INTRA-HOUSEHOLD GENDER-BIAS IN CHILD EDUCATIONAL SPENDING IN RURAL ETHIOPIA: PANEL EVIDENCE[1]

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Abstract

Qualitative and quantitative evidence reveals pervasive gender discrimination in many social and economic aspects in least developing countries, including Ethiopia. Investment in child schooling is an important dimension of this discrimination, which has a lasting consequence on both the child and the country's economic development as a whole. The main objective of this study is to uncover if there is any intra-household gender-bias in the decision to enrollment and allocation of resources to child education. Using a panel data set from Ethiopian Rural Household Survey (ERHS), spanning from 1994-2004, we applied a panel hurdle models consisting of random effects probit for the initial decision in enrollment and conditional linear autoregressive model for the proportion spent. We found statistically significant gender-bias during the initial decision to enrollment against girls, especially those corresponding to secondary school cycle. Since the bias occurs inside the household, public investments should not only focus on facilitating access to school but also work towards altering the demand side as parents have differential preference towards siblings' education. Policies that increase returns to girl's education, increasing intrahousehold productivity, legislations that prohibit early marriage, etc. could mitigate the observed level of intra-household gender-bias against girls aged 15-19 years.

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1. Introduction

Education is broadly considered as critical in income generation, in altering inequality and it is an essential part of personal welfare (Behrman, 1997). Since the works of Mincer (1974) in labor economics, voluminous works regularly confirm that a return to schooling is associated with higher individual earnings. The return to schooling is also much more significant in economies of considerable liberalization and macro stabilization that have become increasingly integrated into international market (Behrman, 1997). In developing countries, education is also crucial in augmenting earnings and improving survival strategies (Dercon and Krishnan, 1999).

Evidence from developing economics shows the importance of investing in female education, which reduces fertility rate (Cochrane, 1979), ameliorates children's health conditions (Thomas 1990, 1994, Subbarao and Raney, 1995), and changes the patterns of households' consumption with a reduction in income share for adult goods (Rosenzweig and Wolpin, 1988; Haddad and Hodinott, 1995). Nevertheless, still there are significant gender differentials in human capital status. For instance, net enrollment ratio in the year 2000-2005 is 70 % and 66% for primary school while it is 30% and 24% for secondary school in Sub-Saharan Africa, for male and female children, respectively (UNICEF, 2007).

For parents in poor economies, children are both *consumption good* as they gives utility, a *production good* as they help in productive and domestic activities and *insurance good* for parents during old age (Dasgupta, 1993). However, a growing concern for many has been the possibility of increasing inequality as parents have different preferences in allocation of resources to boys and girls schooling. This differential treatment may arise from difference in returns of sibling human capital investment (Rosenzweig and Schultz, 1982; Berhman, 1982) because most of women's work is limited within the family for household survival. Women not only have few opportunities to find jobs because of the low level of economic development and the consequent low labor demand but also because of discrimination in the labor market and wage differential. Parents may prefer a particular type of child irrespective of investment (Berhman, 1982). Variation in the costs of investment among siblings also induces differential treatment of children schooling (Strauss and Thomas, 1995).

Following recent development in intra-household models and availability of data, the literature has attempted to scrutinize individual-level outcomes due to differential treatment by gender in different countries. For instance, Rosenzweig and Schultz (1982) explained the excess female mortality in India to be associated with low female labor market participation in terms of the reinforcement of productivity difference. Afridi (2005) from India has found that mothers' autonomy has a significant impact on reducing the gap in educational attainment of girls and boys. Hazarika (2000) for Pakistan, Quisumbing and Maluccio (2000) for Bangladesh, Indonesia, Ethiopia and South Africa are also among the most notable empirical studies.

In the literature there are two commonly applied techniques to detect gender bias in the intra-household resource allocation. The first method, based on availability of individual level data, is the direct comparison of expenditure on males and females. The second methodology is to use the Engel curve approach in situations where reliable data is only available at the household level. In most cases, the former method can not be practical due to absence of such disaggregated survey data. The Engle curve approach has been applied by a number of researchers such as Deaton and Subramanian, 1990 (India), Deaton, 1989 (Thailand and Cote d'Ivoire), Subramanian, 1995 (India), Ahmad and Morduch, 1993 (Bangladesh), Case and Deaton, 2003 (India) and the like.

Using data from rural India and consequently Pakistan, Kingdon (2005) and Aslam and Kingdon (2006) have used a variant of the Engle curve method hurdle models approach to confirm the existence of intra-household gender-bias. According to Kingdon (2005), gender-bias in child educational investment can be explained through two possible channels. First, through positive purchase for males and zero purchase for females. Second, conditional on positive purchases for both, lower expenditure on girl's schooling than boys.

Empirical studies from rural Ethiopia confirm the existence of gender-bias in child education. For instance, a very good work by Tekabe (2005) has attempted to explain differences in the cost of investment in terms of the child's inherent health endowment and their ability to receive education. The result suggests that educational investments are allocated to reinforce initial differences confirming the significance of bias in favor of the able children as they are motivated by return maximization. However, the study doesn't tell us at which stage does this bias occur.
The objective of this study is to identify if there is any intra-household difference in household schooling investment among school age siblings. As there are two different channels of gender bias, bias at the initial stage of deciding on whether to enroll a child and the magnitude of resource allocated among enrolled siblings, we used a panel hurdle model that account for unobserved individual heterogeneity and initial conditions problem. To this end, we have used the Ethiopian Rural Household

Survey (ERHS) panel data set spanning from 1994 to 2004 that enables us to control for a number of observed supply and demand factors as well as unobserved factors. The unique nature of our panel data set enables us to robustly detect the existence and magnitude of intra-household gender bias.

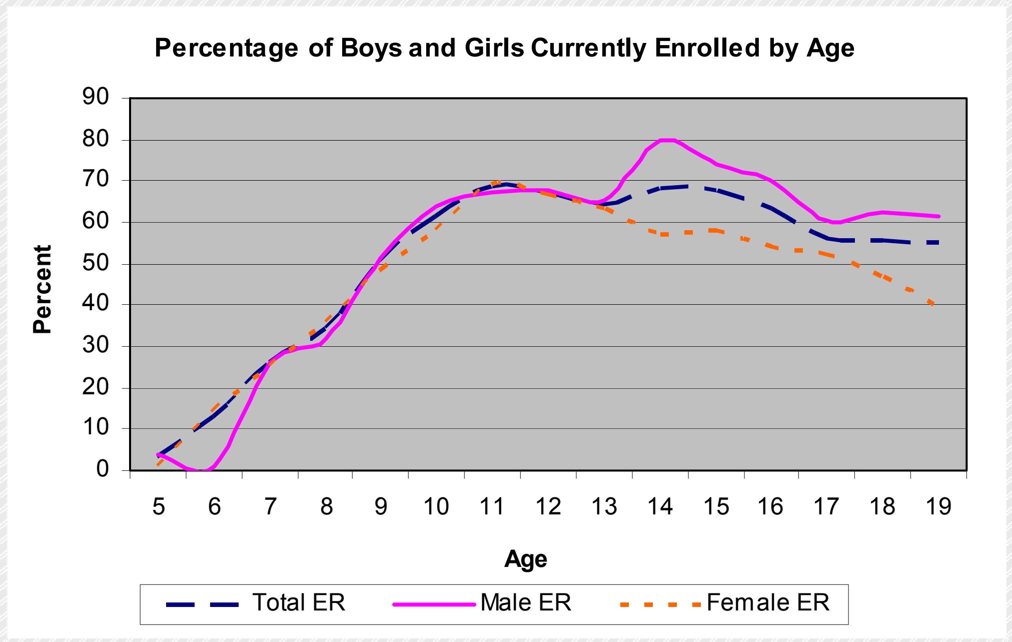
The rest of the paper is organized as follows. In the next section, we briefly present the current education policy and profile in Ethiopia. Section three discusses theoretical underpinning of intrahousehold resource allocation while section four presents the empirical strategies and data used in the study. Having discussed the descriptive and empirical findings in section five, the paper concludes with some policy implications in section six.

2. Background and profile of educational system in Ethiopia

There have been a number of international instruments geared towards gender equality in access to education, which Ethiopia has also ratified. Besides, the country's Education and Training policy aims at providing education on equal basis and in fact attention is given to gender issues through school materials and affirmative actions to girls in educational enrollment. In fact, Ethiopia has made progress in improving access to primary education since the 1990s. For instance, evidence from ERHS shows that it were only 67% of the sampled villages in 1997 that had access to primary school while the coverage has grown to 93% in 2004 (see Table 5).

However, low enrollments, high gender and regional disparity, and low quality of education remained the major challenges of the education system (Chaudhury *et al.*, 2006). There is a wide gender gap, both at the secondary and primary level. While the gap is declining for the primary cycle (grades 1-8) from that of 20% in 2000/01 to 16.5% in 2004/05, it is consistently increasing from as low as 4% in 2000/01 to 14.8% in 2004/05 for the secondary cycle (grades 9-12) (see Table 1 in Annex). Trend of both the Gender Gap (GG) and Gender Parity Index (GPI) reflect consistently rising gender gap at the secondary cycle over time. In fact the micro data from the sixth wave of ERHS data (2004) shown in Figure 1 also confirm this claim that the divergence in gross enrollment rate (ER) between boys and girls increases for children 14 years and above, which corresponds with the secondary school cycle.

Figure 1: Percentage of boys and girls currently enrolled by age - 2004



Source: Author's Calculation from ERHS 2004 data

There are multitudes of social, economic and cultural factors that deter girls' education. Economic factors like extreme poverty, socio-cultural nuisances such as harassment and violence including rape and early marriage; household discriminations and overburdened with household chores as girls time is close substitute to mothers' time in domestic activities, lack of follow-up and encouragement and unequal treatment compared to boys; etc increase the dropout rate of girls as well as hinder new enrollment (MoWA, 2005).

3. Theoretical model of intrahousehold resource allocation and gender-bias

If women, children, or old people are systematically worse off than other members of the household, the reported social welfare will be overstated (Deaton, 1997). Cognizant, in the development theory of intrahousehold resource allocation, there are different hypothesis as to how resources are allocated within the household. The simplest is the dictatorial/monotonic entities model, where households are assumed to be endowed with preferences as a single individual and the *paterfamilias* decides on behalf of everyone so that consumption behavior of the household will look like the behavior of individual consumer of the textbook. On the other extreme, we have the bargaining model, which considered households as a group of individuals who bargain with each other over resources (Deaton, 1997). The consequences of these different assumptions have been explored in the literature.

There are different presumptions as to why parents invest in their children human capital, the wealth model and the pure investment model, for instance. The wealth model presumes that parents can and are willing to substitute bequests for human capital investment and vice versa in order to maximize certain level of total life time wealth. The implication from this model is that, given differences in endowment, human capital and bequest of children, human capital investments reinforce initial endowment differences among siblings. The pure investment model, on the other hand, presumes that investments in human capital, like any other assets, depend on their net return. The marginal benefit and the marginal cost determine the level of investment in children, which is less influenced by the distributional consequences it involve (Behrman *et al.*, 1982; Becker 1991, 1993). Depending on genetic endowments and supply of funds, parents influence the shape and the specific position of the marginal cost and the marginal benefit curves (Taubram, 1996 in Tekabe, 2005).

Models dealing with investment in children are mainly based on unitary household models that maximize a single parental utility. They focused on the distribution of parent-provided resources among children. It is deemed that parents care for the distribution of resources, human capital resources and bequests, among their children (Behrman 1997). Under this framework, parents maximize the household utility function with respect to parental consumption, bequests and children's earning's function. If the household is divided into two groups of members, parents (A) and children (B), the decision making rests on parents. Say, q_a and q_b are vectors of consumption goods for parents and children, respectively. The utility functions for the parents is given by $u_a(q_a, z)$. Given efficiency, the optimal choice of parents can be written as the solution to the problem;

$$\text{Max } u_a(q_a, z^*) \quad \text{s.t.} \quad p_a.q = l_a(p, p_z, y) \qquad \textbf{[1]}$$

Where, z* is the optimal choice of public goods available for both groups, p is the price vector for all goods, p_a is the price of goods consumed by parents, p_z is the price vector of public goods, and $l_a(p, p_z, y)$ is the sharing rule function that determines the total amount that parents gets conditional on the prices of goods, and total household resources y. The solution to the maximization problem is a set of demand functions of parents given by:

$$q_{ai} = f_{pi}(x_a, p, g_a, g_b) \text{ and } x_a = l(p, y, g_a, g_b) \qquad \textbf{[2]}$$

Where, g_a and g_b are characteristics of parents and children, respectively. The argument x_a is the total expenditure that is allocated to adults by the sharing rule. As it is discussed in Deaton (1997), this is a well behaved demand function that holds widely for allocations based on bargaining or altruism. Here, children characteristics affect parents demand in two separate ways, through the amount that parents get through the sharing rule (income effects) and directly though the demand functions (substation effects).

Any change in child characteristics, say the addition of a child to the household, result in a reduction of adult consumption through income effect and rearrangements in adult consumption due to substitution effect which is required to feed, cloth or educate the child. If the sharing rule approach works, we should expect to find a greater negative effect on adult consumption of additional boys than of additional girls (Deaton, 1997).

4. Model and empirical strategy

4.1 Empirical strategy

From the theoretical underpinning of the demand function of parents for different household consumption goods, we have the standard Engle curve method appropriate to the problem under investigation. However, as there are different levels of decisions, the empirical model should be specified so as to account for the difference in decision behavior. The rationale behind the Engle curve approach is that household member composition according to different characteristics (sex, age, education, religion, ethnicity, etc) are a variables that exerts an impact on household consumption allocation pattern. In other words, household expenditure allocation to different purchases depends on the individual demand for a specific commodity and hence the household composition. Based on this economic rationale, an additional household member with specific individual characteristics affects the household's expenditure pattern in such a way as to increase expenditure on items of consumption associated with the additional member. By implication, the budget share of a good consumed by children increases as much when additional girl is added to the household as it does when an additional boy is added (Kingdon, 2005).

The Engle curve can be specified using the extended Working (1943) specification:

$$\omega_{it} = \alpha + \beta \ln(\frac{y_{it}}{n_{it}}) + \sigma \ln n_{it} + \sum \delta_k (\frac{n_{kit}}{n_{it}}) + \gamma Z_{it} + \varepsilon_{it} \qquad \textbf{[3]}$$

Where, ω_{it} is household budget share of education, y_{it} is total monthly consumption expenditure of the household, n_{it} is household size, n_{kit} is the number of individuals in the *k*th age-gender class within household *i*, Z_{it} is a vector of other household level characteristics, ε_{it} is the error term and t is survey round. α , β , σ , δ_k and γ are parameters to be estimated. The coefficient δ_k captures the effect of household composition on household budget allocations. The difference across gender can be tested using an F-test for the hypothesis that $H_0 : \delta_{kmi} = \delta_{kfi}$. Where, *m, f* and *k* denote males, females and a given age group, respectively.

In many optimization problems corner solutions are common. For instance, amount of life insurance coverage chosen by an individual; family contribution to an individual retirement account; expenditure on some consumption goods like alcohol, cigarette; and firm expenditure on research and development, etc are circumstances of corner solutions. Likewise, we observe a significant proportion of the surveyed households reporting zero educational expenditure resulting in censoring of the dependent variable (see Table 3). Consequently, OLS estimation of Equation 3 is not appropriate, which yields biased parameters. First, when $y \geq 0$, $E(y \mid x)$ cannot be linear in x unless the range of x is fairly limited. Second, it also implies constant partial effects. Third, predicted values of y can be negative for many combinations of x and β , which yields downward biased parameters. Although, the tobit model is suggested as an alternative, it is identified only if the assumption of normality and homoskedaticity are fulfilled. In addition, it assumes a single mechanism to determine the choice between $\omega = 0$ versus $\omega > 0$ and the amount of ω given $\omega > 0$. Specifically, $\frac{\partial P(\omega > 0 \mid x)}{\partial x_j}$ and $\frac{\partial E(\omega \mid x, \omega > 0)}{\partial x_j}$ have the same sign (Wooldridge 2002).

Because of the two-tier nature of such a decision of whether to choose a positive ω or a zero ω and the decision of how much to spend conditional on purchasing a positive amount ($\omega \mid \omega > 0$), a Hurdle model is appropriate that allows initial decision of $\omega = 0$ to be separate from the decision of how much ω given positive ω (Wooldridge, 2002). The model can be written as follows:

$$prob(\omega_{it} = 1 \mid x_{it}) = \Phi(x_{it}\theta) \quad [4]$$

$$\log(\omega_{it}) \mid (x_{it}, \omega_{it} > 0) \sim normal(x_{it}\psi, \sigma^2) \quad [5]$$

Where, x_{it} is a vector of explanatory variables, θ and ψ are parameters to be estimated and σ^2 is the variance.

We use random effects panel probit model for tier-one decision model and linear panel autoregressive random effects model for the second decision level, the decision on the magnitude of expenditure conditional on positive spending. The underlying specification of the **tier-one hurdle model** can be written as follows:

$$prob(\omega_{it} = 1 \mid x_{it}, \alpha_i) = F(x_{it}\theta + \varepsilon_{it}) \quad [6]$$

$$\varepsilon_{it} = \alpha_i + e_{it}$$

Where, ω_{it} is budget share of education in the total annual consumption expenditure of household *i* in period *t.* It takes 1 if $\omega_{it} > 0$ and zero, otherwise. α_i captures household and individual specific time invariant and unobserved effects, e_{it} is a transitory error term assumed to be *iid* over time with a distribution $e_{it} \sim normal(0, \sigma_e^2)$.

There are a number of alternative techniques in a limited dependent variable panel data model to estimate Equation 6 that controls for the initial conditions problem and unobserved individual heterogeneity. Here, we use a two-step procedure suggested by Orme (1997) and Wooldridge (2005).

The traditional random effects models assumes that unobserved effects term is normally distributed and it is strictly independent from other regressors, i.e., , $\alpha_i \mid x_i \sim Normal(0, \sigma_c^2)$, which is a strong assumption. As in the linear case, in many applications the point of introducing the unobserved effects, α_i, is to explicitly allow unobservable to be correlated with some elements of x_{it}. Using the Chamberlain's (1980) general specification to allow correlation between α_i and x_{it} and the Mundlak (1978) version, it can be assumed to have the following linear relation:

$$\alpha_i = c_0 + c_1\overline{x}_i + u_i \quad \textbf{[7]}$$

Assuming $u_i \sim IN(0, \sigma_u^2)$, which is independent of x_{it} and $e_{it} \forall$ i and t, c_0 is the intercept and $\overline{x}_i$ is a vector of means of the time-varying covariates for household *i* over time. Another problem is the initial conditions problem due to the correlation between ω_{i1} and the unobservable, u_i, which needs to be controlled. It arises simply because the start of the observation period is different from the start of the stochastic process. Following Heckman (1981) and Wooldridge (2002), the reduced form random effect probit model for the tier-one expenditure process can be written as:

$$prob(\omega_{it} = 1 | x_{it}, ...) = F(x_{it}\theta + c_1\overline{x}_i + \delta\eta_i + \sum \varphi_{tv} D_{tv} + \xi_i + e_{it}) \quad \textbf{[8]}$$

Due to Orme (1997)[3], Equation 8 is a two-step estimable equation using standard statistical software, where η_i is the Generalized Probit Error obtained from a probit estimation of the initial observation[4]. We also include regional and time dummies in Equation 8.

[3] For a detailed discussion and application of a two-step random effect probit model readers can consult Arulampalam et al., 1997.

[4] The correlation $corr(\alpha_i, \eta_i) = \rho$ can be assumed to be linearly related as $u_i = \delta\eta_i + \xi_i$, where, η_i and ξ_i are assumed to be orthogonal to one another. The error term η_i is obtained form $prob(\omega_{i1} = 1 | G_i, ...) = F(G_i\lambda + \eta_i)$.

Tier-two hurdle model

We can specify the positive educational spending Engle curve in panel data setting. In this specification, we allow the error terms to be correlated overtime. The model, which can be estimated using GLS, is written as:

$$\log(\omega_{it}) \mid (\ldots, \omega_{it} > 0) = \alpha + \beta \ln(\frac{y_{it}}{n_{it}}) + \sigma \ln n_{it} + \sum \delta_k (\frac{n_{kit}}{n_{it}}) + \gamma Z_{it} + \sum \varphi_{tv} D_{tv} + v_{it} \qquad \textbf{[9]}$$

$$v_{it} = \mu_i + \varepsilon_{it}$$

$$\mu_i = c_0 + c_1 \overline{x}_i + \zeta_i$$

$$\varepsilon_{ti} = \rho \varepsilon_{it-1} + e_{it}$$

Where, $e_{it} \sim N(0, \sigma_e^2)$ is orthogonal to μ_i, $|\rho| < 1$, $\zeta_i \sim iid(0, \sigma_\zeta^2)$ and $corr(x_{it}, \zeta_i) = 0$. Like we did for the non-linear model, we allowed the unobservable to be correlated with some of the time varying correlates. All variables are as defined before. Finally, the complete models which can be computed using STATA or any other standard software packages are Equation 8 and Equation 9. To better control for observed and unobserved village level factors we have introduced village by round interaction terms, $\sum \varphi_{tv} D_{tv}$. The gain in efficiency of the overall model after the inclusion of these terms is dramatic. Besides, the term control for the role of covariate shocks and any market, infrastructure, political or socio-cultural developments as well as other supply side factors across villages and overtime. In fact, otherwise, gender-bias will be overstated. Since our observation is large, introducing these 14x5 terms should not be a concern to loss of degrees of freedom.

4.2 The data

Our analysis is based on the Ethiopian Rural Household Survey (ERHS) panel data set spanning from 1994-2004 collected by Addis Ababa University, Department of Economics in collaboration with the University of Oxford Center for the Study of African Economies (CSAE) and other institutions like the International Food Policy Research Institute (IFPRI). The survey was undertaken for six waves; 1994a, 1994b, 1995, 1997, 1999/2000 and 2004 consisting of a panel of 1400 households. The sampling was stratified to represent the main sedentary farming system in the country, the plough-based cereals farming system of the Northern and central Highlands, mixed plough/hoe cereals farming system and farming system based on *enset* in the southern parts of the country. Further more, sample size in each village was chosen so as to approximate a self-weighting sample, when considered in terms of the farming system. Fifteen Peasant Associations (PAs) in four regions are included in the panel. The survey is aiming at generating a multi-purpose data set comprising a range of household, community and market variables during each survey period. There are a number of modules included in the questionnaire. The attrition rate was very low, below 7%, attributed to the fact that households in rural Ethiopia can not obtain land when moving to other areas (Dercon and Hodinot 2004). However, the survey does not cover pastoral areas in the country, which accounts for 10% of the total rural population.

4.3 Description and definition of variables

In this study, we used a household level data to identify intra-household gender-bias in the allocation of educational spending. Although, the ERHS data have information on some individual level variables, we preferred to use household level data to minimize measurement error. The dependent variable is share of spending on education. For the first-tier hurdle model, we used a dichotomous variable taking unity, if household allocate resources on child schooling. While for the tier-two model, we used log transformation of the share of educational spending in the total household consumption budget, conditional on positive spending. As can be shown in Figure 1, this is a valid transformation that reduces noise in the regression. The log transformed share of education (panel 4), after scaling up, is normally distributed than the unconditional and conditional level forms (panels 1 and 2). In the questionnaire, all school related direct expenses such as fees, uniforms, materials like book, contributions and club fees, accommodation and transportation to school are merged under school fees and other educational expenses. It should be noted that for primary cycle, there is no school fee in public schools. Besides, mindful of the indirect costs of sending children to school in rural areas, we included variables that capture the opportunity cost such as land ownership, livestock owned, oxen and the level of welfare of the household.

In the right hand side of our equations, we have the proportion of boys and girls in the household in each age-sex grouped into fourteen categories (below 4, 5-9, 10-14, 15-19, 20-24, 25-60, and over 60 years old) for both sexes as regressors. Age-sex group over 60 years are considered as reference group. Other household level characteristics like sex of the head (dummy=1 if male and zero otherwise), age of the head, level of education of the head, mean age in the household, lagged value of log of consumption per adult equivalent unit, size of land holding in hectare, number of livestock owned, number of oxen owned, and interaction of round by village dummies, over time mean values of time-varying household level variables and first difference of these variables are included. Summary statistics of these variables are shown in Table 3.

5. Discussion of results

5.1 Descriptive statistics

In this section the descriptive part of the analysis is presented. Spending on child education is an important aspect of human capital investment. However, evidences from rural Ethiopia, such as Assefa (2002) show that sending children to school has an opportunity cost as their labor is needed for domestic, farm activities or activities. As can be shown in Table 3, the percentage of households with one or more school age children (5-19 years) spending a positive amount of educational expenditure is around 21.64%. The worst figure is observed in the case of Ankober in Amhara Region, where the percentage of households who have school age children in the household that allocate positive amount on child education is only 13%.

Of those who allocate resources to siblings schooling, the level of budget share on education is only 1.3% of total expenditure in the survey areas. Conditional on enrollment, from the sample *weredas* households residing in Kedida Gamela spend the highest proportion of their budget, 2%, on child schooling. While households in Ankober spend very small, only 0.6%, proportion of their household budget. It is very interesting to figure out that compared to other regions, households residing in Amhara region (Ankober, Debre Birhan, Enemayi, and Bugna) have the lowest budget share for education, less than 1%, given households have already decided to spend some positive amount on child education. This could be due to a variety of supply, demand and policy factors on the ground. We cannot simply generalize that households in these areas have lower preference to child education and we need to assess all other factors.

Table 4 presents the proportion of children in households with positive educational spending by gender and age. We can observe that, in the three school age categories; 5-9 years, 10-14 years and 15-19 years, it is those households with the highest proportion of boys who incur the largest magnitude of positive educational expenditure.

5.2 Empirical results

5.2.1 Determinants of resource allocation to child schooling

It is imperative to understand the determinants of intra-household allocation of resources to child education. Beside supply side factors, demand side factors are important in determining the level of school enrollment, completion and rate of success. The demand side is determined by a number of factors; social, cultural, economic and household level preference and characteristics. As can be seen from the regression results in Table 6, sex and age of the individual as well as a number of household level factors determine the behavior of household resource allocation to child education investment.

It is appealing to note that the coefficient of male headship is negative but insignificant in the random effects probit regression equation while negative and significant at 5% on the decision of how much to spend. This implies that male headed households shift away resources from investment in child education. That is, cetirus paribus, male headed households have negative taste to child schooling presumably due to higher preference to adult commodities than children education. It reflects the uneven bargaining power of men and women in the household on intrahousehold resource allocation and reinforces the evidence that women headed households tend to allocate more resources to siblings schooling.

The level of education of the head, on the other hand, has a positive impact on the decision to allocate resources to education and its magnitude. We observe households with higher proportion of pre-school age children, below 4 years, tend to shift away their resources from child schooling, usually to nutrition, health, clothes and other purchases.

Although, in column [1] enrollment increases with the increase in household size, from the coefficient of the squared variable it is shown that very large household size discourages enrollment significantly. Except in Tigray, the coefficient on natural log of household size is positive and significant in Amhara, Oromia and SNNP[5]. However, from the conditional regression, we found a negative and statistically significant impact of household size on the magnitude of share of education in Tigray and Oromia region. The elasticity of share of education to household size is -2.21 and -1.1 implying a 1% decrease in the household size leads to 2.21% and 1.1% increase in the share of educational budget in Tigray and Oromia, respectively.

[5] SNNP stands for Southern Nations Nationalities and People

From the whole sample and Oromia region, we found that having more of both oxen and land have a negative impact on the initial decision to send children to school, which echoes the importance of farm opportunity cost of sending children to school. However, once they have decided to send their children to school, having more land and oxen have positive and statistically significant impact of increasing the magnitude of resource allocated to schooling. This is because the most important rural productive assets are land and oxen. Land is the central source of livelihood while oxen are the major source of traction power and store of wealth. Having more of these assets, increases the capacity of the households to cover school expenditure.

Land ownership has significant and negative impact on school enrollment in Tigray and Amhara regions, again reflecting the opportunity cost of sending children to school. On the other hand, the result from Oromia region is contrary to this finding where owning more of cultivable land increases the probability of child enrollment. Possible reasons may be productivity differences in adult labor and agro-ecological setup as Oromia and SNNP are surplus regions in the country resulting in less demand for child labor on farm activities. As the number of oxen owned increases by one unit, the probability of allocating positive educational resources is 5%, 3% and 6% in Tigray, Amhara and Oromia regions respectively. Generally, the direction and level of significance of asset holding is mixed across regions and stages of decision.
As it can be shown in column [1], the lagged value of log of consumption has positive sign in both stages of decision and it is significant at 1% in tier-two decision. Households with higher welfare, invest more on education, where doubling the level of consumption (total budget) leads to 10.4%, 25.8%, 15.8% and 12.7% increases in share of educational expenditure in Ethiopia as a whole, Tigray, Amhara and SNNP regions, respectively. This implies that for high income households, children are not needed to engage in income generating or productive activities to augment household income at the expense of their schooling.

5.2.2 Detecting gender-bias

When trying to identify intra-household bias, one has to be cautious not to overstate/understate it since bias may arise due to a number of factors and model specification. A number of factors should be controlled both spatially and overtime. There are observed and unobserved, individual, household and village level effects that may lead to the observed level of gender-bias. For instance, individual talent or intelligence in schooling, behavior, level of effort and success in school and other factors may influence the preference to allocate positive or zero sum of resources to child schooling. Along with deciding on the appropriate empirical model, one has to better suit to panel data set that tracks the same household over a long period of time as it enable to control for time invariant individual, household and community specific effects. The salient feature of our analysis is to make use of this advantage.

From the probit regression model of the whole sample, we observe that there are positive and statistically significant coefficients on male and female children aged between 5 and 19 years. That is, households with one or more member of this age category tend to allocate resources to education. However the magnitude and level of significance of these coefficients vary among different age-sex groups and regions like in Amhara and Oromia. Except in Tigray, magnitude of the coefficients is larger for boys than girls. For instance, the probability of allocating a positive resource to male children aged 10-14 years is 60.68%, 39.27%, 75.06% and 78.6% as compared to female children whose probability of getting enrolled is 47.99%, 14%, 46.44% and 62.86% for the whole sample, Amhara, Oromia and SNNP regions, respectively. That is, the probability of allocating a positive educational resource is 0.61 for the next boy and 0.5 for the next girl aged 10-14. Likewise, the magnitude of these probabilities in age group 5-9 and 15-19 years are higher for male children.

From regionally disaggregated marginal coefficients of probit estimation, we observe that the direction of most of the coefficients is theoretically consistent. However, it is only in the case of age-sex categories of male_10-14 and female_10-14 for Tigray; male_10-14 for Amhara; male_5-9, male_10-14 and female_10-14 for Oromia; male_5-9, male_10-14, female_10-14, male_15-19 and female_15-19 for SNNP that these coefficients are positive and statistically significant. This implies that an additional child of that specific age category to the household and region has a positive probability of being enrolled to school.

To give statistical validity of our claim over the existence of gender-bias in the intrahousehold resource allocation in child educational investment, we test the hypothesis $H_0 : \delta_{kmi} = \delta_{kfi}$, which can be accomplished by a Wald-test on the marginal effects of the coefficients of interest (school age children; 5-9 years, 10-14 years and 15-19 years). From the probit marginal effects of the whole sample and SNNP, in Table 7, we found that there is statistically significant pro-boy bias in educational enrollment in the age category of 15-19 years. That is households in rural Ethiopia discriminate against girls who are in the age range of 15-19 years. This age category corresponds to the secondary school (secondary cycle). Unlike other regions, households in Amhara significantly discriminated against girls school enrollment compared to boys aged 10-14 years. The risk in this discrimination is that it denies girls their very chance of being enrolled in school. However, except in

Oromia, test result from the conditional regression indicates that those households who have initially decided to incur positive school expenses do not discriminate against girls by reducing the magnitude of the resource.

One reason why we couldn't verify pro-boys bias in primary and junior school age children in most of the regions and the whole sample is that in many places there is no school fee at these levels. Besides, in most of the sample areas access to primary schools is relatively better, which will have positive impact by reducing transport cost, allowances, and other expenses. However, when children are promoted to high school, they have to travel to the nearest town. In most cases, they have to stay for a week or more. From Table 5, we can see that it is only 20 % of the sampled villages which have a secondary school in the village and the average distance to the nearest town with high school is about 11km in 2004. In this case, the cost of sending children to school becomes significant. Further more, traveling long distance to school in cases where there is no suitable road infrastructure is difficult for girls, which forces them to frequently dropout school.

Households are also reluctant to send their girls far from home fearing abuses and sexual harassment by schoolmates and men teachers. Hence, lack of access to school infrastructure in the village by itself may induce endogenous bias against sending girls to school. In addition, girls' role in the household is important and their time is a close substitute to mothers' time in domestic activities. This age category also corresponds to girls' marriage in most rural areas forcing them to dropout. Parents also may hesitate to invest on their daughters' than their sons' education as they expect low rate of return and low expected transfer to parents during old age. However, as we have observed, if households have found way of sending girls to school, no statistically significant evidence is found to reduce the resource against them. However, it is important to note that once households have decided to incur positive child educational expenditure, there is pro-girls bias in the age category of 10-14 years and significant pro-boy bias in the age category of 15-19 years in Oromia region.

Tigray region is the only exception with no statistically significant gender-bias against girls in both the decision to enroll and the decision on the magnitude of share of budget allocated to child schooling. Interestingly, our finding is consistent with the official macro data, where the Gender Gap and Gender Parity Index is consistently rising at the secondary cycle. Figure 2 also indicates that the enrollment rate for boys diverges significantly from that of girls aged 14 years and above. As we have discussed above, the pro-boys bias is pervasive during the initial decision to enroll children to school (or whether to incur positive educational expenditure or zero) in the age category of 15 – 19 years, which corresponds to secondary school in Ethiopian educational system.

6. Conclusion and policy implications

In this study, we examined whether there is any intra-household gender-bias in household educational resources allocation to boy and girls. Gender-bias may occur at two stages, the initial decision to enroll children to school and conditional on enrollment, whether households discriminate on the amount of the resource based on gender. This is of interest because at the national level, official data reveals the existence of gender gap both at the primary and secondary cycles. The trend shows that this gap is falling for the primary cycle, while it has been rising in the secondary cycle. This bias could be an outcome of a number of multiplicative factors, both from the supply and demand side. Micro evidence from the ERHS 2004 data also reveals divergence in gross enrollment rate between boys and girls for those aged 14 years and above.

The main objective of this study has, therefore, been to uncover if there is any intra-household gender bias on the allocation of resources to child education and during which stage of decision. Using a panel data set from ERHS, spanning from 1994-2004, we have tried to detect any intra-household gender bias in rural areas. The panel nature of our data set enabled us to control for observed and unobserved effects and initial condition problems. We applied panel hurdle model consisting of two regressions; random effects probit for the initial decision on enrollment and linear autoregressive random effects model on the proportion of the educational resource conditional on enrollment.

From the descriptive results we note that the percentage of households in rural Ethiopia with one or more children who allocate positive amount of resource to their children's education is around 21.64% of the sample. The average budget share of spending on child schooling of these households is only 1.3%. We have also observed that it is those households with the highest proportion of boys who frequently incur positive educational expenditure or send their child to school.

Irrespective of the gender of the child, households with male headship have negative taste to child educational investment. Although, large family size has positive and significant impact on child school enrollment, it has an inversely proportional impact on the budget share allocated to education. Having more of both rural farming land and oxen has negative impact on enrollment signifying the opportunity cost of sending children to school. Nevertheless, once they are enrolled, more of rural productive assets have positive and significant impact on the magnitude of the share allocated to child schooling. Households with high level of welfare allocate higher share of their budget expenditure to schooling.

After controlling for a number of observed and unobserved effects, we found that coefficients on male and female children aged between 5 and 19 years are statistically significant. From the whole sample, the observed probability of an additional school age child getting enrolled is higher if it is a boy as compared to a girl. The Wald-test on the marginal coefficients indicates that there is a significant gender bias during the initial decision against girls in the age range of 10-14 years in SNNP and in the age range of 15-19 years for the whole sample and SNNP. However, significant pro-boy bias in the primary school cycle ages, 5-9 years is not observed. From the whole sample, we couldn’t also find gender-bias on the budget share allocated, once households have decided to enroll their child. However, there are mixed results in some places. Such as in Oromia region, we found significant pro-girls bias on the share of education allocated to enrolled children in the age category of 10-14 years and pro-boy bias in the age category between 15 and19 years. The existence of gender-bias in the secondary cycle age children could be due to the absence of high school in the village that buttressed the gender discrimination in enrollment and resource allocation against girls in the age range of 15-19 years. The only region that we couldn’t detect significant gender-bias during both decisions is Tigray.

The implication of our study is that policies that are geared towards increasing human capital should take into account the existence of significant intrahousehold bias against girl’s education, especially among those who are aged 14 years and above. Since the bias occurs inside the household, public investments should not only focus on facilitating access to school but also work from the demand side as parents have different preference towards siblings’ education. Gender specific direct and indirect policy interventions are important at correcting the demand side bottlenecks in poor areas. Policies that increase the returns to girl’s education in the labor market could increase parents’ preference towards daughter’s educational investment. Besides other affirmative actions, supply side targeting of girls in through scholarships and incentives could also mitigate the problem. Besides, a broader objective of increasing labor productivity in rural areas it should also consider increasing intrahousehold productivity so as to reduce the overburden of mothers since girls labor could be a close substitute to their domestic activities. This can be accomplished by increasing access to clean water, grain mill, market infrastructure, alternative sources of energy, etc. Legislations that prohibit early marriage could also reduce the incidence of girls’ dropout from school.

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Annexes

Table 1: Trends in Gross Enrollment Ratios at Primary and Secondary Education by Sex

	Year	2000/01	2001/02	2002/03	2003/04	2004/05
Primary Cycle (1-8)	Total	57.4	61.6	64.4	68.4	79.8
	Boys	67.3	71.7	74.6	77.4	88
	Girls	47	51.2	53.8	59.1	71.5
	GG	20.3	20.5	20.8	18.3	16.5
	GPI	0.7	0.71	0.72	0.76	0.81
Secondary Cycle (9-10)	Total	14.1	17.1	19.3	22.1	27.3
	Boys	16.1	20.4	24	28.2	34.6
	Girls	12.1	13.7	14.3	15.9	19.8
	GG	4	6.7	9.7	12.3	14.8
	GPI	0.75	0.67	0.6	0.56	0.57

Source: Author's Calculation from ERHS data Note: Values in bracket are Standard Deviations

Table 2: Educational spending in households with one or more children aged between 5-19 years: 1994-2004

	Wereda	Share of Education in Total Budget among all HHs	% of HHs Spending Positive Educ'l Expenditure	Share of education in Total Budget among HHs spending Positive Amount
Tigray	Atsbi	0.003	20.12%	0.011
		(0.007)	(.401244)	(0.011)
	Sebhaassahsie	0.004	25.36%	0.014
		(0.011)	(.4356109)	(0.016)
Amhara	Ankober	0.001	12.92%	0.006
		(0.003)	(.3357506)	(0.005)
	Derbe Birhan	0.002	25.77%	0.007
		(0.007)	(.4375416)	(0.011)
	Enemayi	0.003	26.72%	0.009
		(0.008)	(.4430819)	(0.012)
	Bugena	0.002	17.48%	0.009
		(0.007)	(.3799863)	(0.015)
Oromoria	Adaa	0.002	18.73%	0.011
		(0.007)	(.3904634)	(0.013)
	Kersa	0.004	24.24%	0.016
		(0.012)	(.4289108)	(0.019)
	Dodota	0.004	30.22%	0.013
		(0.010)	(.4595619)	(0.014)
	Shashemene	0.008	45.15%	0.016
		(0.014)	(.4980211)	(0.017)
SNNP	Cheha	0.004	30.91%	0.013
		(0.010)	(.4627142)	(0.014)
	Kedida Gamela	0.008	37.08%	0.020
		(0.015)	(.4835319)	(0.019)
	Bule	0.002	13.02%	0.013
		(0.007)	(.3367171)	(0.013)
	Boloso	0.004	25.53%	0.015
		(0.010)	(.441872)	(0.015)
	Daramalo	0.005	31.32%	0.014
		(0.012)	(.4681633)	(0.017)
Whole Sample	Total	0.003	21.64%	0.013
		(0.009)	(.4118043)	(0.015)

Table 3: Summary descriptive statistics

Variable	Description	Mean	Std. Dev.
Dependent Variables			
Monthly Educ Expenditure-Conditional	Monthly Expenditure on School fees and Other school related expenses	7.220138	24.5932
Share of Education - Unconditional	Share of Monthly Educational expenditure in total consumption expenditure	0.002782	0.0088
Share of Education - Conditional	Share of Monthly Educational expenditure in total consumption expenditure conditional on positive expenditure	0.010845	0.014645
Dummy of positive educ spending	Dummy =1, if the household spends positive expenditure on education	0.216393	0.411804
Ratio of Age-Sex Category to Household Size			
Male_below4	Ratio of number of male children aged below 4 years to total household size	0.043624	0.092472
Female_below4	Ratio of number of female children aged below 4 years to total household size	0.040729	0.088702
Male_5-9	Ratio of number of male children aged between 5-9 years to total household size	0.05847	0.097007
Female_5-9	Ratio of number of female children aged between 5-9 years to total household size	0.059446	0.096026
Male_10-14	Ratio of number of male children aged between 10-14 years to total household size	0.058933	0.102086
Female _10-14	Ratio of number of female children aged between 10-14 years to total household size	0.057296	0.103536
Male_15-19	Ratio of number of male children aged between 15-19 years to total household size	0.0522	0.107183
Female_15-19	Ratio of number of female children aged between 15-19 years to total household size	0.052441	0.108422
Male_20-24	Ratio of number of male children aged between 20-24 years to total household size	0.039464	0.100251
Female_20-24	Ratio of number of female children aged between 20-24 years to total household size	0.041516	0.102122
Male_25-60	Ratio of number of male children aged between 25-60 years to total household size	0.144622	0.15154
Female_25-60	Ratio of number of female children aged between 25-60 years to total household size	0.165181	0.155925

Table 3 contd…

Household Characteristics			
Head_sex	Dummy=1, if the household head is male, zero otherwise.	0.769687	0.421061
Head_age	Age in years of head of the household	48.06955	15.56917
Head_agesqr	Age in years squared of head of the household	2491.08	1653.932
Head_primedu	Dummy=1, if the household head 's level of education is primary school	0.151524	0.358583
Head_junedu	Dummy=1, if the household head 's level of education is Junior school	0.028954	0.167688
Head_secedu	Dummy=1, if the household head 's level of education is Secondary school	0.019027	0.136628
Head_teredu	Dummy=1, if the household head 's level of education is Tertiary school	0.004136	0.064185
Household Size	Household size	6.218494	3.122065
ln of hh size	Natural logarithm of household size	1.687668	0.566128
ln of hh size sqr	Natural logarithm of household size squared	3.168691	1.722574
Household_mean age	Mean age in the household	24.41835	10.59169
land	Size of land owned by the household measured in hectar.	1.827598	2.125061
livstk_no	Number of livestock owned, except oxen and bulls	8.941679	11.66209
Oxen_no	Number of oxen and bulls owned	0.946643	1.98277
lncons_lg	Natural logarithm of lagged value of total consumption.	5.797525	1.007634
Regions			
Tigray		0.085153	0.279122
Amhara		0.274199	0.44613
Oromia		0.360171	0.480072
SNNP		0.280477	0.449253

Source: Author's Calculation from ERHS data set

Table 4: Proportion of children in households with positive educational spending

Wereda	Proportion of children 5-9 years		Proportion of children 10-14 years		Proportion of children 15-19 years	
	Mal e	female	male	female	male	female
Atsbi	0.079	0.059	0.085	0.069	0.042	0.058
	(0.113)	(0.102)	(0.120)	(0.103)	(0.087)	(0.095)
Sebhaassahsie	0.062	0.081	0.067	0.092	0.052	0.049
	(0.083)	(0.107)	(0.108)	(0.117)	(0.087)	(0.095)
Ankober	0.089	0.049	0.069	0.052	0.046	0.022
	(0.103)	(0.094)	(0.106)	(0.085)	(0.102)	(0.055)
Debre Birhan	0.073	0.065	0.082	0.078	0.068	0.058
	(0.114)	(0.099)	(0.106)	(0.105)	(0.122)	(0.088)
Enemayi	0.062	0.084	0.072	0.069	0.046	0.059
	(0.094)	(0.098)	(0.091)	(0.088)	(0.088)	(0.086)
Bugena	0.086	0.089	0.063	0.075	0.053	0.041
	(0.115)	(0.118)	(0.099)	(0.128)	(0.099)	(0.115)
Adaa	0.050	0.055	0.075	0.042	0.058	0.046
	(0.075)	(0.082)	(0.084)	(0.061)	(0.079)	(0.084)
Kersa	0.090	0.075	0.073	0.072	0.056	0.043
	(0.100)	(0.094)	(0.088)	(0.115)	(0.076)	(0.105)
Dodota	0.067	0.061	0.097	0.080	0.079	0.043
	(0.089)	(0.086)	(0.112)	(0.107)	(0.122)	(0.077)
Shashemene	0.058	0.055	0.086	0.068	0.075	0.054
	(0.090)	(0.080)	(0.110)	(0.099)	(0.118)	(0.089)
Cheha	0.065	0.048	0.087	0.092	0.057	0.073
	(0.099)	(0.079)	(0.101)	(0.137)	(0.113)	(0.105)
Kedida Gamela	0.053	0.064	0.081	0.074	0.074	0.062
	(0.084)	(0.083)	(0.110)	(0.091)	(0.103)	(0.077)
Bule	0.093	0.078	0.089	0.096	0.067	0.025
	(0.103)	(0.089)	(0.108)	(0.129)	(0.097)	(0.055)
Boloso	0.076	0.078	0.100	0.076	0.081	0.061
	(0.097)	(0.142)	(0.158)	(0.131)	(0.118)	(0.089)
Daramalo	0.062	0.068	0.082	0.099	0.082	0.061
	(0.104)	(0.092)	(0.124)	(0.129)	(0.161)	(0.094)
Total	0.070	0.067	0.082	0.077	0.066	0.051
	(0.099)	(0.097)	(0.111)	(0.111)	(0.111)	(0.090)

Source: Author's Calculation based on ERHS data. **Note**: Values in bracket are Standard Deviations.

Table 5: Availability of school and distance to the nearest town with high school: 2004

Region	Wereda	Peasant Association	1997				2004			
			Primary school	Junior School	Secondary School	Distance to the Nearest High School (km)	Primary school	Junior School	Secondary School	Distance to the Nearest High School (km)
Tigray	Atsbi	Harasaw	Yes	No	No	18	Yes	Yes	No	16
	Sebha Selassie	Geblen	Yes	No	No	18	Yes	No	No	19
Amhara	Ankober	Dinki	No	No	No	?	Yes	No	No	?
	Debre Birhan	Debrebirhan	Yes	No	No	10	Yes	No	No	5
	Enemay	Yetmen	Yes	Yes	No	17	Yes	Yes	No	15
	Bugna	Shumsha	Yes	No	No	10	Yes	No	No	9
Oromia	Ad'a	Sirbana Goditi	No	Yes	No	15	Yes	Yes	No	10
	Kersa	Adel Keye	Yes	No	No	7	Yes	No	No	8
	Dodota	Koro Degaga	Yes	No	No	25	Yes	No	No	15
	Shashemene	Tirurife Ketchema	Yes	Yes	Yes	2	Yes	Yes	Yes	0
SNNP	Cheha	Imdibir	No	No	No	4	Yes	Yes	Yes	4
	Kedida Gamela	Aze Adebo	Yes	No	No	5	Yes	Yes	No	?
	Bule	Adado	No	No	No	22	Yes	Yes	No	29
	Boloso	Gara Godo	No	Yes	No	13	No	No	No	12.5
	Daramalo	Doma	Yes	No	No	?	Yes	Yes	Yes	0
		Percentage Yes	**66.67%**	**26.67%**	**6.7%**	**12.69**	**93.33%**	**53.33%**	**20%**	**10.96**

Source: Author's computation from ERHS community data

Table 6: Random effects probit and autoregressive estimates

Variables	Whole Sample				Samples in Tigray Region			
	[1] Marginal Effects after RE Probit Estimation		[2] Linear Autoregressive Model (AR(1))		[3] Marginal Effexts after RE Probit Estimation		[4] Linear Autoregressive Model (AR(1))	
	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value
Constant	**-2.5904*** **	4.9	**4.0944*** **	7.98	**-4.249*** **	-2.04	2.4443	-1.02
Household Age-sex group ratio								
Male_below 4	**-0.3481*** **	2.7	-0.641671	1.26	**0.077*** **	0.26	-1.2138	0.79
Female_below 4	-0.1639	1.3	0.0466068	0.1	**-0.075*** **	0.23	1.0336	0.51
Male_5-9	**0.2017** **	2.03	0.2845792	0.86	0.0673	0.28	-1.5204	1.29
Female_5-9	0.0195	0.2	0.0060587	0.02	0.1133	0.54	**-2.4023** **	2.09
Male_10-14	**0.6068*** **	6.6	**0.5176797* **	1.85	**0.599*** **	2.47	-0.3688	0.33
Female_10-14	**0.4799*** **	5.51	**0.834276*** **	3.11	**0.824*** **	3.55	-0.3573	0.37
Male_15-19	**0.3504*** **	4.1	**0.5807817** **	2.03	0.6172	2.53	-0.7495	0.64
Female_15-19	**0.1535* **	1.76	**0.7048582** **	2.17	0.6433	2.68	0.0928	0.08
Male_20-24	-0.0091	0.1	-0.1307145	0.37	-0.0031	0.01	0.1086	0.09
Female_20-24	**-0.2782*** **	2.7	0.1796455	0.44	-0.0639	0.22	-0.9389	0.62
Male_25-60	**0.1323* **	1.6	-0.2242455	0.77	0.0328	0.13	-0.0926	0.08
Female_25-60	0.0182	0.22	**-0.5816122* **	1.93	-0.0673	0.26	0.8763	0.61

Table 6 continued…

Household Characteristics								
Head_sex*	-0.0206	0.8	**-0.180022****	2.11	0.0454	0.71	-0.0775	0.28
Head_age	0.0049	1.47	0.0133734	1.21	0.0032	0.36	0.0481	0.93
Head_agesqr	-0.0001	1.2	-0.0001287	1.31	-0.0001	0.7	-0.0006	1.13
Head_primedu*	**0.1118*****	3.82	0.0116446	0.15	0.0449	0.8	0.0418	0.11
Head_junedu*	**0.1708*****	2.59	0.0261754	0.16				
Head_secedu*	0.0909	1.33	-0.0511498	0.26				
Head_teredu*	**0.2863****	2.18	**0.6051018***	1.71				
ln of hh size	**0.3199*****	3.57	-0.4631516	1.36	0.2123	0.85	**-2.2137***	1.86
ln of hh size sqr	**-0.0433***	1.7	0.0973039	1.05	0.0162	0.21	**0.5578****	2
Household_mean age	-0.0037	1.3	-0.0021751	0.2	-0.0079	1.27	0.0138	0.44
Household Asset								
landXox	**-0.0043***	1.8	**0.0161301****	1.96	-0.0331	0.73	-0.0441	0.26
landXlivskt	0.0004	1.35	0.001195	1.18	-0.0002	0.03	**-0.0551***	1.64
land	-0.0059	0.6	-0.0264461	0.7	**-0.197*****	1.44	0.9413	1.55
livstk_no	-0.0024	1.2	-0.0084601	1.31	0.0018	0.28	0.0322	1.04
oxen_no	0.0171	1.47	-0.0282252	0.79	**0.047*****	0.85	-0.1328	0.58

Table 6 continued…

	Household Welfare level							
lncons_lg	0.0155	1.55	**0.104056*** **	3.15	0.0474	2.01	**0.2575*** **	2.84
GPE (Generalized Probit error)	-0.0444	1.3			0.0407	0.51	-	-
Rho		0.2			0.1917*			
sigma_u		0.49			0.4871			
/lnsig2u		1.4			-1.4388			
number of obs.		4897		1786	545		173	
Loglikelihood		-2383.52			-202.598			
Wald Chisquare		958.56*		606.66	101.65		314.34*	
R-squared - Within				0.21			0.6459	
- Between				0.3			0.4112	
- Overall				0.27			0.5651	
rho_ar (estimated autocorrelation				0.31			0.4319	
sigma_u				-			0	
sigma_e				1.05			0.8658	
rho_fov (fraction of variance due to u_i)				-			0	

Note: Reported constants are from the main regression result coefficients (not the marginal effects). ***=Significant at 1%, **=Significant at 5% and *=Significant at 10%. Over time mean and Change of time varying household level variables are included in the regression but not reported here and they are available at request from the author Village by round dummies interaction terms are included in the regression and most of these terms are statistically significant. However, the coefficients are not reported here. Coefficients on education are dropped due to co linearity in Tigray and Amhara region.

Table 6 Random effects…, cont'd

Variables	Samples in Amhara Region				Samples in Oromia Region			
	[5] Marginal Effexts after RE Probit Estimation		[6] Linear Autoregressive Model (AR(1))		[7] Marginal Effexts after RE Probit Estimation		[8] Linear Autoregressive Model (AR(1))	
	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value
Constant	-3.11***	2.89	1.7489	1.23	-1.2569	1.2	**4.9621*** **	4.17
Household Age-sex group ratio								
Male_below 4	**-0.87*** **	5.21	-1.3622	1.24	-0.4432	1.57	-0.34088	0.36
Female_below 4	**-0.91*** **	5.13	-0.8584	0.79	**-0.5326***	1.97	-0.28585	0.31
Male_5-9	-0.0014	0.01	-0.189	0.29	**0.3909***	1.89	0.797052	1.26
Female_5-9	0.0502	0.41	-0.0746	0.12	0.1347	0.61	0.489877	0.74
Male_10-14	**0.39*** **	3.14	**1.2657** **	2.04	**0.751*** **	3.9	0.074034	0.14
Female_10-14	0.1403	1.2	**0.9963***	1.66	**0.464*** **	2.55	**1.31783** **	2.46
Male_15-19	0.1201	1.14	-0.3841	0.07	0.224	1.28	**1.5102*** **	2.93
Female_15-19	0.058	0.53	0.5492	0.86	0.1283	0.7	0.11024	0.19
Male_20-24	-0.0406	0.3	0.4411	0.56	-0.0803	0.41	**1.10906***	1.8
Female_20-24	-0.0727	0.49	-0.5428	0.66	-0.1855	0.85	0.823557	1.13
Male_25-60	-0.0523	0.4	0.3211	0.43	**0.3351** **	2.06	-0.02867	0.06
Female_25-60	0.1644	1.51	-0.4424	0.67	0.0203	0.11	0.130802	0.24

Table 6 continued…

				Household Characteristics				
Head_sex*	-0.0368	0.89	**-0.3852****	2.07	0.015	0.31	**-0.2324***	1.74
Head_age	**0.013****	2.3	0.0078	0.26	-0.0016	0.19	-0.01702	0.69
Head_agesqr	**-0.001****	2.36	-0.0001	0.31	0.00001	0.17	0.000236	1.02
Head_primedu*	**0.099****	2.2	**0.2705****	1.6	0.0315	0.57	-0.03449	0.24
Head_junedu*	0.1225	0.98	-0.1548	0.32	0.2159	1.55	0.273903	0.96
Head_secedu*		-	-		-0.0744	0.72	**0.58932***	1.74
Head_teredu*		-	-		0.2592	1.04	0.440635	0.64
ln of hh size	**0.2873****	2.27	-0.4396	0.59	**0.347*****	1.95	**-1.0738***	1.71
ln of hh size sqr	-0.0592	1.44	0.1696	0.76	-0.0327	0.64	0.245212	1.56
Household_mean age	**0.009****	2.37	-0.0025	0.11	**-0.01*****	1.88	-0.01142	0.6
				Household Asset				
landXox	-0.002	0.86	0.0017	0.12	**-0.02*****	3.2	**0.03974****	2.01
landXlivskt	**0.0006***	1.75	**0.0030****	1.97	0.0012	1.52	-0.00122	0.68
land	**-0.0197***	1.73	-0.0494	0.94	**0.0304***	1.63	-0.01635	0.21
livstk_no	**-0.0039***	1.93	**-0.0188****	1.96	-0.0004	0.1	0.014336	1.22
oxen_no	**0.0305****	2.36	0.0494	0.99	**0.0562***	1.87	**-0.235*****	2.69

Table 6 continued…

	Household Welfare level							
Incons_lg	-0.0218	1.34	**0.1584****	2.35	0.0019	0.1	-0.02025	0.05
GPE (Generalized Probit error)	0.0381	0.84			**-0.106**	1.59		
Rho		0.2306*			0.1519*			
sigma_u	0.55				0.4232			
/lnsig2u	-1.2				-1.7198			
number of obs.	1674		499		1343			554
Loglikelihood	-717.77				-608.105			
Wald Chisquare	271.77*		100.53*		298.55*			97.22
R-squared – Within			0.1757					0.1003
- Between			0.1708					0.2396
- Overall			0.179					0.1727
			0.217					0.2487
sigma_u			0					0
sigma_e			1.0766					1.0527
			0					0

Table 6 Random …, cont'd

Variables	Samples in SNNP			
	[9]		[10]	
	Marginal Effexts after RE Probit		Marginal Coefficients from Linear	
	Coef.	z-value	Coef.	z-value
Constant	-1.7185	1.5	3.579831***	3.9
Household Age-sex group ratio				
Male_below 4	-0.418	1.35	**-1.663432***	1.64
Female_below 4	0.3605	1.3	**-1.414165***	1.67
Male_5-9	**0.5332****	2.34	0.4818685	0.76
Female_5-9	0.1542	0.64	-0.0409092	0.06
Male_10-14	**0.786*****	3.98	0.5448037	1.03
Female_10-14	**0.629*****	3.31	0.3615266	0.75
Male_15-19	**0.89**	4.12	0.6904884	1.25
Female_15-19	**0.3924***	1.79	0.3104279	0.46
Male_20-24	**-0.3792***	1.77	-0.9416805	1.43
Female_20-24	**-0.4314***	1.89	0.568111	0.72
Male_25-60	0.0625	0.32	-0.0738633	0.14
Female_25-60	-0.1875	1.03	-0.0612614	0.12
Household Characteristics				
Head_sex*	0.0209	0.32	-0.0703695	0.39
Head_age	-0.0099	1.15	0.0129079	0.73
Head_agesqr	0.0001	1.55	-0.0000709	0.5
Head_primedu*	**0.0986***	1.88	-0.0128374	0.1
Head_junedu*	0.0632	0.66	-0.0713425	0.29
Head_secedu*	0.1408	1.3	-0.1549146	0.6
Head_teredu*	**0.3892****	2.16	0.2540834	0.59
ln of hh size	**0.3495***	1.69	0.4165212	0.67
ln of hh size sqr	-0.0369	0.6	-0.1475452	0.85
Household_mean age	0.0032	0.42	-0.0044824	0.2
Household Asset				
landXox	0.0223	1.17	-0.0055352	0.15
landXlivskt	0.0016	0.4	**0.0211251****	2.27
land	-0.0331	1.06	-0.0833169	0.9
livstk_no	0.0062	0.53	-0.0349553	1.21
oxen_no	0.0296	0.55	-0.0240563	0.19
Household Welfare level				
lncons_lg	**0.0461***	1.87	**0.1267691***	1.83
GPE (Generalized Probit	-0.0829	1.11		
Rho	0.16			
sigma_u	0.43			
/lnsig2u	-1.67			
number of obs.	1335			560
Loglikelihood	-552.73			
Wald Chisquare	310.26*			70.13
R-squared - Within				0.11
- Between				0.1
- Overall				0.11
				0.41
sigma_u				-
sigma_e				1.09

Table 7: Wald-test results on H0: The marginal effects of coefficients for male and female are statistically equal

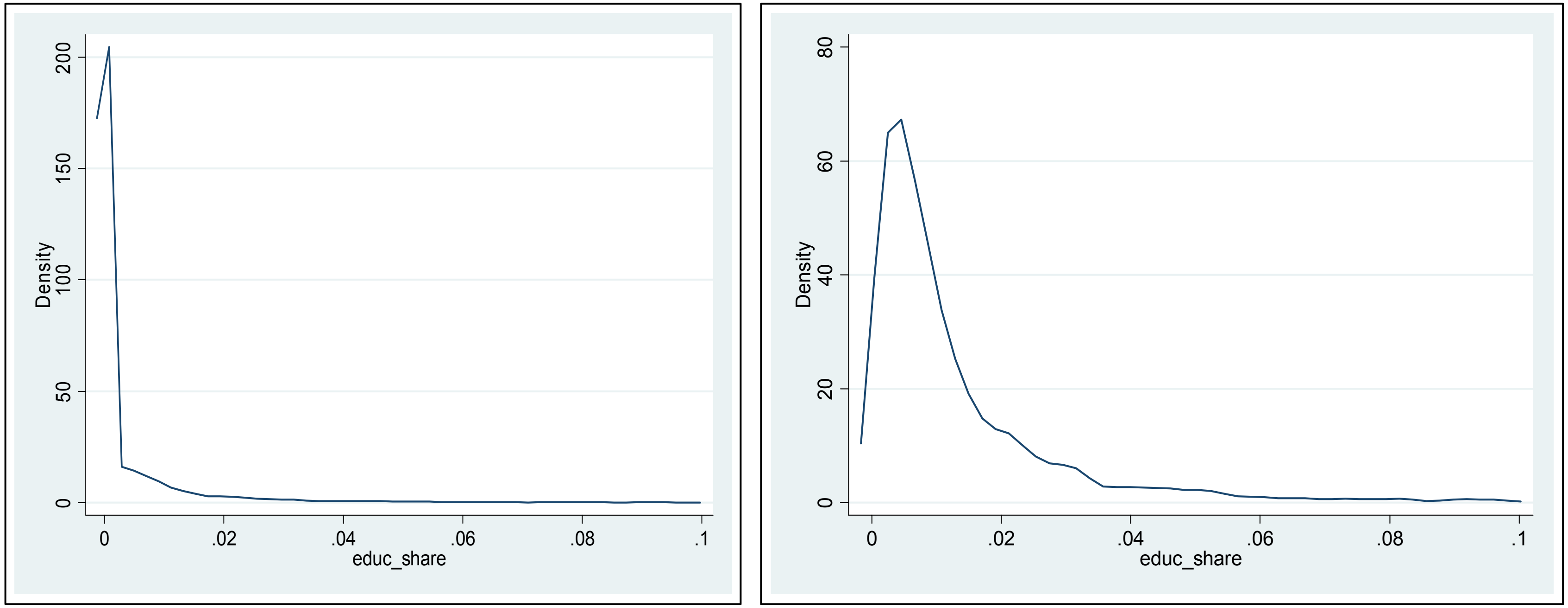
Age Categories	Marginal Effects after RE Probit Estimation		Linear Autoregressive Model (AR(1))		Marginal Effects after RE Probit Estimation		Linear Autoregressive Model (AR(1))	
	Whole Sample				Samples in Tigray Region			
	Chisqrd	**p-value**	**Chisqrd**	**p-value**	**Chisqrd**	**p-value**	**Chisqrd**	**p-value**
Age 5-9	2.3	0.13	0.16	0.69	0.03	-0.86	0.57	-0.45
Age 10-14	1.23	0.27	0.69	0.41	0.66	-0.42	0	-0.99
Age 15-19	**2.97***	0.08	0.51	0.48	0.01	-0.93	0.32	-0.57
	Samples in Amhara Region				Samples in Oromia Region			
	Chisqrd	**p-value**	**Chisqrd**	**p-value**	**Chisqrd**	**p-value**	**Chisqrd**	**p-value**
Age 5-9	0.1	0.75	0.03	0.87	0.94	-0.33	0.14	-0.7
Age 10-14	**2.99***	0.08	0.15	0.7	1.38	-0.24	**3.14***	-0.08
Age 15-19	0.2	0.66	0.65	-0.42	0.16	-0.69	**3.56***	-0.06
	Samples in SNNP							
	Chisqrd	**p-value**	**Chisqrd**	**p-value**				
Age 5-9	1.99	0.16	0.46	-0.5				
Age 10-14	0.39	0.53	0.08	-0.78				
Age 15-19	**3.31***	0.07	0.26	-0.61				

Note: ***=Significant at 1%, **=Significant at 5% and *=Significant at 10%

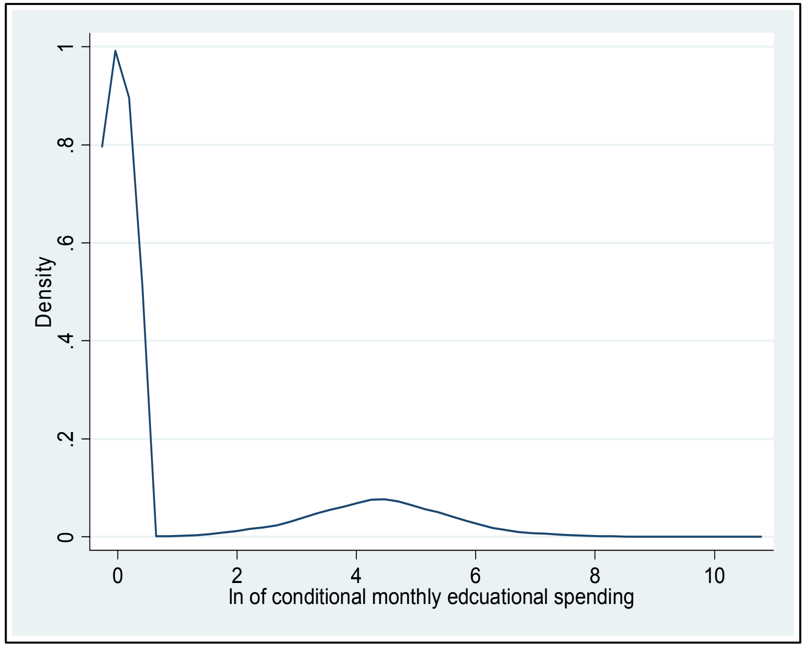
Figure 1: Kernel Density of educational spending

1. Unconditional educ_share

2. Conditional educ_share



3. Unconditional lneshare



4. Conditional lneshare