor supply curve cuts off-farm labor demand curve.

Mathematically

A household maximizes utility which is subject to total time endowment, income, and farm production. Household members utility is a function of members' leisure (L), purchased good Q_1, other factors which affects household consumption decisions presented by Q_2, which includes household members' age, education and household size. The household's utility function can be expressed as follows:

$U = U(L, Q_1, Q_2)$, $(U_i = \frac{\partial U}{\partial i} > 0)$ …… (1)

i= L, Q_1; is assumed to be ordinal and strictly concave. The model assumes three constraints on resource that households experience. The first constraint is household's time endowment (T^t) which is allocated between farm work (T_f), off-farm work (T_{off}), and leisure (T_L) :

$T^t = T_f + T_{off} + T_L$ …… (2)

In the second constraint, household receives their income from three sources. They obtain wage (w_{off}) from off-farm work, farm work income ($PY - w_2x_2$), and income (V) from other sources. And the income of household spent on consumption market goods as follows:

$w_{off}T_{off} + PY - w_2X_2 + V = P_1 . Q_1$ …… (3)

Where P is the anticipated price of farm output (Y), w_2X_2 is total variable cost of farm production, P_1 is the price of market good Q_1. In this model off-farm work schedules is assumed flexible and a household member's wage from off-farm work is exogenous to his present off-farm work amount.[17] Third, farm output (Y) is the function of members' farm labor inputs (X_1), variable

[17] The current wage is assumed to depend on net human capital accumulations. Some of this capital, however, is a result of previous work experience. If firms incur employee related search and administrative costs or on-the-job

purchased inputs (X_2), including hired labor, and other inputs (X_3) which includes farmers' education and agricultural research and extension. The input (X_3) affects production function through by increasing efficiency; but in this model assumed as an exogenous variable. The production function specified as the following:

$$Y = F(X_1, X_2, X_3); (f = \frac{\partial Y}{\partial X_1} > 0, \frac{\partial Y}{\partial X_2} > 0) \quad \ldots\ldots (4)$$

Over-all amount of off-farm work by each household member is total available time for each individual minus time spent on leisure and farm work. From equation (2), the time spent on off-farm work by individual members from their total endowment as follows:

$$T_{off} = T^t - T_L - T_f \quad \ldots\ldots (5)$$

But, demand of leisure (T_L) for consumption and demand of labor in farm work (X_1) are the functions of some or all exogenous variables of the model:

$$T_L^* = d_L \left(w_{off,} P_1, P, w_2, V, Q_2, X_3, T^t\right) \quad \ldots\ldots (6)$$

$$X_1^* = d_1 \left(w_{off,} w_2, P, X_3\right), \left\{\frac{\partial X_1^*}{\partial w_{off}} < 0,, \frac{\partial X_1^*}{\partial P} > 0\right\} \quad \ldots\ldots (7)$$

By substituting equation (6 and 7) into equation (5), we have the following equation:

$$\begin{aligned} T_{off} &= T^t - d_L \left(w_{off,} P_1, P, W_2, V, Q_2, X_3, T^t\right) - d_1 \left(w_{off,} w_2, P, X_3\right) \\ &= S_w\left(w_{off,} P_1, P, W_2, V, Q_2, X_3, T^t\right) - d_1 \left(w_{off,} w_2, P, X_3\right) \\ &= S_{off}\left(w_{off,} P_1, P, W_2, V, Q_2, X_3, T^t\right) \geq 0 \end{aligned} \quad \ldots\ldots (8)$$

$S_w = T^t - T_L^*$; S_{off} is time spend on off-farm work[18]. Equation (8) shows off-farm labor supply function. But, this model was static model, and does not take into account future time periods.

Roninson, Mcmahon, & Quiggin (1982), developed off-farm labor supply model based on kinked demand for labour (Bollman, 1979), and theoretical model of Huffman (1980). This model was based on the asssumption of perfect competition[19]. A household member will generally make choices about how best to allocate their available time between farm and off-farm work which is subject to expected returns from a farm and off-farm work. Moreover, farm production is a function of household's time spent in farm work and all other farm inputs, including employed

training costs, they may capture returns on these "investments" by paying employees who work fewer hours lower wage rates.

[18] See appendix A9 for more mathematical derivation

[19] The model assumes that household's members labour allocation decisions as having no influence on aggregate demand, supply or prices of labour, and that management skills in farm or off-farm work are a component of labour.

labour, land, and capital. Consequently, a household maximizes farm income which is subject to price of a farm input and output and a stock of fixed inputs. The demand for labour on the farm work is a function of the price of a wage of labour in farm work, the price of farm output and all other farm inputs, and the stock of fixed inputs. The household members' off-farm labour supply curve is upward sloping, which shows that an increase in the expected off-farm wage rate result additional household's time spent in off-farm work, holding other variables constant. Demand for off-farm work is the function of expected wage rate of off-farm work (which is itself the function of human capital and cost of commuting), state of economy and institutional constraints, worker in farm activities are assumed price taker in off-farm labor market. The demand of labor in farm work is downward sloping because of price of labor in farm work is negatively related with it. Increases in the prices of farm output, other farm inputs, the price of leisure and in other income reduces time spent in off-farm work. Household members will supply and demand his labour up to the equilibrium point where the marginal return from a farm and off-farm work are equal. The household members will spend more hours on the a farm when the marginal return from a farm work exceeds the off-farm wage rate, and spend more hours in off-farm when the expected off-farm wage rate exceeds marginal return from farm work.

Overall, all of the theoretical models of supply of labor emphasize that allocation of time (labor) between a farm and off-farm depends on the relative returns to labor accruing from different earning activities. Following the classical approach to optimization, a household allocates labor between a farm and off-farm activities. It was claimed that marginal value of off-farm work and marginal value of farm work is an optimal point of allocation of time for householder members, but the determinants of labor supply and demand and the way they expressed is different among themselves.

2.2. Empirical literature review

There were few studies conducted on the effect of household participation in off-farm activities on children's educational outcomes. Huisman & Smits (2009) found the postive effect of household participation in off-farm activites on children's schooling in 30 developing countries. They used 222, 853 children sample, data from Demographic and Health surveys (DHS) and Pan Arabic Project for Family Health (PAP-FAM) of the league of Arab State Surveys which is national

representative. Bivarate multilevel logistic regression result shows the proportion of enrolled children whose father participated in upper off-farm activities was 30 percent higher than children whose father did not. According to their study, upper off-farm activities yields high returns and the available job requires more education. In other words, they argue that off-farm participation solves the income constraints of the household and make easer to fund investment on children education. In addition, they claim that the higher probability of finding job (well paid job) after accomplishing at least primary school stimulates investment on children education. Therefore, participation in off-farm activities drives more investment on children's education.

A study by Tansel (2002) found negative effect of off-farm participation on the children's educational outcomes, using household income and expenditure survey conducted by the State Institute of Statistics of Turkey in 1994. Probit regression result suggests that the probability of children continuing middle and high school[20]whose father being self-employed decreases in Turkey. The study suggests that if the fathers have their own business, this may facilitate the children's potential contribution to the household income, and that decreases opportunities for children's time on schooling.

Admassu & Kassahun (2011) conducted household and social factors on primary school enrollment and dropout in Ethiopia. They used data from Welfare Monitoring Survey (WMS) of Ethiopia collected in 2004 which is nationally representative. They investigated a negative effect of head of household participation in off-farm on school enrollment and positive effect on a dropout using binomial logistic regression models. According to their finding, children living in a household with own business have a 64 percent lower chance of school enrollment than their counterparts living in households by non-self-employed person. Also, the dropout from school by children who live with a participant household has higher dropout rate than the children live with a non-participant household. They claimed that the participation of a household in off-farm activities increases the demand of member's labor, including children's labor. According to their argument when a household runs a household business, children's participation in such household income-generating activities would compete with their schooling.

[20] In his study, middle school takes three years that is from grade five to grade eight. And High schools encompass general, vocational, and technical high schools where additional three years (four years in case of technical high schools) of training is implemented after middle schools.

Some studies examined the impact of household's income on children educational outcomes, using different indicators of educational outcomes. Arnaud & Lanot (2002), using longitudinal data, found children living with poor families are generally have lower educational outcomes than their counterpart children in Britain. According to this study, poorer families are financially constrained and unable to cover direct school costs and high opportunity cost of sending his child to school. Behrman & Knowles (1999) found positive effect of household income on child education in Vietnam, using survey of 1725 households conducted in 1990. According to their study, income elasticity of completed grades was five times the median. Glick & Sahn (2000) found that increases in household income leads to greater investments in girls' schooling but have insignificant impact on schooling of boys in Conakry, Guinea. The result from ordered probit model showed that household's income has positive effects on grade attainment and current enrollment of girls. In addition, it reduces the probability that teenage girls will leave school. But, household's income has an insignificant impact on the schooling of boys. Beegle, Dehejia, & Gatti (2003) conducted study on child labor, crop shocks, and credit constraints, using the panel data (1991-1994) over 800 households from Kagera region in Tanzania. Viewing crop shocks as transitory shocks to household income, experience crop shocks by household significantly increases child labor, and consequently decreases in educational enrollment in Tanzania. According to their study, due to crop shocks, a decrease in educational enrollment could possibly have resulted from the fact that children were sent to work instead of school to cope shocks. But, asset holding by household allows counterbalance the shocks without resorting to child labor.

A study from Ethiopia, by Woldehanna et al. (2017) found the negative effect of child work on child's education achievement, using older cohort children[21], from Young Lives data of Ethiopia. From an instrumental variable (IV) estimation, they found that a unit increase in the number of hours worked per day resulted in a reduction in the educational achievement, measured by the Peabody Picture Vocabulary Test (PPVT) score of a child by 6.2%. Households experience economic shocks, especially by price and crop failure shocks, decrease the income of households so that children are required to devote more time on work instead on their education. A study by Subha, John, & John (2013) found a positive income effect for school enrollment, and particularly

[21] Old cohort children are children who born in 1994/95 (Woldehanna, Gebremedhin and W. Araya, 2017).

stronger effect for relative grade attainment in rural Ethiopia, using longitudinal data from the Ethiopian Rural Household Survey (ERHS). In this study the effect of income is greater for girls compared to boys. Income elasticity of demand of schooling is elastic, increased household income improves demand for grade progression and demand for enrolment. Instrumental variable (IV) estimation result shows that the enrolment-income elasticity values are 0.38, 0.97, and 0.31 in 1994, 1999 and 2004, respectively. The figure suggests that the demand for schooling is significantly responsive to changes in household income. In addition, relative grade attainment income elasticity was 1.38, 1.81, and 0.79 in 1994, 1999 and 2004, respectively. And it implies that children from higher income households are more likely to progress on time compared with children from low-income households.

Abafita & Kim (2015) conducted the study on the determinants of children's schooling in Tigray region, Ethiopia. The probit regression result shows that household income, measured by per capita consumption expenditure has significant positive impacts on children's current enrollment and ever attendance. However, the Heckman's sample selection model result reveals insignificant effect on the highest grade completed and relative grade completed. It implies that children from a richer household have a higher probability of having schooling outcomes than those from poorer families.

The effect of off-farm participation on poverty reduction in rural areas was conducted by some studies. According to Haggblade, Hazell, & Reardon (2007) rural off-farm economy contributes directly to economic growth because of its size and its responsiveness to growing agricultural, urban, and export markets, and indirectly contributes to economic growth through provision of financing, processing, and marketing services that stimulate and accelerate agricultural growth. A study by Haggblade, Hazell, Thomas (2010) found that a rural off-farm economies employs about 30 percent of full-time employment in Asia and Latin America, 20 percent in West Asia and North Africa (WANA), and10 percent in Africa. Ann & Catherine (2001) emphasized that off-farm activities plays an important role in reducing poverty in rural areas; it may absorb surplus labor in rural areas, help farm-based households spread risks, offer more remunerative activities to supplement or replace agricultural income, offer income potential during the agricultural off-season and provide a means to cope when farming fails. It accounts 35 percent of total rural household's income in Africa and roughly 50 percent in Asia and Latin America.

A study in Punjab province of Pakistan by Muhammad, et al. (2018) found that off-farm income generating activities contributes more in poverty alleviation of the household, data from 480 cotton growing respondents. They used Foster, Greer and Thorbecke (FGT) poverty index along with Gini coefficient estimation. The results show that about 65 percent of farm household had per capita income below $2 per day (threshold level of poverty) by only considering agricultural income. After adding off-farm income on agricultural income, the population below poverty level decreased to 57 percent. Babatunde & Qaim (2009), on average off-farm income contribute 50 percent to total household income in Nigeria. Participating in off-farm activities such as agricultural and non-agricultural wage employment and self-employment activities are the main income generating sources. Sosina, Christopher, & Stein (2012) found that participation in off-farm activities had positive impact on the growth of consumption expenditure for both poor and rich households in Ethiopia, using the Ethiopian Rural Household Survey (ERHS). But, rich have much higher expenditure growth elasticity of rural off-farm economic participation intensity than the poor in Ethiopia. Marrit & Kumbib (2006) revealed that because of limited entry barriers in the area, poor households engage more in off-farm activities and they earn more income from off-farm sector in Oromia, Ethiopia. The study found that participation in off-farm activities such as in handcrafts, food and drink and trade benefit the poor households, and reduce poverty in the area.

It is important issue to understand why individual/s entering into off-farm activities. According to Barrett, Reardon, & Webb (2001) because of diminishing returns from agriculture (diminishing or time-varying returns to labor in farm sector farm), working capital constraints to purchasing necessary variable inputs for farming and adverse agricultural shocks during post harvesting and ex ante planting season, households diversify into off-farm activities. In addition, because of incomplete markets, households enter into off-farm activities to exploit comparative advantage in off-farm activities. A study by Haggblade et al. (2010) claimed that the poor in rural areas have restricted access to participate in most lucrative off-farm activities in some settings because of gender, caste, and social status likewise restrict access. In the similar way, children-rearing responsibilities is another constraint that limits women's movement and force them into home-based work, greatly labor-intensive works such as weaving, silk rearing, and basketry, caste and social restrictions may force specific poor household groups into traditionally reserved, low-productivity rural off-farm activities. Shehu & Abubakar (2015) found that household head's

education, household size, community level infrastructures, and its distance to market significantly affects off-farm participation decision of the household in Nigeria.

Ackah (2013) found that human capital (a person having completed at least primary education) and access to electricity are positively correlates of off-farm participation, but access to larger parcels of land are less likely to diversify into off-farm participation in rural Ghana. A study by Adugna (2009) claimed that households with high dependency ratio, household headed by female, high livestock value, and deprived quality of land were into less participated in off-farm activities in rural Ethiopia. In addition, the result states that households whose crop production increased and sold part of production during the main harvest season engaged less in off-farm activities.

The determinants of educational outcomes as well as off-farm participation context are wide. Careful analysis on demand side and supply side constraints on schooling should be taken to employ policy measurements. Income shocks of the household is detrimental to children's educational outcomes and participation in off-farm activities increase in income of household results in positive outcomes on children's education. In other words, household participation in off-farm activities provides an important pathway to reduce poverty level and cope shocks, off-farm income is the one of the source for poor households and would significantly add to income of agricultural households (poor as well as rich), results more investment on children's schooling. However, targeting education by income level, particularly poverty reduction program such as expansion of off-farm activities may not be effective if the perceived current contribution of child in off-farm activities outweighs future return of schooling. The current contributions of the child in off-farm and the employment opportunity after accomplishing at least primary school and future return from schooling are compete with children's schooling. The household's participation in off-farm activities may compete with children's education by increasing demand of member's labor including child labor.

Even if some studies explored the impact of household participation in off-farm income generating activities on children educational outcomes, none of them explored the impact of household participation in off-farm activities on children's education at rural Ethiopian context straightforwardly. Their models do not take into account the endogeneity problem comes from observable and unobservable difference among the household who participated and who did not participated. Many of the existing studies used incomprehensive indicators of educational

outcomes. Therefore, this important issue has called forth further investigation for improvements in the previous studies. The current study contributes to the forgoing study in the following ways. First it looks at the impact of household participation in off-farm activities on children's educational outcomes in rural Ethiopia by taking accounts the endogeneity problem. Second, this study uses more comprehensive measurements to educational outcomes. Thirdly, it assesses the determinants of household participation in off-farm activities in the context of rural Ethiopia.

2.3. Conceptual framework

Households allocate their total time endowment (supply of labor) including children's time into farm work, off-farm activities, schooling, and leisure. According to labor supply in off-farm theory, if return from off-farm participation overweighs return from other activities, households more supply labor in off-farm activities (Huffman, 1980; Roninson, Mcmahon, & Quiggin, 1982). In case of children's allocation of time, the decision is generally made by parents. Participation in off-farm activities generates additional income to households, and consequently empowers poor households to investment on their children education (Huisman and Smits, 2009). In rural areas, because of imperfect credit market, participation in off-farm activities solves financial constraints to cover the direct costs associated with child's education, such as books, uniforms, pens and pencils, school fees and others. Household participation in off-farm activities impedes children's education through increasing demand of child labor (Admassu and Kassahun, 2011; Appleton, 1991; Tansel, 2002). Schooling of children from poor parents have high opportunity costs. The perceived current contribution of children in off-farm activities, also in farm and home work is greater than future return after accomplishing their schooling. Therefore, increment of demand for children's labor by household hinders children's schooling by reducing time on their education.

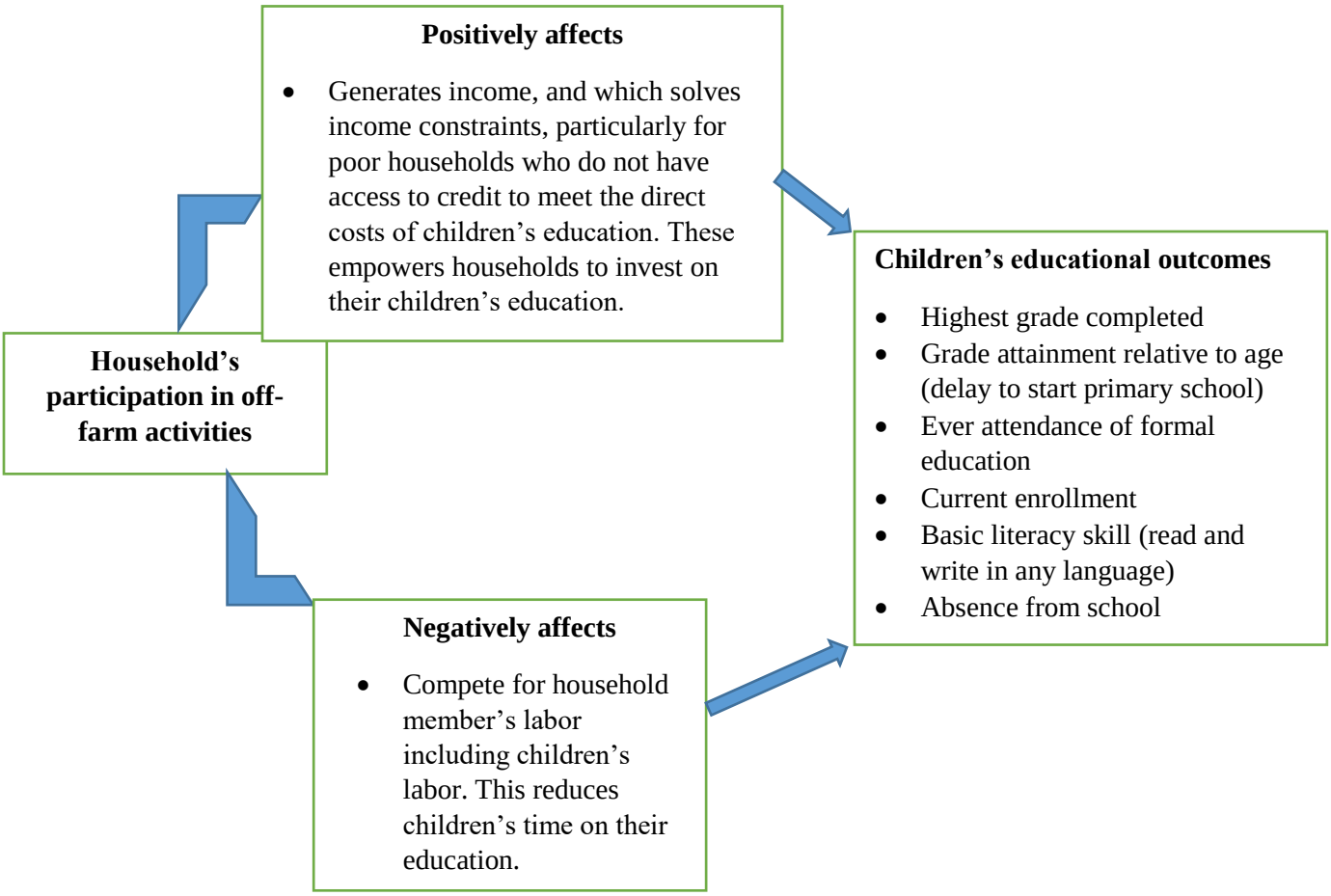

Figure 1. A flow chart showing interlinks between household off-farm participation and children educational outcomes.

Chapter Three: Data and Methodology

3.1. Sources of data and its description

To measure the impact of household participation in off-farm income generating activities on educational outcomes of children in rural Ethiopia, the study used Ethiopian Socio-economic Survey (ESS) panel data of the World Bank's Living Standards Measurement Survey-Integrated Surveys in Agriculture (LSMS-ISA) project. The survey employed two-stage probability sampling. At first stage, enumeration areas (EAs) were selected. A total of 433 EAs were selected based on probability proportional to size of the total EAs in each region. For the rural sample, 290 EAs were selected. And 43 and 100 EAs were selected for small and large town areas, respectively. In order to ensure sufficient sample size in the most populous regions such as Amhara, Oromiya, SNNP, and Tigray and Addis Ababa, quotas were set for the number of EAs in each region. The sample was not representative for each of the small regions such as Afar, Benshangul Gumuz, Dire Dawa, Gambella, Harari, and Somalie regions. 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 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 small and large town, 12 and 15 households, respectively were selected randomly from each enumeration area with no stratification.

Ethiopian Socio-economic Survey is a countrywide representative survey of over 5,000 households living in rural and urban areas. The first wave implemented in 2011/12 covering only rural areas and small urban areas[22]. By adding samples from large town areas, the second, and the third waves implemented in 2013/14 and in 2015/16, respectively. The household participation in off-farm in 2011/12 affects the children's educational outcomes in in later years (2013/14 and 2015/16). Participation in 2011/12 could improve welfare of household. Therefore, the welfare improvement solves income constraint particularly to poor households and enables household to send their child to school in later years. In contrary, it may be increase demand of children work.

[22] According to CSA, small urban areas are areas with less than 10,000 inhabitants based on estimates from population. Large town areas with the population of above 10,000 based on population estimates from the 2007 Population Census.

The households would plan to use their child labor in the next years if they faced labor shortage in 2011/12. Furthermore, if the members of a household participated in 2011/12, there may be attracting other members including children in 2013/14 and 2015/16. In rural areas, the participation of members of household in the previous period, particularly undertaking off-farm activities in urban areas attracts other members including school children into off-farm participation in the next year. To avoid such endogeneity problem, household who participated in 2011/12 were dropped from the sample. Rural Ethiopia was our target, therefore, to conduct this study sample of rural areas for non-participants only in 2011/12, and both participants and non-participants in 2013/14 and 2015/16 sample used.

3.2. Methods of data analysis

Both descriptive statistics and econometric modeling are employed to analyze the data. Descriptive statistics such as mean and standard deviations are used in order to show the summary statistics to a participant and non-participant households. In line with this, the extent of engagement in off-farm activities and its variation over three periods was presented. Econometric modelling was employed in order to show existence of the impact of a household's participation in off-farm activities on children's educational outcomes. In addition, the study investigated determinants of a household's decision to participate in off-farm activities in rural Ethiopia.

3.3. Model specification and Variable Description

3.3.1. Model specification

In this part, the study has examined an econometric model to identify the impact of off-farm participation on educational outcomes. Moreover, determinants of off-farm participation were focused. In order to meet our objective, two models were developed. In the first part, the household decision to participate in off-farm activities was modelled as function of various determinant factors using a probit estimation. In the second part, the impact of household participation in off-farm activities on children's educational outcomes was modelled. This particularly focused on the Propensity Score Matching (PSM) method in combination with the Difference-in-Difference estimator (DID). The PSM controls for observable differences between households that participated and those who did not. However, it does not control for unobserved heterogeneity (the unobserved difference in mean counterfactual outcomes) between participants and non-

participants in off-farm activities. To address this shortcoming of the PSM impact estimator, the DID impact evaluation technique was employed on the data balanced via the PSM. The DID method eliminates unobservable time-invariant differences between a participant and non-participant households.

Model 1: Off-farm participation decision model

In this section, non-linear probability model is used to identify determinants of the decision to engage in off-farm activities by following Rosenbaum & Rubin (1983) and Shahidur, Gayatri, & Hussain (2010). To examine the decision to participate, a probit model was employed (Verbeek, 2012). The Probit model assumes that participation is determined by a continuous latent variable, Y^*, that 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), implies 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 equation (1 and 2) and specifying $\Pr(Y = 1|X) = F(X\beta)$ to be the cumulative distribution for conditional on X yields participation 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 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 at least one 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 of head, age (age of head and child), mean schooling of male and female, highest grade completed by head, household size, farm income, livestock owned (measured by tropical livestock unit, TLU), plot of land owned, idiosyncratic and covariate

shocks, credit , assistance, children's participation in off-farm activities, and electricity access. β and ε_i are the coefficients of explanatory variables and an error term, respectively.

Model 2: Evaluating the impact of off-farm participation on educational outcomes

Following Nguyen (2012) and Nguyen & Grote (2015), the study employed PSM combined with DID. First, propensity Score Matching (PSM) was estimated to control endogeneity problem that comes from observable covariates. PSM matches participated and non-participated households based on by using propensity score conditional on socio-demographic household characteristics, shocks and community level characteristics. To satisfy conditional independent assumption, 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 in the subsequent two periods (2013/14 and 2015/16), conditional on pre-treatment characteristics, X in 2011/12. Pre-treatment characteristics of household such as head's sex, mean schooling of a male and female, credit and assistance received by households, age and schooling of head, covariate and idiosyncratic shocks that households faced, and household size were included in the estimation. Covariates, X, that affects the likelihood of household being assigned into the treatment groups[23].

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

Where, D_i determines whether households are treated or not; D_i = 1 if households are treated, 0 otherwise. Based on matched data in equation (1), difference–in-difference (DID) estimation, quantify the effect of off-farm participation is identified. In other words, after generation of the propensity score for household level data, DID regressions are estimated for individual children data. And this model estimation controls endogeneity arises from unobservable characteristics. This model allows us to examine the impact of household off-farm participation on children educational outcomes using observational data. Suppose Y_{1i} and, Y_{0i} denote child educational outcomes 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 eduational outcomes of an individual child i as follows:

[23] Refer appendix A7 for more explanation of participated and non-participated household who were taken as treated and control groups (non-treated groups) in this study.

$\Delta i = Y_{1i} - Y_{0i}$ …… (2)

Equation (2) states that the difference in the educational outcomes of a child whose household participated (non-participated) and had did not participated (participated). To quantify the effect of off-farm participation on educational outcomes, the study estimated average treatment effect of the population (ATE) and average treatment effect of the treated (ATT) in 2015/16. ATE modeled as follows:

$ATE = \Delta Y_i = E[Y_{1i}] - E[Y_{0i}]$ …….. (3)

Equation (3), implies the average treatment effect.

We can compute ATE conditional on covariates, X, as follows:

$ATE_X = \Delta Y_i|X = E[Y_{1i}|X] - E[Y_{0i}|X]$…..…….…….. (4)

In equation (4), it is impossible to estimate the off-farm participation impact on each child's educational outcomes because we cannot know the counterfactual outcomes. One can not observe Y_{1i} and Y_{0i} in the same child i. For those children whose household participated (non-participated), we can observe only Y_{1i} and for those whose husehld non-participated (participated), we can observe only Y_{0i}. To evaluate the impact, we introduce participated and non-participated household.

$ATE_X = \Delta Y_i|X =$

$$\overbrace{\langle E[Y_{1i}|X, D_i = 1] - E[Y_{1i}|X, D_i = 0]\rangle}^{\text{Educational outcome for the child whose household participated (non-participated) over time}}$$

$$-\underbrace{\langle E[Y_{0i}|X, D_i = 1] - E[Y_{0i}|X, D_i = 0]\rangle}_{\text{Educational outcome for the child whose household did not participated (participated) over time}} \quad (5)$$

Equation (5) implies that ATE_X is the sum of average treatment effect on treated (ATT_X) and average treatment effect on non-treated($ATNT_X$) conditional on covariates. Therefore, equation (5) can be rewritten as follows:

$ATE_X = ATT_X + ATNT_X$…….……..…. (6)

Average treatment on treated expressed in the following:

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

$\{E[Y_{1F}|X, D_1 = 1, D_2 = 1] - E[Y_{1iF}|X, D_1 = 1, D_2 = 0\}$ +

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

$\{E[Y_{0iF}|\ X, D_1 = 0,\ D_2 = 1] - E[Y_{0iF}|\ X, D_1 = 0,\ D_2 = 0]\}$ ……(7)[24]

Also, average treatment of non-treated can be expressed as the following:

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

$E[Y_{1F}|\ X, D_1 = 1,\ D_2 = 1]\text{-}E[Y_{1iF}|\ X, D_1 = 1,\ D_2 = 0]\} +$

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

$E[Y_{0iF}|\ X, D_1 = 0,\ D_2 = 1]\text{-}E[Y_{0iF}|\ X, D_1 = 0,\ D_2 = 0]\}$…… (8)[25]

From equation (7 & 8), we identify ATE_X. In this study household's participated in 2015/16 only were belonged to treatment groups and matched with non-participated in both periods (i.e. 2013/14 and 2015/16) which were taken as control groups. In this case we estimate the impact of household's participation in off-farm activities on children's educational outcomes. In the second case households who exit from off-farm activities in 2015/16 (non-participated) were taken as treatment groups and matched with participant households in both periods which were taken as control groups. In this case we estimate the impact of household's exit from off-farm participation on children's educational outcomes[26].

[24] Refer appendix A7 for more explanation. Pr ($D_1 = 1|X,\ D_2 = 1$) and Pr ($D_1 = 0|X,\ D_2 = 1$) are the proportion of participants in 2013/14 and 2015/16 and participants only in period two (i.e. 2015/16), respectively.

[25] Refer appendix A7 for more explanation. Pr ($D_1 = 1|X,\ D_2 = 0$) and Pr ($D_1 = 0|X,\ D_2 = 0$) are the proportion of participants in 2013/14 only and non-participants in both periods (i.e. 2013/14 and 2015/16), respectively.

[26] For more explanation, refer A7 in appendix.

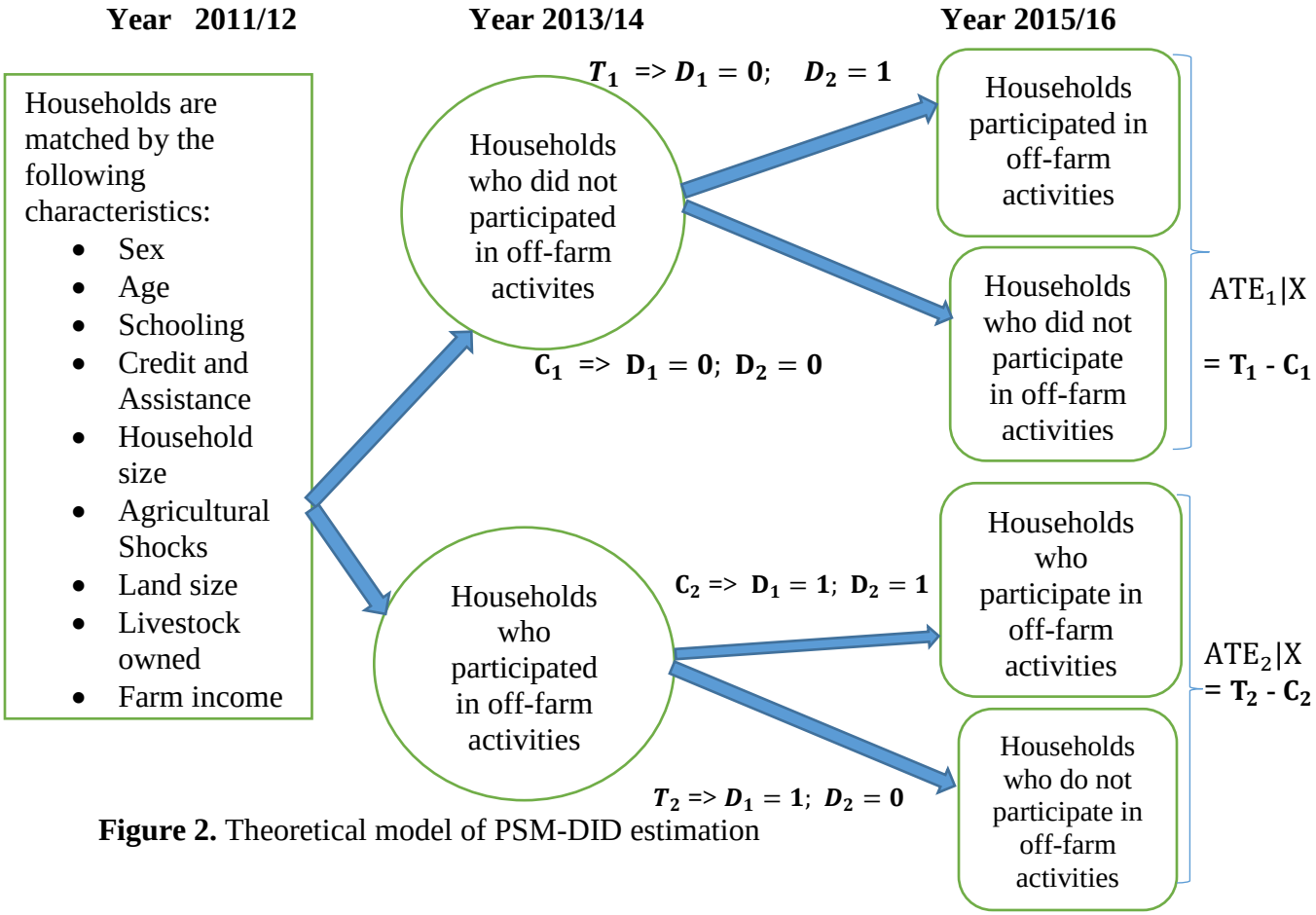

Figure 2. Theoretical model of PSM-DID estimation

Figure 1 shows theoretical modeling of PSM-DID estimation, and treatment (T) and control groups (C). In the first part (ATE_1 conditional on X), participant in period two only and non-participant in 2013/14 and 2015/16 are belonged to treatment and control groups, respectively.

In the second part (ATE_2 conditional on X), non-participant in period two (exit from off-farm activities in 2015/16) and participant in off-farm activities in both periods (i.e. 2013/14 and 201516) are belonged to treatment and control groups, respectively.

Following Angrist & Pischke (2008) and Villa (2016), linear regression of DID can be expressed as follows:

$Y_{i2015|16} = \beta_0 + \beta_1$year dummy_$T_i + \beta_2$off-farm_ $D_i + \delta$ off-farm_D_i *year dummy_$T_i + X'_i\beta_3 + \varepsilon_i$ (9)

In equation (9), Y_i shows the educational outcomes of the child i, T_i is the time dummy which takes 1 if the period is 2015/16, and 0, otherwise. And variable D_i expresses the participation dummy, which takes the value 1 if the household participated in second period only (non-participated in

2015/16), whereas 0 if non-participated in both periods (participated in both periods). The coefficients have the following interpretation:

- β_0: intercept (the mean educational outcomes of child in 2013/14 who live with non-treated household).
- $\beta_0 + \beta_1$: the mean educational outcomes of child in 2015/16 who live with non-treated household.
- β_2 : the educational difference between child who live with treated household and who live with non-treated in 2013/14.
- $\beta_0 + \beta_2$: the mean educational outcomes of child in 2015/16 who live with treated household.
- $\beta_0 + \beta_1 + \beta_2$: mean educational outcomes of child whose household is treated
- δ : the DID estimated. In other words, it is the coefficient of interaction term between the dummies for the treatment group and the post-treatment period (2015/16). It estimates the impact off-farm participation on children's educational outcomes.
- β_3: the coefficient of other covariates that influences educational outcomes of children.

3.3.2. Description of variables

Based on both theoretical literature and empirical finding, variables that affect participation in off-farm activities[27] and children's educational outcomes were focused in this section. Table 1 presents variables explanation and their expectation sign. The variables that affect children's educational outcomes were analyzed at child level.

[27] The rural off-farm economy comprises all those non-agricultural activities that generate income to rural households (including income in-kind and remittances), either through wage work or in self-employment. Off-farm activities are all economic activities other than the production of primary agricultural commodities. It includes mining, manufacturing, utilities, construction, commerce, transport, and a full gamut of financial, personal, and government services. Also it includes agro processing such as the transformation of raw agricultural products by milling, packaging, bulking, or transporting that forms a key component of the rural off-farm economy (Davis, 2004; Haggblade, Hazell, & Reardon, 2010). In this study, off-farm activities includes owned a non-agricultural business or a non-agricultural service from home or a household-owned shop, as a carwash owner, metal worker, mechanic, carpenter, tailor, barber; processed and sold any agricultural by-products, including flour, local beer ("tella"), "areke", "enjera", seed, etc., but excluding livestock by-products, fresh/processed fish; owned a trading business on a street or in a market, offering any service or sold anything on a street or in a market, including firewood, home-made charcoal, construction timber, wood poles, traditional medicine, mats, bricks, cane furniture, weave baskets, thatch grass etc; owned a professional office or offered professional services from home as a doctor, accountant, lawyer, translator, private tutor, midwife, mason, etc., driving a household-owned taxi or pick-up truck to provide transportation or moving services; owned a bar or restaurant and owned any other non-agricultural business, even if it is a small business run from home or on a street.

Table 1. Definition of variables as included in the probit specification and DID estimation

Variables	Measurements and variable description	Expected signs of variables	
Dependent variable (Y)	**Educational outcome is measured by** ✓ Ever attendance (1 if child ever attended formal education, 0 otherwise) ✓ Enrolment status (1 if child currently in school, 0 otherwise) ✓ Highest grade completed by child ✓ Grade attainment relative to age by child (age in year – (7+grade attainment)); note that in Ethiopia official entrance age is 7 to start primary school. ✓ Basic literacy skill (1 if child can read and write by any language, 0 otherwise) ✓ Absence from school (1 if child absent from school more than a week, 0 otherwise)	**On household off-farm participation**	**On children Educational outcomes**
Independent variables (*X*)	Variables that affect participation in off-farm activities and educational outcomes, and their description		
Sex	A dummy variable taking value 1 if the household head is female, 0 otherwise	Negative	Negative
Age	Age of household head (in years)	Positive	Positive/ Negative
Household size	Total number of household member	Positive	Negative
Mean schooling of male	Mean Years of formal schooling of male in household	Positive	Positive
Mean schooling of female	Mean years of formal schooling of female in household	Positive	Positive
Head's Education	Formal education of household head (highest grade level completed)	Positive	Positive
Credit	Household access to formal credit, dummy variable (1, if yes; =0, otherwise)	Positive	Positive
Farm real income	Total income from farm per year (measured in birr)	Positive/ Negative	Positive
Livestock owned	Livestock owned by household at the end of the period in Tropical Livestock Units (TLU)[28]	Positive/ Negative	Positive/ Negative

[28] Refer Mulisa (2017) for more explanation.

Child labor	✚ Dummy variable, taking 1 if child participate in household off-farm activities; 0, otherwise.	Positive	
Land size	✚ Size of land holding by household (measured in hectares)	Negative	Positive/ Negative
Assistance	✚ Dummy variable, taking 1 if at least one of the household member receive assistance (government and non-government 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	Positive	Positive
Agricultural Shocks	✚ Dummy variable, taking value 1if during household affected by one of the following shock in the last 12 months ✓ 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); taking value 0, otherwise ✓ 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); taking value 0, otherwise	Negative	Negative
Electricity	✚ Dummy variable; taking value 1if household get electricity for cooking and light from one of the following sources: Electricity meter – private, electricity meter – shared, electricity from generator, solar energy, electrical battery, light from dry cell with switch; 0 otherwise	Positive	Positive
Off-farm	✚ Takes the value 1, if household participated, and 0, otherwise		Positive/ Negative

Chapter Four: Results and Discussion

4.1. Descriptive statistics

In this section, we discuss demographic as well as socio-economic characteristics of households and community level characteristics to which the children under study belong to. From Table A1, presented in an appendix, we observe that the first six variables show the children's educational outcomes in this study and other remaining variables are explanatory variables which affect the participation in off-farm activities as well as educational outcomes. In the sample, 64 percent of the children were attended formal education. This result shows that still many school aged children (36 percent of the children) were never attended formal education in rural areas. This is because access to education falls short of the demand. Also, illness and death of parents, live with a poor household may expose children to labor work and compete with schooling. The proportion of children who attended formal education increased on average from the year 2011/12, 2013/14, and 2015/16; 61 percent, 65 percent, and 66 percent, respectively. The rationale behind this result is that expansion of primary education in rural areas improved opportunity of children to attend formal education.

For the whole sample, 92 percent of children were currently enrolled. But, the enrollment status (currently enrolled) was declined from the year 2011/12 to 2013/14; it was decreased from 93 percent to 92 percent and increased to 93 percent in 2015/16. About 46 percent of children in the sample have a basic literacy skill (can read and write in any language) and it was increased from 2011/12 to 2015/16. This is because as the year of education increased, basic literacy skill increased. Also increase in access to educational materials such as textbooks may improve children's reading and writing skills at any language. But as a general, more than half of children (54 percent) had no basic literacy skill. And this figures indicates education in the rural Ethiopia has a poor quality. Education sector only focus on the distribution of education access, rather than take into account about the quality of education.

About 10 percent of children were absent from school, and this was highest in 2011/12 (15 percent) and lowest in the 2013/14 (7 percent). On average, the highest grade completed was low as compared to their average age (9.44 years), about 1.37 years of schooling, and it was increased from the year 2011/12 to 2015/16. On average, child delayed about 0.55 years to start primary school. In other words, the child started primary school at the age of 7.55 years (in Ethiopia, the

official entry age is seven). This delay to start primary school was increased from the year 2011/12 to 2015/16. In 2011/12, they delayed 0.5 year, in 2013/14 and 2015/16 they delayed around 0.6 year. This may be due to several combination factors. For instance it may be due to household's low income, access of education mismatched with demand (limited access to education), and large household size (if the household has limited resource and limited assets, they give priority to the elder child and boys, and this increases the delay to start primary school for the younger child and girls in rural areas). In general, our results reveal that the children educational outcomes were low in rural Ethiopia, since above half of children did not read and write in any language. Children who are currently attending were delayed to start primary school. About 36 percent of school-aged children were never attended formal education. Among the attended school children, around 8% of children were not currently enrolled and this figure is high because the rural area takes high proportion.

The majorities of rural households were male-headed; only 17 percent of a household were a female headed in the sample. The age of head on average was 45.44 years. On average, household had over 6 household sizes, and the size was more or less similar in all periods. The mean schooling of a male and female in the household was 1.66 and 1.46 years, respectively. The mean schooling of both sexes was increasing from the year 2011/12 to 2013/14, and lower in 2015/16. Mean years of schooling of a female was higher than mean schooling of male in 2015/16. This 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, and the highest is in 2015/16 (1.99 years).

The average age of children was 9.44 years in the sample. On average, 24 percent of children participated in off-farm activities. The use of child labor is obvious in rural areas; poor households send their child to work instead of school in order to support household's income. After school, also children help their family in off-farm activities. A poor household cannot also afford the expenses of clothing, school fees, textbooks, transportation; therefore, the children in rural areas participate in different off-farm activities to come up with the money for these expenses. The participation was high in 2011/12 (32 percent). It was declined to 21 percent and 20 percent in 2011/12 and 2015/16 on average, respectively. About 29 percent of household received credit, and the figure were high in 2013/14 which was 32 percent. In the sample, 19 percent of households

received assistance from government as well as non-government agencies and the proportion of household who received assistance were highest in 2015/16, 24 percent on average in the sample. About 23 percent and 43 percent of a households experienced idiosyncratic and covariate shocks, respectively. In the year 2015/16, the highest number of household faced idiosyncratic and covariate shocks. Household's average annual income from farm activities was Br. 820.28 and income from farm activities per year were declined. This is due to the case of bad weather condition, fluctuation of a price for agricultural output in the world market, increase for a price of agricultural inputs and others. And declining income from farm activities is one challenge for the livelihood for rural households. Therefore, rural households participate in off-farm activities as a mechanism to smooth income or consumption. On average, households owned 3.6 livestock in TLU, and this number is equivalent to three oxen and three sheep. The number was increased from the year 2011/12 to 2015/16. On average in the sample, the households owned 1.69 hectares of land. But the size was decreasing because the rapid growth of population.

4.1.1. Differences in participant and non-participant households in off-farm activities

The difference in participants and non-participants, confirmed by simple statistical tests of differences in means are discussed in this section. Table 2 summarizes the difference in socio-demographic household characteristics, community level characteristics, shocks, and child participation in off-farm activites between a household who participated in off-farm and who did not participated. The results show that a households who participated in off-farm activities are characterized a better educated head and household members in both sexes, better credit access, larger household size and younger head compared to non-participant households. Regarding livestock and land holding, household who did not participated in off-farm activities had larger number of livestock and larger land size than participant households. The proportion of households who faced both covariate and idiosyncratic shocks, the proportion of households who were headed by a female and households who were received assistance from government and non-government agencies are equal for both participant and non-participant groups. Also, the mean age of children and mean income from farm activities (income from livestock and crop production) are the same for a participant and non-participant households.

Educational outcomes of the children who live with participated household were characterized by higher proportions of children who read and write in any language and ever attended, and larger highest grade completed. Regarding enrollment status (currently enrolled), the proportions of children from non-participant household were larger than the proportion of children from participant households. And children who live in a non-participated household have higher number of grade attainment relative to age in years/or months. In another words, children from non-participant household were delayed more to start primary school compared to their counterparts. Both a participant and non-participant households have the same proportion of children who absent from school. Children live with household who participated in off-farm activities were working more in off-farm activities.

The results from Table 2 show that, on average, the proportion of children who have basic literacy skill and attended formal education was greater by 2% and 4%, respectively for who live with a household participated in off-farm activities compared to their counterparts. The result was statistically significant at 1% level of significance. The enrollment status (currently enrolled) was statistically significant at 1% level of significance. The proportion of children who currently enrolled was higher by 2% for children whose household did not-participated. The highest grade completed for children lives in the participated household greater on average by 0.08 year than their counterparts, and this was statistically significant at 10 percent. On average, grade attainments relative to age for children whose households were participated and did not participated was positive. This result shows that children from both households delayed to start the formal education. The grade attainment relative to age was 0.47 year and 0.58 year for children whose household participated and did not participated, respectively. This result indicates that on average children from participant household are younger to begin primary school. In other words, delaying to begin primary school was higher for children live with non-participant household, but the difference between two groups was small. Average age of head in participant group was younger by 2.17 years than non-participants. The difference of household size for households who were participated and did not participated was statistically significant at 1%. On average, the household size for participant household was higher by 0.12 than non-participant household.

The mean schooling for a male and female in the household and highest grade completed by head was higher for households who participated in off-farm activities than their counterparts. Mean schooling of a male in participant household was higher by 0.25 years, and mean schooling of a female in a participant household was higher than their counterpart by 0.18 years. Head's schooling for participant household was higher by 0.45 years than non-participant household. Household who participated in off-farm activities borrows more credit than non-participant household. On average, 32 percent of participant households borrowed credit, and 28 percent of non-participant households borrowed credit, and the difference was statistically significant at 1%. For the non-participant households, total livestock unit and plot of land owned was higher than participant households. On average, households who did not participated in off-farm activities have 0.86 larger livestock in TLU than participated. This means that they have more one bull, two sheep, and 6 poultry. Also, the size of plot of land owned for non-participant was higher by 0.19 hectares than participant.

Table 2. Difference in participant and non-participant households in off-farm activities

	Participant(P)			**Non-participant(NP)**			
Variable	Mean	Std. Err.	Obs.	Mean	Std. Err.	obs.	Diff = (NP-P)
Ever attendance (1 = attended)	0.67	0.01	3555	0.63	0.00	9533	-0.04*
Enrollment status (1 = currently enrolled)	0.91	0.01	2397	0.93	0.00	5977	0.02*
Basic literacy skill (1 = read and write)	0.47	0.01	3555	0.45	0.01	9534	-0.02***
Absence(1 = absent)	0.10	0.01	2171	0.11	0.00	5567	0.01
Highest grade completed	1.42	0.03	3,594	1.36	0.02	9,614	-0.08***
Grade attainment relative to age	0.47	0.04	3,587	0.58	0.02	9,577	0.11*
Sex of head(1 = F)	0.18	0.01	3583	0.17	0.00	9597	-0.01
Credit (1 = borrowed)	0.32	0.01	3594	0.28	0.00	9614	-0.04*
Assistance (1 = received)	0.19	0.01	3594	0.18	0.00	9586	-0.01
Child labor in off-farm (1 = participated)	0.26	0.01	3594	0.23	0.00	9614	-0.03*
Head's age	43.86	0.18	3,567	46.03	0.13	9,553	2.17*
Child's age	9.43	0.05	3,594	9.44	0.03	9,614	0.01
Household size	6.70	0.04	3,592	6.58	0.02	9,614	-0.12*
Mean schooling of male	1.84	0.03	3,536	1.59	0.02	9,494	-0.25*
Mean schooling of female	1.59	0.03	3,566	1.41	0.02	9,536	-0.18*
Head's schooling	2.10	0.05	3,569	1.64	0.03	9,555	-0.45*

Idiosyncratic shocks (1 = faced)	0.23	0.01	3594	0.24	0.00	9614	0.01
Covariate shocks (1 = faced)	0.42	0.01	3594	0.43	0.01	9614	0.01
Farm earning, real (birr)	759.5	70.70	3,594	737.20	32.55	9,614	-22.35
Livestock owned in TLU	3.07	0.06	3,594	3.94	0.04	9,614	0.86*
Plot of land	1.55	0.06	3,594	1.75	0.04	9,614	0.19*

Note: * and ***, shows statistically significant variables at 1% and 10% level of significance, respectively.
Source: Authors' computation based on 2011/12, 2013/14, and 2015/16 ESS data.

Table 3 shows the annual change in off-farm participation from the year 2011/12 to 2015/16. In the sample, 27.21 percent of the households participated in off-farm activities. There was the slight difference in the proportion of off-farm participation in the year 2011/12-2015/16. And the participation was highest in the year 2013/14 which was 28.07.

Table 3. Variation in household participation from 2011/12 to 2015/16

	2011|12	2013|14	2015|16	Average in three periods
Not-participated	3,093	3,218	3,303	3,205
Percentage (%)	72.69	71.93	73.74	72.79
Participated	1,162	1,256	1,176	1198
Percentage (%)	27.31	28.07	26.26	27.21
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.

4.2. Econometric Analysis

4.2.1. Determinants of participation in off-farm activities

In this section, factors that affect household's participation in off-farm activities in rural Ethiopia are discussed from three period panel data. Table 4 reports the panel probit regression result. And in the table coefficients, Marginal Effects at the Means for both the discrete and continuous independent variables and their standard errors were presented. The standard errors for marginal effect at the means are adjusted for household clusters and corrected for using the delta method. The result shows that 12,811 households in the data set were used in the analysis. The Wald chi2(15) of 203.57 and 173.86 for pooled and panel structure of data, respectively with p-value of 0.000 indicates that our model as a whole is statistically significant; that is, it fits significantly better relative to model without predictors. In other words, it shows that at least one of the

regression coefficients in our model affects the participation in off-farm activities. Rho = 0.786 indicates that 78.6 percent of the variance is due to differences across panels. One of the community level dummy variable, namely, electricity, was automatically dropped from the model due to multicollinearity problem. Probit regression result reveals that credit, child's labor, age of head, household size, mean schooling of male, mean schooling of female, covariate shocks and livestock owned in TLU significantly affects the participation in off-farm activities in both pooled and panel structure of the data. Sex of head, child's age, and farm earnings are only statistically significant in pooled data cases, whereas assistance was only significant in panel data cases. Among the variables that significantly affect off-farm participation, credit, child's labor, age of child, household size, mean schooling of male and female and assistance have positive coefficient. This implies that an increase in the predictor leads to an increase the probability of participation in off-farm activities. Whereas age of head, sex of head, livestock owned, covariates shocks and farm earning have negative coefficients and it indicates that an increase in the predictor leads to a decrease in the probability of participation in off-farm activities.

A female headed households were into less participated in off-farm activities than their male counterparts, holding other factors constant at their means. This result is the same with other studies such as Adugna (2009) and Yishak (2017); but contradicts by Charles (2013), Musa & Kumilachew (2018). The marginal effect for female in pooled structure of data result implies that the probability of participation in off-farm activities for a female headed household lowers by 3.3 % than a male headed household, holding all other variables at their means. The result was statistically significant at 10 percent level of significance. The rationale behind this is that most of the time in rural Ethiopia, the home based work was taken by female, particularly for those who have low education; this limits the female headed households to have more responsibilities in home management.

Increase in the age of head of household decreases the average likelihood that the household participates in off-farm activities. This result was statistically significant at 1% level of significance. This result is similar with Woldenhannaa & Oskam (2001) and Amare & Belaineh (2013). The coefficient implies that the age of head negatively affects off-farm labor supply. The coefficient of marginal effect on probability was 0.3 %. And which implies that holding other variables at their means, increase in one year of head's age decreases the probability of

participation of household in off-farm activities by 0.3%. This may be related with asset holding, young household have small amount of asset particularly land and farm inputs such as oxen, donkeys because of rapid population growth rate in rural area compared to older household. Therefore, young headed household supply more labor to off-farm activities. In addition, as age increases the income effect may be dominates, and household demand more leisure and reduce time allocation in off-farm activities at later age.

Holding other factors constant at their means, households who have more livestock (in TLU) on average tend to participate less in off-farm activities. And this result confirms with the previous study such as Adugna (2009), and Yishak (2017). Other previous studies found the positive effect of livestock owning on off-farm participation (Amare & Belaineh, 2013). The marginal effect of livestock can be interpreted as follows. If owning livestock which is measured by tropical livestock unit increases by one unit, the probability of households' participation decrease by 0.8 % when allowed for panel structure of data, and 1.3% in pooled data case, and the coefficients are statistically significant at 1% level of significance. This may be because household who have more livestock would sell their livestock as coping strategy instead of engaging in off-farm activities during the period of crop production failure. In addition, from total time endowment, the amount of time allocated to livestock sector by household reduces the available time that could have been spent on off-farm activities. Furthermore, this may be due to the higher value of livestock over value of off-farm activities since households are consciously reallocating their time in response to changes in economic conditions.

Child labor positively affects the mean predicted probability of participation in off-farm activities, holding other factors constant at their means. The result of child labor is the same with Amare & Belaineh (2013). And the marginal effect was statistically significant at 1% level of significance. Child labor increases probability of household participation by 2.4% in panel structure of data, and increase the probability by 4% in pooled structure of data. This might be due to that children participation increases labor supply in off-farm activities. The coefficient of child's age was statistically significant at 5%. The coefficient of child's age was positive, and the marginal effect implies that as age of child increases the probability of participation in off-farm activities increases by 0.5 percent. The age of child may be related with the increment of time allocation in off-farm

activities. As the age of child increases, the time allocation in off-farm activities also increases; the older children spent more time than the younger one in the household.

One more household member increases the likelihood of household's participation in off-farm activities by 1.1% and 0.9% holding other factors constant at their means, panel, and pooled structure of data, respectively. The result was statistically significant by 1%. This result agrees with Mohammedawel (2015) and Musa & Kumilachew (2018), but contradicts by Woldenhannaa & Oskam (2001). Higher household size may be increase time endowment (labor supply) and increase time allocation in off-farm activities. The coefficient of mean schooling for both female and male in the household was statistically significant by 1% level of significance. Mean schooling of female increase the probability of off-farm participation by 1.3% and 0.9%, pooled and panel structure of data, respectively. Previous study such as Hossain, et al. (2013) found that schooling of female have no effect on off-farm participation. The participation in off-farm activities likely increase due to that higher educated female exit path from low productivity farm employment and participate in off-farm income generating activities, particularly participate in professional jobs. Since individual's response to returns and higher marginal values of time in off-farm over homework attracts women's participation in off-farm activities.

Holding other variables constant at their means, the mean schooling of male increases the probability of household participation by 1.5% and 1.6% for panel and pooled structure of data results, respectively. This may be due that as individual more and more educated the probability of getting job opportunity outside farm work, particularly in professional off-farm activities increases. More educated household allocate his time efficiently on farm as well as off-farm work, if the farm return is lower than off-farm work, they allocate their time more on off-farm work. Having access to credit increases the probability of off-farm participation by 6.6% and 3.3% for pooled and panel structure of data results, respectively than having with no access to credit, holding other factors constant at their means. The coefficient was significant at 1% level of significance. This result is supported by the previous study such as Mohammedawel (2015) and Abebe (2010). This is likely that access to credit uses as startup capital to off-farm activities, particularly for poor households. In other words, credit solves liquidity problem in rural areas and thereby increases the probability of participation in off-farm activities. Holding other variables at their means, the probability of participation in off-farm activities for household who receive assistance was higher

by 3.5%. This may be the same with credit case that solves liquidity problem. The probability of off-farm participation decreases by 2.2% and 2.1%, panel and pooled structure of data result, respectively for a household who faced covariate shocks, holding other variables constant at their means. The rationale behind to this is that in rural areas because of credit constraint/or financial liquidity problem, the covariate shocks reduces annual income for those households who only participate in farm, participate in both farm and off-farm, and only participate off-farm work. Consequently, decreases selling goods and services from off-farm activities by decreasing the demand for off-farm goods and service. In addition to this, a household who faced shocks particularly poor households are not able to get startup capital if off-farm activities need high startup capital, which reduces the probability of off-farm participation.

In line with Adugna (2009) and Woldenhannaa & Oskam (2001), farm earning affects the household participation in off-farm activities negatively, and this result was statistically significant at l% level of significance. This contradicts by Yishak (2017); this study found positive effect of farm income on participation in off-farm activities. The coefficient of marginal effect was

-0.000008. The coefficient is interpreted as follows. If the farm income increases by 10,000, the probability of household participation in off-farm activities decreases by 8%. The small increments of farm income have insignificant effect on participation in off-farm activities. The higher increments of farm income have effect on off-farm participation. The household who have higher farm income earned likely want to spent more time on farm, leisure rather than supply their labor to off-farm activities. In addition, the negative effect of farm income on the probability of participation may be because households who have higher income from farm activities send their children to school, which reduces the labor supply in off-farm activities. In other words, if the household earns higher farm income and send their children to school instead using their labor, the remaining time endowment of the household is more spent on farm activities.

Table 4. Determinants of household participation in off-farm activities

	Pooled data			**Panel data**		
	Coef.	dy/dx	Std. Err.	Coef.	dy/dx	Std. Err.
sex of head (1 = F)	-0.110	-0.033	0.018***	-0.033	-0.005	0.013
Credit(1 = borrowed)	0.220	0.066	0.011*	0.222	0.033	0.008*
child labor in off-farm (1 = participated)	0.135	0.040	0.014*	0.160	0.024	0.009*
Assistance (1=received)	0.007	0.002	0.015	0.232	0.035	0.009*

head's age	-0.009	-0.003	0.001*	-0.018	-0.003	0.000*
child's age	0.018	0.005	0.002**	0.012	0.002	0.002
household size	0.032	0.009	0.003*	0.070	0.011	0.002*
mean schooling of male	0.054	0.016	0.003*	0.097	0.015	0.002*
mean schooling of female	0.043	0.013	0.004*	0.063	0.009	0.002*
head's schooling	-0.011	-0.003	0.002	-0.010	-0.002	0.002
idiosyncratic shocks (1 = faced)	0.055	0.016	0.012	-0.032	-0.005	0.008
covariate shocks (1= faced)	-0.069	-0.021	0.011***	-0.147	-0.022	0.007*
farm earning, real (birr)	-0.000027	-0.000008	0.000**	-0.00003	-0.000008	0.0000006
livestock owned in TLU	-0.042	-0.013	0.002*	-0.051	-0.008	0.002*
plot of land	-0.004	-0.001	0.001	0.007	0.001	0.001
cons.	-0.734		0.137	-1.283		0.193
sigma _u				1.919		0.067
rho				0.786		0.012
Number of observation		12,811			12,811	
Number of groups					6,691	
Wald chi2(15)		203.57			173.86	
Prob > chi2		0.000			0.000	

Note: *, ** and ***, shows statistically significant variables at 1%, 5% and 10% level of significance, respectively.
Standard Errors adjusted for 6,691clusters.
The standard error for marginal effect is corrected by delta method.
dy/dx is for a discrete change of the dummy variable from 0 to 1.
Marginal effects computed at the mean values of the respective variables.
Source: Authors' computation based on 2011/12, 2013/14, and 2015/16 ESS data.

4.2.2. Impact of household off-farm participation on children's educational outcomes

The results on impact of household participation in off-farm activities on children's educational outcomes from propensity score matching (PSM) in combination with difference-in-difference (DID) estimation was presented in this section. The average treatment on treated (ATT) and average treatment on the whole sample (ATE) of off-farm participation on children's educational outcomes is estimated. Participated and non-participated households were balanced from PSM in terms of observable characteristics. To ensure conditional independent assumption (CIA) was met, data from 2011/12 was used to generate the propensity scores for households' participation in 2013/14 and 2015/16. Households who participated and non-participated in off-farm activities were balanced based on the covariates such as sex of household head, credit access, receiving assistance from government and non-government agencies, household's age, age of children,

household size, mean schooling of male and female in the household, head's schooling (highest grade completed), idiosyncratic shocks and covariate shocks; and balancing test was met[29].

Before our main estimation, the study applied panel estimation; random effect estimation for both continuous and binary outcome variables. The result was presented in Appendix Table A7. The results show that household's participation in off-farm activities has inconsistence effect on children's educational outcomes. For instance, it has negative effect on the proportion of children who currently enrolled. Whereas, positive effect on the proportion of children who attended formal education. The inconsistence result of this estimation is because of endogeneity that arises from both initial observable and unobservable characteristics. Propensity score matching (PSM) estimation from the period one (i.e. 2011/12) data was employed before applying difference-in-difference (DID) estimation based on matching data for the three period panel data. The result of PSM is presented in Appendix Table A8. And the study provides only a summary of results. The PSM results suggest that household's off-farm participation in off-farm activities have negative impact on current enrollment and highest grade completed by children, and positive impact on children who delayed to start primary school for children belonging to participant households and the whole sample. But, the proportion of children who attended formal education increased and absent from school decreased for children belonging to participant households. PSM estimation does not control endogeneity from unobservable characteristics. To overcome the limitations of PSM, the study applied PSM-DID estimation which utilizes three period data.

Matching on full sample with difference-in-difference estimation was employed at first level. The result is presented in Appendix Table A4 and Table A5. The results show a negative and significant effect of off-farm participation on highest grade completed by children and proportion of children who have a basic literacy skill. Also, participation in off-farm activities has positive and significant effect on proportion of children who delayed to start primary school for the whole sample (ATE). Leaving off-farm participation (non-participation in 2015/16) has negative effect on proportion of children who absent from school for whole sample (ATE). But have negative effect on highest grade completed by children and positive effect on proportion of children who absent from school for children belonging to non-participated households (ATT). The inconsistence results of impact of off-farm participation on highest grade completed by children and proportion of children who

[29] Refer Table A6 in appendix for the formal test of balancing.

absent from school is because of endogeneity problem. Household's off-farm participation in period one affects children's education in period two through attracting children to participate in off-farm activities. In rural areas, the participation of one household member particularly older child from the household in the current period attracts the younger child to participate in the off-farm activities in the next year; in Ethiopia, many children migrate from rural to urban areas to participate in different off-farm activates particularly in informal sectors. Also, participation in the period one increases annual income of a household at the end of period one, and this empowers household's financial capacity to invest on children's education in the period two. Therefore, to control endogeneity problem, participants in 2011/12 were dropped from the sample.

Table 5. DID with Matching estimates of impact of household participation on children's educational outcomes (ATT_1 and ATE_1)

	Highest grade completed		**Grade attainment relative to age**		**Ever attendance**		**Enrollment Status**		**Basic literacy skill**		**Absence from school**	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
ATT	-0.21	0.11**	0.16	0.13	0.09	0.15	0.22	0.34	0.19	0.14	-0.04	0.32
ATNT	-0.01	0.05	-0.07	0.06	0.16	0.06*	0.03	0.11	0.11	0.05**	0.26	0.12
ATE	-0.07	0.13	0.11	0.14	-0.06	0.19	-0.65	0.33**	-0.34	0.18**	0.00	-
Number of obs.		3,297		3,283		3255		1574		3258		1356
F test	F(17, 2078)	141.23	F(17, 2074)	82.1								
Wald chi2(17)						354		79.74		575.12	Wald chi2(16)	31.51
P- value		0.00		0.00		0.00		0.00		0.00		0.01

Note: * and ** shows significant variables at 1% and 5 % level of significance, respectively.
Source: Authors' computation based on 2011/12, 2013/14, and 2015/16 ESS data.

Table 6. DID with Matching estimates of impact of households exit from off-farm participation on children's educational outcomes (ATT_2 and ATE_2)

	Highest grade completed		**Grade attainment relative to age**		**Ever attendance**		**Enrollment Status**		**Basic literacy skill**		**Absence from school**	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
ATT	-0.03	0.11	0.01	0.13	-0.01	0.13	0.08	0.23	0.00	0.12	0.40	0.27
ATNT	0.07	0.15	-0.07	0.17	-0.19	0.14	0.35	0.24	0.01	0.13	0.43	0.26***
ATE	0.01	0.16	-0.08	0.17	0.32	0.16**	-0.13	0.31	0.20	0.16	-0.92	0.36*
Number of obs.		1,161		1,159		1,139		618		1137		526
F test	F(17, 728)	59.45	F(17, 726)	42.65								
Wald chi2(17)						161.58		58.43		292.83		38.28
P- value		0.00		0.00		0.00		0.00		0.00		0.00

Note: *, **, *** shows significant variables at 1 %, 5%, and 10% level of significance, respectively.
Source: Authors' computation based on 2011/12, 2013/14, and 2015/16 ESS data.

Table 5 reports the ATT and ATE of household participation in off-farm activities (ATT_1 and ATE_1) on the children's educational outcomes. In this part, household who were participated in off-farm activities in 2015/16 only were taken as treatment groups and households who did not participated in both periods (i.e., 2013/14 and 2015/16) were taken as control groups. The overall results show that household's participation in off-farm activities influenced negatively and significantly on children's educational outcomes. In line with the previous studies such as Admassu and Kassahun (2011), Appleton (1991) and Tansel (2002) showing that household's participation in off-farm actiites negatvely affects children's educational outcomes. Unlike previous studies, the present analysis of the impact of off-farm participation addressed the endogeneity problem. This problem is controlled for by way of using propensity score matching (PSM) on observable sources of endogeneity and unobservable sources of endogeneity were controlled through difference-indifference (DID) estimation.

The rationale behind this result is that off-farm participation by household members often include using children's labor in off-farm work. Children helps their household in off-farm activites and this compete with their schooling time. For, poor households, immediate needs of income generating by children outweigh future benefits from schooling. Therefore, poor households use their child labor in off-farm activites instead send to school. This implies that household participation in off-farm activities increases the demand of household member's labor, including

child labor and it compete with children's schooling. In other words, household participation in off-farm activities depresses the schooling of children by creating providing either full-time or part-time opportunity to work in off-farm activities to school-age children. Also, household participation in off-farm activities reduces schooling of children by arising demanding of children to work on home and farm instead of adults in the household, since the adult's labor was supplied into off-farm activities. Girls hold the responsibility of home work, such as cooking food, fetching water and carrying their youngs. Farm activities, keeping livestock and collecting fire wood responsibility hold by boys. Therefore, falling these responsibilities on both boys and girls shoulder hinders following their education by reducing the available time.

Also, children who live in a poor household have great difficulty in financing investment on their education. And instead they are forced to self-finance their schooling by working part-time in off-farm activities or participate within there off-farm activities [30] (or sometimes they drop totally from schhool, absence from school.). The prior participation of one member of household attracts other childrens, particularly, it rises the rural-urban migration in rural households; priorly one member of household work in off-farm activities attracts other children from within household and neighbour household, and this impede their schooling. In addition, lower employment opportunity of educated adults adversely affects demand for schooling, particularly household investment on their children's education. Instead, their children involve in apprenticeship training of household off-farm activities. Since there is a financial/or credit access constraint in rural areas, poor househods invest on the education of their off-spring by selling their assets such as land, livestocks, and house[31]. They expect primarily their children's education will improve their future well-being – a form of long term consumption insurance. Poor parents could expect to get paid back later

[30] In Ethiopia there are a lot of children participate in off-farm activities in urban areas, particularly in informal sectors, migrated from rural areas. Activities such as shoes shine, selling lottery tickets, working in tax, working in others kitchen, washing cars, washing clothes to others, selling vegetables in street, selling second hand clothes and shoes, small electronic items like watches, sockets, electric wires, tape in the street and carrying others children. When they left their parents, more work burden (such as collecting fire wood, fetching water, keeping livestock, participate in farm and other works, and home works) fall on the shoulder of remaining children at home. And this work burden on the remaining children at home pushes them drop out from school and absence from school. In addition, one children left their household to participate in off-farm activities initially, particularly in urban areas, and open the door to migration of other children who lives within household and neighbor into urban areas for off-farm activities. Therefore, for the poor household there is high opportunity cost of children's time; it increases the probability of dropping out and absent from school.

[31] Poor families sell already corrugated iron roof hut house ("Taraw korkoro Bet") and instead build thatched roof hut house ("Sar Bet") to finance their child's schooling.

when they are old. Children may carry out parent's part of the bargain by sending money. If there is low perceived employment opportunity at the end of education[32] and there is no/or very few modern labor markets or there are abundant low-skill jobs, parents cut off investing on their children's education and use children's labor to work with their off-farm activities or send them to labor market to contribute to household income. Buchmann & Brakewood (2000) stated that employment opportunities for educated individuals influences the demand for school, particularly parents investment in their children's education. They argued that there is positive effect to access of employment opportunity in modern labor sectors such as employment access in manufacturing sector, service sectors that pay higher wage than that of agricultural sectors.

As reported in Table 5, the coefficient of household participation in off-farm activities has a negative and statistically significant effect on children's enrollment status (current enrollment) and basic literacy skill for the whole sample (ATE_1). And it also had negative and statistically significant effect on highest grade completed by children belonging to participant household (ATT_1). The values of highest grade completed by children belonging to participated households was reduced by 0.21 years compared to those who belonging to households who did not participated. The proportion of children who have basic literacy skills (read and write in any language) and currently enrolled reduced by 34 percent and 65 percent, respectively.

Table 6 presents ATT and ATE of households exit from off-farm activities (ATT_2 and ATE_2) on children's educational outcomes. In this section, households exit of off-farm participation in 2015/16 (participated in 2013/14 only) were taken as treatment groups and households participated in both periods (i.e. 2013/14 and 2015/16) were taken as control groups. Household's departure of off-farm participation increased the proportion of children who ever attended formal education and reduced proportion of children who absent from school in the whole sample. Leaving participation in off-farm by household increased the proportion of children who attended formal education by 32 percent, and reduced proportion of children who absent from school by 92 percent. The reason for this is that children who live in household only work in farm activities, the scheduling of child labor (i.e., seasonal and part-time) was more compatible with schooling. In other words, exit from off-farm activities by household reduces a demand of household member's labor including child labor, and this gives the chance to children who could not work with their parents in off-farm

[32] Perceive employment opportunity from the experience of well-educated adults in their neighbor.

activities. If the children can not participate in their families off-farm activities, there is lower opportunity cost of going to school in relation to household income and more time to spend on their education; the parents expect more future earnings and send their children to school.

Corresponding with the estimation of the impact of off-farm participation on educational outcomes, Table A2 and Table A3 in Appendix, presents the results of other factors influence children's educational outcomes[33]. The regression is estimated for individual children data. The results show that sex of head, head's age, credit access, assistance from government and non-government agencies, household size, mean schooling of a male, and female, and head's highest grade completed have statistically significant impact on children's educational outcomes. In addition, idiosyncratic and covariate shocks, farm earning, livestock owning and land size were found have significant impact on children's educational outcomes. Children age has inconsistent effect on children's educational outcomes.

Table A2 presents that the effect of other factors on children's educational outcomes. In this estimation household participated in 2015/16 only, and did not participated in 2013/14 and 2015/16 were taken as treated and control groups, respectively. Sex of head has negative and significant impact on children's educational outcomes. On average, highest grade completed by children belonging to female headed household was lower by 0.51 years compared to children lives with male headed household. The result was statistically significant at 1% level of significance. The children whose household headed by female was delay to start primary school by 0.59 years than their counterparts. The result was statistically significant at 1% level of significance. The coefficient of ever attendance was statistically significant at 1%. The proportion children who ever attended formal education belonging to female headed household was lower by 30 percent compared to their counterparts. On average, proportion of currently enrolled children whose household headed by female was lower by 28 percent than whose household headed by male. The result was statistically significant at 5%. The proportion of children who read and write in any language was lower by 28 percent whose household headed by female than their counterparts. The result was statistically significant at 1% level. On average, the proportion of children who absent from school was 31 percent higher for whose household headed by female

[33] See full regression result in the appendix, Table A2 and Table A3

than their counterpart children whose household headed by male, and the result was statistically significant at 5% level of significance.

The coefficient of head's age was statistically significant at 1% level of significance for highest grade completed, grade attainment relative to age, ever attendance, and basic literacy skill of children. As the head's age increases, highest grade completed by children decreases by 0.01 year. Grade attainment relative to age by child (delay to start primary school) increased by 0.02 years. As head of age increased by one year, the proportion of children who ever attended formal education and have skill of writing and reading by any language decreases by 1%. Access to credit increased the proportion of children who ever attended formal education, and who read and write by any language by 15 percent and 11 percent, respectively. The result was statistically significant at 5% level of significance. Assistance from government and non-government organization has positive and significant effect on enrollment status and basic literacy skill, and statistically significant at 10%. And negative impact on absence from school, and the result was statistically significant at 1%. Receiving assistance increased the proportion of children who currently enrolled and have basic literacy skill by 27 percent and 11 percent, and reduced the proportion of children absent from school by 38 percent.

Household size negatively and significantly influences the children's educational outcomes. One more household member reduced highest grade completed by children by 0.12 years, and increased delay to start primary school by 0.15 years. Results are statistically significant at 1% level of significance. On average, the proportion of children who ever attended formal education decreased by 0.9%, and the result was statistically significant at 1% level of significance. The proportion of children who currently enrolled and have basic literacy skill (writing and reading by any language) decreased by 0.6% when household have one more member. And the result was statistically significant at 1% level of significance for both coefficients. Head's schooling negatively and significantly affects children's educational outcomes. Increase of head's school by one year decreases highest grade completed by children by 0.11 years. And delay to start primary school increased by 0.12 years. The coefficients are statistically significant at 1%. The proportion of children who ever attended formal education and have basic literacy skill decreased by 0.3% and 0.5%, respectively. Results are statistically significant at 5% and 1%, respectively.

The mean schooling of male and female in the household have positive impact on children's educational outcomes. Mean schooling of male increased highest grade completed by children and decreased delay to start primary school by 0.28 years and 0.31 years, respectively. Highest grade completed by children increased and delay to start primary school by children decreased by 0.32 years and 0.36 years as the mean schooling of female increased. The proportion of children who ever attended formal education and have basic literacy skill increased and absent from school decreased by 16 percent, 19 percent, and 0.6%, respectively as mean schooling of male increases. The results were statistically significant at 1% for ever attendance and basic literacy skill, and 10% for absence from school. Increases in mean schooling of a female increased the proportion of children who ever attended and currently enrolled by 22 percent and 12 percent, respectively. And the proportion of children who have basic literacy skill increased by 20 percent. The results are statistically significant at 1% level of significance.

Shocks have negative and significant impact on children's basic literacy skill. A household experienced idiosyncratic shock decreased the proportion of children who have basic literacy skill by 14 percent. Result was statistically significant at 5% level of significance. Age of children was positively and significantly affected the highest grade completed by children, proportion of children who ever attended formal education and has basic literacy skill. The proportion of enrolled children decreased and delayed to start primary school children increased. Farm earning influenced proportion of children who have basic literacy skill. The coefficient was 0.00004, and statistically significant at 1% level of significance. The number of livestock owned in TLU influenced positively and significantly current enrollment and basic literacy skill of children. The result was statistically significant at 1%, and as the number of livestock in TLU increased by one unit, proportion of children who currently enrolled and have basic literacy skill increased by 5 percent and 2 percent, respectively. Our findings are consistent with Abafita and Kim (2015) on credit and assistance, household size and mean schooling of male. The result of livestock owned, head's schooling and head's age contrasts by previous studies such as Abafita & Kim (2015), Admassie, et al. (2007), Cockburn & Dostie (2007) and Admassu & Kassahun (2011).

Table A3 presents impact of other factors on educational outcomes when household's exit from off-farm activities (non-participation in 2015/16) were taken as treatment groups and household participated both periods (i.e. in 2013/14 and 2015/16) were taken as control groups. Sex of head has negative and significant impact on children's educational outcomes. On average, highest grade

completed by children belonging to female headed household was lower by 0.27 years compared to children belonging to male headed household. On average, proportion of children who delayed to start primary school increased by 0.32 years when household headed by female. The proportion of children who ever attended and have basic literacy skill decreased by 32 percent and 24 percent, respectively. The results are statistically significant at 10 percent level of significance for all coefficients. Access of credit increased proportion of children who ever attended formal education and currently enrolled by 21 percent and 36 percent, respectively. Results are statistically significant at 5% level of significance. Assistance from government and non-government organization has positive and significant effect on proportion of children who ever attended formal education and negative effect on children delayed to start primary school. Assistance received by household increased proportion of children who ever attended formal education by 42 percent and reduced proportion of children delayed to start primary school by 35 percent. And results are significant at 1% and 5%, respectively.

The household size negatively and significantly influenced highest grade completed by children, proportion of children who ever attended formal education, and have basic literacy skill. Whereas positively influenced proportion of children who delayed to start primary school. The results are statistically significant at 1% level of significance. The highest grade completed by children, proportion of children who ever attended formal education and have basic literacy skill reduced by 0.08 years, 15 percent, and 9%, respectively; whereas delay to start primary school increased by 0.1 year. Mean schooling of male increased highest grade completed by children, proportion of children who ever attended and have basic literacy skill by 0.28 years, 26 percent, and 20 percent, respectively. Mean schooling of male decreased proportion of children who delay to start primary school by 0.32 years. The results are statistically significant at 1% level of significance. Mean schooling of female increased highest grade completed by children, proportion of children who ever attended, currently enrolled, and have basic literacy skill by 0.33 years, 20 percent, 13 percent, and 26 percent, respectively. Mean schooling of female decreased proportion of children who delay to start primary school and absent from school by 0.36 years and 12 percent, respectively. The coefficient of highest grade completed, grade attainment relative to school, ever attendance, and basic literacy skill are statistically significant at 1%. And enrollment and absence from school are statistically significant at 5% and 10% level of significance, respectively.

The household faced covariate shocks decreased proportion of children currently enrolled by 28%, the result was statistically significant at 10% level of significance. Age of children was positively and significantly affected the highest grade completed by children, proportion of children who ever attended formal education and have basic literacy skill, and delay to start primary school. Whereas negatively affected current enrollment. The number of livestock owned in TLU influenced positively and significantly proportion of children who have basic literacy skill, and statistically significant at 5% level of significance. Increases by one unit livestock in TLU increased proportion of children who have the basic literacy skill by 3%. Increase one hectare plot of land owning increased highest grade completed by children and decreased the delay to start primary school by 0.02 years and 2%, respectively. Results are statistically significant at 5% level of significance.

Chapter Five: Conclusions and Policy Implications

5.1. Conclusions

It is necessarily to identify widely factors that influence children's educational outcomes. The impacts of off-farm participation on children's educational outcomes have inconsistence result in the previous studies. Some studies found the negative effect of household participation in off-farm activities on children's educational outcomes. Whereas, other studies investigated positive effect of household's participation in off-farm activities on children's educational outcomes. The absence of consistence results motivated this study for further investigation on impact of household participation in off-farm activities on children's educational outcomes in rural Ethiopia. The study used Ethiopian Socio-economic Survey (ESS) panel data of the World Bank's Living Standards Measurement Survey-Integrated Surveys in Agriculture (LSMS-ISA) project collected in three periods (i.e. 2011/12, 2013/14, and 2015/16). In addition, determinants of household's off-farm participation and other variables influence on children's educational outcomes were assessed. Propensity score matching combination with Difference-in-Difference method (PSM-DID) was employed.

The findings show that household off-farm participation has negative and significant impact on highest grade completed by children, proportion of children who currently enrolled and have basic literacy skill. Household's exit from off-farm activities has significantly reduced proportion of children who absent from school and increased proportion of children who ever attended formal education. Household's off-farm participation exposes children to work instead to follow education. It increases demand of child labor in off-farm activities, and also increases demand of children work at home and farm. The prior participation of one member of household attracts other children within the household and neighbor to generate immediate income for himself and his households which outweigh future return from children schooling. Probit estimation indicated that credit, household size, mean schooling of male and female in the household, household received assistance from government and non-government agencies, children's labor, and age of children have positive and significant effect on household's participation in off-farm activities. Whereas, age of head, sex of head (household headed by female), livestock owned in TLU, covariate shocks and farm earning negatively and significantly affected off-farm participation. The study also explored other factors impact on children's educational outcomes. The results show that mean

schooling of male and female, credit and assistance, livestock owned in TLU, farm earning and land size have positive and significant impact on children's educational outcomes. Educational outcomes of children are negatively affected by household size, sex of household head, head's age, highest grade completed by household head and both covariate and idiosyncratic shocks.

5.2. Policy implications

The finding in this study leads to policy implications on children's educational outcomes in rural Ethiopia. The study found negative impact of household's participation in off-farm activities, and positive impact of exit from off-farm participation on children's educational outcomes. The negative impact of off-farm participation is related with outweigh of high foregone income over schooling children in rural areas for poor households. Household's participation in off-farm activities impedes children's education by increases demand of children's labor in off-farm activities. Also, it increases the demand of children work in farm particularly for boys and in home work for girls. Therefore, providing incentives to households to schooling their children instead using their time on off-farm activities, and on home and farm woks should be taken. Incentive such as cash transfer, free supply of education materials such as pens, exercise books, school uniforms, cloths during a big holidays such as New Year and Christmas should be given to children belonging to participant households. In rural areas, households have low or no awareness about the long-term benefits of education, high benefit of education from girls, and indirect benefit such as better health which results higher opportunity cost of their children that overweigh future benefit from schooling. These increase the demand of children's work in off-farm activities, and home and farm works. Therefore, Provision of relevant information to households by government about the relative importance of schooling should. Because of modern sector demands high schooling, and better reward and creates high employment opportunity, households invest more on their children's education instead demanding their children's labor. Expansion of modern economic sectors, which require lesser man power is suggested.

Empowering rural households should be taken through promoting livestock sector, expanding modern agricultural systems such as irrigation system, encouraging cash crops production, and providing modern inputs such as improved seed and fertilizers, and tractor should be needed to increase agricultural output and income. Family planning policy should be worked widely because family size has negative impact on educational outcomes.

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Appendix

Table A 1. 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 literacy skill (1= read and write)	0.46	0.50	0	1	13,089	0.43	0.49	0	1	4,183
Absence (1 =absent)	0.10	0.30	0	1	7,738	0.15	0.35	0	1	2,343
highest grade completed	1.37	1.84	0	9	13,208	1.24	1.77	0	8	4,255
Grade attainment relative to age	0.55	2.15	-3	7.33	13,164	0.48	2.27	-3	7.333	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
child labor in off-farm (1 = participated)	0.24	0.43	0	1	13,208	0.32	0.46	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	14.333	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 = f 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	162498.9	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	77.05473	4,255
Off-farm (1 = participated)	0.27	0.45	0	1	13,208	0.27	0.45	0	1	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	4,427	0.66	0.47	0	1	4,478
Enrollment status (1 = enrolled)	0.92	0.28	0	1	2,863	0.93	0.25	0	1	2,977
Basic literacy skill (1= read and write)	0.46	0.50	0	1	4,428	0.49	0.50	0	1	4,478
Absence (1 =absent)	0.07	0.26	0	1	2,621	0.10	0.30	0	1	2,774
highest grade completed	1.38	1.84	0	9	4,474	1.49	1.89	0	9	4,479
Grade attainment relative to age	0.58	2.11	-3	7	4,461	0.59	2.08	-3	7	4,458
Sex head (1 = F)	0.18	0.38	0	1	4,472	0.17	0.38	0	1	4,478
credit (1 = borrowed)	0.32	0.47	0	1	4,474	0.28	0.45	0	1	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
assistance (1= received)	0.14	0.35	0	1	4,474	0.24	0.43	0	1	4,479
head's age	45.38	12.11	17	97	4,430	45.98	12.20	13	98	4,462
child's age	9.46	2.67	5	14	4,474	9.62	2.66	5	14.75	4,479
household size	6.63	2.09	1	16	4,474	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	4,474	0.32	0.47	0	1	4,479
covariate shocks (1 = f experienced)	0.31	0.46	0	1	4,474	0.55	0.50	0	1	4,479
farm earning, real	838.93	1586.50	0	33530.62	4,474	519.60	1284.51	0	17559.73	4,479
livestock owned in TLU	3.54	4.15	0	65.18	4,474	4.31	4.31	0	45.92	4,479
plot of land	1.65	3.97	0	126.478	4,474	1.58	2.45	0	47.39149	4,479
Off-farm (1 = participated)	0.28	0.45	0	1	4,474	0.26	0.44	0	1	4,479

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

Table A 2. DID with matching estimates of impact of household participation and other factors also influence children's educational outcome (ATT_1 and ATE_1)

	Highest grade completed		Grade attainment relative to age		Ever attendance		Enrollment Status		Basic skill		Absence from school	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
ATT	-0.21	0.11**	0.16	0.13	0.09	0.15	0.22	0.34	0.19	0.14	-0.04	0.32
ATNT	-0.01	0.05	-0.07	0.06	0.16	0.06*	0.03	0.11	0.11	0.05**	0.26	0.12
ATE	-0.07	0.13	0.11	0.14	-0.06	0.19	-0.65	0.33**	-0.34	0.18**	0.00	-
sex of head (= F)	-0.51	0.09*	0.59	0.10*	-0.30	0.09*	-0.28	0.13**	-0.28	0.08*	-0.31	0.16**
credit (1= borrowed)	-0.02	0.06	-0.05	0.07	0.15	0.06**	-0.11	0.10	0.11	0.06**	0.07	0.11
assistance	0.01	0.07	-0.04	0.08	0.02	0.07	0.27	0.15***	0.11	0.07***	-0.38	0.15*
head's age	-0.01	0.00*	0.02	0.00*	-0.01	0.00*	-0.01	0.00	-0.01	0.00*	0.00	0.00
child's age	0.46	0.01*	0.50	0.02*	0.19	0.01*	-0.13	0.03*	0.24	0.01*	0.00	0.03
household size	-0.12	0.02*	0.15	0.02*	-0.09	0.02*	-0.06	0.02*	-0.06	0.01*	-0.01	0.03
mean schooling of male	0.28	0.02*	-0.31	0.02*	0.16	0.03*	0.00	0.03	0.19	0.02*	-0.06	0.03***
mean schooling of female	0.32	0.02*	-0.36	0.02*	0.22	0.03*	0.12	0.03*	0.20	0.02*	-0.02	0.03
head's schooling	-0.11	0.01*	0.12	0.01*	-0.03	0.02**	0.00	0.02	-0.05	0.01*	-0.02	0.02
idiosyncratic shocks	0.03	0.07	0.01	0.08	-0.06	0.07	-0.07	0.12	-0.14	0.06**	0.19	0.12
covariate shocks	0.04	0.06	0.00	0.07	-0.07	0.06	-0.04	0.11	0.02	0.06	0.08	0.11
farm earning, real	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00004	0.00002**	0.00	0.00
livestock owned in TLU	0.01	0.01	-0.01	0.01	0.00	0.01	0.05	0.02*	0.02	0.01**	-0.01	0.01
plot of land	0.00	0.01	0.00	0.01	0.00	0.01	-0.01	0.01	0.01	0.01	0.00	0.01
_cons	-2.25	0.19	-5.15	0.22	-0.52	0.20	3.24	0.41	-2.09	0.19	-1.26	0.42
Number of obs.		3,297		3,283		3255		1574		3258		1356
F test	F(17, 2078)	141.23	F(17, 2074)	82.1								
Wald chi2(17)						354		79.74		575.12	Wald chi2(16)	31.51
P- value		0.00		0.00		0.00		0.00		0.00		0.01

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

Table A 3. DID with matching estimates of impact of household exit from off-farm participation and other factors also influence children's educational outcome (ATT_2 and ATE_2)

	Highest grade completed		Grade attainment relative to age		Ever attendance		Enrollment Status		Basic literacy skill		Absence from school	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
ATT	-0.03	0.11	0.01	0.13	-0.01	0.13	0.08	0.23	0.00	0.12	0.40	0.27
ATNT	0.07	0.15	-0.07	0.17	-0.19	0.14	0.35	0.24	0.01	0.13	0.43	0.26***
ATE	0.01	0.16	-0.08	0.17	0.32	0.16**	-0.13	0.31	0.20	0.16	-0.92	0.36*
sex of head (= F)	-0.27	0.16***	0.32	0.19***	-0.32	0.17***	0.32	0.26	-0.24	0.15***	0.18	0.25
credit (1= borrowed)	0.00	0.10	-0.08	0.12	0.21	0.11**	0.36	0.18**	0.08	0.10	0.03	0.21
assistance	0.21	0.13	-0.35	0.15**	0.42	0.16*	-0.02	0.20	0.00	0.12	0.30	0.25
head's age	0.00	0.01	0.00	0.01	-0.01	0.01	-0.01	0.01	0.00	0.00	0.00	0.01
child's age	0.39	0.02*	0.57	0.03*	0.17	0.03*	-0.23	0.05*	0.23	0.02*	0.04	0.05
household size	-0.08	0.03*	0.10	0.03*	-0.15	0.03*	0.03	0.05	-0.09	0.03*	-0.05	0.06
mean schooling of male	0.28	0.03*	-0.32	0.03*	0.26	0.05*	0.07	0.05	0.20	0.03*	-0.07	0.06
mean schooling of female	0.33	0.03*	-0.36	0.04*	0.20	0.04*	0.13	0.06**	0.26	0.03*	-0.12	0.07***
head's schooling	-0.03	0.02	0.03	0.03	-0.03	0.02	0.04	0.04	-0.01	0.02	0.01	0.04
idiosyncratic shocks	-0.07	0.11	0.15	0.13	-0.11	0.11	-0.29	0.18	-0.09	0.11	0.28	0.19
covariate shocks	0.15	0.10	-0.12	0.11	0.05	0.11	-0.28	0.16***	-0.05	0.09	0.05	0.23
farm earning, real	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
livestock owned in TLU	0.00	0.02	0.00	0.02	-0.01	0.02	0.00	0.02	0.03	0.02**	0.01	0.02
plot of land	0.02	0.01**	-0.02	0.01**	0.06	0.04	0.01	0.01	0.00	0.01	0.00	0.02
_cons	-2.92	0.40	-4.28	0.46	-0.33	0.39	3.63	0.81	-2.51	0.38	-1.80	0.85
Number of obs.		1,161		1,159		1,139		618		1137		526
F test	F(17, 728)	59.45	F(17, 726)	42.65								
Wald chi2(17)						161.58		58.43		292.83		38.28
P- value		0.00		0.00		0.00		0.00		0.00		0.00

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

Table A 4. Matching full sample with DID estimation of impact of household off-farm participation and other factors also influence children's educational outcome (ATT_1 and ATE_1)

	Highest grade completed		Grade attainment relative to age		Ever attendance		Enrollment Status		Basic literacy skill		Absence from school	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
ATT	-0.10	0.10	0.04	0.12	0.04	0.12	-0.08	0.23	0.07	0.11	-0.55	0.41
ATNT	0.02	0.05	-0.12	0.06**	0.15	0.05*	0.12	0.10	0.14	0.05*	0.34	0.11*
ATE	-0.19	0.11***	0.22	0.13***	-0.16	0.16	-0.20	0.30	-0.41	0.13*	0.54	0.48
sex of head (= F)	-0.44	0.09*	0.52	0.10*	-0.28	0.08*	-0.20	0.12***	-0.26	0.08*	-0.12	0.13
credit (1= borrowed)	0.00	0.06	-0.08	0.06	0.15	0.06*	0.07	0.10	0.11	0.05**	0.06	0.10
assistance	0.04	0.07	-0.06	0.08	0.04	0.07	0.28	0.13**	0.13	0.06**	-0.29	0.13**
head's age	-0.01	0.00*	0.02	0.00*	-0.01	0.00*	-0.01	0.00	-0.01	0.00*	0.00	0.00
child's age	0.44	0.01*	0.52	0.01*	0.19	0.01*	-0.15	0.03*	0.24	0.01*	0.01	0.03
household size	-0.11	0.02*	0.14	0.02*	-0.10	0.01*	-0.03	0.02	-0.06	0.01*	-0.01	0.02
mean schooling of male	0.28	0.02*	-0.31	0.02*	0.18	0.03*	0.04	0.03	0.18	0.02*	-0.04	0.03
mean schooling of female	0.33	0.02*	-0.37	0.02*	0.21	0.03*	0.12	0.03*	0.21	0.02*	-0.01	0.03
head's schooling	-0.11	0.01*	0.12	0.01*	-0.03	0.01*	0.01	0.02	-0.05	0.01*	-0.01	0.02
idiosyncratic shocks	-0.01	0.06	0.06	0.07	-0.09	0.06	-0.10	0.10	-0.17	0.06*	0.22	0.11**
covariate shocks	0.08	0.06	-0.04	0.06	-0.03	0.05	-0.10	0.09	0.03	0.05	0.07	0.10
farm earning, real	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00**	0.00	0.00
livestock owned in TLU	0.01	0.01	-0.01	0.01	0.00	0.01	0.05	0.02*	0.01	0.01***	-0.02	0.01
plot of land	0.01	0.01	-0.01	0.01	0.00	0.01	-0.01	0.01	0.01	0.01	0.01	0.01
_cons	-2.31	0.18	-5.07	0.21	-0.50	0.19	3.10	0.37	-2.10	0.18	-1.49	0.40
Number of obs.	3,852		3,834		3,797		1,892		3802		1,649	
F test	F(17, 2500)	160.8	F(17, 2493)	102.23								
Wald chi2(17)					394.4		82.47		669.3		37.94	
P- value	0.00			0.00	0.00			0.00		0.00		0.00

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

Table A 5. Matching full sample with DID estimation of impact of household exit from off-farm participation and other factors also influence children's educational outcome (ATT_2 and ATE_2).

	Highest grade completed		**Grade attainment relative to age**		**Ever attendance**		**Enrollment Status**		**Basic literacy skill**		**Absence from school**	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
ATT	-0.14	0.08***	0.08	0.09	0.04	0.09	-0.01	0.17	-0.08	0.09	0.34	0.17**
ATNT	-0.02	0.10	-0.09	0.11	0.03	0.09	0.29	0.17***	0.16	0.09***	0.11	0.18
ATE	0.09	0.11	-0.04	0.12	0.09	0.12	-0.04	0.24	0.05	0.12	-0.86	0.29*
sex of head (= F)	-0.44	0.10*	0.46	0.12*	-0.14	0.11	0.05	0.15	-0.18	0.10***	-0.03	0.17
credit (1= borrowed)	0.02	0.07	-0.07	0.08	0.16	0.07**	0.08	0.11	0.10	0.07	-0.06	0.13
assistance	0.27	0.09*	-0.34	0.10*	0.27	0.10*	0.12	0.14	0.12	0.08	-0.02	0.17
head's age	-0.01	0.00*	0.02	0.00*	-0.01	0.00*	-0.01	0.01	0.00	0.00	0.00	0.01
child's age	0.44	0.02*	0.52	0.02*	0.17	0.02*	-0.17	0.03*	0.22	0.02*	0.04	0.03
household size	-0.08	0.02*	0.09	0.02*	-0.07	0.02*	-0.01	0.03	-0.04	0.02**	-0.06	0.03***
mean schooling of male	0.31	0.02*	-0.35	0.03*	0.23	0.04*	0.05	0.03***	0.21	0.03*	-0.10	0.04*
mean schooling of female	0.35	0.02*	-0.38	0.03*	0.20	0.03*	0.11	0.03*	0.22	0.02*	-0.04	0.04
head's schooling	-0.09	0.02*	0.09	0.02*	-0.02	0.02	0.01	0.02	-0.02	0.02	0.01	0.02
idiosyncratic shocks	0.01	0.08	0.03	0.09	-0.05	0.08	-0.12	0.12	-0.11	0.07	0.29	0.14**
covariate shocks	0.01	0.07	0.03	0.08	-0.06	0.07	-0.17	0.11	-0.06	0.07	0.16	0.14
farm earning, real	0.00	0.00	0.00	0.00***	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
livestock owned in TLU	0.00	0.01	0.00	0.01	0.00	0.01	0.03	0.02***	0.01	0.01***	0.00	0.01
plot of land	0.01	0.01	-0.02	0.01	0.00	0.01	-0.01	0.01	0.00	0.01	0.01	0.01
_cons	-2.59	0.26	-4.67	0.30	-0.54	0.26	3.24	0.51	-2.34	0.25	-1.44	0.53
Number of obs.	2,372			2,365	2,324		1,314		2320		1,135	
F test		125.33		76.91								
	F(17, 1755)		F(17, 1749)									
Wald chi2(17)					226.7		68.5		443.48		44.6	
P- value	0.00		0.00		0.00		0.00		0.00		0.00	

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

Table A 6. A Formal test of balance before and after matching

- **Households participate in off-farm activities**

Covariates	Highest grade completed				Grade attainment relative to age				Ever attendance			
	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	0.26	1.07	1.49	0.03	0.26	1.07	1.49	0.23	1.06	1.45	1.45
credit (1= borrowed)	-0.18	0.09	0.81	1.08	-0.18	0.10	0.81	1.09	-0.18	0.15	0.81	1.13
assistance	-0.09	0.30	0.85	1.45	-0.10	0.29	0.85	1.43	-0.09	0.21	0.85	1.34
head's age	-0.24	-0.09	1.01	0.80	-0.24	-0.11	1.01	0.79	-0.24	-0.20	1.01	0.66
child's age	-0.51	-0.12	0.69	0.76	-0.51	-0.12	0.69	0.76	-0.51	-0.05	0.70	0.83
household size	-0.02	-0.16	0.65	0.58	-0.02	-0.16	0.65	0.56	-0.03	-0.19	0.65	0.55
mean schooling of male	0.01	0.04	0.88	0.79	0.01	0.04	0.88	0.79	0.01	0.04	0.89	0.76
mean schooling of female	-0.09	-0.06	0.93	0.92	-0.09	-0.07	0.93	0.90	-0.09	-0.08	0.92	0.82
head's schooling	0.26	-0.06	1.08	0.63	0.26	-0.05	1.08	0.67	0.26	0.00	1.09	0.68
idiosyncratic shocks	-0.15	0.10	0.81	1.12	-0.15	0.11	0.81	1.13	-0.15	0.05	0.81	1.06
covariate shocks	-0.22	0.07	0.90	1.02	-0.22	0.09	0.90	1.02	-0.21	0.02	0.90	1.01
Total obs.	2,101	4,202			2,099	4,198			2,075	4,150		
Treated obs	98	2,101			98	2,099			98	2,075		
Control obs	2,003	2,101			2,001	2,099			1,977	2,075		

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)	0.17	-0.15	1.32	0.72	0.03	0.24	1.07	1.47	0.20	0.00	1.37	1.01
credit (1= borrowed)	-0.14	-0.10	0.88	0.90	-0.18	0.13	0.81	1.12	-0.11	0.01	0.92	1.01
assistance	0.17	0.04	1.30	1.06	-0.09	0.22	0.85	1.35	0.15	-0.05	1.26	0.92
head's age	-0.30	0.14	0.62	0.74	-0.24	-0.17	1.01	0.72	-0.29	0.09	0.66	0.65
child's age	-0.55	-0.11	0.60	0.49	-0.51	-0.04	0.70	0.83	-0.50	-0.12	0.63	0.62
household size	-0.16	-0.23	0.58	0.56	-0.03	-0.18	0.65	0.57	-0.17	-0.34	0.58	0.45
mean schooling of male	-0.15	-0.12	0.78	0.51	0.01	0.05	0.89	0.76	-0.10	-0.18	0.77	0.47
mean schooling of female	-0.08	-0.15	1.06	0.81	-0.09	-0.06	0.92	0.88	-0.05	-0.30	1.07	0.74
head's schooling	0.21	0.11	1.11	0.81	0.26	0.02	1.09	0.71	0.25	0.00	1.12	0.77
idiosyncratic shocks	-0.16	0.13	0.80	1.16	-0.15	0.06	0.81	1.07	-0.20	0.32	0.74	1.35
covariate shocks	-0.11	0.09	0.98	1.02	-0.21	0.02	0.90	1.01	-0.12	0.07	0.97	1.02
Total obs.	1,126	2,252			2077	4,154			1,075	2150		
Treated obs	43	1,126			98	2077			41	1075		
Control obs	1083	1126			1979.00	2077			1,034	1075		

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

- **Households exit from off-farm participation**

Covariates	Highest grade completed				Grade attainment relative to age				Ever attendance			
	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)	-0.04	0.16	0.92	1.32	-0.04	0.16	0.92	1.32	-0.05	0.21	0.90	1.49
credit (1= borrowed)	0.06	-0.06	1.05	0.94	0.06	-0.06	1.05	0.94	0.07	0.05	1.07	1.05
assistance	0.04	0.09	1.07	1.17	0.04	0.09	1.07	1.17	0.04	-0.10	1.07	0.85
head's age	-0.26	-0.04	0.91	0.95	-0.26	-0.04	0.91	0.95	-0.26	-0.09	0.91	0.90
child's age	-0.80	-0.01	0.60	0.84	-0.80	-0.01	0.60	0.84	-0.79	0.01	0.60	0.86
household size	-0.21	-0.13	1.06	1.29	-0.21	-0.13	1.06	1.29	-0.21	-0.14	1.06	1.24
mean schooling of male	-0.20	0.03	0.64	0.82	-0.20	0.03	0.64	0.82	-0.22	-0.03	0.64	0.77
mean schooling of female	-0.14	0.03	0.76	0.77	-0.14	0.03	0.76	0.77	-0.15	0.00	0.75	0.78
head's schooling	0.06	-0.04	0.88	0.69	0.06	-0.04	0.88	0.69	0.05	-0.04	0.84	0.70
idiosyncratic shocks	-0.13	0.10	0.85	1.12	-0.13	0.10	0.85	1.12	-0.12	-0.01	0.85	0.98
covariate shocks	-0.07	0.00	0.98	1.00	-0.07	0.00	0.98	1.00	-0.05	0.01	0.98	1.00
Total obs.	733	1,466			733	1,466			718	1436		
Treated obs	297	733			297	733			293	718		
Control obs	436	733			436	733			425	718		

Covariates	Enrollment status				Basic literacy skill				Absence			
	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)	-0.04	0.04	0.93	1.08	-0.05	0.04	0.91	1.08	-0.01	0.03	0.99	1.05
credit (1= borrowed)	0.09	-0.04	1.09	0.97	0.07	0.04	1.06	1.04	0.15	-0.14	1.15	0.87
assistance	0.14	-0.12	1.23	0.82	0.04	-0.06	1.07	0.90	0.17	-0.21	1.29	0.70
head's age	-0.19	-0.09	1.01	0.94	-0.26	-0.01	0.91	1.01	-0.17	-0.08	0.98	0.84
child's age	-0.84	-0.08	0.83	0.90	-0.79	0.01	0.60	0.84	-0.84	-0.16	0.77	0.72
household size	-0.27	0.10	0.93	1.53	-0.22	-0.09	1.07	1.18	-0.31	0.11	0.90	1.62
mean schooling of male	-0.13	-0.05	0.80	0.79	-0.22	0.03	0.64	0.84	-0.14	0.10	0.80	1.33
mean schooling of female	-0.11	-0.11	0.72	0.63	-0.16	0.01	0.75	0.74	-0.15	-0.08	0.73	0.69
head's schooling	0.15	-0.03	1.05	0.90	0.05	0.00	0.84	0.76	0.13	0.13	0.97	1.02
idiosyncratic shocks	-0.07	-0.03	0.92	0.97	-0.12	-0.08	0.85	0.90	-0.02	0.15	0.98	1.16
covariate shocks	-0.07	0.04	0.98	1.01	-0.06	-0.04	0.98	0.99	-0.06	-0.02	0.99	1.00
Total obs.	437	874			717	1,434			399	798		
Treated obs	153	437			293	717			140	399		
Control obs	284	437			424	717			259	399		

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

Table A7: Panel regression of the impact of household's off-farm participation with other factors on children educational outcomes

	Highest grade completed		**Grade attainment relative to age**		**Ever attendance**		**Enrollment Status**		**Basic skill**		**Absence from school**	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
Off-farm (1=Participated)	0.01	0.03	-0.04	0.03	0.17	0.05*	-0.25	0.06*	0.02	0.04	-0.04	0.05
sex of head (= F)	-0.28	0.04*	0.30	0.05*	-0.18	0.07*	-0.26	0.08*	-0.20	0.06*	-0.04	0.06
credit (1= borrowed)	-0.03	0.02	0.00	0.03	0.13	0.04*	0.02	0.06	0.07	0.04***	0.15	0.04*
assistance	0.03	0.03	-0.05	0.03	0.15	0.05*	0.07	0.07	0.07	0.05	-0.02	0.06
head's age	-0.01	0.00*	0.01	0.00*	-0.01	0.00*	-0.01	0.00*	0.00	0.00**	0.00	0.00
child's age	0.36	0.01*	0.58	0.01*	0.39	0.01*	-0.14	0.01*	0.38	0.01*	0.00	0.01
household size	-0.07	0.01*	0.07	0.01*	-0.08	0.01*	-0.03	0.02***	-0.04	0.01*	-0.04	0.01*
mean schooling of male	0.25	0.01*	-0.27	0.01*	0.25	0.02*	0.03	0.02***	0.23	0.01*	-0.07	0.01*
mean schooling of female	0.27	0.01*	-0.30	0.01*	0.23	0.02*	0.10	0.02*	0.24	0.01*	-0.05	0.01*
head's schooling	-0.09	0.01*	0.10	0.01*	-0.05	0.01*	0.02	0.01	-0.06	0.01*	0.00	0.01
idiosyncratic shocks	-0.05	0.03***	0.07	0.03**	-0.07	0.05	-0.12	0.07***	-0.15	0.04*	0.24	0.05*
covariate shocks	0.03	0.02	-0.04	0.02	0.08	0.04**	-0.06	0.06	0.10	0.04*	-0.02	0.05
farm earning, real	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00***
livestock owned in TLU	0.00	0.00	-0.01	0.00***	0.00	0.01	0.04	0.01*	0.00	0.00	0.00	0.01
plot of land owned	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.01	0.01	0.00	0.01	0.00***
cons.	-1.93	0.07	-4.97	0.09	-2.79	0.14	3.61	0.25	-4.05	0.14	-0.87	0.15
sigma _u	1.02		1.20		1.17		0.80		0.92		0.38	
rho	0.57		0.60		0.58		0.39		0.46		0.12	
Number of observation	12,811		12,771		12694		8,101		12,695		7,497	
Number of groups	6,691		6,681		6657		4806		6657		4552	
Wald chi2(15)	7922.1		9916.3		1205.05		145.17		1612.5		101.34	
Prob > chi2	0.00		0.00		0.00		0.00		0.00		0.00	

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

Table A 8 : Household's participation in off-farm activities effect on children's' educational outcomes matching estimates

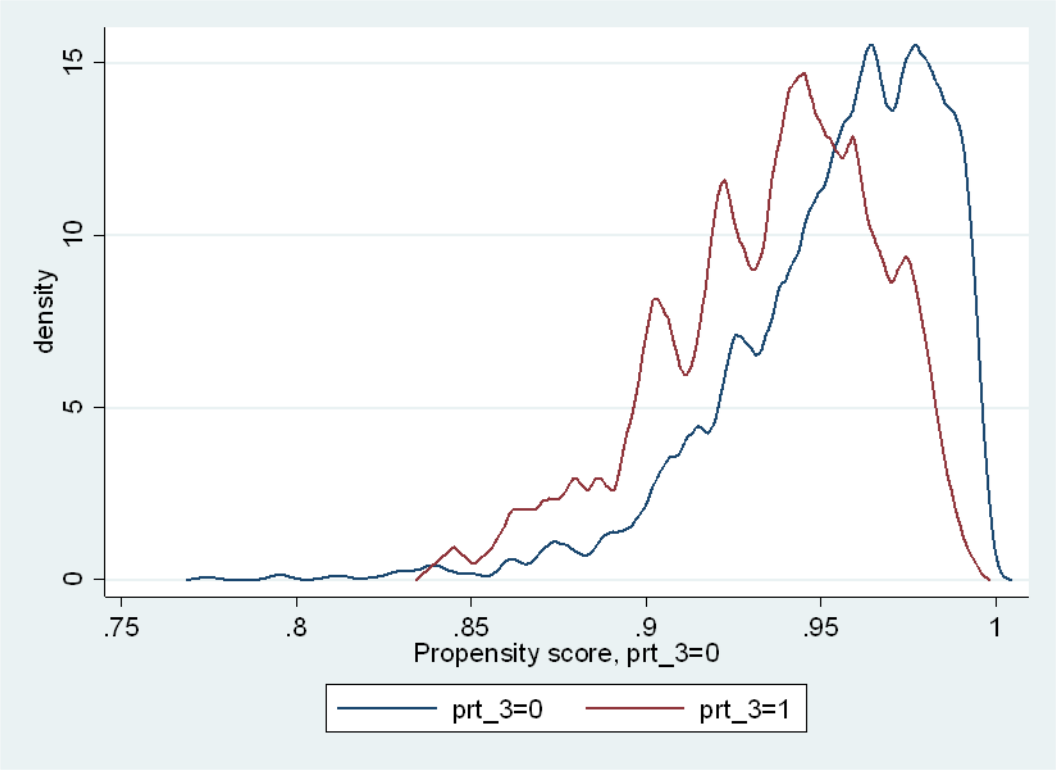
	Highest grade completed		Grade attainment relative to age		Ever attendance		Enrollment Status		Basic literacy skill		Absence from school	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
ATT	-0.09	0.06***	0.11	0.06***	0.03	0.02***	-0.07	0.01*	-0.01	0.02	-0.03	0.02***
ATE	-0.08	0.05***	0.15	0.06*	0.05	0.02*	-0.07	0.01*	0.00	0.02	-0.02	0.02
Total obs.	4125		4,117		4,055		2,446		4,055		2,263	
Participated	1123		1,122		1,096		711		1,096		627	
Non-participated	3002		2,995		2,959		1,735		2,959		1,636	

Source: Authors' computation based on 2011/12 ESS data.

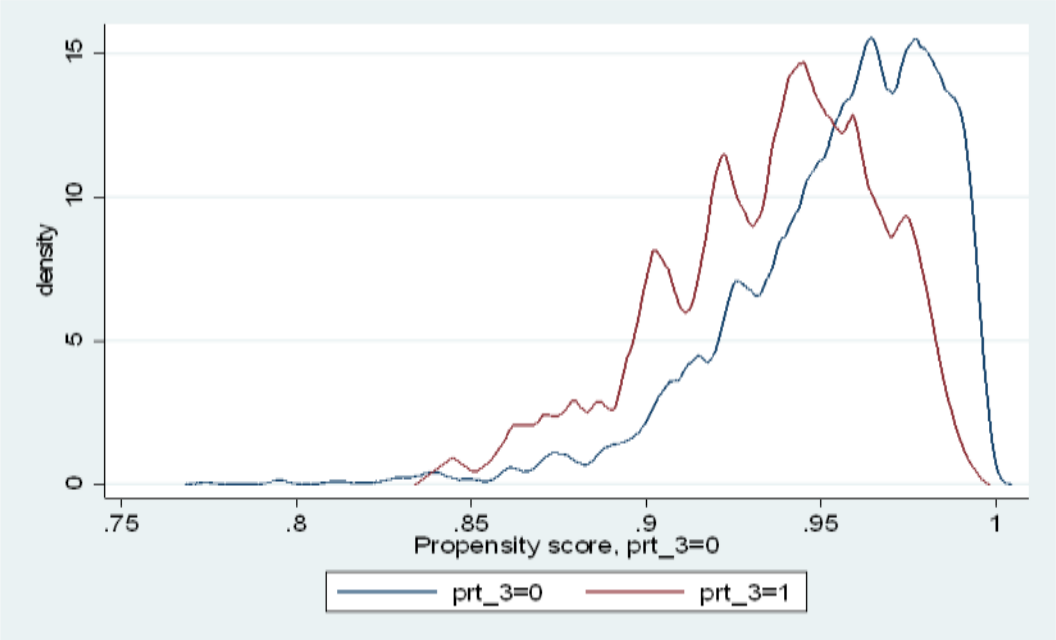
Figure 3. Overlap between participants before and after matching for main results

- **Households participate in off-farm activities**

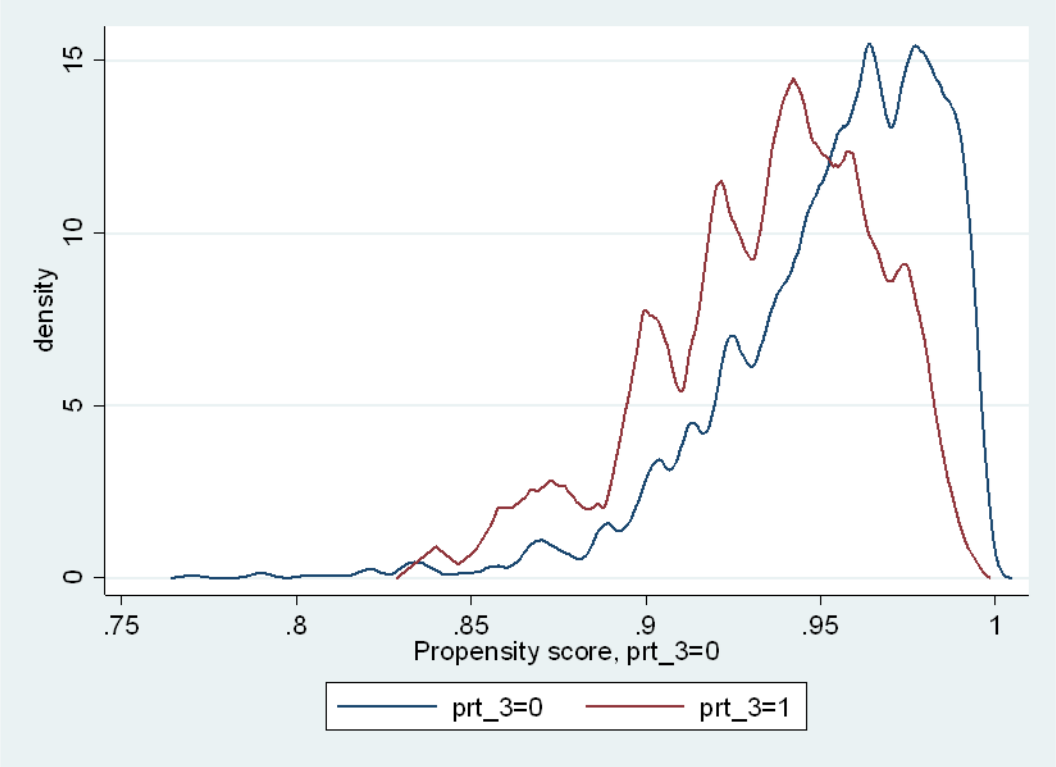
Highest grade completed



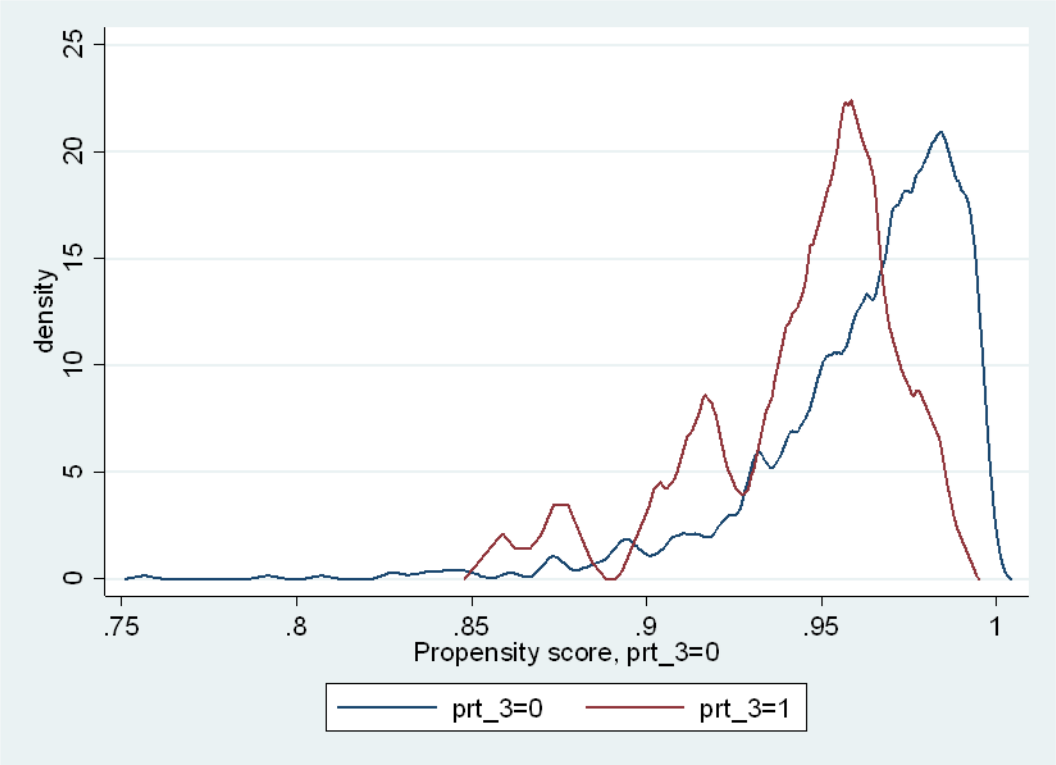
Grade attainment relative to age (delay to start primary school)



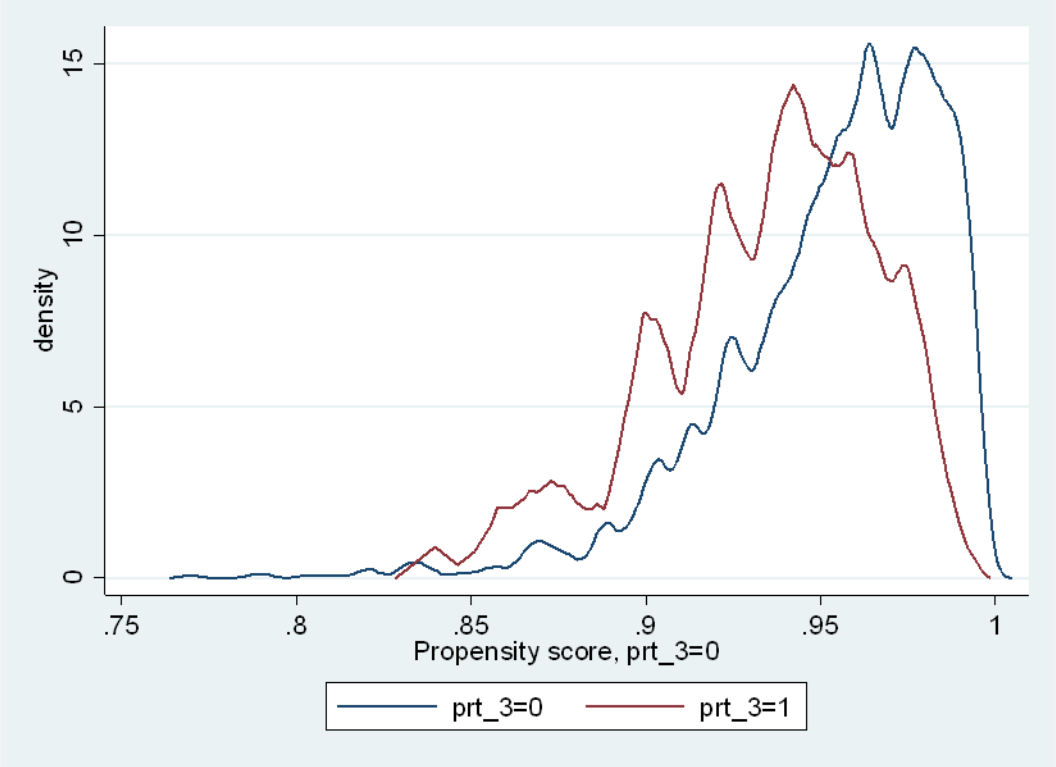
Ever attendance



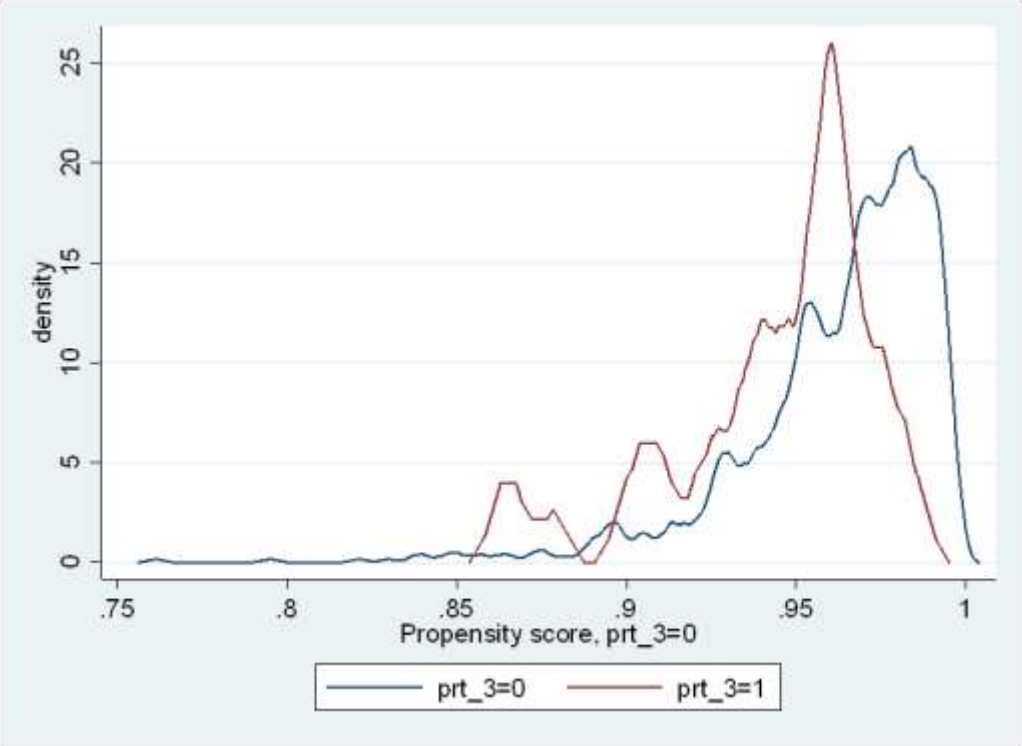
Enrollment status



Basic literacy skill

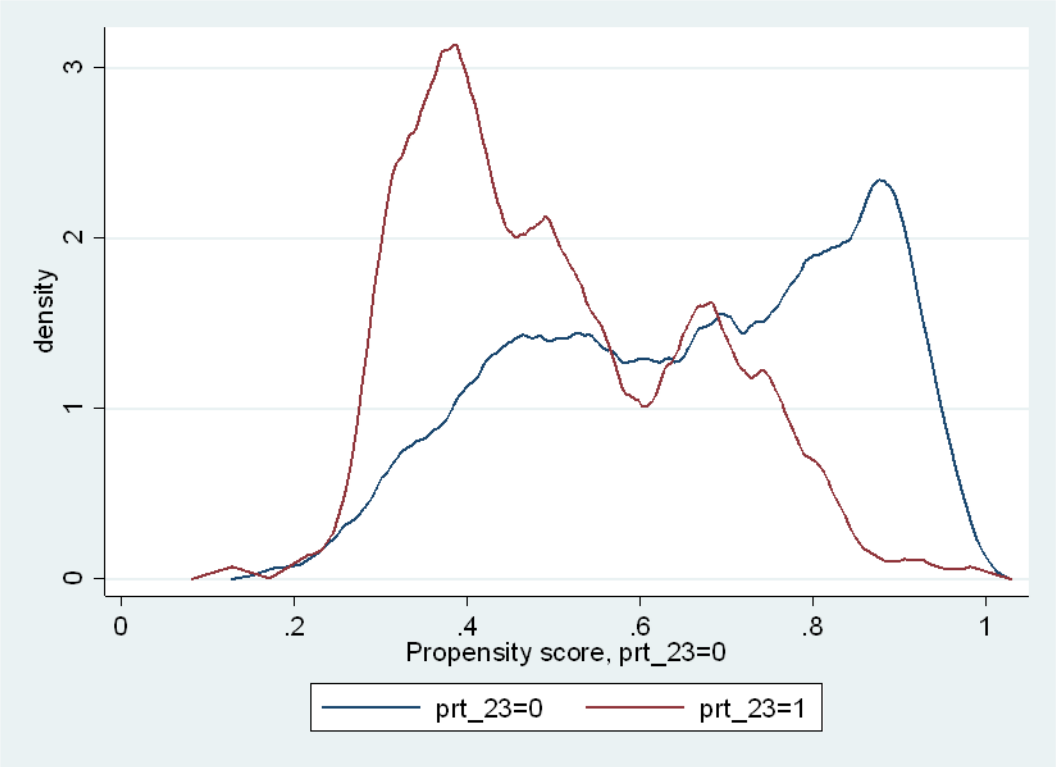


Absence from school

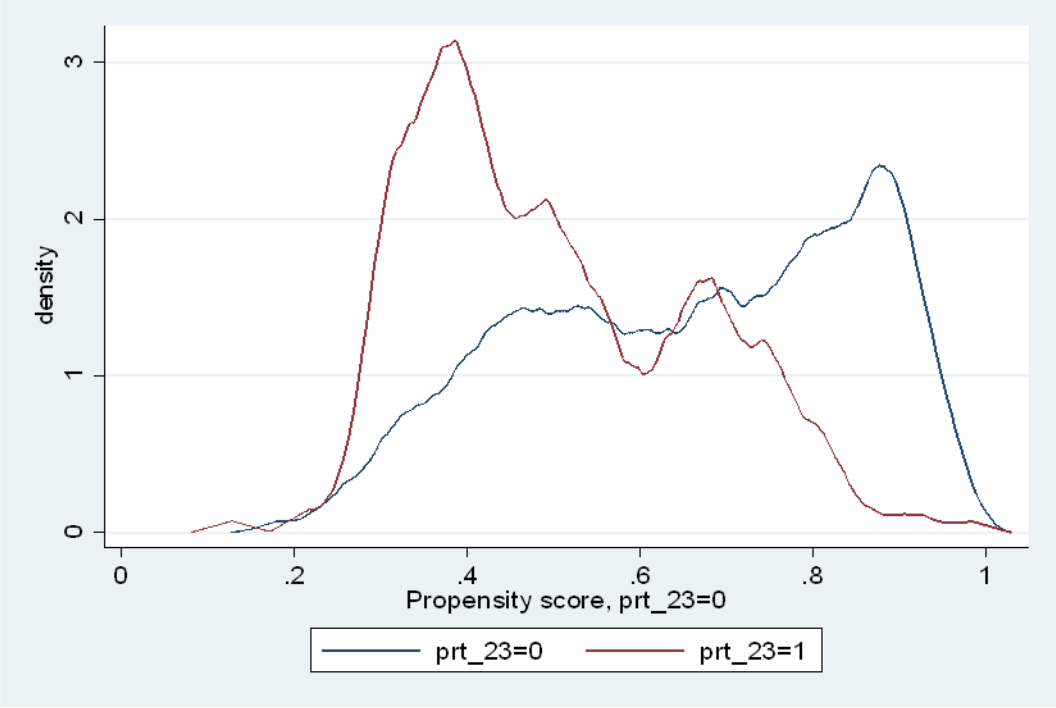


- **Households exit from off-farm activites**

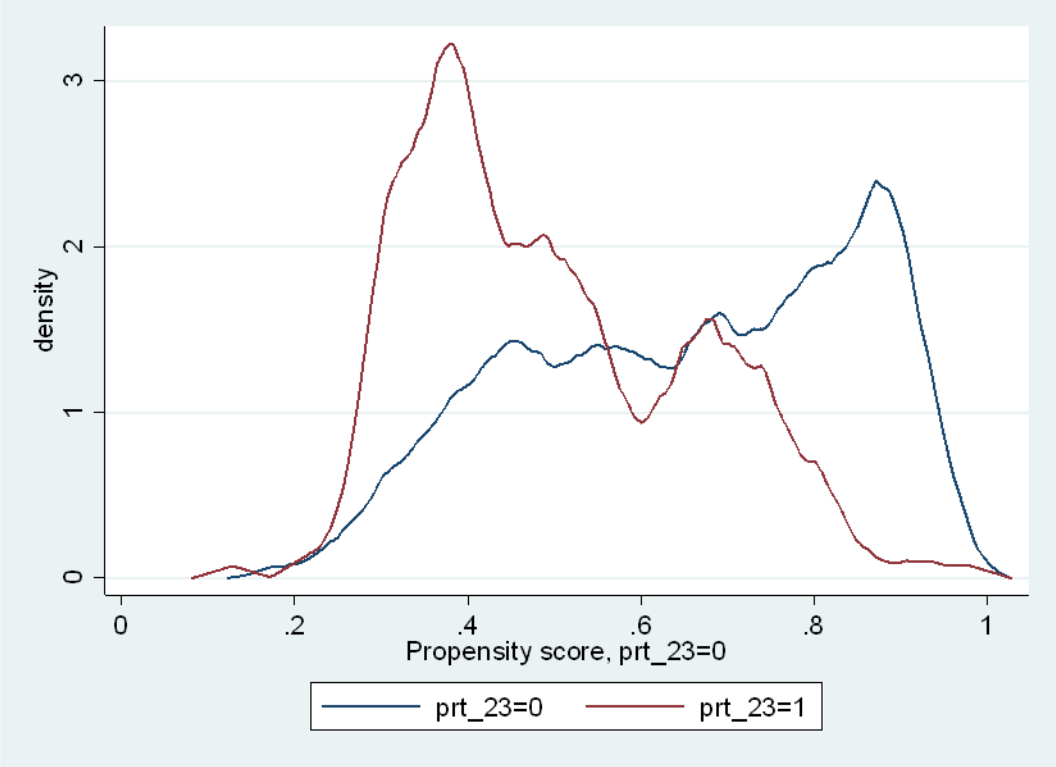
Highest grade completed



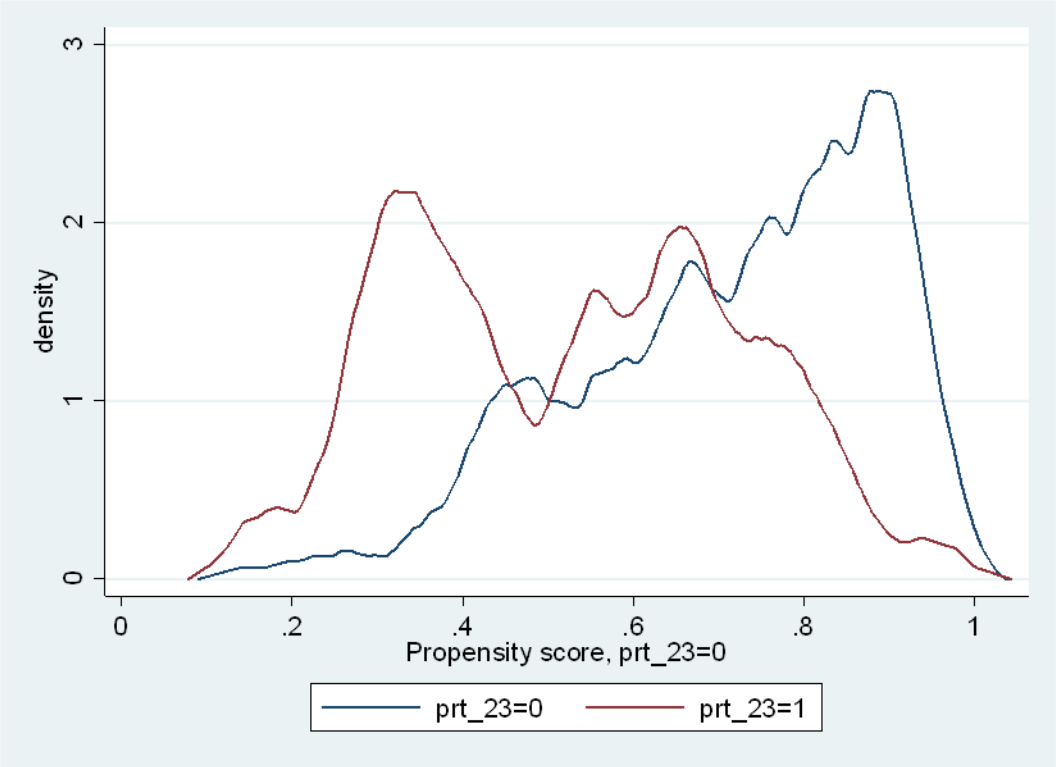
Grade attainment relative to age (delay to start primary school)



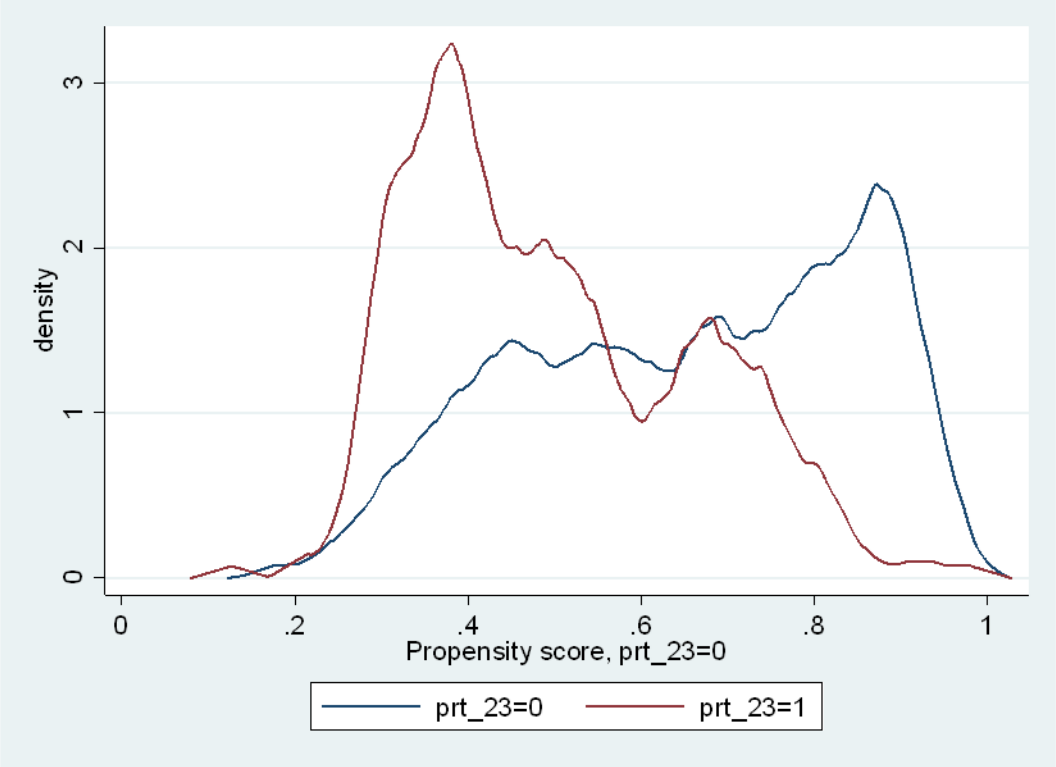
Ever attendance



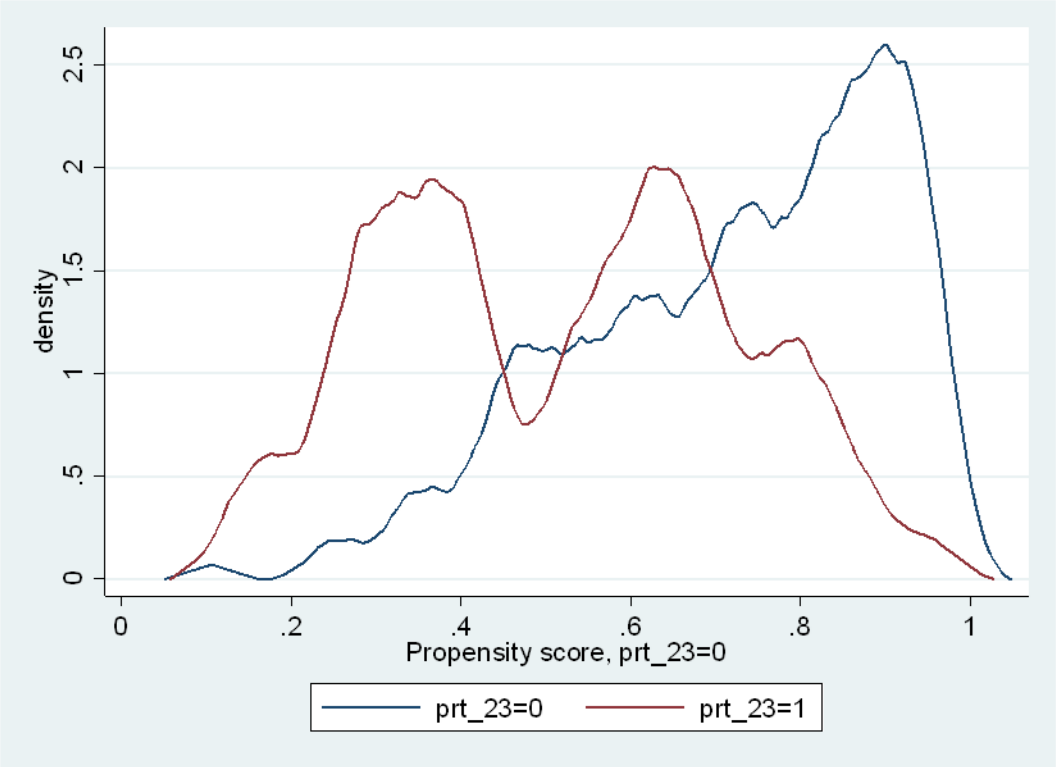
Enrollment status



Basic literacy skill



Absence from school



A7. Estimation of ATE_X and ATT_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's educational outcomes[34] with participant household and non-participant in off-farm activities, respectively in period one. Further, let Y_{1iS} and Y_{0iS} denote the potential child's educational outcomes with household participate in off-farm activities and without participate in off-farm activities in period two, respectively. The average treatment effect as follows:

$ATE_X = \Pr(D_2 = 1)\, ATT_X + \Pr(D_2 = 0)\, ATNT_X$ ……..……..…… (1)[35]

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) states that average treatment effect on treated, the difference between mean educational outcomes of children belonging to treated household ($Y_{1i} | X, D_2 = 1$), and their counterfactual (expected educational outcome of children whose household treated had did not treated, $E[Y_{0i} | X, D_2 = 1]$). However, the counterfactual terms ($E[Y_{0i} | X, D_2 = 1]$) is not observable. Therefore we rewrite equation (2) as follows:

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

$\Pr(D_1 = 0 | X, D_2 = 1)(E[Y_{1iS} | X, D_1 = 0, D_2 = 1] - E[Y_{0iS} | X, D_1 = 0, D_2 = 1])$…. (3)[36]

In equation (3), $E[Y_{0iS} | X, D_1 = 1, D_2 = 1]$, and $E[Y_{0iS} | X, D_1 = 0, D_2 = 1]$ are not observable. To identify ATT, we need the following assumptions:

$E[Y_{0iS} | X, D_1 = 0, D_2 = 1] - E[Y_{0iS} | X, D_1 = 0, D_2 = 0]$

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

$E[Y_{0iS} | X, D_1 = 1, D_2 = 1] - E[Y_{0iS} | X, D_1 = 1, D_2 = 0]$

$= E[Y_{1iF} | X, D_1 = 1, D_2 = 1] - E[Y_{1iF} | X, D_1 = 1, D_2 = 0]$……..……. (5)

Equation (4), the first assumption means that the difference in the without treatment educational outcome between children belonging to household did not treated in both periods (i.e 2013/14 and

[34] See child's schooling outcomes measurements in the variable section.

[35] Pr (D_2=1) are the proportions of households who treated, whereas Pr (D_2=0) shows the proportions of households who did not treated in 2015/16.

[36] $\Pr(D_1 = 1 | X, D_2 = 1)$ and $\Pr(D_1 = 0 | X, D_2 = 1)$,implies the proportion of treated in both periods, and treated in 2015/16 only, repectively.

2015/16) and those whose household treated only in 2015/16 is unchanged overtime. It implies that the average time effect is the same for these two groups. Equation (5), the second assumption means that the difference between educational outcomes without treatment in period two and treatment outcome in period one is the same for children whose household treated in both periods (2013/14 and 2015/16) and those whose household treated in the period one only. This assumption implies that the sum of the time effect and program effect (off-farm participation effect) is the same for children whose household treated in both periods (2013/14 and 2015/16) and those whose household treated in 2013/14 only. We identify $ATT_{(X)}$ by substituting equation (4 and 5) into (3) as follows:

$ATT_X = Pr(D_1 = 1|X,\ D_2 = 1)\ \{E[Y_{1iS}|X, D_1 = 1,\ D_2 = 1] - E[Y_{0iS}|, D_1 = 1,\ D_2 = 0]\}$-
$\{E[Y_{1iF}|X, D_1 = 1,\ D_2 = 1] - E[Y_{1iF}|\ X, D_1 = 1,\ D_2 = 0\}$ +
$(Pr(D_1 = 0|X,\ D_2 = 1)\ E\ \{[Y_{1iS}|X, D_1 = 0,\ D_2 = 1] - E[Y_{0iS}|X, D_1 = 0,\ D_2 = 0]\ \}$-
$\{E[Y_{0iF}|\ X, D_1 = 0,\ D_2 = 1] - E[Y_{0iF}|\ X, D_1 = 0,\ D_2 = 0]\}$ ……………………………..…… (6) [37]

Equation (6), have the following two components:

$ATT_1 = Pr(D_1 = 0|X,\ D_2 = 1)\ E\ \{[Y_{1iS}|X, D_1 = 0,\ D_2 = 1] - E[Y_{0iS}|X, D_1 = 0,\ D_2 = 0]\ \}$ -
$\{E[Y_{0iF}|\ X, D_1 = 0,\ D_2 = 1] - E[Y_{0iF}|\ X, D_1 = 0,\ D_2 = 0]\}$……………………………….. (7)

In equation (7), households who participate in 2015/16 only match with those who do not participate in both periods (2013/14 and 2015/16). In this case, households who participate on in 2015/16 were taken as treatment groups. Whereas household did not participated in both periods were taken as control groups. Therefore, we measure the average treatment effect of off-farm participation on children's educational outcomes for child belongs to participant household.

$ATT_2 = Pr\ (D_1 = 1|X,\ D_2 =1)\ \{E[Y_{1iS}|X, D_1 = 1,\ D_2 = 1] - E[Y_{0iS}|, D_1 = 1,\ D_2 = 0]\}$
$- \{E[Y_{1iF}|X, D_1 = 1,\ D_2 = 1] - E[Y_{1iF}|\ X, D_1 = 1,\ D_2 = 0\}$ ………………………………. (8)

[37] We need assumption to calculate ATT, average effect of time and average effect of participation in off-farm activities are the same for two treatment and two control groups. As result, a difference in one potential outcome of one participation status at one point of time between two groups is the same as the difference in another outcome of one participation status at another point of time between these two groups. In the equation (1); the participation status is determined by observed variables and time-invariant unobserved variables.

In equation (8), households participated in off-farm activities in 2013/14 only match with those participated in both periods (2013/14 and 2015/16). Participant in 2013/14 only were taken as treatment groups, and non-participant in both periods were taken as control groups. Therefore, we estimate the average treatment effect of exit of off-farm activities (non-participation in 2015/16) on children's educational outcomes for child belongs to non-participant household in this part.

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

$ATNT_X = E[Y_{1iS}|X, D = 0] - E[Y_{0iS}|\, X, D = 0]$ …….……..….. (9)

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

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

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

$\Pr(D_1 = 0|\, X, D_2 = 0)(E[Y_{1iS}|X, D_1 = 0,\ D_2 = 0] - E[Y_{0iS}|\, X, D_1 = 0,\ D_2 = 0])$.....(10)

Similarly, we need two assumption for the identification of $ATNT_X$

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

$$= (E[Y_{1iF}|X, D_1 = 1,\ D_2 = 0] - E[Y_{1iF}|\, X, D_1 = 1,\ D_2 = 1]) \text{ ……. (11)}$$

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

$$= (E[Y_{0iF}|X, D_1 = 0,\ D_2 = 0] - E[Y_{0iF}|X, D_1 = 0,\ D_2 = 1]) \text{ ……. (12)}$$

The assumption in equation (11) implies that the time effect of treatment on children's educational outcome is the same for whose households treated in period one and period two and those whose household treated in period one only. The assumption in equation (12) implies that both the time effect and treatment on educational outcomes is the same for children whose household did not treated in both periods and those whose household treated only in period two. We identify $ATNT_{(X)}$ by inserting equation (9 and 10) in equation (10):

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

$E[Y_{1iF}|\, X, D_1 = 1,\ D_2 = 1]\text{-}E[Y_{1iF}|\, X, D_1 = 1,\ D_2 = 0]\} +$

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

$E[Y_{0iF}|\, X, D_1 = 0,\ D_2 = 1]\text{-}E[Y_{0iF}|\, X, D_1 = 0,\ D_2 = 0]\}$…… (13)[38]

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).

[38] Similarly $ATNT_{(X)}$have two components, $ATNT_1$ and $ATNT_2$.
$\Pr(D_1 = 1|\, X_{2011/12},\ D_2 = 0)$ and $\Pr(D_1 = 0|\, X_{2011/12},\ D_2 = 0$, shows the proportion of treated in 2013-14 only and the proportion of non- treated in both 2013/14 and 2015/16.

The matching to estimate ATNT in equation (13): (1) households who participated in off-farm activities in 2013/14 only are matched with those who participated in off-farm activities in 2013/14 and 2015/16, and (2) households who did not participated in off-farm activities in both periods are matched with households who participated in off-farm activities in 2015/16 only.

A8. **Mathematical derivation of kinked demand curve for labor model**

$$L = U(C, L_T - L_f - L_{off}) + \lambda\left[\left(P_Q . Q(X, L_f) + w_{off} . L_{off} + N_{off} - P_C . C\right) + \mu L_{off}\right] \ldots\ldots\ldots (1)$$

We can derive the first order necessary conditions that give optimal labor supply in off-farm activities using Kuhn-Tucker conditions as follows:

$$\frac{\partial L}{\partial L_f} = U_{Le} + \lambda P_Q Q_{Lf} = 0 \ldots\ldots\ldots (2)$$

$$\frac{\partial L}{\partial L_{off}} = U_{Le} + \lambda w_{off} + \mu = 0 \ldots\ldots\ldots (3)$$

$$\frac{\partial L}{\partial C} = U_c - \lambda P_C = 0 \ldots\ldots\ldots (4)$$

$$\frac{\partial L}{\partial \lambda} = P_Q . Q(X, L_f) + w_{off} . L_{off} + N_{off} - P_C . C = 0 \ldots\ldots\ldots (5)$$

$$\frac{\partial L}{\partial \mu} = L_{off} = 0 \ldots\ldots\ldots (6)$$

$$\mu \frac{\partial L}{\partial \mu} = \mu L_{off} = 0 \ldots\ldots\ldots (7)$$

All variables are assumed to be strictly positive except

$$L_{off} \geq 0 \ldots\ldots\ldots (8)$$

$$\mu \geq 0 \ldots\ldots\ldots (9)$$

It is assumed that asset A>0 (i.e. the income constraint is strictly binding). An examination of Equations (6, 7 and 8) reveals that if $\mu > 0$, then $\frac{\partial L}{\partial \mu} = 0$ or if $\frac{\partial L}{\partial \mu} = 0$, then $\mu = 0$. By dividing equation (2) into equation (3), we get

$$P_Q Q_{Lf} = w_{off} + \frac{\mu}{\lambda} \ldots\ldots\ldots (10)$$

Equation (10) states that, at the equilibrium solution, the value of the marginal product of operator's labor in farm work ($P_Q Q_{Lf}$) equals the off-farm wage (w_{off}) plus the term $\frac{\mu}{\lambda}$. The

basic objective is to get equilibrium solution for off-farm labor. Therefore if we include off-farm labor supply in the model, $L_{off} > 0$, the equilibrium solution in equation (10) becomes:

$P_Q Q_{Lf} = w_{off}$ ..... (11)

Equation (11) indicates that the return from farm work ($P_Q Q_{Lf}$) and off-farm work (w_{off}) are equal. Alternatively, if we solve λ, we can obtain:

$\frac{\partial U_{Le}}{\partial P_Q Q_{L_L}} = \frac{U_{Le} - \mu}{w_{off}} = \frac{U_c}{P_C}$ ..... (12)

A9. **Household labor supply model by Huffman**

The optimal quantity of off-farm work (T_{off}), leisure and consumption goods by household (L and Y_1) and labor and purchased other inputs (X_1 and X_2) in farm output production are obtained by maximizing the following equation subject to labor supply in farm work (X_1) and other purchased inputs for farm production (X_1), farm output (Q, leisure (L), consumption good (Y_1) and off-farm labor supply (T_{off}).

$Ł = U(L, Y_1, Y_2) + \lambda[w_{off} T_{off} + PQ - w_2 X_2 + V - P_1 . Y_1] + \delta[F(X_1, X_2, X_3) - Q] + \Upsilon[T^0 - (X_1 + T_{off} + L)]$ ..... (1)

First order condition interior solutions are

$\frac{\partial Ł}{\partial X_1} = -\Upsilon + \delta f_1 = 0$ ..... (2)

$\frac{\partial Ł}{\partial X_2} = -\lambda w_2 + \delta f_2 = 0$ ..... (3)

$\frac{\partial Ł}{\partial Q} = \lambda P - \delta = 0$ ..... (4)

$\frac{\partial Ł}{\partial L} = U_L - \Upsilon = 0$ ..... (5)

$\frac{\partial Ł}{\partial Y_1} = U_1 - \lambda P_1 = 0$ ..... (6)

$\frac{\partial Ł}{\partial T_{off}} = \lambda w_{off} - \Upsilon = 0$ ..... (7)

$\frac{\partial Ł}{\partial \lambda} = w_{off} T_{off} + PQ - w_2 X_2 + V - P_1 . Y_1 = 0$ ..... (8)

$\frac{\partial Ł}{\partial \delta} = F(X_1, X_2, X_3) - Q = 0$ ..... (9)

$\frac{\partial Ł}{\partial \Upsilon} = T^0 - (X_1 + T_{off} + L) = 0$ …….. (10)

Where, λ, δ and Υ are multiplier effects. Equation (2- 10) shows households make decision on off-farm work and farm inputs, including household member's farm work and other inputs, and on purchased household goods simultaneously. Equation (2, 5 and 7) imply the equilibrium solution; optimal allocation of time that represents marginal value of farm work, marginal value from off-farm work and marginal value of leisure are equal. Equation (2, 3, 7, and 10) shows cost minimizing input combination in farm production. Equation (4) says that equilibrium farm output, where marginal cost equals the anticipated price ($P = \frac{\delta}{\lambda}$). Equation (5, 6, 7, and 8) insures optimal combination of L and Y_1 in consumption. We substitute equation (9 and 10) into equation (8) to get total resource constraint, which is endogenous because variables X_1 and X_2 are decision variables.