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Abstract

Although the impacts of the Productive Safety Net Program in Ethiopia have been widely studied, the effects on children's welfare and school participation are relatively new areas of interest. Applying the framework of the agricultural household model and incorporating the related issue of household labor endowment, two rounds of a panel from the region of Tigray will be used for analysis. The Food-for-Work elements of the Program will be of special focus. Comparing output obtained through Difference-in-Difference and Random Effects estimation, the results indicate a positive effect of Food-for-Work on school participation, and partly support hypotheses regarding gender and age disaggregated labor endowment. Per capita endowment of adult equivalent labor units does not appear to be significant by either estimation method.

Keywords: School participation, Food-for-Work, gender segregated labor markets

Sammendrag

Selv om gjennomslaget til Productive Safety Net Program i Etiopia har blitt grundig undersøkt, har effekten på barns velferd fått relativt lite oppmerksomhet. Gjennom å bruke landbrukshusholdningsmodellen som grunnlag, og inkludere det beslektede området tilgang på arbeidskraft, vil to runder av et panel fra regionen Tiray bli benyttet for analysen. Food-for-Workelementet av programmet vil være gjenstand for særlig fokus. Resultater oppnådd ved henholdsvis Difference-in-Difference og Random Effectsestimering indikerer en positiv effekt av Food-for-Work på skoledeltakelse, og støtter delvis hypoteser angående tilgang på arbeidskraft disaggregert i henhold til kjønn og alder. Verken tilgang på arbeidskraft per husholdsmedlem eller graden av deltakelse har en signifikant effekt.

Nøkkelord: Skoledeltakelse, Food-for-Work, kjønnsdelte arbeidsmarkeder

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1. INTRODUCTION

Human capital investment, both in health and education, has been recognized as a main determinant of economic growth (UNDP, 2010). Ethiopia has made rapid progress within the area of education (MoFED, 2010b): Primary schools reached a net enrolment rate of 89.3 per cent in 2008-2009 compared with only 30.1 per cent in 1996. The gender gap is closing, albeit slowly (UNDP 2010). Universal education is, however, still far from achieved; School enrolment is only compulsory for children from 7 to 13 years of age, and parents cite lack of opportunities for further education, along with uncertain return to education, as reasons not to invest (Oumer, 2009). Costs are still high – although fees for primary education were abolished in 2002, fees for secondary education and 'fee creeps' in the form of voluntary contributions both in cash and kind and expenditure on school books and uniforms still persist. Because of thin or nonexistent markets for labor and credit, households are reluctant or unable to make productive investments such as investment in human capital, even though longer term returns might surpass current income (Oumer, 2009).

The prevalence of structural poverty in rural Ethiopia, both in terms of communal and private assets, was addressed by the introduction of the Productive Safety Net Program (PSNP), a joint initiative of Ethiopian government and a consortium of foreign donors, in 2005 (Brown et al., 2006) and rooted in the Plan to Accelerated and Sustained Action to End Poverty (PASDEP). The Program has two main elements: Food- or Cash-for-Work where able-bodied households receive compensation for public works, and Direct Support for households that qualify for assistance but are unable to fulfill the work requirement. Participants are enrolled as recipients for five years at a time, which ensures consistency of payments (MoARD, 2009). As opposed to previous efforts, the Productive Safety Net Program could have an effect not only on short-term survival rates, but also on investment and protection of physical assets. In addition, poorer households might reach a higher-yield growth trajectory as input constraints are eased (Barrett et al., 2002).

Low levels of educational attainment are a challenge for several reasons, both for the economy as a whole and for individual households. Ethiopia, together with the majority of developing countries, has high population growth and a low GDP per capita (MoFED, 2010b). A majority of the population lives in rural areas, where land is scarce and the soil degraded (Hagos & Gebreselassie., 2002). Tigray, the northernmost region of the country and the focus area of this thesis, has the added disadvantage of receiving less rainfall than the rest

of Ethiopia, and with higher variability, a contributing factor to the wide-spread food-insecurity in the region (Bezu & Holden, 2008).

In order to limit the dependence on the uncertain output of the land, households need to diversify, developing sources of income with higher yield and lower risk. Education has an important role to play in this regard. Even after only four years of primary education, research indicates productivity gains in that farmers can more easily adopt new technology and plan household production (Weir, 1999), meaning education is important even for agricultural and livestock work. This is a crucial argument for education in areas where jobs requiring formal education (beyond literacy) are hard to come by. For the wider regional and national economy, education is crucial. In order to achieve a higher sustained rate of country-wide economic growth, industrialization is key. There is, however, in Ethiopia as in other developing countries, an acute lack of qualified labor. This deficiency of human capital, in terms of education, becomes even more apparent as foreign investors increase their presence within Ethiopia since education is a precondition to benefitting from the transfer of technology (Brautigam, 2010).

Apart from the purely economic reasons, lack of literacy is also a democratic problem, as an uneducated population can hardly make an informed choice of political leaders (Sen, 1999). Education has, moreover, a role to play with regard to gender equality. Research suggests females with even limited levels of education are less likely to be subjected to domestic violence and coerced into early marriage, and more likely to benefit from health services along with their children (UNAIDS et al., 2002).

With this multitude of reasons for investment in education, and the multiple constraints stopping poorer households from investing, increased research and attention is of great importance. This study will attempt to explore some contributing factors which can explain household ability and propensity to invest in education by posing the following research questions:

i) How does household participation in Food-for-Work affect investment in education?
ii) How do household labor endowments affect investment in education?

Analysis will be conducted using data collected from around 400 Tigrayan households in 2006 and 2010, comparing measures obtained through the Difference-in-Difference and

Random Effects approaches. Food-for-Work participation is expected to be endogenous by targeting design, and thus instrumental variables are included to control for this endogeneity.

This paper will be structured as follows. Part 2 will present a brief outline of the Productive Safety Net Program. Additionally, a brief overview of the educational sector in Ethiopia is given, along with descriptive information on the study area of Tigray. Part 3 will explore the existing literature on human capital investment and other issues relevant to the study at hand. Part 4 outlines the theoretical framework, while Part 5 will focus on the research questions and hypotheses. Part 6 describes the data and discusses the choice of method. The results and interpretations will be presented in part 7, while part 8 concludes the thesis.

2. BACKGROUND

2.1 Productive Safety Net Program

The Ethiopian Productive Safety Net Program (PSNP) was introduced to counter structural causes of poverty, especially the prevention of asset depletion caused by adverse rainfall shocks. While previous food aid programs were meant primarily to hinder present-day starvation, PSNP was designed to address long-term issues related to asset poverty, and to introduce a stronger element of predictability for recipients. The target groups are chronically food insecure households in chronically food insecure districts, with administrative selection based on asset, income and livelihood criteria. The degree of which these criteria are used varies significantly; as poverty is widespread, participation must be rationed even within the target group (Coll-Black et al., 2011). The program was designed by the Ethiopian government in conjunction with a consortium of foreign donors (Brown et al., 2006), and includes two components: Public Works (Food- or Cash-for-Work) and Direct Support for those qualified for support but unable to fulfill the work requirement (MoARD, 2009).

Food-for-Work (FFW), a public works program, has been a fixture of Ethiopian rural work since the early 1960s. It partly branched into an aid program in three Ethiopian zones, including Tigray, under the lead of the World Food Program in 1972 (Bezu & Holden, 2008). It is now the main component of the Productive Safety Net Program. In addition to providing short term nutritional benefits through food payments, the project offers work opportunities as a form of income diversification to facilitate consumption smoothing and attempts to ensure a build-up of both communal and private assets through soil conservation and other structures. For the maximum compensation, the work requirement is five days per month per household member, with food wages at approximately three kilograms of grain per working day (Bezu & Holden, 2008) although this amount seems to vary between recipients. The projects are implemented in the agricultural slack season, which runs from January through June, so as to not to subtract from the time available for farm labor (Brown et al., 2006). It should be noted that the work requirement does not consider what share of household members are able to work, meaning an individual could be required to work substantially more than five days per month to cover the share of other members of his/her household (Gilligan et al., 2008).

The treatment status of a given household is based on self-selection and administrative criteria, whereby allocation authority is delegated to the local-level Food Security Task Forces

(MoARD, 2009). Research suggests targeting is largely successful (Brown et al., 2006), although some have questioned the applicability of the self-targeting approach in areas with thin or missing markets (Barrett & Clay, 2003). This concern arises as off-farm income opportunities are likely to be limited were markets function sub-optimally. One result could be that even households not classified as poor, or rather, not poor enough for PSNP participation, would be tempted to participate simply for lack of other options, which means there are limited opportunity costs of participation. The timing of work in the agricultural slack season adds to this challenge, as the opportunity cost of on-farm work is limited.

With the start of the Productive Safety Net Program, compensations in cash rather than kind - Cash-for-Work (CFW) - were introduced as a complement to the Food-for-Work program. In 2005, around half of all districts participating in the Productive Safety Net Program planned to pay recipients in cash rather than food, although regional differences were large. Among Tigrayan districts, Food-for-Work is by far the most common method of transfers (Gilligan et al., 2008), although the PSNP guidelines state that compensations in cash should gradually supplant payment in food (Brown et al., 2006). While cash transfers are easier to administer and distribute, serious concerns have been raised about their appropriateness in areas where food markets are thin and there is a large degree of price fluctuation (Kumar & Webb, 1995). Recent research from Ethiopia indicates that higher impact on poverty reduction is obtained by the combination of payments in cash and in food than by Cash-for-Work alone (Devereux & Sabates-Wheeler, 2010).

2.2 The Ethiopian education system

The current Ethiopian education system is rooted in the Education and Training Policy (ETP) formulated by the Ministry of Education in 1994. The structure was changed to a 4-4-2-2 system, in which the first two periods are the two cycles of primary school, followed by the first and secondary cycles of secondary school (World Bank, 2005). Targets were set for achieving universal primary education by 2015, in accordance with the Millennium Development Goals. To achieve this goal, five year programs for the educational sector were initiated in 1997, and the last cycle is set to finish in 2016. Primary education is compulsory for children of 7 to 13 years of age (Oumer, 2009), corresponding to Grades 1 through 8 with normal progression, although this is not universally enforced (UNESCO, 2011a). In recent

years, the Ethiopian government has made development of higher learning institutions a priority, and the country houses 31 state universities to date (MoE, 2011).

To encourage school participation, primary school fee abolition was integrated in the Ethiopian Poverty Reduction Strategy Paper in 2002, and matched by a compensated increase in public funding for schools (Oumer, 2009). The education sector is partly funded through Protection of Basic Services (PBS), a cooperative effort between foreign donors and the Ethiopian government initiated when budget support was discontinued after a disputed election in 2005 (Oumer, 2009).

Specific measures are integrated in the national strategy for economic growth and poverty alleviation. In accordance with the Plan for Accelerated and Sustained Action to End Poverty (PASDEP), investment in the sector is focused on increased enrolment at all levels, in addition to improving quality of teachers through the Technical and Vocational Education and Training Program (TVET) (MoFED 2006). As a result of the increased effort following implementation of the PASDEP, there was a surge in enrolment in 2005-2006 (UNDP 2010).

2.3 Study area

Tigray is the northernmost region of Ethiopia, and is divided into four zones, which differ regarding rainfall variability and arability of the land. Inhabitants in the Southern zone have larger farms, on average, and higher wealth when measured in oxen holdings (Hagos & Holden 2002). The zone encompasses the regional capital of Mekele. Prior to the introduction of the Productive Safety Net Program, the Central and Southern region had the highest ratios of Food-for-Work participants. Access to credit for consumption was highest in the Western region. For the subsample residing in this region, schools were only constructed in the 1990's (Hagos & Holden 2002).

The population of Tigray mainly reside in rural areas; less than twenty per cent were listed as urban residents in 2007 (PSC 1997). More than 4.3 million inhabitants resided in Tigray in 2007, and the population growth rate was 2.5 per cent, which is slightly lower than the national average. The average household size in rural areas is 4.6. The population is relatively homogenous, with the majority being ethnically Tigrayan and religiously Ethiopian Orthodox.

The region is regularly plagued by drought, and one third of the residents belong to the lowest wealth quintile in Ethiopia. The adult literacy rate for males was 67.5 per cent according to the 2007 census (PSC 1997), while the corresponding rate for females was 33.7 per cent.

The main income generating activity is mixed-crop livestock farming, and there are few opportunities for income diversification. The cash constraint is thus thought to be significant. There is a general lack of means of transportation, which means inhabitants rely on pack animals and walking (Bezu & Holden, 2008). Due to a high degree of simultaneity of decisions caused by limited variation in income generating activities, markets are thin (Hagos et al., 2002).

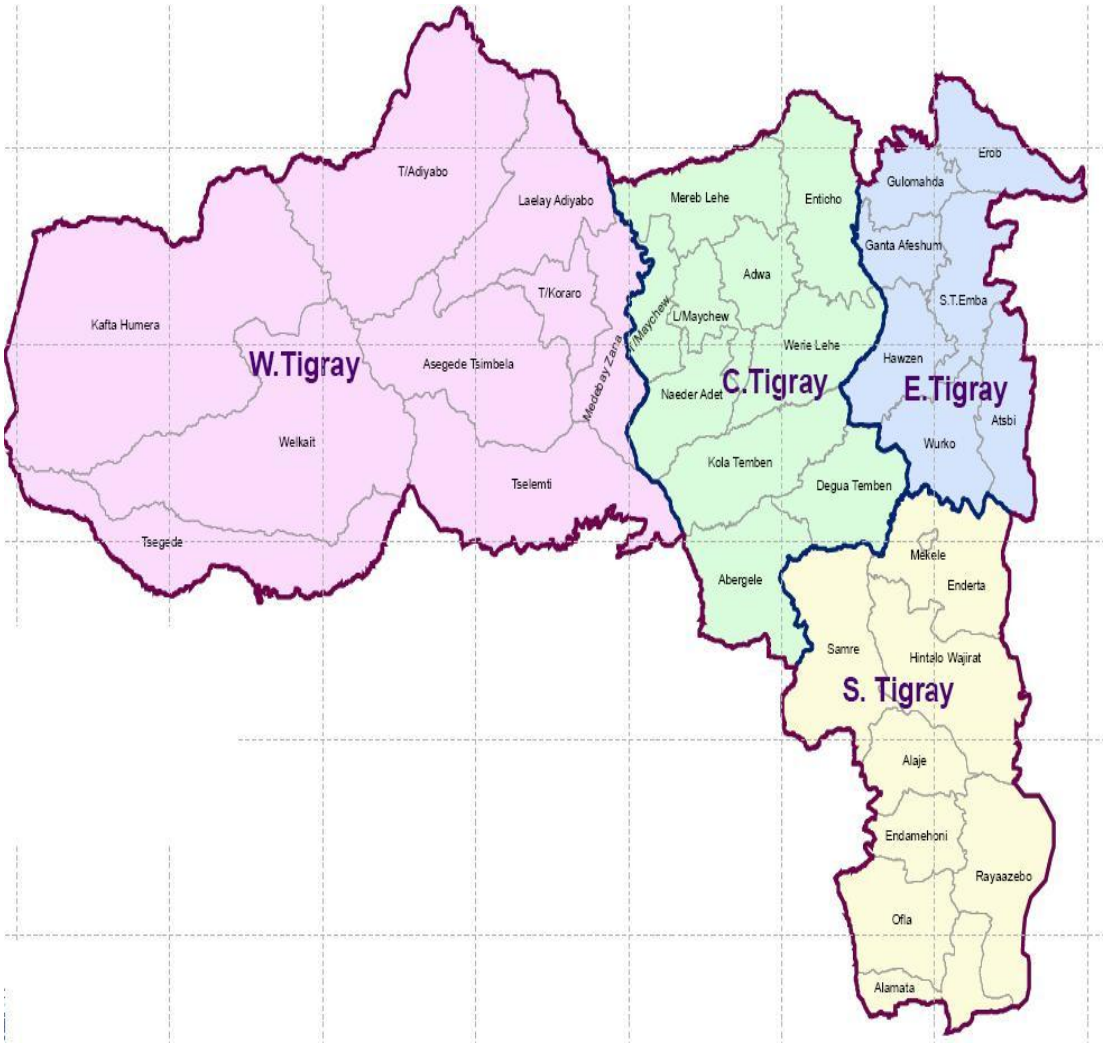

Figure 2.1 Map of Tigray

3. LITERATURE REVIEW

A multitude of factors are expected to affect the decision to send children to school, including household wealth and individual and household characteristics. In addition, expected returns to education and costs will likely play a nontrivial role. The factors that are most relevant to rural households in Tigray are discussed here, with special emphasis being given to Food-for-Work participation and the role of labor endowments.

3.1 Food-for-Work

In-kind payments received through Food-for-Work might be consumed by the recipient household or sold to a third party (Devereux et al., 2006). Both options would be expected to ease the liquidity constraint of poor households (Bezu & Holden, 2008), thereby decreasing the demand for child labor. Child labor, in turn, is expected to be negatively related to human capital investment (Emerson & Souza, 2006), suggesting a decrease in child labor is expected to give an increase in education. Devereux et al. (2006) find that a significant share of recipients invest Food-for-Work payments in educational attainment, although Gilligan et al. (2008) note that the effect is partly muted by the lateness and variability of transfers. This research underlines the positive effect of increased participation in Food-for-Work, although the choice between work hours and actual payments as measurement of participation degree has all but trivial implications. Although payments should be done monthly and only as compensation for hours worked, empirical data show large discrepancies between hours worked and received amount (Gilligan et al., 2008). An additional challenge is that planned employment does not necessary equal actual employment, further decreasing stability of payment. Research by Gilligan et al. (2008), however, suggests the divide is smaller in Tigray than in other regions of Ethiopia.

In addition to the negative effect of income on the demand for child labor, dubbed the ‘luxury axiom’ by Basu & Van (1998), public work programs might have an opposite effect resulting from adult and child labor being (partial) substitutes. This ‘substitution axiom’ entails children and adolescents carrying more of the agricultural work burden as adult members of the household fulfill the work requirements of the public works program. A higher degree of participation can paradoxically lead to lower school participation. Gilligan et al. (2008) find evidence of both effects in Ethiopia when disaggregating school participation according to gender and age, with the added concern that variability and non-predictability of transfers

limits long-term investments. Food-for-Work participation has an additional effect in that it is designed to smooth consumption by providing income in the slack season. Research indicates that reduced volatility is correlated with less child labor (Dehejia & Gatti, 2002) and higher investment in human capital such as education (Flug et al., 2000). In addition to protection of private assets, and communal assets built through the program which benefit participants and non-participants alike, Food-for-Work recipients benefit from increased nutrition, although research suggests this effect is limited in the short term (Quisumbing, 2003).

As the Food-for-Work program targets poor, but able-bodied, households (MoARD, 2009) participation is expected to be endogenous. To avoid endogeneity bias, an instrumental variable approach should be applied (Wooldridge, 2009). The administrative criteria state that participants should belong to chronically food insecure districts and have experienced recurrent food gaps in the three years immediately prior to the introduction of the Productive Safety Net Program (Brown et al., 2006). Chronic food insecurity of a district would be expected to be matched by a higher prevalence of Food-for-Work participation in the village, given efficient targeting. The height-for-age z-ratio (HFAZ) is an alternative to the more commonly used Body Measurement Index (BMI) as a measure of historic food deficiency of the head of household. The advantage of HFAZ is that a lower ratio indicates food deficiency in formative years, rather than present-day food availability, and is therefore more robust to random variation (Blössner & Onis, 2011).

3.2 Gender segregated labor markets

In agricultural households, labor is one of the main assets. When labor markets are imperfect, as in Tigray (Barrett & Webb, 2001), initial allocation matters even more. With perfect markets, households can choose whether to rent in or out labor, or alternatively use only household labor, according to requirements. With imperfect markets, however, households are unable to rent in labor, no matter their wealth, meaning they are dependent on fulfilling their requirements with the work of the members residing in the household - partly or fully, depending on the degree by which the market for labor functions. This challenge increases further in areas such as Tigray where most inhabitants of any village are engaged in the same sectors of production. Even though ample labor might be available during slack season, come harvest there will be a labor shortage. With this insecurity tied to whether labor will be

available, households might question the ability to commit children to school for long periods of time.

In addition to considering general labor endowments, available labor should be disaggregated according to gender due to the segmentation of labor markets, which means male and female labor are only partial substitutes (Fredriksen, 2006). This occupational segregation can be explained by three distinct theories: neoclassical theory, which emphasizes effect through preferences and individual endowment of human capital; segmentation theory, which focuses on barriers between different sectors of the economy; and non-economic theory that stresses cultural norms and restrictions (Fredriksen, 2006). Although both the degree of segregation and which tasks are allotted to men and women differ (Fredriksen, 2006), a general tendency across countries is that women spend more time in the household (Boserup, 1970). Research from Tigray (Kong, 2010) confirms that non-economic theory more accurately describes the gender based occupational segregation that is still common. A household that has sufficient labor endowments to fulfill their requirements, then, might still be deficient in male or female labor, meaning a male or female child might still be difficult to spare.

Aggregation of labor according to age might reveal different effects on school participation based not only on the endowment of male and female labor, but also on the presence of male and female school-age children. Research related to the effect of household size on investment in education shows mixed results when disaggregated simultaneously by gender and age. Becker & Lewis (1973) introduced a framework in which there is a trade-off between the quantity and 'quality' of children, and assumed that the cost of one additional child increases with quantity when quality is held constant, and vice versa. An increase in household size, however, might also mean there are more children, and adults, to share the work, prompting Ponczek & Souza (2007) to consider the opposite effect.

3.3 Off-farm income

In areas such as Tigray where labor markets are assumed to be imperfect, and where the lack of variability in income strategies means there are issues related to simultaneity (where there is excess labor in agricultural slack season and lack of labor in agricultural high season), there tends to be limited availability of off-farm income generating options. With rationing of work, access to off-farm income might be endogenous rather than near-random as would be the case with well-functioning markets.

The effect of off-farm income on education will likely be affected by both the luxury and the substitution axiom in the same manner as Food-for-Work. Research seems to support the notion of opposing effects: Khanam & Ross (2005) find a positive effect of household income on children's education in Bangladesh, although effects differ according to whether employment is motivated by 'pull factors', such as higher return, or 'push factors', such as inadequate farm output (Reardon, 1998). Heath & Mubarak (2011) highlight the importance of pull factors when comparing the effect of increases in demand for educated labor to school-related transfers.

3.4 Household characteristics and endowments

Even in countries where primary schooling is compulsory, as in Ethiopia, it is the parents/guardians that ultimately decide on whether the child attends school or not. Characteristics of the main decision maker within the household are thus expected to have a significant effect on preferences, in addition to constituting endowments. Preferences can partly be gathered through observing actions, but as research shows there might be significant discrepancies between revealed and stated preferences due to constraints (Urama & Hodge, 2005). Thus supplementary indicators might prove valuable.

Among the variables expected to affect preference for, and ability to, educate children are gender, own level of formal education and age of the household head. The level of formal education of the household head has been found to have a positive effect on school participation in earlier studies (Khanam & Ross, 2005). The effect of parents' education, however, is not necessarily homogenous across gender. Research by Fafchamps & Shilpi (2011) suggests educated mothers are more likely to wish for their children to attend school, regardless of the child's gender, while research by Lloyd & Blanc (1996) suggests the same positive relationship between female heads of households and school participation regardless of own education. Female heads have previously been expected to be more resource constrained, which would counteract this effect, although research suggests this perception should be further explored (Dercon, 1999; Joshi, 2004). Education of the household head affects household endowments as well as preferences, as research suggests a positive effect of income of the household head both on family income (Aikaeli, 2010) and on the nutritional status of children (Al-Herbish et al., 2010).

The age of the household head can be expected to affect the decision to educate children both through the effect of generation-specific preferences , through income, as household endowments are accumulated over time (Nwaru et al., 2011), and through life-cycle related preferences: As educated children might be better equipped to care for their parents (Raut & Tran, 2005), and older parents see their own dependent days as more imminent, this suggests a positive relationship between age and investment in schooling (Mauldin et al., 2001).

In addition to characteristics of the household head, common endowments of agricultural households are land, animals and labor. Research indicates that the luxury and substitution axioms of Basu & Van (1998) contribute to a wealth paradox with regard to the effect of land holdings on children's education (Bhalotra & Heady, 2003; Fan, 2011). Land holdings are sticky in Ethiopia, due to a system of land distribution based on administrative criteria rather than an open market. In addition to this initial inflexibility, the rental market is not efficient (Alemu et al., 2007). As a result, landlords might be poorer in Ethiopia than elsewhere (Holden, 2008) and the luxury axiom might be of limited applicability, though still significant. The wealth paradox will be likely to hold for livestock holdings as well, as younger children often take on the role as animal herders in Ethiopia (Roschanski, 2007). The net effect, then, is an empirical issue, prompting Nkamleu (2006) to suggest using quality of housing as an indicator of wealth. Quality of housing is likely to be correlated with household income and wealth, but as it is not a productive asset, it should have no substitution effect.

3.5 Costs of schooling

School fees were abolished for primary education in 2002 (Oumer, 2009), paving the way for a surge in enrolment (JRM, 2006). Secondary school fees, however, still remain and school books and uniforms need to be privately funded. Regardless of the abolishment of certain official fees and costs, various charges are retained, such as voluntary contributions both in cash and in kind. These 'fee creeps' (Oumer, 2009) often increase when formal fees are abolished, and dropout rates can increase as a result (JRM, 2006). Similar challenges regarding the abolishment of school fees have been reported from Ghana, Kenya, Malawi and Mozambique (World Bank, 2009).

In addition to the explicit costs mentioned above, there is a significant opportunity cost of schooling in countries where child labor is prevalent. These opportunity costs are often particularly high in rural areas such as Tigray, where labor markets are inefficient and labor is

mainly agricultural (Oumer, 2009). The costs tend to increase with age, as children become able to perform other tasks in the household, and on and off-farm. For girls, the opportunity costs increase further as marriage becomes an option (Admassu 2008). Both monetary and opportunity costs increase with the distance to school (Admassu, 2008; Schaffner, 2004), and girls are adversely affected as concerns for their safety means they are less likely to be enrolled (Rihani, 2006). Research from Ethiopia (Admassu 2008) confirms that these risks, especially related to sexual violence, are perceived as increasing with age.

3.6 Return to education

Investment in human capital, like other investments, depends on expected return. The expected return to education, in turn, relies on several factors. Schaffner (2004) underlines the effect of perceived quality of education, and finds a positive and significant correlation with school participation. This finding is of particular relevance for Ethiopia, where the recent abolishment of school fees led to a surge in enrolment, which in turn contributed to a decrease in perceived quality (Plank, 2007). This indicates that one possible effect of the surge in enrolment mentioned in section 2.2 could be followed by a decrease in the mid-to long term.

In addition to quality, the demand for labor necessarily affects the expected return. This expectation is supported by research from Bangladesh, where demand for educated labor is found to have a strong and significant effect on girl enrolment (Heath & Mubarak, 2011). This finding, in turn, suggests that pull factors might be more important than previously expected. Glick & Sahn (2000) further explores the issue of expected returns by finding that return to education is lower for females than males, supplementing the difference in opportunity costs mentioned in section 3.5 as a determinant of which child to prioritize.

Empirical studies indicate a gender differential in enrolment, progression and completion (Degnet & Andinet, 2008). In Tigray, this gender gap is slightly in favor of girls (Oumer, 2009), though it should be underlined that this is in relation to enrolment only. The findings of Nankhuni & Findeis (2003) from Malawi indicate girls are more likely to do other chores alongside school participation, which might lead to slower school progression and a higher rate of dropouts. Research from Ethiopia by Jones et al. (2006) confirms this expectation. A recent report from UNESCO (2011b), however, finds that girls are more likely to complete education in Ethiopia, suggesting an improvement in recent years. Nonetheless, the effect of individual characteristics such as age and gender in determining the outcome of intra-

household competition for educational resources should not be underestimated (Edmonds, 2006).

The relation to the household head has been found to be significant in previous surveys (Bhargava, 2007), with heads of household giving priority to their natural-born children. One reason may be that closer ties means the heads of households expect a larger share of the return to education, both in the near future and in old age. An alternative explanation is that most parents have a stronger emotional link to natural-born children, so that the effect on education is through preferences rather than expected return. Even though the prevalence rate of HIV/AIDS is low (UNAIDS, 2002), the share of orphans in Ethiopia is among the highest in the world, with 13 per cent of children missing one or both parents.

3.7 Income shocks

One of the objects of the Productive Safety Net Program is to hinder the asset depletion that can occur as a result of an income shocks. This depletion can take several forms, the most common of which are distress sales of assets or livestock, alternatively distress rentals in the case of land. Myopic behavior in the wake of a shock can also affect human capital.

The effects of recurrent income shocks on investment in children's education are twofold: while recurrent shocks might increase the willingness to diversify income (Barrett & Webb, 2001), it will simultaneously decrease the ability of the household to follow up on these preferences (Duryea et al., 2003). Research from Tanzania (Krutikova, 2010) indicates that adolescent girls and younger boys are affected adversely by shocks in rural households.

3.8 Measuring investment in education

Education is a concept that cannot easily be measured accurately, as it encompasses a large number of factors. Several variables, however, can serve as indicators of the decision to invest in education, the most common of which are enrolment, current school participation, progression and completion (Cockburn & Kabubo-Mariara, 2010). The quantitative measures obtained will likely differ among the four, and they often display varying estimates when disaggregating across gender and age (Degnet & Andinet 2008; Schaffner, 2004). Enrolment will ordinarily yield the most optimistic figures, as it only indicates one-time enrolment.

Especially when (primary) enrolment is compulsory, as is the case in Ethiopia, incentives for initial enrolment might be substantial.

Current school participation is a slightly more demanding measure, especially if observations are available for an individual for multiple years. In addition to enrolment, the children must have schooling as their main occupation. School participation/current enrolment has a weakness in that is does not contain information about previous decisions (Schaffner, 2004). Progression measures whether individuals proceed at the intended rate, or whether they drop classes, or alternatively proceed faster. Progression necessarily depends on enrolment, but not on school participation – a common reason for delayed progression is temporary drop outs due to income shocks (Krutikova, 2010).

Completion of education is the most demanding measure, but less precise as it does not indicate what happens along the way. Ideally, the three latter measures will be used together, as they largely complement each other by containing different information, but this relies on a strong focus on education in the data collection process. Ultimately, the choice of outcome variable will depend on the available data (Schaffner, 2004).

The importance of quality of education should not be overvalued, though it is difficult to measure. Alternative measures are teacher-to-student, student-to-textbook and similar ratios (Plank, 2007), although these are rarely publicly available at a village-disaggregated level for rural economies. As previously indicated, quality is implicitly included in all the education measures listed above, as parents are unlikely to invest if the quality is perceived as insufficient (Schaffner, 2004).

4. THEORETICAL FRAMEWORK

Academic literature on poverty and poverty traps has increasingly centered on an asset-based, rather than income-based, approach, to better differentiate between stochastic and structural poverty (Barrett & Carter, 2006). Incorporating Food-for-Work and similar safety net programs in this framework entails looking at the effects of these transfers, and of the work requirement which sets them apart from their direct aid counterparts, in building and preserving assets.

Considering investment in human capital, specifically investment in education, it might be helpful to envision two separate income-generating options: the first, $F_u(L_u, K, A)$, is a more traditional set of activities including farming and seasonal dependent off-farm work in short supply; the other, $F_e(L_e, K, A)$, is an option depending on a certain level of education. It should be noted that this level need not be high to make an impact. Research suggests that even limited education increases productivity by enabling subjects to make written plans for production, store records, defend their property rights and introduce productivity enhancing measures. In accordance with the research of Weir (1999), the 'educated' path need not be off-farm. L denoting land is thus included in both production functions.

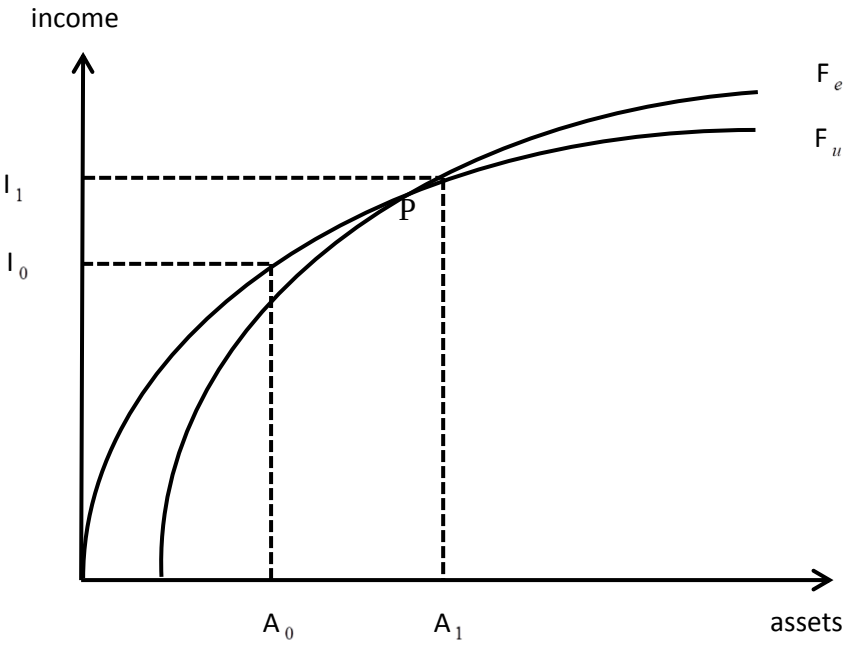

Figure 4.1 Potential effects of education on income path

The point P in the figure represents the poverty trap as outlined by Barrett & Carter (2006). Because of limited access to credit, poor households are reluctant or unable to invest. Were they enabled to do so, however, they might be able to move from the current production function F_u to option F_e, which is both higher-yielding and less dependent on the varying returns of the land.[1] Food-for-Work and other similar programs constitute one such means of enablement by allowing the movement from A_0 to A_1.[2] The investment decision of the household will be analyzed within the framework of the agricultural household model, as outlined by Singh et al. (1986).

In agricultural households, a majority of households produce partly for sale and partly for their own consumption, and markets for labor, land and credit are assumed to be thin or nonexistent (de Janvry et al., 1991). The model is thus non-separable (Bardhan & Udry, 1999), meaning production and consumption decisions must take place simultaneously. Education is incorporated in the decision model in accordance with the seminal work of Becker (1965). Angemi (2011) incorporates child labor in the agricultural household model, after estimating that 40 % of African children between the ages of five and fourteen participate in the labor force.

Before proceeding to outlining the hypotheses, a note should be made regarding the decision making process. Although only the preferences of the household head have been mentioned explicitly, it should be underlined that the household unit consists of individuals with different utility functions, and diverging means of following up on their preferences. The intra-household bargaining process has long since become an object of debate, and the applicability of the household as a single decision-making unit challenged (Deadman, 1990). Acknowledging this debate while underlining that it lies outside of the scope of this thesis, the decision-making process will be sidestepped as a 'black box' (Cherchye et al. 2005). The only matter of interest, then, is that a decision is made – not how.

[1] In this figure, the time element of the decision to educate is underplayed. An investment in education does not lead to an instant movement from one production function to the next, and the time period from the initial investment is initiated until it bears fruit might be substantial.

[2] It should be noted that it is by no means given that even a large increase in assets leads to a move from one income option to the other – without knowing the production function or the exact location of the poverty trap, this remains an empirical issue.

5. RESEARCH QUESTION AND HYPOTHESES

5.1 Conceptual framework

As outlined in the introduction, two research questions underlie the hypotheses soon to be stated, namely:

i) How does household participation in Food-for-Work affect school participation?
ii) How does household labor endowment affect school participation?

These questions will be analyzed within the two-stage conceptual framework outlined below. As seen from the literature review, there are a multitude of factors that might be expected to affect investment in education, and these will have to be controlled for in order to isolate the ceteris paribus effects of Food-for-Work participation and labor endowments on investment in education. The relationship between the different variables is presented graphically in two steps, where Stage 1 presents the different factors that affect, and are affected by, participation in the Food-for-Work program. The thicker arrows represent the effects that will be specifically addressed in the econometric analysis, as outlined in the literature review.

Geographic location necessarily affects off-farm income options, as it entails distance to markets, climate and distance to urban areas. Characteristics of the household are affected only through the formal education level of the household head – as mentioned in the background on the study area, districts differ on the basis of when schools were constructed, among other things, both of which are expected to have affected education. The same holds for household endowments, as districts exhibit differences in average farm holdings and average family sizes, and for community level food insecurity as the climate varies across the four zones. These factors, in turn, affect whether a household participates in the Food-for-Work program, and to which degree.

Conceptual simplicity necessarily entails some loss of specificity. Special note should be made of the time recursive nature of the FFW program, and the multiple entry points. Household endowments are related to characteristics of the household head, and both are expected to affect, and be affected by, off-farm income options, which will all affect Food-for-Work participation. Due to the simplifications undertaken to ease graphic representation, these figures should not be seen as exhaustive in the analysis of Food-for-Work participation or education.

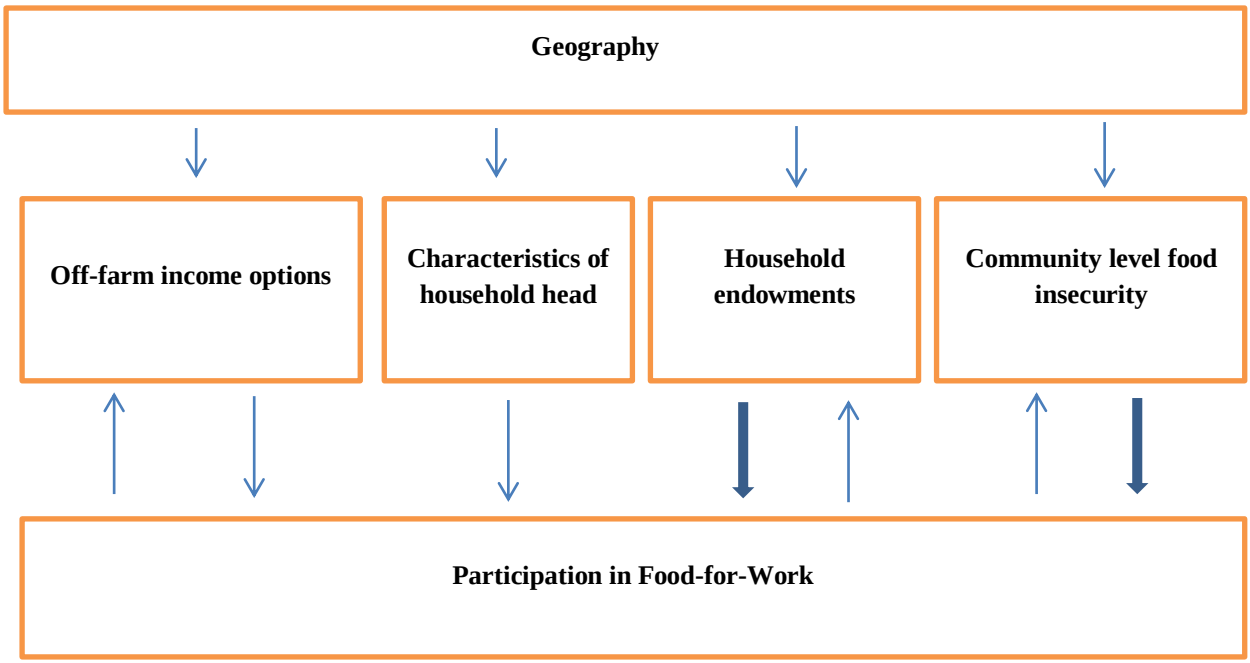

Figure 5.1 Factors affecting, and affected by, Food-for-Work participation (Stage 1)

Stage 2, meanwhile, represents the factors affecting the investment decision, among them participation in the FFW program. Stage 1 details the effect of Food-for-Work on ability to invest. Double arrows, again, indicate the effects that have been touched upon in the literature review, and will be further analyzed. This stage is perhaps more difficult to grasp due to the sheer number of variables, but the reasoning is the same as in stage 1: geographical location affects FFW participation, and household endowments, among others, which again affect the ability to invest. Preferences, the ability to invest and expected returns together determine investments in education. Preferences are unobservable, but some indicators have been outlined in the literature review. Returns to education are not unobservable, but expected returns to education for any given child are difficult – if not impossible – to estimate. This is more of a conceptual framework, then, in order to help organize the ways in which different effects affect the investment in education, rather than a specification of the analysis ahead.

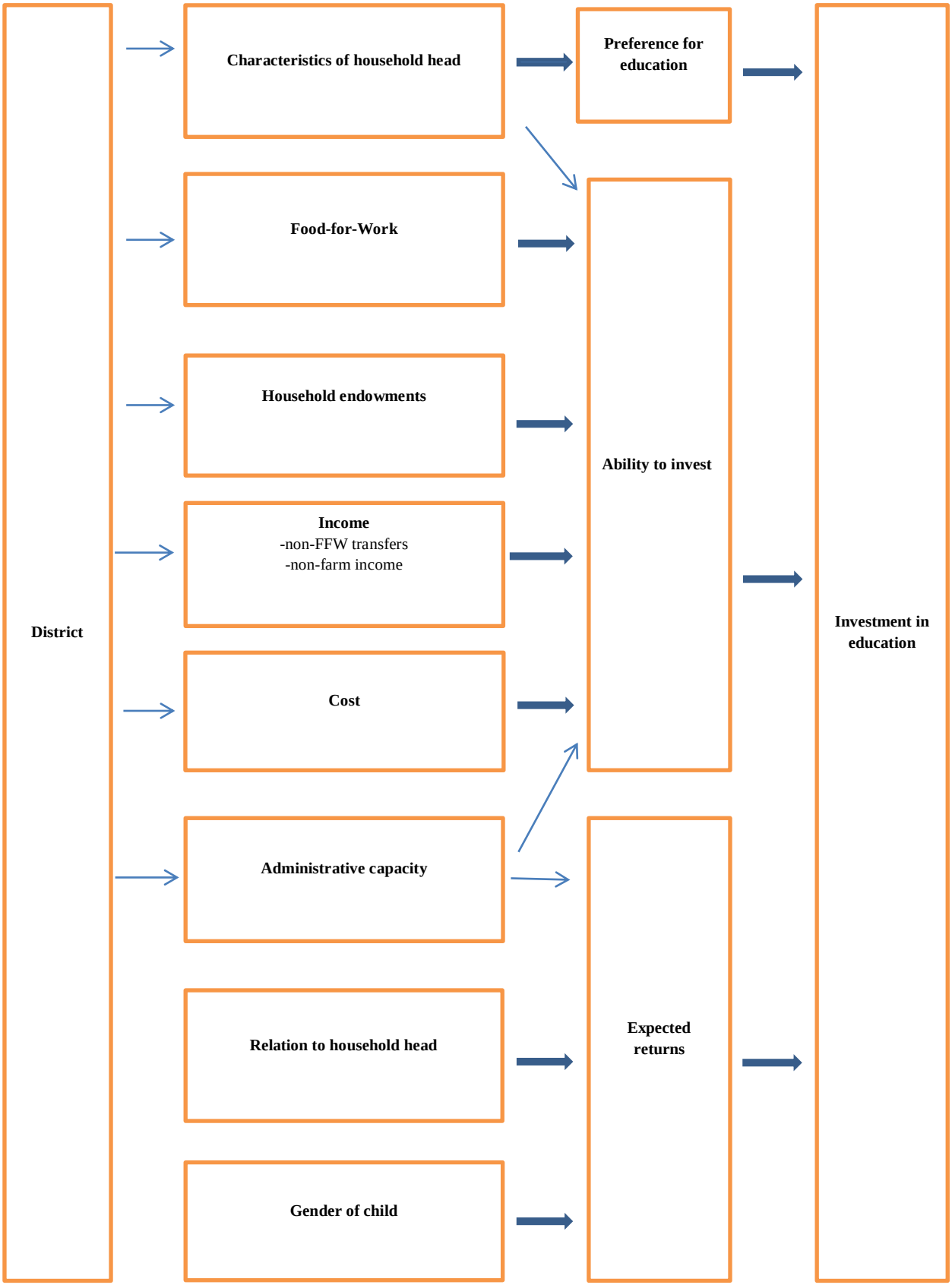

Figure 5.2 Factors affecting school participation (Stage 2)

5.2 Hypotheses

Two hypotheses spring out of the first of the research questions above, namely how household participation in Food-for-Work affects school participation. The luxury paradox outlined in the literature review postulates that the investment Food-for-Work participation presents an increase in real income. In addition, the regularity of compensation should offer increased stability of expected income, thereby easing long-term investment. Increased and less variable income is expected to have a positive effect on education, assuming education is a normal good.

H1a: Participation in Food-for-Work has a positive effect on school participation

Food-for-Work payments per capita per days worked in participant households are by design identical. The degree of participation, however, may differ – either due to supply constraints or factors affecting demand, and is expected to affect school participation primarily through easing the income constraint.

H1b: The degree of participation in Food-for-Work has a positive effect on schooling

Income is not the only constraint that might affect investment in education – access to labor is also related to the decision to send children to school. Labor endowments are expected to affect school participation for two distinct reasons: labor is an asset, which indicates that labor-rich households should send their children to school because of the income effect. The second reason is related to the prevalence of child labor: because children contribute to the labor endowment of the household, time spent at school has an opportunity cost. The expected return from education, however, is in the future, meaning there is no immediate compensation for time spent in school. Although some of this effect can be cushioned by a decrease in leisure, rural children are not expected to have enough leisure initially to fully compensate for time spent at school. Households that are well endowed in labor will have less need for any additional unit of labor, thus allowing for school attendance.

This second issue of labor constraint is closely related to Food-for-Work participation, which has work requirement as a central component. Although the income effect is expected to be positive, as postulated in hypothesis 1a, the effect through tightening the labor constraint might well be negative in the short run. The higher the initial labor endowment, the less

binding will be the restraint, all else equal.[3]

H2a: Adult equivalent units of labor per capita have a positive effect on school participation

Exploring the issue of labor endowment further, adult equivalent units are not expected to be perfect complements across genders. Some tasks are traditionally performed by men, while others are almost exclusively reserved for females. A household can have adequate labor measured in labor units per capita, but still be deficient in either male or female labor. Male children are expected to mainly contribute to tasks performed by male adults, whereas female children are expected to perform tasks reserved for women. Endowment of same-sex adult labor, then, is expected to have a positive effect in allowing for school attendance.

H2b: Male labor endowment has a positive effect on school participation for boys

H2c: Female labor endowment has a positive effect on school participation for girls

Table 5.1 Overview of hypotheses

Outcome measure:		School participation		
Years in sample:		Both years		
Ages in sample:		Age 6-20		
Effect on:		All	Boys	Girls
Effect of:	Hypotheses:			
Food-for-Work (participation)	H1a	+	+	+
Food-for-Work (degree of participation)	H1b	+	+	+
Labor per capita	H2a	+	+	+
Male adults	H2b	n.a.	+	
Female adults	H2c	n.a.		+

n.a. means 'not applicable', information on the effect will not be apparent by the proposed methods. A blank, on the other hand, means information can be gathered but that no hypothesis has been made regarding the sign.

[3] Whether all else will be equal when labor endowment per capita changes is an empirical issue. It is not unlikely that labor rich households chose labor intensive industries. As markets for land and labor are sticky, however, and a vast majority of the households are mixed crop-livestock farmers, this issue will be disregarded in the analysis to come.

6. DATA AND METHODS

6.1 Data collection

The data were collected in the months of June, July and August 2006, and June and July of 2010. The data contribute to a five round panel starting in 1998. Initial stratified sampling was done on the community level, ensuring that all four of the Tigrayan zones were represented, and using criteria of distance to market, population density and access to irrigation. By this sampling process, 16 communities were chosen, and 25 households were randomly selected from each community (Hagos & Holden, 2002). Fifteen of these communities remained in the panel throughout the five rounds.

Data were collected on both household and community level, and each participant household was compensated in coffee, fertilizer or cash at the end of each round. Mainly data from the household questionnaire are used in this survey, the exception being land per capita where the household land holding, aggregated over plots, was obtained from the plot level questionnaire.

6.2 Definitions

The dependent variable, school participation, is a dummy variable which takes the value 1 if the main occupation of any given child was studying and 0 otherwise. The subsample of individuals is restricted to those who were of school age throughout the survey period. The lower age limit is set at six years, while the upper limit is set at 20 years. There are challenges related to both limits. Official age of starting school is seven years, so one year is added as a buffer. It should be noted that some children in the data set were registered as students even when below this limit. This could be caused by misreporting of ages, or alternatively misreporting of occupation. The actual cause cannot be gathered from the data material, so the official lower limit will be maintained. Likewise, individuals might be registered as students even above 20 years of age. This might be due to misreporting of age or occupation, because of delayed progress, or because they have continued higher education past 12th grade. The latter explanation does not seem likely for these particular study sites, as none of them are close to institutions of higher learning. Individuals attending colleges or universities, then, are not likely to reside in the household at the time of studying. Among the other three possible explanations, no conclusions can be drawn.

The most significant challenges regarding the outcome variable are those of wrongful data entry, misunderstandings and (partly) intentional misreporting of occupation due to primary school being compulsory. The prevalence of such misreporting is difficult to estimate, as occupation was not observable for the survey teams. It should be noted, however, that cases of intentional misreporting were uncovered for observable variables[4] due to misalignment of incentives.

Food-for-Work participation will be indicated by two measures: Recipient status as a binary variable, and the degree of participation. Whereas the first measure is self-explanatory, the second measure is non-trivial. As mentioned in the literature review, actual compensation may not be equal to planned compensation by hours worked. These two measures, then, are not necessarily equivalent. This would not present a problem if all recipient households participated to the maximum degree of 5 days per month per household member in January through July, and if compensation was accurate, meaning all household received exactly the going rate. In that case, the choice of measurement, whether hours worked or food received, would not have any implication for the regression. As it is, however, both degree of compensation and the de facto wage rate per day worked differs (Gilligan et al. 2008), and the two measures will not necessarily be equal. Because the effect on the income constraint is expected to depend on the amount received rather than the amount earned, the former measure of compensation received will be applied. The households sampled were requested to estimate the monetary equivalent of the food received, and thus Ethiopian Birr will be the unit of measurement.

On the basis of previous research outlined in the literature review, several variables were constructed using a combination of secondary and primary data. These variables are as follows:

Tropical Livestock Units per Capita

The index was constructed using a standard conversion table (Jahnke, 1982), before being divided by the household size.

Adult Labor Units per Capita

The index was constructed using a standard conversion table (Barrett et al., 2002). It should

[4] Animal holdings, one of the initial wealth indicators used when assigning Food-for-Work, were at times misreported. Mistakes were uncovered because the animals sighted at the time of survey far exceeded the number of animals reported. Likewise, health extension programs in the region had provided financing for toilet huts, and as a result several households reported having built toilet huts even when none existed.

be noted that no distinction is made between male and female labor, which might be counterintuitive. Even though females are less physically strong, however, data indicate that they work more hours per day (UNICEF, 2007), so that one working day might be equivalent across genders.

*Quality of hous*ing

Three categories in the questionnaire refer to the quality of house, namely whether the household has a kitchen hut, a toilet hut, and the number of corrugated iron roofs. A rough index is made from these measures, simply adding them up and dividing by the number of categories. The higher the value of the index, the better quality is the house.

Program prevalence in the village

A questionnaire was designed for village level administrators, asking for the names of Food-for-Work participants in each village. These data, however, were not consistently gathered, and the surveyed administrators rarely reported having written records to verify recipients. As an indicator of these figures, then, the following index was created:

$$y_{hv} = \frac{p_v - t_h}{n_v}$$

The dependent variable is the program prevalence in the village adjusted for the participation status for household h. p_v indicates the number of program participants in the village, t_h is a dummy indicating the treatment status of household h, subtracted to avoid endogeneity of this variable, and n_v is the number of household in the village that are included in the sample. This index, then, is normalized between 0 and 1.

Height-for-Age Z-ratio

Anthropomorphic measures were only recorded in 2010. As children of school age are still in their formative years, and the variable would thus be endogenous to FFW participation, the ratio for household heads was utilized as an approximation. Previous research from Ethiopia (D'Amatop, 2001) indicates a close relationship between the ratio of male household heads and that of children residing in the household. As most household heads in the sample are male, this suggests the ratio might be applicable as an indicator of current family food insecurity.

To construct this ratio, household heads were separated by gender and divided into five intervals based on age. The width of these intervals was set to 15 years, roughly the

equivalent of one generation in Tigray (UNFPA, 2008). Because large databases are only available for children, the means and standard deviations are constructed from the sample only. The formula used was

$$y_{hh} = \frac{h_{hh} - \bar{h}_g}{SD_g}$$

where the dependent variable is the ratio for the head of household h, h_{hh} is the height of head of household h, $\bar{h}_g$ is the mean of group, or interval, g, and SD is the standard deviation for interval g.

6.3 Descriptive statistics

For further analysis, it is useful to note certain characteristics of the households in the sample. Differences between FFW participants and non-participants will receive particular attention. Where the number of observations in one group differs for between variables, this is due to missing information. This could potentially cause bias, but as the number of households with missing information rarely surpasses two or three, this matter will not be pursued further.

A few relevant factors from table 5.1 should be noted: Around 59 per cent of all households with children of school age are Food-for-Work participants. The distance to the nearest primary school is on average only half an hour away, whereas the average distance in minutes to a secondary school is around 99 minutes, or about three times as far away. More than 75 per cent of all household heads are male, and they are not likely to have received formal education. On average half of the participants in every village participate in Food-for-Work. The average worker units per capita is 0.65, meaning that around one third of household members are dependent.

Recipients of Food-for-Work, on average, have less endowment of wealth, both in terms of the quality of housing and tropical livestock units. The households are larger in terms of number of inhabitants, they live farther away from schools and have less work opportunities. This suggests accurate targeting. Recipients are more endowed in male labor, partly reflecting that the household head is more likely to be male. This latter point follows from the fact that female-headed households are among the explicit target groups of Direct Support. Surprisingly, heads of recipient households tend to be more educated, with a higher height-

for-age z-score and higher likelihood of having access to consumer credit. These latter findings might be caused by weaknesses in the data, or by incorrect targeting.

Table 6.1 Characteristics of households with children in age group 6-20

	All		Participants		Non-participants	
Variable	Obs	Mean	Obs	Mean	Obs	Mean
Food-for-Work (1=yes)	262	.59	n.a.		n.a.	
Household size	262	6.12	154	6.15	108	6.09
Adult Labor per capita (index)	261	0.66	153	0.65	108	0.67
Land per capita (tsimdi*)	262	0.83	154	0.82	108	0.86
Distance to primary (minutes)	262	29.73	154	30.83	108	28.15
Distance to secondary (minutes)	260	99.19	153	106	107	89.49
Access to non-farm labor (1=yes)	262	0.36	154	0.33	108	0.39
Male adults 20-65 (number)	262	1.3	154	1.33	108	1.25
Female adults 20-65 (number)	262	1.37	154	1.36	108	1.38
Male adolescents 12-20 (number)	262	0.59	154	0.55	108	0.64
Female adolescents 12-20 (number)	262	0.54	154	0.51	108	0.6
Male children 6-12 (number)	262	0.56	154	0.6	108	0.49
Female children (6-12) (number)	262	0.56	154	0.54	108	0.58
Tropical livestock units per capita (index)	262	0.51	154	0.48	108	0.55
Quality of housing (index)	262	0.54	154	0.5	108	0.59
Age of household head	262	52.64	154	52.65	108	52.62
Gender of household head (1=male)	262	0.77	154	0.79	108	0.75
Formal education of head (ordered^)	261	0.14	153	0.14	108	0.13
Height for age z-score (ratio)	241	0.05	138	0.07	103	0.03
Access to consumer credit (1=yes)	262	0.04	154	0.04	108	0.03
Prevalence of Food-for-Work in village of residence (ratio)	262	0.49	154	0.57	108	0.37

* 1 tsimdi=0,25 hectares
^0=none, 1=primary, 2=secondary

Table 6.2 Characteristics of children 6-20

Variable	Observations	Mean	Standard Deviations	Min	Max
Student (1=yes)	1261	.385	.487	0	1
Age	1261	12.785	4.094	6	20
Gender	1259	.546	.498	0	1
Child of head (1=yes)	1261	.941	.237	0	1

Thirty nine per cent of the children of school age are students. Slightly more than half the children of school age are boys, and close to 95 per cent are children of the household head. Roughly the same percentages are maintained when disaggregating by age (above or below 12 years of age) and by gender.

School participation is expected to vary by age, and might display a gender differential either generally or according to the age. Examining Figure 6.1, several factors deserve closer attention.

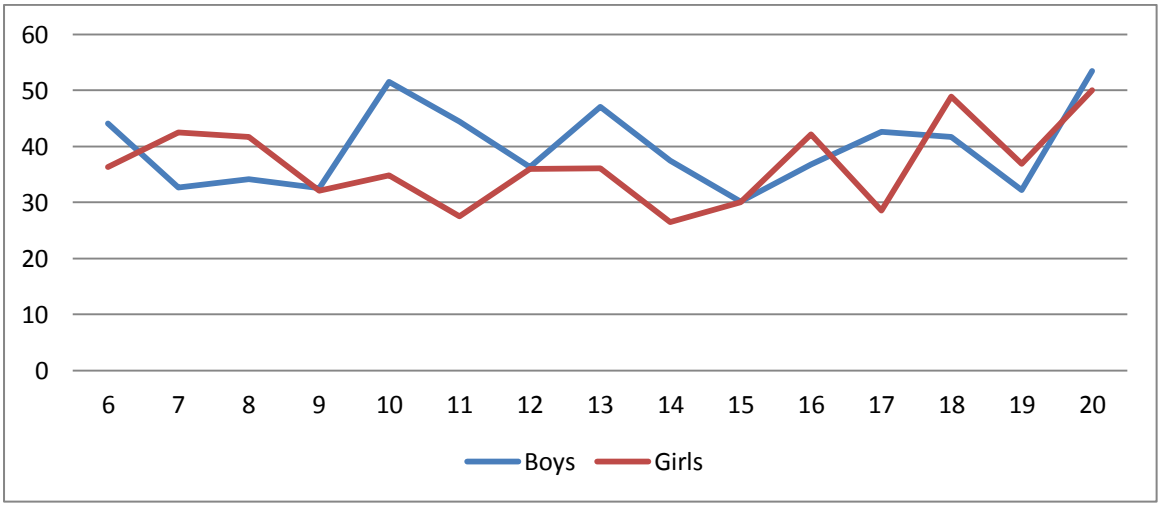

Figure 6.1 School participation according to age and gender

Girls, on average, start schooling slightly later than boys, but are more likely to be students through primary first cycle. A larger percentage of boys are enrolled until the age of 15, when they begin the second cycle of secondary school. As percentages for girls approach those for boys for late teens, three explanations arise: girls might not report being full time students in the age echelon from 9 till 15 or they might be significantly delayed. Age was among the variables that exhibited the largest degree of data weaknesses, and this should be kept in mind when inferring from these results.

Hypothesis 1a is that Food-for-Work participation will have a positive effect on school participation. When mapping education against participation status and age certain patterns appear, as seen from figure 6.2.

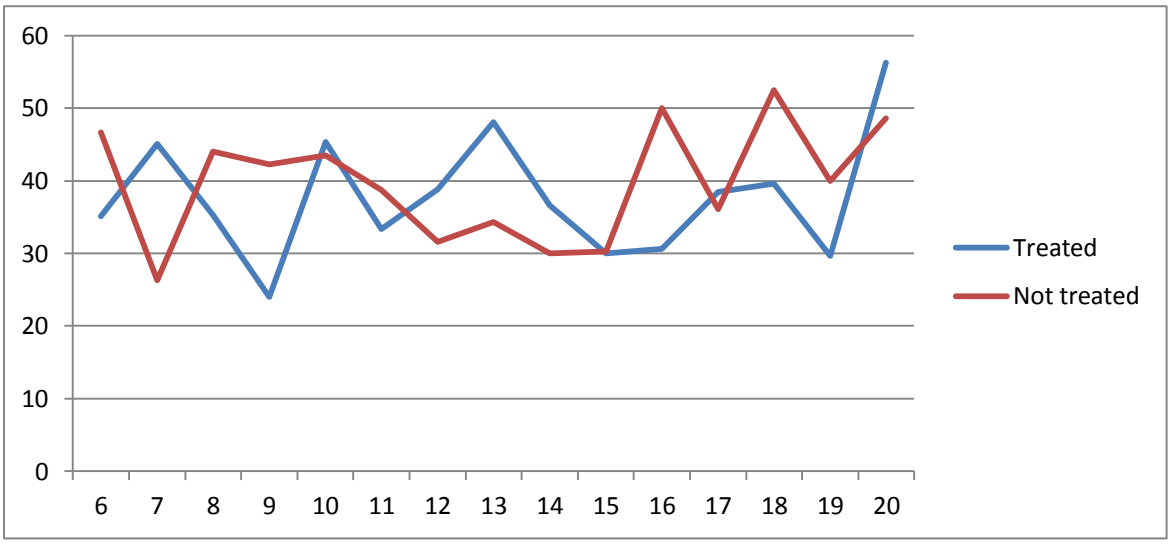

Figure 6.2 School participation according to age and treatment status

Those participating in the Food-for-Work program are more likely to enroll late, to be students between the age of 11 and 15. The picture is inverted between the ages of 15 and 19. Because of the limited length of the panel, these might be coincidental trends due to macroeconomic events such as major drought, policy interventions or similar. There was a drought in 2002-2003, the consequences of which might have included a delayed start and an increased rate of drop-outs. The drought might have affected the recipients adversely because of the endogeneity bias.

Several factors are expected to have varied between 2006 and 2010, and the changes might have affected FFW recipients in a different manner. Mapping school participation against year and treatment status as in figure 6.3 displays these trends.

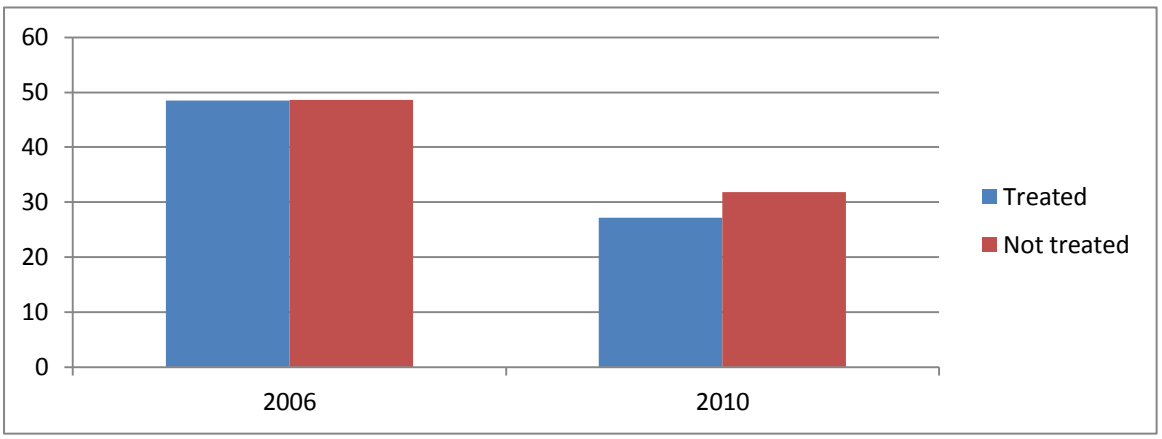

Figure 6.3 School participation according to year and treatment status

Unexpectedly, there seems to be a smaller percentage attending education both among the treated and non-treated. This might be a sign of normalization to pre-2005 levels after the surge in enrolment in 2005-2006. Alternatively, it might be caused by decreased enrolment as a direct result of a decrease in quality, in line with Plank (2007). Perhaps more difficult to explain is that the gap between school participation rates for receivers and non-receivers seems to widen between 2006 and 2010. This gap might have existed pre-2006, but could have been masked by a stronger enforcement of compulsory education at primary level, or alternatively, a stronger tendency among households to report enrolment. The underlying reason cannot be grasped from these data alone.

In addition to participation status, the degree of participation in the Food-for-Work program is likely to matter for education. Mapping school participation against cash equivalent per capita of food compensation received, the following pattern emerges:

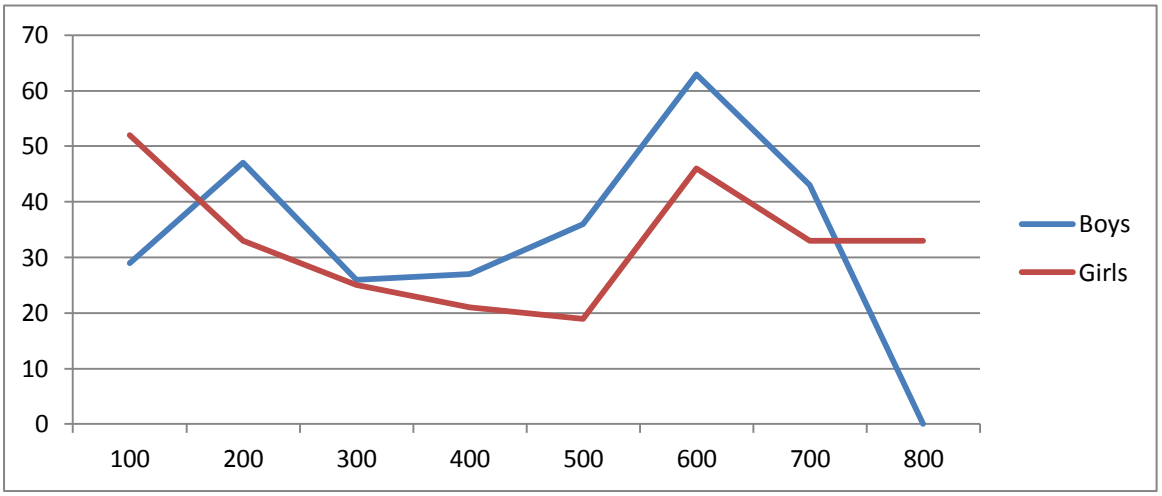

Figure 6.4 School participation and the degree of participation in Food-for-Work

It can be seen from this figure that school participation decreases for values of Food-for-Work up until a money equivalent value of around 500 Ethiopian Birr per capita, where school participation sharply increases, before reaching a peak value at around 600 Birr before decreasing. It might be that the second positive effect is due to the insurance element of FFW participation, where participation protects against volatility thus enabling investment in assets, before the negative effect through the work requirement outweighs this initial effect. Only at high values, the income effect outweighs the work requirement effect. This, however, is only conjecture with a sample of this size.

6.4 Methods

As the data obtained are part of a panel, several approaches can be applied to control for unobserved characteristics. Participation in the Food-for-Work program suggests a Difference-in-Difference approach is applicable, where participant status is the treatment variable. The model can be specified by the following equation:

(i) $E_{iht} = \beta_o + \beta_1 H_{ht} + \beta_2 P_{iht} + \beta_3 Y + \beta_4 T_h + \beta_5 I_{ht} + \lambda_h + \lambda_t + €_{iht}$

E_{iht} is the outcome variable, school participation, which takes the value 1 if individual i in household h is a student in year t. H_{ht} is a vector of observable household characteristics of household h in year t, including asset endowments. P_{iht} is a vector of observable personal characteristics of individual i registered in household h in year t. Y is a year dummy, taking the value 1 for 2010. T_{ht} is a treatment dummy, taking the value 1 if the household is in the treatment group. I_{ht} is an interaction term combining the treatment and the year dummy, taking the value 1 only for those participating in the Food-for-Work program, and only for observations in year 2010. λ_h is the fixed effect intercept for household h and λ_t is the time specific fixed effect intercept.

The Difference-in-Difference approach has faced repeated criticism, mainly due to the likelihood of a bias in the estimated standard errors introduced by serial correlation, which leads to overly optimistic levels of significance (Bertrand et al., 2001). In addition, the method depends on having base data from strictly before treatment, and is vulnerable to interventions around the time of treatment. As will be further argued in section 5.8, neither of these two conditions hold in the strictest sense, which challenges the interpretation of the coefficient of the interaction term, β_5. To circumvent criticism of results based on methodology, I will compare the results to those obtained through a panel data approach.

Because the variable of most interest, participation in Food-for-Work, is time invariant, Random Effects is the preferred method of estimation. The model specification, then, is:

(ii) $E_{iht} = \beta_o + \beta_1 H_{ht} + \beta_2 P_{iht} + \beta_3 T_{ht} + \alpha_h + €_{iht}$

E_{iht} indicates school participation, H_{ht} indicates household characteristics and asset endowment, P_{iht} denotes personal characteristics and T_{ht} takes the value 1 if the household participates in Food-for-Work.

The crucial assumption for estimates obtained through Random Effects being consistent, is that unobserved characteristics α_h should not be correlated with the exogenous variables. If this assumption holds, estimates obtained are efficient as well as consistent. In the opposite case, the estimates will be inconsistent. If unobserved characteristics are correlated with the exogenous variable, a Fixed Effects like method such as the Mundlak-Chamberlain approach is more appropriate.

The Mundlak-Chamberlain approach is a compromise between the Fixed Effects (FE) and the Random Effects (RE) approach. It is consistent even when there is correlation between α_h and the exogenous regressors, like FE, but does not drop time invariant regressors (Zabel, 1992). This is achieved by including averages across time for all household-level characteristics:

(iii) $E_{iht} = \beta_o + \beta_1 \ddot{H}_{ht} + \beta_2 P_{iht} + \beta_3 \bar{H}_h + \beta_4 T_{ht} + \mu_h + €_{iht}$

E_{iht} indicates school participation. $\ddot{H}_{ht}$ is a vector of household characteristics and asset endowment. If variation across years is strong, so that observations for both years are close to the average, issues of multicollinearity can arise, causing inefficient estimates even in large samples. To avoid this, the mean across years was subtracted from each observation, so that $\ddot{H}_{ht} = H_{ht} - \bar{H}_h$ where $\bar{H}_h$ is an average of household characteristics and endowments across the two time periods. P_{iht} denotes personal characteristics and T_{ht} takes the value 1 if the household participates in Food-for-Work, as in the Difference in Difference model. If the averages are found to be relevant to the model, so that β_3 is significantly different from 0, the M-C approach should be applied.

Participation in Food-for-Work, which by extension includes the interaction term in the Difference-in-Difference equation, is expected to be endogenous because the targeting is non-random. Expected treatment status can be estimated by following equation:

(iv) $T_h = \delta_0 + \delta_1 V_v + \delta_2 H_{ht} + \mu_{ht}$

V_v denotes participation in Food-for-Work at the village level. H_{ht} is a measure of household characteristics and endowment. The challenge of finding good instruments that did not simultaneously affect the dependent variables was severe in this case. As markets are sticky and economic mobility is limited in the region of Tigray, variables tended to be strongly interrelated. Although participation in FFW at the village level proved to be a strong instrument, the test for instrument validity depends on over identification. The instruments

ultimately elected to supplement this measure were access to credit and the height-for-age z ratio (HFAZ) of the household head. Access to credit, although referring mainly to informal credit, indicates credit worthiness and social safety nets. The HFAZ, on the other hand, indicates previous food-insecurity of the household head, which is correlated with food security of his children.

Regarding the effect of the degree of Food-for-Work participation on education, a slightly more complicated method must be applied. Values for degree of participation will only be observed for those households participating in the program. The selection into the FFW program is non-random by targeting design, meaning selection bias is not unlikely. To control for this, a two-stage approach will be applied. In the first stage, a Probit model will be specified to control for variables that might affect the decision (or the opportunity) to participate in Food-for-Work.

(v) $T_h = \delta_0 + \delta_1 V_v + \delta_2 H_h + \mu_{ht}$

The selection equation (v) only differs from the instrument equation (iv) in that exogeneity of factors expected to affect participation is not demanded (Wooldridge, 2009), meaning several variables can be included. From this equation, the Inverse Mills Ratio (IMR) is constructed by predicting the value of z, and dividing the standard normal density function divided by the standard normal cumulative density function at point z. In notation,

$$\text{IMR} = \frac{\phi(z)}{\Phi(z)}$$

In the second stage, the right hand side variable is degree of participation in Food-for-Work. Because a significant share of the sample will have a value of 0 for the dependent variable, Tobit estimation is utilized. For robustness of identification, an exclusion restriction is added, meaning at least one variable should be added in the selection equation that is not expected to affect the degree of participation (Cameron & Trivedi, 2009). The Inverse Mills Ratio should be included in the reduced form equation to control for selection bias (Wooldridge, 2009), giving the specification:

(vi) $FFW_{ht} = \lambda_0 + \lambda_1 H_{ht} + \lambda_2 V_v + \lambda_3 \text{ IMR} + €_{ht}$

FFW_{ht} is the degree of participation, measured in Ethiopian Birr (ETB)[5] per capita, H_{ht} is a vector of household endowments and characteristics, V_v are village level characteristics and

[5] 1 ETB=0.33NOK on 11/12/2011

$€_{ht}$ is the household specific error term. If the hypothesis of λ_3=0 is rejected, this indicates selection bias, and the Inverse Mills Ratio should be included in the structural equation. It should be noted that the degree of participation, unlike the treatment variable, has a subscript for time. Although participant status is invariant by design in the survey period, the degree of participation may vary.

Although inclusion of the Inverse Mills Ratio in the reduced form equation (vi) should control for selection bias, a second related issue of endogeneity is likely to arise in regards to the degree of participation. Participant households can work a maximum of five days per household member per month, but might also work considerably less. The difference might be caused by either supply or demand factors – the household might wish to work more but be unable to due to de facto rationing, or it might be unwilling to work more because of more attractive work opportunities or, alternatively, insufficient labor endowments.

To control for endogeneity of the degree of participation, the predicted value of the compensation received as obtained from the reduced form equation (vi) will be included as an instrument of the for the degree of participation in the structural equation (vi).

(vi) $E_{iht} = \beta_o + \beta_1 H_{ht} + \beta_2 P_{iht} + \beta_4 FFW_{ht} + \beta_5 IMR + \beta_6 \mu_h + €_{iht}$

H_{ht} is a vector of household characteristics, P_{iht} is a vector of personal characteristics, and FFW_{ht} is the degree of participation. If the coefficient of IMR in the reduced form equation, λ_3 in equation (v), was not found to be significantly different from zero, the Inverse Mills Ratio does not have to be included in the structural equation (vi). The endogeneity of the degree of participation can be represented by the following equation:

(vii) $FFW_{ht} = \delta_0 + \delta_1 V_v + \delta_2 H_h + \mu_{ht}$

Analogous to equation (v) and (vi), which specify the endogeneity equation for Food-for-Work participation and the selection equation respectively, V_v indicates village level variables. Here, a village identifier will be included to control for the supply side constraints that might affect degree of participation. H_{ht}, meanwhile, is a vector of household characteristics that might be expected to affect the demand for Food-for-Work[6]. Included in this vector is other income options and household composition, disaggregated by age and

[6] Here, it is assumed that supply is only relevant at the village level, and only demand depends on household composition. Discretionary rationing on the part of Food Security Task Force, then, is assumed away.

gender.
The effect of the degree of FFW participation on education cannot be analyzed with the Difference-in-Difference approach, which is only used for impact assessment of a treatment. While the participation status does not change for a household within the time period status, the degree of participation can change several times per year.

It should be noted that Food-for-Work is used as the only indicator of participation in the Productive Safety Net Program (PSNP), although Cash-for-Work (CFW) and Direct Support (DS) are additional elements. The exclusion of Direct Support participant status as an indicator is due to targeting, which indicates participants are not strictly comparable to those receiving compensation through Food-for-Work. Those receiving Direct Support are by definition unable to fulfill the work requirement (MoARD, 2009), and the dataset suggests targeting is rather efficient in this regard (Table A.4, Appendix A). Cash-for-Work is, at least in theory, preferred mainly where markets for food are (partly) functioning (Devereux & Sabates-Wheeler, 2010). Empirical evidence from the data set, however, suggests simultaneously receiving Cash-for-Work and Food-for-Work is becoming increasingly common (Table A.5, Appendix A), suggesting the two forms are complements rather than supplements. Results do not change qualitatively when Cash-for-Work is included in a common measure (Public Works) compared to results obtained focusing only on FFW participants (Tables A3a and A3b, Appendix A).

It is increasingly common to use linear regression even if the outcome variable is binary. According to recent research (Angrist & Pischke, 2008), disregarding the binary nature of the outcome variable does not significantly skew marginal effects. In this case, in addition to be a valid option linear regression was the only option: While Probit recognizes the dependent variable as binary, and switching regressions method restricts endogenous variable to being binary, neither converged to optimum with two endogenous regressors as in the Difference in Difference model. Regarding the Random Effects/Mundlak Chamberlain method, no standard STATA software exists for estimating an instrumental variable Probit model with panel data. Therefore, linear regression with instrumental variables is applied.

6.5 Data weaknesses

Data weaknesses are an ever present problem in data analysis, and in this particular panel, a few deserve particular attention. As in many surveys conducted in developing countries, most household heads in the sample were illiterate, meaning they kept no written records except for

their land certificate. The recall period was long, one year for income and expenditures, which commonly leads to bias due to underreporting of transitory variation (Gibson and Kim, 2010). Birth certificates are not commonplace, which was a challenge in the matching of individuals across years, and in assessing their ages. In addition, all measurements differ from international standards. In some cases, they are easily convertible – 1 tsimdi of land equals 0.25 hectares. In other cases, however, conversion depends on a series of judgment calls, like in the case of converting bushels and stacks to kilograms and centimeters. This has been partly corrected for by attempting to enforce standard conversion rates within the group of enumerators. These measurement errors can nonetheless give rise to significant bias in estimation.

In conducting the field work, enumerators and master students were divided into three groups, each covering between five and six villages. Because of this team structure, across which communication was rare due to a lack of infrastructure, the data are prone to inter-group inconsistencies. Adding to these coordination challenges, all questionnaires were translated from English to Tigrinya, and the answers from Tigrinya to English, which was at times a source of confusion.

Weaknesses of data necessarily have an effect on the chosen method of analysis, and the choice of both dependent and independent variables and on interpretation of results. The fact that only the rough measure of school participation is available to indicate education, is a clear flaw, and will necessarily limit the conclusion that can be drawn from the analysis. Especially so as research from Ethiopia (Admassu 2008) indicates that both drop-outs and delayed school progression is a significant problem. Where observations are lacking for independent variables that should have been included, omitted variable bias is a likely result. Specifically, data on current food insecurity and current and past time allocation of different members of the household are likely factors in explaining school participation. Partly for the sake of robustness against wrongful reporting and entry, dummies are preferred to amounts where applicable (Bezu & Holden, 2006), although this does not mitigate the risk of omitted variable bias.

6.6 Attrition

In addition to the one community that chose to opt out of the survey in 2010, several households within participating communities, and individuals within participating household, could not be matched between years. This could be caused by data weakness in the entering

process or flawed matching of households and individuals. Another cause could be actual migration by some or all members of a household, or death (Deaton, 1997). These changes could cause attrition bias if those individuals who were only registered in the household in one of the two years, have significantly different characteristics. A household might have migrated in search of employment opportunities due to poverty, and an individual might have relocated to pursue education. The only attrition relevant to this sample concerns households with one or more members between six and 20 in both periods, and individuals of the same age. Because of this limitation in size of potential bias, the matter will not be pursued further. It is noted that the results should be interpreted with caution.

6.7 Choice of baseline year

As the Productive Safety Net Program to which the Food-for-Work program belongs was initiated in 2005, the ideal base year would have been immediately before selection of participants. Data were only collected in 2003 and 2006, however, and the latter was chosen although the participants had already taken part in the program for one full year. There are two main reasons for this choice: First, that there is a gap of one year might not be of importance, as the majority of the variables included in the regression are not likely to change significantly and systematically within one year of participation. This argument is strengthened by the fact that participation in the Food-for-Work program is based on participation in previous programs. The main difference, as previously mentioned, is the long-term nature of the Productive Safety Net Program, and as such one additional year should not constitute a systematic difference.

Secondly, although there might still be significant challenges in using 2006 as a base year, the alternative would likely have been worse. To infer the effect of Food-for-Work in 2010 based on a baseline survey in 2003 would have demanded a multitude of assumptions, not all of them trivial. As mentioned in the background, there was a surge in investment in education in 2005-2006. A severe drought affected the region in 2002-2003 (REST, 2004), of which the backlash is still likely to have been felt throughout 2003 and 2004.[7]

[7] In addition, there is the practical question of matching on an individual level across a time span of seven years.

7. RESULTS – DESCRIPTION AND DISCUSSION

The results are reported for all children before being disaggregated by gender for further comparison. All results are reported with 400 bootstraps. The coefficients of the averages included in the Random Effects model were not jointly significant, so the Random Effects approach yields both efficient and consistent estimates.

A few points should be noted before relating the results in table 6.1 to the hypotheses postulated. As noted in the literature review, quality of housing was incorporated to control for household wealth, and was thus expected to have a positive effect. That the effect is negative and significant could stem from several sources: as noted in section 5.3, the index could be flawed, in that it adds different elements of quality of housing in a random manner. Secondly, it might be that households consider housing and education as supplementary investment opportunities. These speculations cannot be tested within the current framework. A third possibility, however, from which a testable hypothesis can be made, is that the link between quality of housing and education might be spurious. Geographical location might be an underlying factor affecting both. To control for this option, I construct a variable comparing the quality of housing to the mean value in the village. The qualitative results do not, however, differ significantly (Table A.2, Appendix A) suggesting local differences is not the true explanation between this counterintuitive effect.

Food-for-Work participation has a positive and significant effect on school participation. The interaction term, however, capturing the effect of treatment in 2010, is negative. This signifies that being in the treatment group had a positive effect on education, whereas the effect decreased over time. One explanation might be that recipients were aware that the program was long-term from the beginning and made their decision accordingly. Expected receipt, then, would matter more than actual receipt, in accordance with expectancy theory (Wanous et al., 1981). This explanation, if correct, would suggest interpretation of results obtained through Difference-in-Difference should be done with caution, as 2006 would not be appropriate as a base line survey. Another explanation is that the diminishing effect of participation in the Food-for-Work program is caused by stabilization after the surge in enrolment that occurred in 2005-2006. This latter explanation seems to be supported by the trend exhibited in figure 6.3. A third explanation might be that targeting efficiency and the timeliness of transfers declined over time, although this is challenged by recent research (MoARD 2009). Hypothesis 2a postulates a positive effect of labor endowment per capita on

school participation. This hypothesis is not supported for the aggregated group of children, as the coefficient of labor is not significantly differently different from zero. This result might be caused by the gender segregation of labor markets, which would mean only gender specific allocation of labor matters.

Table 7.1 Model A: Factors affecting school participation (all)

	Difference-in-Difference	Random Effects
Effect of FFW participant status over time (1=recipient in 2010)	-0.229* (0.135)	n.a.
Year (1=2010)	-0.049 (0.084)	n.a.
Food-for-Work (1=participates)	0.277** (0.099)	0.182** (0.063)
Labor per capita (index)	0.057 (0.103)	0.037 (0.118)
Quality of housing (index)	-0.109*** (0.039)	-0.192*** (0.042)
Age of individual	-0.057** (0.026)	-0.052 (0.027)**
Age of individual^2	0.022** (0.001)	0.002 (0.001)**
Gender of individual (1=male)	0.020 (0.029)	0.028 (0.027)
Distance to primary (minutes)	-0.001 (0.001)	-0.001 (0.001)
Distance to secondary (minutes)	-0.001** (0.000)	-0.001*** (0.000)
Constant	0.619 0.225	0.653*** (0.253)
Observations	1109	1109

Standard errors in parentheses
*p<0.1 **p<0.05 ***p<0.01

Note! Variables included in the regression but excluded from the table of results because of lack of significance are gender of household head, access to off-farm labor, child of head, formal education of household head, age of household head, land per capita and tropical livestock units per capita.

When results are conditional on gender of the child, and with the inclusion of labor allocation by gender and age, several results deserve attention: Housing quality has a negative effect on girls, whereas the variable has no significant effect on school participation for boys. One possible explanation could be that there is a three-tiered list for investment opportunities: All else equal, education for boys is seen as the best investment, followed by investments in

housing, and lastly investments in education for girls. Quality of housing, then, would be seen as a substitute of investing in education for girls. A more likely explanation is perhaps that the correlation is spurious and caused by cultural or geographical factors, in that the same communities that tend to build kitchens and toilet huts, tend to disregard education for girls. According to table A.2 in Appendix A, however, this conclusion does not seem to be supported by the data. Remaining candidates for explanations are inaccurate measures of the indicator 'Quality of housing', or alternatively that quality of housing is random. The true explanation cannot be gathered from the data.

Distance to school has a negative effect for girls only, in accordance with research referred to in the literature review. This might be due to a difference, perceived or actual, in return to education according to gender, in which case parents would be willing to bear higher costs of sending boys to school. It might also be that boys can reside elsewhere during the school week, whereas girls are required to spend the nights at home. Distance to school indicates risk, in addition to cost, and heads of households are perhaps taking into account that girls are more exposed to high risk when travelling. This explanation is supported by the finding that school participation for girls decreases with age. As referred to in the literature review, the risk incurred while travelling also increases with age for girls. In addition, the opportunity cost of time spends schooling increases, as the other tasks the child could undertake increases, meaning the value of their time is higher. For girl children, this cost-benefit analysis takes into account the cost of postponing marriage.

Lastly, it should be noted that a negligible share of the variables has explanatory power regarding the decision on whether to send boys to school. This indicates that further research should be conducted, as the main determinants of education for boys might still be unidentified. As opposed to previous findings (Gilligan et al., 2008), the results did not differ significantly when disaggregated by age groups within gender.

Table 7.2 Model A: Factors affecting school participation (by gender)

	Difference-in-Difference		Random Effects	
	Boys	**Girls**	**Boys**	**Girls**
Effect of FFW participant	-0.446	-0.112		
status over time			n.a.	
(1=recipient in 2010)	0.334	(0.169)		
Year	-0.302	0.135		
(1=2010)	(0.267)	(0.113)	n.a.	
Food-for-Work	0.204	0.221*	-0.021	0.189**
(1=participates)	0.239	(0.126)	(0.430)	0.098
Labor per capita	0.005	0.154	0.021	0.114
(index)	(0.585)	(0.152)	(1.745)	(0.215)
Males 20-65	0.005	0.020	-0.016	0.017
(number)	(0.085)	(0.021)	(0.207)	(0.026)
Females 20-65	-0.033	0.055**	-0.023	0.053*
(number)	(0.097)	(0.026)	(0.253)	(0.032)
Males 12-20	0.126	-0.005	0.145	0.011
(number)	(0.119)	(0.033)	(0.327)	(0.034)
Females 12-20	0.228*	-0.004	0.226	0.004
(number)	(0.126)	(0.034)	(0.340)	(0.040)
Males 6-12	0.041	0.006	0.045	0.007
(number)	(0.116)	(0.030)	(0.322)	(0.033)
Females 6-12	0.075	-0.077***	0.082	-0.080***
(number)	(0.115)	(0.030)	(0.329)	(0.032)
Quality of housing	-0.138	-0.203***	-0.436	-0.299***
(index)	(0.239)	(0.053)	(0.618)	(0.057)
Age of individual	-0.135	-0.086**	-0.116	-0.086*
	(0.143)	(0.039)	(0.404)	(0.043)
Age of individual^2	0.006	0.004**	0.005	0.004**
	(0.005)	(0.002)	(0.015)	(0.002)
Distance to primary	-0.001	-0.002*	-0.002	-0.002
(minutes)	(0.004)	(0.001)	(0.011)	(0.002)
Distance to secondary	-0.001	-0.001**	-0.001	-0.001**
(minutes)	(0.001)	(0.000)	(0.003)	(0.000)
Constant	0.681	0.626	0.549	0.708*
	(1.306)	(0.320)	(3.910)	(0.426)
Observations	653	484	653	484

Standard errors in parentheses
*p<0.1 **p<0.05 ***p<0.01

Note! Variables included in the regression but excluded from the table of results because of lack of significance are gender of household head, access to off-farm labor, child of head, formal education of household head, age of household head, land per capita and tropical livestock units per capita.

The effect of FFW participation is positive for girls, lending support to hypothesis 1a. The effect for boys is not significant. It should be kept in mind that there might well be a gross

positive effect of increased real income, but that the labor requirement outweighs this positive effect for boys, leaving the net effect of participation insignificant.

Aggregated labor endowment per capita has no effect on school participation for either of the genders, and hypothesis 2a is thus rejected. When labor endowment is disaggregated by gender, however, there is support for hypothesis 2c which postulates that endowment of female labor has a positive effect of school participation for girls. This effect is significant only in the Difference-in-Difference model, and only at the ten per cent level. Regarding male labor endowment, no effect on school participation of boys can be discerned by either method.

As recalled, Food-for-Work participant status is assumed endogenous, and instruments were introduced to control for this. For the instrumental variable regression to be consistent, certain assumptions about the instruments will have to be fulfilled. Namely, they will have to be valid, in that they cannot belong in the initial model – their effect on the dependent variable cannot be significantly different from zero. When the model is over-identified, in that it has more instruments than endogenous regressors, the test for over-identification can be applied. It should be recalled that the instruments for FFW participation are prevalence of participation in the village, height-for-age Z-ratio, and access to credit. The endogenous variables, however, are only two in the Difference-in-Difference model and one in the Random Effects model, meaning the test can be conducted. Here, p-values are above 0.9 for all three models (see Appendix A), meaning the hypothesis of over-identifying restrictions cannot be rejected. The instruments are thus valid.

A second assumption is that the instruments should be correlated with the endogenous variable(s). At worst, bias caused by weak correlation can be as grave as if endogeneity was ignored in the initial model (Wooldridge, 2009). The rule of thumb for this test is that F-statistics when testing for joint significance has to exceed 10. Here, the F-value exceeds 16 for all three models (see appendix A), meaning the hypothesis of weak instruments can be rejected.

If the two assumptions above are not violated, a third test should be performed to verify that endogeneity was indeed a problem in the initial model. The hypothesis is exogeneity, which can be rejected for the model for all children and for girls, with p-values far below 0.05. For the model for boys, however, the p-value exceeds 0.1, meaning exogeneity cannot be rejected.

Conditional Logit (Ilon & Moock, 1991) was used rather than instrumental variable regression when testing hypothesis 1, 2a and 2b for boys.

In order to evaluate whether a higher degree of participation increases the likelihood of schooling, the first step is to run a Probit regression where the dependent variable is the binary variable of FFW participation/non-participation, as outlined in the methodology. The second stage is to estimate the predicted degree of participation with a Tobit model specification, controlling for initial selection bias. The Inverse Mills Ratio coefficient was significantly different from zero in this second equation (Table A.5, Appendix A), suggesting selection bias was indeed present. In the third stage, specified in table 7.3 below, the Inverse Mills Ratio was included as a regressor while the predicted degree of participation from stage 2 was included as an instrument for the amount received in compensation. This approach is an alternative to IV estimation that is more applicable when there is selection bias, and it is robust to possible misspecification of the Tobit equation in equation 2 (Wooldridge, 2009). It should be recalled that this approach was chosen because of assumed endogeneity of the degree of participation, which was expected to rely both on supply and on demand factors.

Exogeneity, however, could not be rejected (Table A.5, Appendix A), and after checking for the joint significance of the averages, as in the Mundlak-Chamberlain approach outlined in the methodology, a Random Effects logit model was applied. As seen from the results in table 7.3, the hypothesis of a positive effect of the degree of participation could not be supported for any of the three groups. There are many possible explanations for this result, one of which is measurement error, but two other possible explanations will be the focus of discussion:

One possibility is that the positive income effect of increased participation might be cancelled by a negative effect of an increased work requirement. This explanation is in line with the research done by Gilligan et al. (2008) and can be neither supported nor opposed without more specific data on intra-household workloads.

A second option, which is perhaps more complimentary to the Food-for-Work design and intention, is that the relevant element in regards to school participation (and possibly other forms of investments) is the insurance element rather than the income effect. Education is a bulky investment in that one extra day has little value, as does one extra week or one extra month – households are unlikely to send their children to school if they do not think will be able to bear the costs through the entire school year, perhaps even throughout the cycle. Particularly the last months of the school year are likely to be challenging in regards to

income, as the agricultural slack season lasts until the long rains start during the summer months. If they are Food-for-Work participants, however, they have some kind of insurance against destitution. The amount of compensation received, then, might be insignificant with knowing that they can receive. This, too, is a possible explanation of the results as listed below (though not of those obtained by Gilligan et al. (2008)) The true reason cannot be gathered from this analysis alone, but might merit further research.

Table 7.3 Model B:Factors Affecting School Participation

	All	**Boys**	**Girls**
Food-for-Work	-0.001	-0.001	-0.001
(amount)	(0.001)	(0.002)	(0.002)
Labor per capita	0.381	0.150	0.686
(index)	(1.175)	(1.755)	(2.701)
Quality of housing	-0.891*	-0.577	-1.497
(index)	(0.467)	(0.625)	(1.747)
Age of individual	-1.74	-0.121	-0.310
	(0.296)	(-0.485)	(0.604)
Age of individual^2	0.007	0.005	0.013
	(0.011)	(0.017)	(0.023)
Distance to primary	-0.006	-0.005	-0.012
(minutes)	(0.009)	(0.012)	(0.023)
Distance to secondary	-0.002	-0.001	-0.003
(minutes)	(0.002)	(0.002)	(0.004)
Inverse Mills Ratio	-0.441	-0.450	-0.636
	(0.402)	(0.676)	(0.918)
Constant	1.301	0.883	2.172
	(1.984)	(3.302)	(4.272)
Males 20-65		-0.032	0.053
(number)		(0.218)	(0.307)
Females 20-65		-0.11	0.259
(number)		(0.268)	(0.456)
Males 12-20		0.211	0.027
(number)		(0.346)	(0.436)
Females 12-20		0.314	0.001
(number)		(0.382)	(0.477)
Males 6-12		0.074	0.027
(number)		(0.327)	(0.435)
Females 6-12		0.053	0.001
(number)		(0.334)	(0.630)
Observations	1109	653	484

Standard errors in parentheses
*p<0.1 **p<0.05 p***<0.1

It should perhaps be noted that these two explanations are not necessarily mutually exclusive – figure 6.4 suggests different effects at different areas of the curve. It seems, from this curve, as though the net effect of participation is positive at low amounts, before the income effect is surpassed by the negative income effect as participation increases. The income effect only outweighs the work requirement effect at higher amounts, peaking at 600 ETB per person.

A summary of all the results is reported below, sorted by hypotheses. As seen, all hypotheses were rejected for boys, whereas hypothesis 1a postulating a positive effect of FFW on school participation could not be rejected neither when tested for all children simultaneously nor for girls separately. The hypotheses regarding a positive effect of gender aggregated labor endowment on school participation are rejected both for all children and for boys, whereas the effect of female adult labor on girls' school participation was found to be positive and significant using both estimation techniques.

Table 7.4 Summary of results

Outcome measure:		School participation		
Years in sample:		Both years		
Ages in sample:		Age 6-20		
Effect on:		All	Boys	Girls
Effect of:	Hypotheses:			
Food-for-Work (participation)	H1a	Partly rejected	Rejected	Not rejected
Food-for-Work (degree of participation)	H1b	Rejected	Rejected	Rejected
Labor per capita	H2a	Rejected	Rejected	Rejected
Male adults	H2b	n.a.	Rejected	
Female adults	H2c	n.a.		Not rejected

'Not rejected' means the hypothesis could not be rejected by either the Difference-in-Difference or Random Effects estimation, 'Partly rejected' indicates rejection in one model only, and 'Rejected' means the hypothesis was rejected in both models.

8. CONCLUSION

Households make decisions on whether to school their children based on preferences, within the limits of resource constraints. The Food-for-Work program was introduced in 2005 partly to alleviate these constraints, thereby allowing households to invest in assets where expected returns might only materialize in the medium or long term. In the analysis, particular attention was therefore given to whether FFW participation did in fact lead to increased investments in education.

Considerable challenges arose in estimation as only a rough measure of education, namely school participation, was available. This limits the opportunity of drawing more specific conclusions, which may have been possible with more exact data on school progression and completion. In addition, data on intra-household work allocation were unavailable, meaning likely effects would have to be conjectured rather than concluded from the data.

Participation status has a significant effect on the education of children aggregated by gender and on girls, giving rise to hope that participants may escape the poverty trap. The effect on boys' education, however, is not significantly different from zero.

Regardless of the wealth constraints, thin or missing markets for labor could mean household labor endowments might pose a constraint regardless of wealth. Food-for-Work participation, particularly when measured by degree of participation, could further add to this constraint through the work requirement of the program.

When labor markets are gender segregated, an additional constraint is placed on the household, as the female labor endowment must equal total female work requirement whereas the male labor endowment must equal total male work requirement. In the analysis, gender disaggregation proved necessary to establish the effect of labor endowments on school participation, supporting the expectation of gender segregated labor markets. This relationship, however, only holds for the effect on education of girls.

In addition to Food-for-Work participation, and the related issue of labor endowments, a number of other variables were included in the analysis. The expectation that they would affect the education decision was based on prior research, as outlined in the literature review. Results of interest regarding the effect of these variables were that gender was not significant,

meaning the gender differential in education seems to pose less of a problem, and that age had a negative effect.

In combination, the two results suggests parents tend to withdraw children from school as opportunity costs – and travelling costs – increase, and that this tendency holds for both genders. It should be remembered, here, that only primary school is free of official charges, so costs are expected to rise significantly with the transfer to secondary school. The distance to school, moreover, proved to have a negative effect for girls only, suggesting safety concerns means parents keep children at home.

From these results, a few suggestions arise. One is that the construction of schools should continue to be a focus area for the Ethiopian government, to ensure the continued participation of girls. A second result is that measures might be considered to increase the expected returns of higher education. Scholarships might be one such option. Alternatively, one could consider subsidizing education by offering compensation for education, so as to increase shorter-term returns.

Further research might be warranted regarding the effects of the Food-for-Work program on boys, as the effect seems to be twofold. If this research indicates that the two effects of the program, the positive effect on income and the negative effect of increased labor requirements respectively, pull in opposite directions, further measures should be taken to ensure that school participation for boys does not suffer as a result.

In conclusion, it seems that both income and labor constraints affect the choices made by agricultural households in Tigray, hindering them from bypassing the poverty trap by diversifying to a higher yield production function. Food-for-Work participation has a positive effect, although the effect is limited in size and partly counteracted by the strain the work requirement puts on labor endowments. The urgency of the issue of education suggests that Ethiopian authorities, perhaps in collaboration with foreign donors, consider targeted interventions to increase school participation.

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APPENDIX A

Table A. 1 Summary for test statistics for instruments FFW participant status				
	Test for weak instruments (F-value)	Test for over identification (p-value)	Test for endogeneity (p-value)	Method chosen
Model 1 (All)	Treatment: 36.33 FFW: 79.9	0.88	0.003	Instrumental Variable regression
Model 2 (Boys)	Treatment: 33.51 FFW: 18.99	0.69	0.122	Logit
Model 3 (Girls)	Treatment: 41.67 FFW: 21.41	0.89	0.006	Instrumental Variable regression

Table A.2 Controlling for local differences in quality of housing

	Control for local differences in housing	Standard measure of housing
Food-for-Work	0.198***	0.182***
(1=participates)	(0.063)	(0.065)
Labor per capita	0.013	0.037
(index)	(0.123)	(0.116)
Quality of housing	-0.087*	-0.193***
(index)	(0.052)	(0.044)
Distance to primary	-0.001	-0.001
(minutes)	(0.001)	(0.001)
Distance to secondary	-0.001***	-0.001***
(minutes)	(0.000)	(0.000)
Age of individual	-0.049*	-0.052**
	(0.028)	(0.026)
Age of individual^2	0.002*	0.002**
	(0.001)	(0.001)
Gender of individual	0.028	0.028
(1=male)	(0.026)	(0.028)
Constant	0.508**	0.653***
	(0.259)	(0.247)
Observations	1109	1109

Standard errors in parentheses
*p<0.1 **p<0.05 ***p<0.01

Table A.3a Comparison of regression with Public Works and FFW (by gender)

	Boys		Girls	
	Public Works	Food-for-Work	Public Works	Food-for-Work
Public Works (1=participates)	-0.065 (0.459)	n.a.	0.216* (0.113)	n.a.
Food-for-Work (1=participates	n.a.	-0.021 (0.424)	n.a.	0.189** 0.094
Labor per capita (index)	0.0185 (1.754)	0.021 (1.813)	0.118 (0.193)	0.114 (0.213)
Males 20-65 (number)	-0.015 (0.209)	-0.016 (0.228)	0.019 (0.024)	0.017 (0.025)
Females 20-65 (number)	-0.021 (0.254)	-0.023 (0.263)	0.050* (0.030)	0.053* (0.030)
Males 12-20 (number)	0.143 (0.326)	0.145 (0.367)	0.011 (0.035)	0.011 (0.032)
Females 12-20 (number)	0.224 (0.345)	0.226 (0.322)	-0.001 0.039	0.004 0.038
Males 6-12 (number)	0.047 (0.323)	0.045 (0.320)	0.009 0.032	0.007 0.032
Females 6-12 (number)	0.084 (0.330)	0.082 (0.347)	-0.076** (0.033)	-0.080*** (0.034)
Quality of housing (index)	-0.442 (0.622)	-0.436 (0.679)	-0.296*** (0.059)	-0.299*** (0.061)
Distance to primary (minutes)	-0.002 (0.011)	-0.002 (0.011)	-0.002 (0.002)	-0.002 (0.001)
Distance to secondary (minutes)	-0.001 (0.003)	-0.001 (0.003)	-0.001* 0.000	-0.001** 0.000
Age of individual	-0.115 (0.408)	-0.116 (0.466)	-0.084** (0.041)	-0.086* (0.044)
Age of individual^2	0.005 (0.015)	0.005 (0.017)	0.003** (0.002)	0.003** (0.002)
Constant	0.578 (3.976)	0.549 (3.944)	0.659 (0.407)	0.708* (0.415)
Observations	653	653	484	484

Standard errors in parentheses
*p<0.1 **p<0.05 ***p<0.01

Table A.3b Comparison of regression with Public Works and Food-for-Work (all)

	Public Works	Food-for-Work
Public works (1=participates)	0.214*** (0.082)	n.a.
Food-for-Work (1=participates)	n.a.	0.182*** (0.065)
Labor per capita (index)	0.049 (0.117)	0.037 (0.116)
Quality of housing (index)	-0.188*** (0.042)	-0.193*** (0.044)
Distance to primary (minutes)	-0.001 (0.001)	-0.001 (0.001)
Distance to secondary (minutes)	-0.001** (0.000)	-0.001*** (0.000)
Age of individual	-0.051* (0.027)	-0.052** (0.026)
Age of individual^2	0.002** (0.001)	0.002** (0.001)
Gender of individual (1=male)	0.029 (0.031)	0.028 (0.028)
Constant	0.599** (0.243)	0.653*** (0.247)
Observations	1109	1109

Standard errors in parentheses
*p<0.1 *p<0.05 *p<0.01

Table A.4: Correlation between Direct Support recipient status and wealth

	Adults (number)	Tropical Livestock Units per capita	Land per capita	Quality of housing^
Direct Support	-0.53	-0.05	0.05	-0.21

^ controlled for local differences

The signs of correlation are as expected when considering that the target group for Direct Support consists of households that are poor both in terms of assets and labor. This suggests efficient targeting, although the correlation between land and Direct Support recipient status might seem counterintuitive. As touched on in the literature review, however, Ethiopian land is allocated according to administrative criteria rather than through an open market. Poor landlords, then, will rent out rather than sell, meaning land holdings might be less efficient as an indicator of wealth than in countries where it can be bought and sold freely (Holden et al., 2008).

Table A.5: Compensation in cash (CFW) or in kind (FFW)			
Year	**Cash-for-Work**	**Food-for-Work**	
		0	**1**
2006	**0**	**36.22 %**	**48 %**
	1	**5.51 %**	**10.24 %**
2010	**0**	**37.89 %**	**35.55 %**
	1	**5.08 %**	**21.48 %**

The percentages indicate the share of the sub-sample (households with children of school age) in each category. From the table, one change in composition should be brought to attention. The percentage of the sample receiving both Food-for-Work and Cash-for-Work doubled from 2006 to 2010. This change was brought about almost entirely by a shift within the group receiving Food-for-Work both years, indicating that a combination of compensation in cash and in kind is becoming more common. This finding resonates with the objective of increasing the share of compensations made in cash (Brown et al., 2006). Alternatively, the shift might have been be caused by the dramatic rise in food prices that began in late 2006 (FAO, 2011) as high and variable food prices would mean a sharp increase in the cost of the Program unless a shift was made.

Table A.6 Summary for test statistics for instruments FFW degree of participation					
	Test for weak instruments (F-value)	Test for over identification (p-value)	Test for endogeneity (p-value)	Inverse Mills Ratio (p-value)	Method chosen
Model 1 (All)	47.53	0.363	0.427	0.000	Random Effects logit

Masters program: Norad fellows
Collaboration: Mekelle University
Agricultural University of Norway

Household Questionnaire

The information collected will be used for research purposes. It will be treated as confidential and will not be used by tax authorities or others to assess the need for food aid or other assistance.

Zone _____

Woreda _____

Tabia _____

Kushet _____

Household number _____

Name of household head
Distance to woreda town
Distance to primary school
Distance to secondary school
Distance to all weather road
Distance to transporatation service
Distance to health center
Distance to grain mill
Distance to nursery site

Enumerators:	Dates interviewed
First interview:	
Second interview:	
Third interview:	

Data checked by	When	Status		Comments
		ok	Return	

Data punched	When	Who	Comments
Pages			
Pages			
Pages			
Pages			

Farm household survey: Household characteristics **Page 1**

Woreda:		Interviewer:		Household number:	
Tabia		Date of interview:			
Kushet		Household head name:			

Household composition in 1995(e.c)

Household members Religion:

MNo:	Name	Rel. to head	Sex	Age	Education	Skills	Occupation	Presence
1		Head						
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								

Codes: Relation to household head: 1=wife, 2=child, 3=grand child, 4=brother, 5=sister, 6=hired labour
7=other, specify:
Sex: 1=female, 2=male. Age: Years. Skills: specify
Education: 0=illeterate, 1=read and write, 2= elementary, 3= church education, 4= secondary, 5=other, specify.
Occupation: 0=dependent, 1= student (in school), 2=watch after animals, 3=housewife, 4= farming
5=hired labourer, 6=off-farm activity, 7 PA/village official:specify
Presence: Months staying in the household during last 12 months

Do any of the household members live outside the village this year (EC 1995)? Yes No

Name	Place	Purpose	Since when	Coming back when

Farm household survey: Household Expenditures **Page 2**

Expenditure on farm inputs EC 1994-95

Item	Quantity	Own prod.	Purchased	Price	Unit	Tot. Expend.	Where bou	source of cash
Seed, teff								
Seed, wheat								
Seed,maize								
Seed, barley								
Seed, sorghum								
Seed, chickpea								
Seed, Millet								
Seed, Fava bean								
Seed, pea								
Seed, Latyrus								
Seed, others								
Seed, vegetables								
Seed, Pepper								
Other tree seedl.								
Fertilizer: Urea								
Fertilizer: DAP								
Herbicide								
Pesticide								
Tools/equipment								
Manure								
Hired oxen								
Animal salt								
Animal medicine								
Animals bought								
Animal feed:								
Grass								
crop residue (hay stover, etc.)								

Where bought: 1: from neighbour, 2: within kushet, 3: local market, 4: woreda market, 5: trader visiting village

Source of cash: ownsavings, formal credit, informal credit, other specify.

Have you obtained credit to pay for farm inputs or for farm investments? If yes, give details for the 3 last years:

Source	Year	Purpose	Amount	Repayment conditions			
				Frequency	Duration	Interest	completed

Have you over the last 3 years received credit for			Amount	Source	Year
Nonagricultural investments	Yes	No			
Consumption loans	Yes	No			
Family events	Yes	No			
Other, specify	Yes	No			
	Yes	No			

If you want, are you able to obtain credit for

Purpose	Yes/No	Source	Max amou	Interest ra	Duration	Comment	
a. Investment							
in farm inputs							
in oxen purchase							
in other business							
b. Consumption							
c. Family events							

If you have already received credit for some purpose, are you able to obtain more loans before paying back what you have already obtained? Yes\no

Do you have savings in any formal credit instituion or bank? Yes\no

If yes, how much? _____ and since when? _____

Do you have savings in any informal credit instituion (e.g. Equib)? Yes\no

If yes, how much? _____ and since when? _____

Are you member of a credit association?	Yes	No		
If yes, do you prefer to get credit on individual basis?			Yes	No
Has any member in your credit group defaulted?		Yes	No	

If yes, what were the consequences?

Farm household survey: Livestock Production Activities **Page 5**

Animal type	**Stock** 2 years ago	Stock 1 year ago	Stock Current	Born during EC 94-95	Died during EC 94-95	Slaughtered EC 94-95	Bought EC 94-95	Sold during EC 94-95	Months in milking (94-95)	Milk per day (EC94-95)
Cattle										
Milking cow										
Other cows										
Oxen										
Heifer										
Bulls										
Calves										
Sheep										
Ewes										
Ram										
Lamb										
Goats										
Does										
Bucks										
Kids										
Horses										
Mules										
Donkeys										
Chicken										
Bee hives										

If there has been a change over the last 8-10 years in the number of livestock your household owns, what are the reasons for the change(s)?

Drought		Reduction in grazing land		More land needed for food production	
Livestock disease		Unprofitable production		Other, specify	
New breeds available		Credit available		Veterinary services improved	
Fodder shortage		More profitable production			

What do you see as the most important constraints in your livestock production?

How old are your oxen? How many years do you expect your oxen to last?

Farm household survey: Other Sources of Income (EC94-95) **Page 7**

Source	Input quantity	Input costs	Who earned	Where/to whom	When/Period	Quantity	Price/Wage	Income
Hiring out oxen								
Hire out labour								
Labour exchange								
Assistance received								
Assistance given								
Rent out land								
Employment								
Food for Work								
EGS								
Cash for Work								
Migrant income								
Remittance Income								
Assistance from relatives								
Food Aid								
Government Transfers								
Gifts								
Sale of firewood								
Sale of Handicraft								
Sale of beverages								
Petty trade								
Grain mill								
Other business/services								

Employment: permanent job locally, Hire out labour: temporary job locally, Migrant income: temporary job outside community member by household Remittance income: Money sent by relatives permanently living elsewhere

What durable commodities and implements does the household have?

Household Assets	Number	Year boug	Price	Current value	Need replacement wher	Implements
Farm inplements						Owned EC1983
Plough						
Donkeycart/horsecart						
Plough parts						
Hoe						
Sickle						
Hammer						
Ax						
Spade						
Wheelbarrow						
Other production assets:						
Irrigation equipment						
Irrigation well						
Pond						
Assets						
Furniture						
Radio/cassetplayer						
Wrestwatch						
Bicycle						
Stove						
House with iron roof						
Hut						
Kitchen house						
Jewelry						

What is the impact of road access on	High	Low	No impact	Explain
Your income				
Cash crop production				
Livestock production				
Access to employment				
Education of children				
Soil and water conservation				
Health services				

MASTERS PROGRAM: 2010 NOMA FELLOWS
NORWEGIAN UNIVERSITY OF LIFE SCIENCES
IN COLLABORATION WITH MEKELLE UNIVERSITY

HOUSEHOLD QUESTIONNAIRE

The information collected will be used for research purposes. It will be treated as confidential and will not be used by tax authorities or others to assess the need for food aid or other assistance.

Zone _____

Woreda _____

Tabia _____

Kushet _____

Household ID _____

Name of household head _____

Distance to woreda town (walking minutes)	
Distance to local market (walking minutes)	
Distance to primary school (walking minutes)	
Distance to secondary school (walking minutes)	
Distance to all weather road (walking minutes)	
Distance to transporatation service (walking minutes)	
Distance to health center (walking minutes)	
Distance to grain mill	
Distance to nursery site	
Distance to protected water source(walking minutes)	
Distance to tap water(walking minutes)	

Enumerators:	**Dates interviewed**
First interview:	
Second interview:	
Third interview:	

Data checked by	**When**	**Status**			**Comments**
		ok	**Correct**	**Return**	

Data punched	**When**	**Who**	**Comments**
Pages			
Pages			
Pages			
Pages			

Farm household survey: Household characteristics **Page 1**

Woreda:		Interviewer:		Household number:	
Tabia		Date of interview:			
Kushet		Household head name:			
Household composition in 2002 (E.C.)					

Household members Religion:

MNo:	Name	relationship	Sex	Age	Education	Skills	Occupation	Presence
1		Head						
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								

Codes: Relation to household head: 1=wife, 2=child, 3=grand child, 4=brother, 5=sister, 6=hired labour
7=other, specify:
Sex: 1=female, 2=male. Age: Years. Skills: specify
Education: 0=illeterate, 1=read and write, 2= elementary, 3= church education, 4= secondary, 5=other, specify.
Occupation: 0=dependent, 1= student (in school), 2=watch after animals, 3=housewife, 4= farming
5=hired labourer, 6=off-farm activity, 7=Tabia/kushet officia PA/village official:specify
Presence: Months staying in the household during last 12 months

Do any of the household members live outside the village this year (EC 1995)? Yes No

Name	Place	Purpose	Since when	Coming back when

Farm household survey: Livestock Production Activities

Animal type	**Stock** 2 years ago	Stock 1 year ago	Stock Current	Born during EC 2001/02	Died during EC 2001/02	Slaughtered EC 2001/02	Bought EC 2001/02	Sold during EC 2001/02	Months in milking (2001/02)	Milk per day (EC2001/02)
Cattle										
Milking cow										
Other cows										
Oxen										
Heifer										
Bulls										
Calves										
Sheep										
Goats										
Horses										
Mules										
Donkeys										
Camel										
Chicken										
Bee hives										

Source of cash to buy the livestock

1	Sale of output		Other
2	Remittance		
3	Credit		
4	Sale of food from FFW		
5	Sale of other livestock		

HOUSEHOLD NAME:_____ HH id:_____ **Page 8**

Farm household survey: Other Sources of Income 2001 -02 E.C)

Source	Input quantity	Input costs	Who earned	Where/to whom	When/Period	Quantity	Price/ Wage	Income	Years of Experience
Hiring out oxen									
Hire out labour									
Labour exchange									
Assistance received									
Assistance given									
Rent out land									
Employment									
Cash support									
Migrant income									
Remittance Income									
Assistance from relatives									
Government Transfers									
Gifts									
Sale of firewood									
Sale of Handicraft									
Sale of beverages									
Petty trade									
Grain mill									
Other business/services									

Source	Number of months/yr worked	how many person in the hh	Who earned (hh member id)	Input quantity (toal labor mandays)	Outoput Quantity (food in kg or days of work) per year		price/wage (price of wheat per kg or daily payment rate of CFW		Total income	Quantity of food sold
					unit	quantity	unit	price		
Food for Work										
Food Aid										
Cash for Work										
OFSP(Other Food Security Program)										

Employment: permanent job locally, Hire out labour: temporary job locally, Migrant income: temporary job outside community member by household Remittance income: Money sent by relatives permanently living elsewhere

What durable commodities and implements does the household have?

Household Assets	Number now	Year boug Latest	Number bough last year	Price	Current val	Need replacement (# of years)	Implements Owned 1998 EC	Source of cash
Farm inplements								
Plough								
Donkeycart/horsecart								
Plough parts								
Hoe								
Sickle								
Hammer								
Ax								
Spade								
Wheelbarrow								
Other production assets:								
Irrigation equipment								
Irrigation well								
Irrigation pump								
Pond								
Assets								
Furniture								
Radio/cassetplayer								
Wrestwatch								
Bicycle								
Stove								
House with iron roof								
Hut								
Kitchen house								
toilet*								
Jewelry								
Mobile phone								

Source of cash: 1:Sale of output, 2:Remittances, 3:Credit, 4:Sale of food from FFW, 5:Sale of livestock, 6:Savings, 7:Others, specify

*Whether the household has toilet or not should be verified by the interviwer