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Children's Schooling in Rural Ethiopia: The Role of Household Food Security, Parental Education and Income

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Abstract
Investment in children's education is widely recognized as one of the basic requirements for economic development. However, for the vast majority of the poor in developing countries like Ethiopia, hunger and food insecurity are linked with low schooling among children. However, the effect of food security and other household factors on rural children's schooling outcomes in Ethiopia remains largely unexplored. This paper used three different measures of schooling to examine the impact of household food security, and other household and child-specific factors on children's schooling outcome using probit, Heckman sample selection, Tobit and IV regressions. The results revealed that household food security had a significant positive impact on all of the schooling outcomes and that this impact differed by gender in favor of girls. Income and the literacy of adult household members in general and mother's education in particular also had a significant positive impact on children's schooling. Children's school achievements were on average lower for female-headed households (except for ever-attendance). On the other hand, child labor demand by household (for domestic chores and farm work) negatively affected children's schooling (grade attainment and schooling efficiency). Interventions that raise household food security, literacy of adult household members, and household income in rural areas help enhance children's schooling, thereby positively contributing to human capital development. Moreover, improvements in household food security would also have an important implication for intra-household distribution of wellbeing in such a way that helps enhance girls' education in rural Ethiopia.
Keywords: Children's schooling outcomes, Grade attainment, Household Food Security, Ethiopia

1. Introduction

The benefits to economic development of investments in human capital in general, and children's education in particular, have long been acknowledged. However, widespread absolute poverty in developing countries hampers education through poor nutrition and health, low parental education, limited financial resources for education, and poor home circumstances. An estimated 1.2 billion people worldwide are classified as poor with over 70 percent of the poor in developing countries living in the rural areas. While issues of poverty reduction, food security and basic education assume central place in current development discourse, the rural nature of these challenges is often overlooked. Consequently, poverty and illiteracy remain overwhelmingly rural phenomena, with majority of the rural poor caught in the vicious cycle of lack of access to services and opportunities (such as education, employment, and adequate nutrition) that might take them out of poverty (Atchoarena and Gasperini 2003).

In particular, food insecurity – a direct consequence of poverty – is a serious concern with numerous consequences for human development. The experience of food insecurity is linked with adverse health and schooling outcomes among children. Ethiopia has been persistently facing a wide-scale food insecurity problem for several years. According to results from a nation-wide Welfare Monitoring Survey conducted in 2004, 31 percent of Ethiopian households had difficulty meeting their food demands during the past 12 months prior to the survey (Demeke and Zeller 2011). Backward agriculture, unstable weather, recurrent drought, pests and disease, population pressure, weak institutional capacity, and inadequate infrastructures and social services are some of the factors identified as major challenges for ensuring food security.

A number of researchers have studied the potentially negative effects of food insecurity on the emotional, cognitive, and behavioral functioning of children (Boivin, et al. 1996, Martorell 1993 and 1996, Glewwe and Miguel 2008, Evans and Schamberg 2009). There is ample evidence that food insecurity results in developmental impairments such as poor learning capacity in children (Joyti et al. 2005, Connell et al. 2005), adversely affects children's intellectual development (Alaimo et al. 2001, Winicki and Jemison 2003), school attendance (Sarlio-Lähteenkorva and Lahelma 2001), health (Belachew et al. 2011), and academic performance and social skills (Alaimo et al. 2001, Winicki and Jemison 2003).

However, the effect of food security on educational attainment of rural children in developing countries has not been adequately explored. In particular, empirical evidence documenting the relationship between household food security, human capital and children's schooling in the context of rural Ethiopia has not been comprehensively analyzed. A few studies have explored issues of food security in Ethiopia (Demeke and Zeller 2011, Beyene and Muche 2010, Mitiku et al. 2013, Goshu et al. 2013). Much of the focus has been on examining

the determinants of household food (in)security (Hailu and Regassa 2007, Adenew 2004, Ramacrishna 2002). Other studies have attempted to assess determinants of child health (Kebede 2009) and schooling achievements (Deginet et al. 2007, Haile and Haile 2007). None of these studies have examined the association between food security and children's schooling outcomes.

As a result, empirical evidence on the effects of food security on rural children's schooling outcomes in Ethiopia remains largely unexplored. Hence, this paper aims to address the deficit by analyzing the effects of food security on the schooling of children in rural Ethiopia using various measures of schooling outcomes. Specifically, the study aims at analyzing the impact of household food security and other household level factors on children's schooling outcomes, a key determinant of children's well-being. Accordingly, the next section presents the state of education in Ethiopia. Section 3 deals with some literature on the relationship between food security and children's education. Section 4 would present the conceptual and analytical framework. Section 5 would provide the results and discussion. Finally section 6 concludes.

2. The State of Education in Ethiopia

Ethiopia is amongst the poorest countries in the world. The country's per capita income of $370 for the year 2011 was substantially lower than the regional average of $1,258 for Sub-Saharan Africa (World Bank 2013). The country compares unfavorably with sub-Saharan Africa[1] on many social indicators: expected years of schooling (8.7), mean years of schooling (2.2), infant mortality rate (46.5 deaths per 1,000 live births), and adult literacy rate (below 50 percent). The 2013 United Nations Human Development Report ranks Ethiopia 173 out of 187 countries and territories in terms of HDI. Specifically, the 2012 HDI of 0.396 for Ethiopia is below the average of 0.466 for countries in the low human development group and below the average of 0.475 for countries in Sub-Saharan Africa (HDR 2013).

The rationale for investment in primary education is universally accepted in both developed and developing countries. Beyond improvements in the skills and productivity of labor, it helps improve health, hygiene, nutrition practices and childcare as well. It is thus not only a right in itself but a means of realizing other rights. The Ethiopian Government has long recognized that basic education is a human right as evidenced by the inclusion in the country's Constitution of 'the rights of all children to education'. To realize this, the government introduced a new Education and Training Policy (ETP) and an Education Sector Strategy in 1994.

Prior to 1994, the structure of the education system in Ethiopia has been a three-cycle (6-2-4) system: six years of primary education followed by two years of junior and four years of senior secondary education cycles. Promotion between cycles was based on results on national examinations at the end of each cycle. Following the Education and Training Policy (ETP) issued in 1994, a four-cycle (4-4-2-2) education system was introduced consisting of eight years of primary education in two cycles (i.e., first-cycle of four years of basic education plus a second-cycle of four years of primary education) to be followed by two years each of a general and a preparatory secondary education cycles (EEA 2011)

The education sector was suffering from multifaceted problems during the previous regime. Consequently, the current government2 developed a twenty year Education Sector Indicative Plan divided into a series of five-year Education Sector Development Programs (ESDP) in 1997. The last of this series – ESDP IV, which covers the years 2007 to 2015 – is currently under implementation. The ESDP aims to improve quality, relevance, and equity and expand access with special emphasis on primary education in rural and underserved areas, as well as the promotion of girls' education. To this end, the country is committed to realize universal primary education by 2015. Vast strides have been made and encouraging trends have emerged compared to the past. However; with a net enrolment rate of only 57.4 percent, universal primary education is a long way to go. Education is still not only undersized but is also unevenly distributed, where females and children from rural areas are still disadvantaged. With less qualified teachers and high student-teacher and student-section ratios, quality is not to the desired level and it is more so in the rural areas. Internal efficiency is also low mainly as a result of high dropout rates.

The country's effort to enhance access to education is further manifested through increased allocation of government budget to the sector. The share of education expenditure from the total government expenditure has shown an increasing trend. As shown in Table 1 the education budget has been growing at an average of 27.3 percent while the total government expenditure was growing by only 16.5 percent. The share of educational expenditure in the total government expenditure also grew from 17.8 percent in 2005/06 to 25.4 percent in 2009/10.

[1] 2012 figures
[2] The current government took power in 1991 after getting rid of the previous socialist regime

Table 1 Education budget and expenditure (in millions of Birr)

Year	2005/06	2006/07	2007/08	2008/09	2009/10	AAGR
Education Expenditure	5,991	7,633	9,373	11,341	15,659	27.3
Total Government Expenditure	33,616	30,998	41,071	48,035	60,342	16.5
Percent Education of Total Government Exp.	17.8	24.6	22.8	23.6	25.9	

Source: Ministry of Education, Education Statistics, Annual Abstracts of Various Years

This has led to a significant expansion of schools and number of teachers in the country. In the past ten years, the number of schools increased by 128 percent to reach 26,951 primary schools in 2009/10 from 11,780 in 2000/01 (MoE 2010). Likewise, the number of teachers in primary schools has increased by 186 percent from 102,121 in 1995/96 to 292,130 in 2009/10. First-cycle primary schools were the most beneficiary of such huge allocation of resources (Gurmu and Etana 2013). In terms of access to education, there has been a significant growth in enrollments at all levels of education throughout the country. Over 40 percent increase in gross enrollment ratio (GER) was achieved between 2000 and 2009. The largest share of this increment was for female students (EEA 2011). The GER for primary education (grades 1-8), which was 68.4 in 2003/04, grew to over 95 percent by 2012/13. The net enrollment rate (NER) for primary education similarly reached 85.9 percent in 2012/13 from its level of 51.8 percent in 2003/04 (EEA 2011, MOE 2013).

Overall, fifteen years after the new education and training policy is launched in 1994, there has been impressive achievement in aggregate enrollment rates at all levels. And with average net enrolment in primary education now standing at 85.9 percent, Ethiopia is well placed to reach the goal of universal primary education as long as a major effort is made to improve quality and get the estimated 2.8 million children that are still out of school back in. However, a number of problems still persist. Despite the remarkable changes over the last years in access, equity and relevance of primary education, schooling indicators are still poor, and below regional averages, meaning that Ethiopia is ranked 27th out of 28 countries in terms of the African Education for All (EFA) development index. The state education system remains under-resourced, especially in rural areas. Demand side issues must also be addressed, especially in terms of the cost of schooling for poor families, through advocacy, and improving equity1.

More than a quarter of children who enroll in first grade drop out before they complete their first school year. In basic education, Ethiopia's sector plan seeks a balance between providing access to the approximately 3 million children who remain out of school and improving quality for the more than 15.8 million children enrolled in the 8-year primary cycle. Nearly 20 percent female and over 15 percent male primary school-age children didn't go to school during the 2008/09 school year. There is still disparity in primary school enrollment rate. In 2009/10, the net enrollment rate of females was 81 percent compared to 84 percent for males. The drop-out rate of primary school students tends to rise during the last four years while the repetition rate in primary school remains to be constant with slight rate of decline (Gurmu and Etana 2013, EEA 2011). The dropout rate is very high in grade one and is slightly higher for girls than boys. Factors contributing to such a high dropout rate include distance to school, low household income and inability to pay, demand for child labor, need to look after younger siblings, and illness, death or migration of a parent.

Moreover, there is substantial regional disparity with regard to enrollment. While Tigray and Amhara regions have the highest gross and net enrollment ratios, these figures are relatively low in SNNPR and the lowest in Somali region. There is also considerable variation in school enrollment between urban and rural areas, which is exceptionally large in Ethiopia compared to other developing countries (World Bank 2006). While nearly equal percentage of male and female students in urban areas are enrolled to primary schools (50.6 percent of males and 49.4 percent of females), the percentage of female students in rural areas that were enrolled to school in 2009/10 was less than their male counterparts by 6.2 percent (53.1 percent males and 46.9 percent for females) (Gurmu and Etana 2013, MoE, 2010).

Other challenges related to access to quality education have been identified by the National Learning Assessments conducted in 2000, 2004 and 2008. Accordingly, academic achievement of students in Grade 4 shows a slight improvement, from 47.9 percent in 2000 to 48.5 percent in 2004, whereas achievement scores for Grade 8 deteriorated, from 41.1 percent to 39.7 percent over the same period (MoE 2007, UNICEF 2010). Moreover, an assessment carried out in 2008 reveals that 62.1 percent failed the national examination. Poor school organization and management, inadequate teacher training on subject mastery and pedagogic skills, inadequate school facilities, and insufficient curricular and instructional materials are issues that have been

[1] Ethiopia EFA (Education for All) Profile, UNESCO, Dakar Office accessed on 19/4/14 at www.unesco.org/eri/cp/factsheets_ed/ET_EDFactSheet.pdf

widely acknowledged as causes for such a performance (UNICEF 2010). Furthermore, issues like large average class size (class-student ratio of 1:64); high average number of students per teacher (1:59); low motivation of teachers and students; lack of and/or non-use of teaching-learning aids; insufficient provision of reference materials; weak capacity to correctly interpret, plan, implement and monitor policies and programs; and inadequate resources for operations are major supply-side constraints (MoE 2007).

Overall, the state of education in Ethiopia suffers from a number of supply- and demand-side problems as reviewed above. Despite progress as a result of implementation of government's education sector development programs in the country, challenges remain. Given the progresses and the challenges on both the supply and demand side of education discussed thus far, a detailed examination of the situation is crucial to gain an understanding of the underlying causes particularly in rural areas. Specifically, analysis of the demand side determinants of schooling is important in addressing the wider problems constraining progress in the sector. Against this backdrop, the following section provides the analytical framework for analyzing the determinants of children's schooling in rural Ethiopia.

3. Food Security and Children's Education

Food insecurity has long been recognized as one of the factors with multidimensional consequences for children's wellbeing. Food security is used to describe the situation where people have access to sufficient quality and quantity of food. Narrowly defined, it refers to availability of sufficient food at the global, national, community or household level. However, availability alone doesn't guarantee access and that the issue of access needs to be addressed if food security is to be used as a measure of household or individual welfare (Pinstrup-Andersen 2009).

Although food security has been subject of much research in the past, the bulk of the available empirical literature has been focused on the analysis of determinants of food security. A few studies have reported that food insecurity negatively affects children's health (Gundersen et al 2011, Nord 2009, Cook et al. 2004, Alaimo et al 2001); children's development through creating developmental delays (Rose-Jacobs et al 2008); motor and social skills (Skalicky et al 2006, Beard 2008); and brain memory and psychological functioning (Evans and Schamberg 2009). Early childhood is the narrow window during which one builds the basic capacity to learn and interact productively with others. Disrupting this brief period diminishes children's ability to acquire complex school skills as they grow, and, later, job skills.

The developmental impact of food insecurity in early childhood is sustained through a child's critical first years in school. Researchers examining the role of food insecurity in cognitive outcomes found that food-insecure children scored lower than their food-secure peers on a measure of child intelligence. The same study also found that these children had a harder time getting along with others, were more likely to have repeated a grade, and had lower arithmetic and general achievement test scores than food-secure children in the same age group (Ashiabi 2005). A study using data from the 1999 National Survey of American Families found that food insecurity predicts poor school engagement partly because food-insecure children tend to be in poor emotional and physical health (Jyoti 2005). In a longitudinal study, other researchers found that food insecurity in kindergarten was associated with poor reading performance and impaired social skills in later grades.

Most of the research reviewed above carried out within the area of public health based on mainly data from USA. Empirical evidence on food security in Ethiopia indicates the prevalence of a high level of food insecurity, with significant idiosyncratic and spatial characteristics. Food security studies by Bogale and Shimelis (2009), Beyene and Muche 2010, Hadleya et al. (2011), Abebaw et al. (2011) Mitiku et al. 2013, and Goshu et al. 2013 generally suggest that the depth and intensity of food insecurity are high, influenced by poor functioning of marketing systems and other household and socioeconomic factors. On the other hand, studies on children's schooling in Ethiopia have focused on factors that determine some selected schooling outcomes (Deginet et al. 2007, Haile and Haile 2007, Mani et al. 2013, Admassie and Bedi 2003). None of these studies have examined the association between food security and children's schooling outcomes.

In summary, the bulk of empirical evidence available on the link between food insecurity and children's education falls largely within the field of (public) health research based on mainly data from USA. While most of the studies mentioned relied on self-reported measurements/indicators for household food insecurity, the indicators used for measuring children's schooling outcomes have been relatively rich. However, much of the available empirical evidence on Ethiopia focuses on the analysis of determinants of food insecurity and that of children's schooling separately. And the link between the two, however, remains largely unexplored. The current study, therefore, attempts to bridge this gap.

4. Conceptual Framework and Empirical Strategy

The theoretical framework for the analysis of children's schooling outcomes would be based on a standard household production model by Becker (1965), as applied in Rosenzweig and Evenson (1977). This framework takes into account multitudes of children's activities in developing countries. Empirics based on this framework

highlights the importance of factors related to individual characteristics of the child such as gender and age; family structure and the relative position in terms of age of the child within the family; family income and parental labor force participation; labor market conditions such as the wages of children and adults; local infrastructure, such as schools, water, electricity, road, etc. (Vuri 2008).

It is assumed that decisions about children's time allocation are made by parents. In particular, parents are assumed to maximize a utility function, where the time children spend in school (and/or on work) is one of the arguments, together with domestic and market goods, given the household head's hours of market work and unearned income. Basically, parents make these choices on the basis of the relative costs and benefits of their children's education (Admassie and Bedi 2003, Vuri 2008). These effects of parental choices are also likely to be differentiated by the characteristics of the household and of the child. For example, parental choices over their children's time use and returns to education, as well as child productivity, may depend on the gender and age of children, but also on parental characteristics such as parents' education. Similarly, the level of household income and wealth is likely to influence the relative size of the income and substitution effects (Admassie and Bedi 2003, Vuri 2008).

On the other hand, there is also ample evidence that child labor has a negative impact on children's schooling. If the cost (direct as well as indirect) of sending children to school is high, then poor households may be forced not to send their children to school or id already in school take them out of school, which in turn creates a fertile ground for the use of child labor. To the extent that this is true, policy reforms targeted at affecting the cost (direct or indirect) of schooling will affect the allocation of children's time. Moreover, household composition has an important effect on children' time use but the sign of this effect is indeterminate a priori. In general, the presence of very young children in the household may lead to a higher probability of working (either performing economic activity if it is necessary to increase household income or doing household chores if child care activities are needed). On the contrary, the presence of older children may increase child's work if more work is created, or increase school attendance if older children act as substitutes. Differences in labor market and educational opportunities across regions may also affect household decisions concerning children's time use (Vori 2008).

The utility-maximizing framework explained above, therefore, can be used to model household decisions regarding children school and work activities as a function of individual, parental, household and community characteristics. These reduced form expressions for schooling and work will form the basis for specifying the estimable form demand equations. Accordingly, the following equation is specified for the estimation of children's schooling outcomes:

$$S_{ij} = \beta_1 C_{ij} + \beta_2 H_j + \beta_3 D + \varepsilon_{ij} \quad (1)$$

Where Sij is the schooling outcome for child i belonging to household j, Ci is a vector of child-specific characteristics (e.g., age, gender); Hj is a vector of households characteristics (e.g., consumption-based measure of income, education of household head); D is a vector of region-level dummies which proxy for a wide range factors such as prices, agro-ecological conditions, infrastructure, and school quality; and ε_{ij} is a normally distributed error term with mean zero and variance σ. We augment equation (1) by introducing household's food security status as one of the household level characteristics in the H vector.

Our household food security is a composite index that is constructed using Principal Components Analysis (PCA) based on a selected set of indicators that are intended to capture the various components of household food security status. Since food security is a complex concept, the PCA approach helps capture its multiple dimensions based on a set of selected indicators. The selection of the indicators was guided by insights drawn from the food security literature as well as availability of data. All the three major dimensions (availability, access and utilization) have been represented by at least one indicator. Accordingly, the variables selected for constructing the index are: land area, availability of food stocks, number of crops cultivated, ownership of cattle, and utilization of sanitary services (improved toilet, improved water supply) at household level. The justification for each of the variables used is explained in detail in Abafita and Kim (2014 forthcoming1).

With regard to measures of children's schooling outcomes, there are several dimensions that are dependent on the schooling decisions that households make regarding their children. The first dimension is school entry decision, which can be captured in two ways: whether or not a child has ever entered the school system and (if so) whether or not the child is currently enrolled. This is the most important stage in the schooling of a child. Delays in school at this time will have serious implication for child education with possible outcome that some of them may never attend school or if they do they are likely to lag on their progress perform poorly or even drop out early (Handa et al. 2004). We analyze the impact of food security and household's access to resources on the chances that a primary school-age child has ever attended school (EVATTND). We employ probit model for assessing each selected explanatory variable influences the probability of children's school attendance as explained above.

[1] Paper accepted for publication by the Journal of Rural Development, available under request to the authors.

Once children are in school, they should stay in the school system for as long as possible. In this regard, the major challenge for such children would be to be able to progress in their schooling through each subsequent levels or grades. To understand the determinants of this dimension of schooling, we examine the grade or years of schooling attained (GRADE) by children who have ever attended to school. Some of the children who ever gone to school are still attending school, others may no longer be in school (may have dropped out or completed school). Following Handa et al. (2004), we account for such censored nature of the outcome using tobit regression specification. We also account for possible selectivity biases using Heckman sample selection model. However, we extend the analysis of Handa et al. (2004) by employing Instrumental Variable (IV) regressions to account for endogeniety bias inherent in such analyses.

Finally, an issue of policy concern in the schooling system is relates to efficiency. Schooling efficiency refers to the length of time it takes a student to achieve a given level of education. Delays in starting schools, interruptions and repetitions in schooling reduce efficiency and negatively affect children's motivations for schooling. This outcome is measured as the child's actual grade attained divided by the grade the child is supposed to attain given her/his age (Handa et al. 2004, Mani et al. 2013). We proxy this trend by the schooling gap variable (SCHGAP), calculated as grade completed divided by the grade that should have been completed, given the child's age. We analyze the determinants of this outcome as well for children who have ever attended school. We do so by employing Heckman sample selection model the same way as for GRADE to account for selectivity bias. Similarly, we also employ tobit and IV regressions to account for censoring of data and endogeniety issues.

5. Empirical results

5.1 Descriptive Analysis

Table 2 provides data on the proportion of children who have ever attended school for children aged 7-11 (first-cycle primary school age) and 12–15 (second-cycle primary school age). For the two groups 68 and 80 percent report ever attending school, respectively. The number of girls who reported to have ever attended school was slightly higher for the first-cycle primary school age, while the reverse is the case for second-cycle.

Table 2 Children who have ever attended school, by age group (percent)

	7-11 Years	**12-15 Years**
All	68.01	80.05
Boys	66.44	81.35
Girls	69.62	78.68

As shown in figure 1 below, the enrolment among children who have ever attended generally increases with age, reaches a peak around age 13 and declines after that for both sexes. Mani et al. (2013), characterize such a trend as one of a non-linear relationship between age and enrolment for which they found a similar trend for girls only using previous rounds of ERHS data. Moreover, the trend figure 1 further shows that few children are enrolled at young ages with relatively more females than males.

Figure 1. Children who have ever attended school, by age (percent)

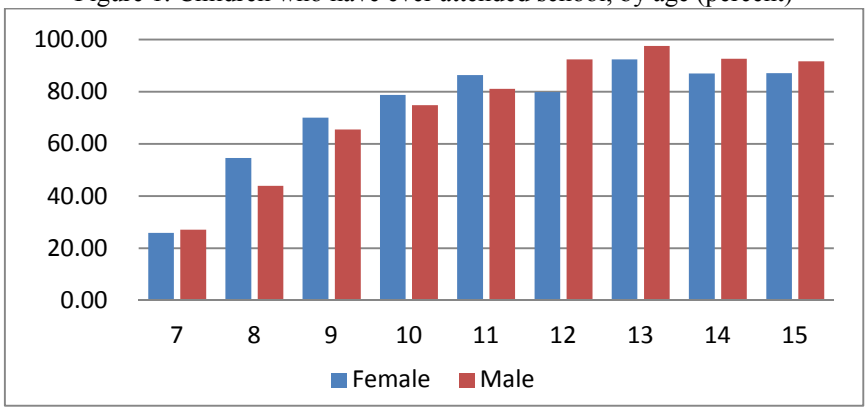

Table 3 provides summary statistics for the mean of highest grade attained for the two age groups. The average grade completed for children in the first-cycle primary school age (nearly 40 percent of whom no longer attend school currently) 1.323, which is about grade one. The corresponding number for the whole primary school age children is just about two grades (2.242). These figures are somehow indicative that the grade progression is quite slow.

Table 3. Mean grade attained, by age group

	7-11 Years	12-15 Years
All	1.323	3.781
Boys	1.271	3.881
Girls	1.376	3.675

Table 4 presents means for the schooling efficiency, which measures how long it takes a child to pass the schooling system. As mentioned earlier, this indicator is generated by dividing the child's actual grade attained by the grade she or he should have attained, given her/his age and if she/he had started school on time and did not repeat. For children no longer in school, the year they completed their highest grade was recorded during the survey and that information was used to calculate the age at which they completed that grade. For children who are in the right grade for their age, the indicator takes the value 1 (or 100 percent). Children who never attended school will have a value 0 and are excluded for the table.

Table 4. Schooling efficiency, by age group

	7-11 Years	12-15 Years	All (7-15 Years)
All	0.307	0.445	0.349
Boys	0.291	0.457	0.349
Girls	0.323	0.432	0.349

For both boys and girls aged 7-15 years, the mean efficiency was 35 percent. This indicates that on average children who have entered school have achieved only 35 percent of what they should have achieved1. This is indicative of a very low efficiency. According to Handa et al. (2004), this could be attributable to factors on either the demand side (family decisions) or supply side (schooling system). As can be seen in the table, efficiency is considerably lower for first-cycle primary school age children (30 percent on average).

5.2 Econometric Analysis

The means and standard deviations of the variables included in the econometric analysis are presented in annex 1 at the end of the paper. In what follows, we present the results of our regression analysis on each of the three schooling measures.

Determinants of ever attending school

The estimates for the probability of ever attending school are presented in table 5. All four models are estimated using probit regression with only difference in household level of human capital. Models 1 and 2 are estimated with only literacy level of the household head and the spouse respectively. Model 3 is estimated using literacy of adult household members only, while model 4 was estimated using all household human capital variables. As expected, household food security is significant and positive in all four regressions. This implies household food security raises the probability of a child ever attending school on average. The fact that our food security variable is an index value makes it difficult to meaningfully quantify the extent the impact on the outcome variable. Hence, we prefer not to give interpretation on that. However, we found that food security had a differential impact by gender as evidenced by the negative significant coefficient of the interaction term between the male dummy and food security index in columns 1, 2 and 4. This finding indicates that the impact of household food security is on average lower for male students than for their male counterparts. This is quite interesting in terms of the importance of food security in promoting girls' education. That is, improvements in household food security status enhance girls' education in rural Ethiopia. This is imperative in terms of narrowing down the persistent gender bias in education observed at national level.

[1] According to Handa et al. (2004), this figure could also be interpreted as the 'extra' time it takes for a child, once enrolled in school, to complete a given level. In our case, it would be 185 percent [(1/.35) – 1]

Table 5. Estimates of the probability of ever attending school

	(1)	(2)	(3)	(4)
	coef/t	coef/t	coef/t	coef/t
AGE	1.280***	1.300***	1.373***	1.385***
	(13.865)	(13.927)	(13.957)	(13.981)
PCAI	0.153***	0.156***	0.125**	0.133**
	(2.664)	(2.707)	(2.084)	(2.206)
PCAI * MALE	-0.178***	-0.181***	-0.119*	-0.130*
	(-2.661)	(-2.692)	(-1.717)	(-1.856)
LPCE	0.092***	0.076**	0.088**	0.072**
	(2.782)	(2.270)	(2.557)	(2.072)
HHDSZ	-0.006	-0.006	-0.121***	-0.121***
	(-0.360)	(-0.393)	(-6.563)	(-6.507)
AGEHHD	0.004	0.005**	0.004*	0.007**
	(1.430)	(1.980)	(1.820)	(2.388)
SEXHHD	-0.095	-0.002	-0.024	-0.019
	(-1.042)	(-0.017)	(-0.264)	(-0.196)
MALE	0.055	0.038	0.075	0.065
	(0.861)	(0.594)	(1.125)	(0.968)
HHDLITERATE	0.268***			-0.012
	(3.474)			(-0.140)
MOLITERATE		0.424***		0.264***
		(6.111)		(3.445)
PRIMADULT			0.394***	0.375***
			(12.872)	(11.992)
No. of observations	2,451	2,452	2,452	2,451
Adjusted R2	0.351	0.360	0.409	0.413

Notes: Method of estimation is probit. Values in parenthesis are z-statistics. Included but not shown are regional dummies, the square of child age and a constant. *** p<0.01, ** p<0.05, * p<0.1

All the household human capital variables are also highly statistically significant determinants of the probability of a child ever attending school. In particular, mother's education (level of education of the spouse of the head to be precise) and the number of household members with primary level of education were consistently significant in all equations they were included, while literacy level of the household head was not statistically significant in the last equation. The implication is that children from a family with better household level education are on average more likely to have ever attended school than those from illiterate families. This finding is in line with many past findings (Haile and Haile 2007, Mani et al. 2013, Cockburn and Dostie 2007, Handa et al. 2004). However, literacy of the head lost its significance once the effect of number of family members with primary level of education and mother's literacy were accounted for, indicating its relatively less importance compared to literacy of other adult family members.

The parameter estimate of household per capita consumption expenditure was also positive and statistically significant. This implies that household wellbeing as measured by higher per capita income (consumption expenditure) is an important determinant of children entering school. Specifically, a 10 percent increase in consumption expenditure increases the probability of ever attending school by 0.6 percentage points on average[1]. Similar results have been reported by Mani et al. (2013) for Ethiopia and Handa et al. (2004) for Mozambique. The coefficient estimates of household size also turned out to be negative in all equations while it was also significant in equations 3 and 4. This indicates that large families are more likely faced with difficulty of meeting the schooling needs for their children in terms of educational costs (both direct as well as opportunity costs, the latter being related to labor demand). That is, available family resources are spread more thinly the larger the family size. Moreover, larger families may be more likely to seek additional income through making children work in the labor market or having them provide labor within the household or to work on family farm. This will ultimately have a negative effect on child schooling. This finding is consistent with those of Emerson and Souza (2008) for Brazil. Remaining variables were not significant and hence not important determinants of child schooling as measured by ever attendance of school.

[1] This calculation is based on column 4 [= 0.072*log(1.10)]

Determinants of grade attainment

The estimates for grade attainment are provided in table 6. The purpose of the estimates in this part is to find out what factors determine whether children who have ever attended school stay longer in the schooling system thereby accumulating more years of schooling. The first model (HECKMAN) attempts to control for the selectivity into schooling by including the inverse Mills ratio from a probit regression of the probability of ever attending school. The Mills ratio was statistically significant. The second model (TOBIT) takes into account the censored nature of the data as explained in section 4. Finally, the third model reports the instrumental variables regression (IV) counterpart of the same schooling outcome. This regression was run to account for the endogeniety of household income (measured by per capita consumption expenditure) and household food security (measured by PCA index). Accordingly, the two variables were instrumented by the percentage of less-productive land owned by households, the number of working adult members in the family, per capita household food expenditure and whether or not there was increase in input price. The diagnostic tests point out that per capita consumption expenditure was in deed endogenous (Durbin Wu-Hausman tests) and that the instruments were valid (Sargan test).

The results reveal that household food security (PCAI), household income (LPCE), mother's education (MOLITERATE), age of household head (AGEHHD), and hours of study per week (HSTUDY) significantly enhance children's grade attainments. Accordingly, household food security continues to have an important influence on the length of time a child stays in school. Similar to the school attendance outcome, the impact of household food security was not uniform by gender as can be seen from the negative and significant interaction term (PCAI * MALE), indicating that girls benefit more on average from better household food security status. Such a differential impact is indicative of a differentiated intra-household distribution of wellbeing. This has an important implication in terms of promoting girls' education. Given the longstanding gender bias in children's schooling in favor of boys at national level, this finding points towards the importance of food security as a means to achieving this goal.

Table 6. Estimates of the determinants of grade attainment (years)

	HECKMAN	**TOBIT**	**IV**
	coef/t	**coef/t**	**coef/t**
AGE	0.045	1.427***	0.080
	(0.556)	(10.565)	(0.924)
MALE	0.014	0.068	0.046
	(0.196)	(0.663)	(0.586)
PCAI	0.133**	0.077	0.751***
	(2.379)	(0.997)	(2.786)
PCAI * MALE	-0.235***	-0.254***	-0.231
	(-3.556)	(-2.749)	(-1.060)
LPCE	0.165***	0.224***	0.249***
	(5.003)	(4.898)	(3.718)
MOLITERATE	0.389***	0.577***	0.354***
	(5.532)	(5.953)	(4.164)
HHDLITERATE	0.098	0.161	0.058
	(1.245)	(1.461)	(0.669)
AGEHHD	0.007***	0.012***	0.007**
	(2.629)	(3.136)	(2.431)
SEXHHD	-0.021	-0.067	-0.197*
	(-0.239)	(-0.553)	(-1.701)
HSTUDY	0.059***	0.078***	0.057***
	(15.257)	(15.521)	(12.528)
HDOMESTIC	-0.012***	-0.016***	-0.011***
	(-3.923)	(-3.911)	(-3.538)
HFARM	-0.015***	-0.021***	-0.015***
	(-6.197)	(-6.014)	(-5.878)
Number of observations	2,441	2,451	2,418
Adjusted R2		0.208	0.495

Notes: Method of estimation is probit. Values in parenthesis are z-statistics. Included but not shown are regional dummies, the square of child age, and a constant. *** p<0.01, ** p<0.05, * p<0.1

Similarly, mother's education, is a significant determinants of grade attainment. A cautious remark to be made here is the fact that education level of the household head was not an important determinant of grade attainment once human capital levels of other family members is accounted for. However, in a separate regression run with

the household heads education level only (not reported here), it was found significant and positive, suggesting the importance of household head's education is but relatively weak compared to that of mother's education. The level of household resources as measured by per capita consumption expenditure was also found to be important determinant of grade attainment. More specifically, a proportionate increase in per capita consumption leads to a 0.3 additional grades attained.

On the other hand, time spent on household chores (HDOMESTIC) and on family farm (HFARM), significantly reduced children's grade attainment. Similar findings have been reported by Haile and Haile (2007) for Ethiopia, Bezerra et al. (2009) for Brazil. Finally, sex of the household head was found to be negative and significant in the IV model only after endogeniety of income and food security status are accounted for. Given that the IV model is preferred as it addresses endoegeniety of income and food security, this finding is indicative of the fact that children from female-headed households attain relatively less on average than their counterparts from male-headed households.

The tobit model in column 2 indicates that censoring has in deed led to improvements in the magnitudes of the impacts of most of the statistically significant variables with the exception of household food security. For instance, the coefficient of household income is larger in the tobit specification than the Heckman model. However, the coefficient of household food security was not only smaller in the tobit model, but also insignificant. This indicates that accounting for the censoring of grade attainment didn't have significant impact in the estimated coefficient. A similar finding was reported in Handa et al. (2004) for Mozambique. A possible explanation is that either there was not much censoring problem in the sample or there was a much stronger sampling bias that was not accounted for in the tobit specification[1]. On the other hand, the estimates from the IV regression in column indicate that the magnitudes got larger in the case of food security and income, while it got smaller for mother's education, head's age and hours of study among others compared to the tobit model. However, the magnitudes of most of the variables were similar between the Heckman and IV models, with the exception of food security variable.

Determinants of schooling efficiency (relative grade attainment)

The results for schooling efficiency are reported in table 7. Similar to grade attainment discussed in the previous section, the first model (HECKMAN) attempts to control for the selectivity into schooling by including the inverse Mills ratio from a probit regression of the probability of ever attending school. Here too, the Mills ratio was statistically significant. The results from this regression provide estimates on the determinants of schooling efficiency for children who have ever enrolled in school. The second model (TOBIT) takes into account the censored nature of the data. Finally, the third model reports the instrumental variables regression (IV). As was done for highest grade attainment, the IV regression was run to account for the endogeniety of household income and household food security as these were considered to be endogenous to the households' demand for children's schooling. Accordingly, we used the same instruments as in the case of highest grade attainment (the percentage of less-productive land owned by households, the number of working adult members in the family, per capita household food expenditure and whether or not there was increase in input price). The diagnostic tests point out that per capita consumption expenditure and household food security were deed endogenous (Durbin Wu-Hausman tests) and that the instruments used were valid (Sargan test).

The results reveal that household food security has a positive and significant impact on schooling only after endogeniety is accounted for. Furthermore, this impact also differed by gender in favor of girls similar to the case of grade attainment and school attendance. The other factors that enhance children's schooling efficiency are largely similar to those of grade attainment. Mother's education, age of household head, and hours of study had significant positive impact on schooling efficiency. Similar to highest grade attainment, sex of household head had a significant negative impact on schooling efficiency in the IV model. Similarly, child time spent on household chores and family farm were also found to significantly reduce schooling efficiency. Overall, comparison of the models gives a similar trend as for the case of grade attainment. Furthermore, comparison of estimates all three schooling measures indicate that, the impact of the important factors such as food security, income, mother's education, are generally the larger for grade attainment. Moreover, while all schooling measures didn't differ by gender, there was difference in grade attainment and schooling efficiency by gender of household head. That is, children from female-headed households had on average higher grade attainment and schooling efficiency than their male-headed counterparts. Although female-headed households are generally considered to be more likely poorer than their male counterparts, the fact that they were better in educating their children comes as a bit of surprise. This could be an interesting question for further investigation.

[1] Tobit model does not control for sample selection bias

Table 7. Estimates of the determinants of schooling efficiency

	HECKMAN	TOBIT	IV
	coef/t	coef/t	coef/t
AGE	0.121***	0.309***	0.129***
	(7.072)	(12.144)	(7.168)
MALE	-0.001	0.004	0.001
	(-0.073)	(0.243)	(0.056)
PCAI	0.008	0.018	0.133***
	(0.778)	(1.323)	(2.736)
PCAI * MALE	-0.031**	-0.048***	-0.056*
	(-2.546)	(-2.864)	(-1.893)
LPCE	0.019***	0.026***	0.046**
	(3.223)	(3.153)	(3.695)
MOLITERATE	0.076***	0.105***	0.075***
	(5.938)	(6.058)	(4.763)
HHDLITERATE	0.008	0.022	0.005
	(0.581)	(1.114)	(0.318)
AGEHHD	0.001**	0.002***	0.001**
	(2.558)	(2.933)	(2.564)
SEXHHD	-0.014	-0.026	-0.045**
	(-0.876)	(-1.185)	(-2.140)
HSTUDY	0.010***	0.013***	0.010***
	(14.094)	(14.740)	(12.118)
HDOMESTIC	-0.001***	-0.003***	-0.002***
	(-2.610)	(-3.410)	(-2.820)
HFARM	-0.002***	-0.003***	-0.002***
	(-4.488)	(-5.069)	(-4.778)
Number of observations	2,447	2,361	2,329
Adjusted R2		0.292	0.184

Notes: Method of estimation is probit. Values in parenthesis are z-statistics. Included but not shown are regional dummies, the square of child age, land, and a constant. *** p<0.01, ** p<0.05, * p<0.1

6. Conclusion

In this study, we analyzed various dimensions of children's schooling outcomes in rural Ethiopia with particular emphasis on how household food security affects those outcomes. This was quite imperative because each indicator entails a different target group requiring different policy interventions. The results revealed that household food security had a significant positive influence on all the schooling outcome measures considered. Quite interestingly, this impact differed by gender and in favor of girls. Other significant determinants include education of adult family members (particularly mother's), and household income, which had positive impacts. In particular, mother's education had a strong positive influence on all measures of schooling outcomes, while the schooling of adult family members positively contributed to enrolment (ever attendance).

Children's schooling outcomes were on average lower for female-headed households (with the exception of ever-attendance). Child labor demands by household (for domestic chores as well as for working on family farms) unfavorably affected children's time allocation with an ultimate negative effect on their schooling outcomes (grade attainment and schooling efficiency). Older family heads were also found to have positive influence on most of the schooling outcomes than their younger counterparts. Therefore, interventions that enhance household food security, raise the literacy of adult household members and enhance household incomes in rural areas help enhance children's education achievements, thereby positively contributing to human capital development. In particular, such interventions would have stronger impact in enhancing grade attainment. Moreover, improvements in household food security leads to a favorable intra-household redistribution of wellbeing that would help enhance girls' education.

Finally, we end by making a couple of notes. First, this study has attempted to address a number of issues relating to food security and its impact on children's schooling. However, as the study was limited to only one round of data, it didn't capture the dynamic nature of the impact of food security status and schooling investments. The impact of such household decisions may not be captured fully in one time, rather may materialize with time lag. In particular, current schooling outcomes observed for a survey year may be dependent on schooling decisions made in the past. The same may apply to household food security status. A panel data

analysis could prove very useful in this case. Secondly, the fact that female-headed households had better average schooling outcomes for their children than male-headed household may be considered counter-intuitive and needs further investigation. Thirdly, refining of the food security indicators used, say by the specific dimension of food security being studied could be interesting to explore. For instance, generating PCA indices for food availability, access and utilization separately could result in an interesting analysis because from intervention point of view, all dimensions may not and should not get equal priority.

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Annex 1. List of variables used in the regression analysis with summary statistics

Variable	Description	Mean	SD	Min	Max
Dependent variables					
EVATTEND	1 if ever attended school, 0 otherwise	0.66	0.47	0	1
GRADE	Grade level attained (years)	2.24	2.25	0	10
SCHGAP	Schooling gap/efficiency	0.35	0.32	0	4.5
Household characteristics					
HHDSEX	1 = male, 0 = female	0.80	0.40	0	1
HHDLITERATE	1 = literate, 0 = illiterate	0.28	0.45	0	1
MOLITERATE	1 = literate, 0 = illiterate	0.24	0.43	0	1
PRIMADULT	No. of adults with primary education	2.99	1.46	1	9
NADULT	No. of adult working members	3.16	1.44	1	9
HHDSIZE	Family size	7.4	2.31	2	16
LPCE	Log of Per capita consumption expenditure	4.62	1.17	0.04	8.36
Child characteristics					
AGE	Child age in years	10.52	3.00	7	15
SEX	Sex of child (1 = male, 0 = female)	0.49	0.49	0	1
HSTUDY	Time spent on studying at home per week (hours)	7.33	8.78	0	56
HDOMETIC	Time spent on domestic work at home per week (hours)	12.59	12.18	0	96
HFARM	Time spent on farm work per week (hours)	13.23	15.15	0	84

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