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Children's endowment, schooling, and work in Ethiopia

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Abstract

I investigate the relationship between children's endowment and parental investment using a rich dataset on a cohort of children from Ethiopia, who were surveyed at ages eight, twelve and fifteen. Children's endowment is measured by scores on tests of cognitive skills/ability. A child's enrollment in school, participation in work and work hours are employed as measures of parental investment in human capital. The results provide strong evidence of reinforcing parental investment—higher ability children are more likely to be enrolled in school and less likely to work and, conditional on participation, also work fewer hours. These results are mostly robust to addressing potential feedback effects between schooling and test scores, especially for the latter ages, and household heterogeneities. On the policy front, the results suggest that the seeds of inequality in human capital and earnings capability during adulthood may be sown quite early in childhood, and thereby underscore the importance of interventions that, among others, attempt to improve prenatal and early life health and nutrition, which are often cited as the sources of deficiencies in children's cognitive ability.

Keywords: endowment, human capital, schooling, child work/labour, Ethiopia
JEL classification: D10, I24, O12, J13

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Figures and tables are at the end of the paper.

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1 Introduction

The pattern of allocation of resources by parents among offspring with varying endowments can be compensating or reinforcing. Compensating allocations provide more resources to the less endowed, to enable equitable opportunities and quality of life later in adulthood. Early models of household utility maximization with intergenerational provision of resources assumed that parents inherently possess such a preference for equity among their children, and hence for compensating allocations (Becker and Tomes 1976). However, this assumption was challenged soon after, on theoretical grounds as well as with evidence that market signals, such as differential earning opportunities in adulthood, can shape and dominate household behavior, possibly leading to reinforcing allocations (Behrman et al. 1982; Rosenzweig and Schultz 1982). Very likely, idiosyncratic preferences combine with market mechanisms to determine the final nature of investments, the dynamics of which are highly dependent on relevant household characteristics, society's general level of development, market imperfections, and the degree of social and economic inequality. Such nonlinearities render the nature of intra-household allocation of resources largely empirical and contextual (Behrman 1997).

Human capital investment often constitutes a core component of resources allocated to children by parents (the other takes the form of 'transfers'). Given preferences, testable implications consistent with compensating, reinforcing or neutral investments in human capital are derived from consensus models of the family (Behrman et al. 1982; Behrman 1997 provides an extended review). Empirical tests, in turn, have mostly investigated differences in investment by a child's sex. This is mainly due to the fact that sex is the most directly observable genetic endowment.[1] Variations in children's health endowment and whether parents invest to compensate or reinforce such inequalities have also been emphasized (see Pitt et al. 1990 for a seminal contribution).

A child's cognitive or educational ability, despite the presumed central role it plays in the efficiency (returns and costs) of human capital investment broadly, and educational investments specifically, has been the subject of fewer studies. This is largely because [innate] cognitive ability is unobservable to the researcher. Although they are available, IQ or ability tests are usually difficult to administer alongside large-scale household surveys that also collect the requisite information on a wide array of control variables. In spite of this difficulty from the point of view of the researcher, it can be argued that parents can adequately assess their children's ability, in relative if not absolute terms, and will likely condition their investment allocations on such differences in perceived ability.

In theory at least, the prevalent pattern of educational investment allocation is expected to be of the reinforcing type. To the extent that marginal product of investment in human capital increases in child endowment, an "economic" allocation should favor more endowed children. There are factors that could attenuate and may even alter this, however, including inequality-

[1] Also, gender exhibits interesting interactions with parental preferences, production technology and culture which, in combination, often translate into differences in general labour market opportunities, giving it a special role in studies that examine the endowment—investment relationship (Rosenzweig and Schultz 1982; Behrman 1988; Pitt and Rosenzweig 1990; Sen 1990; Behrman and Deolalikar 1995).

averse parental preferences. Specific parametric assumptions about the human capital production and parental welfare functions are also crucial, as are total resources available for parents for allocation (Behrman 1997).

In this study I examine the nature of the association between children's educational endowment and parental investment in schooling using a unique longitudinal survey from Ethiopia. The contributions to the literature derive from the following. First, it uses a direct measure of children's endowment. In the three rounds of the survey, a sub-sample and later the full sample of children completed widely-known, standardized measures of cognitive ability/intelligence tests. Controlling for a rich array of child and household characteristics, the study therefore tests whether poor Ethiopian households condition educational investment decisions on child ability and, if so, whether these decisions follow reinforcement or compensation. Only a handful of recent studies have used direct measures of ability in this context. Second, the educational investment decision is examined from two angles—child schooling and work. This is relevant because studies have shown that these two are not necessarily substitutes and drawing inferences about one (e.g. schooling status) based on the other (e.g. child work) can sometimes be fallacious.[2] More importantly, by examining child work as a separate parental decision variable, the study also contributes to the now-extensive child labour literature that has almost entirely been unable to evaluate or isolate the endowment effect on child work in poor developing economies. In doing so, the effect on both the extensive and intensive margins of child labour is analyzed.

Bacolod and Ranjan (2008) is the study closest to this one in adopting a direct measure of educational endowment to examine the impact on child schooling as well as work. Using data from the Cebu metropolitan area in the Philippines, they report that children with higher scores on an IQ test are more likely to be in school even in poor (low wealth) households. Conversely, households of even of moderate wealth may be opting to let low-ability children stay idle rather than sending them to school or work. The study, however, does not consider the amount or intensity of child work. Two more studies, Ayalew (2005) and Akersh et al. (2012a), employ data from a village in Ethiopia and a province in Burkina Faso, respectively, to measure children's ability using test scores and examine the association with child schooling. Both report higher rates of school enrollment for higher ability children, while Akresh et al. (2012a) find reinforcing patterns in longer-term schooling achievement measures as well. Neither study considered child work.[3]

Third, the data employed have attributes that are especially pertinent to a study of this type: (a) the cohort children are surveyed at three important junctures—ages eight, twelve and fifteen—spanning the crucial years of primary education and shedding light on the endowment—

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[2] Among other reasons, this could be due to the potential confounding effects of leisure (Ravallion and Wodon 2000) and idleness (Biggeri et al. 2003), and possible complementarity between schooling and work, as happens for instance when a child's earnings can finance own education (Moehling 1995).

[3] To the best of my knowledge, Ayalew (2005) is the first study to adopt a direct measure of endowment (i.e. test score on ability test) in the specific literature. Interestingly, he also reports that although households seem to reinforce educational endowment, investment in health is compensating—less endowed children receive more health-related resources.

schooling/work linkage from early school entry to expected primary completion. The primary years are also when parents' say is arguably the most important factor determining a child's status (e.g. in schooling and work), hence the latter's use to proxy parental human capital investment decisions; (b) the sample has extremely low attrition, which minimizes selection bias often associated with cohort data; (c) unlike most of the above-cited studies that were confined to a particular area/region, the sample in this study comes from about 20 sites in five major regions of Ethiopia, providing a balanced representation of the country's geographical, cultural and regional diversity, and enabling potentially broader inferences from the results; and (d) the three rounds of surveys took place between 2002-09, a period in which Ethiopia recorded arguably the fastest growth in its economy as well as the largest expansion in schooling opportunities for children, especially at the primary level. The repeated cross-sectional analysis therefore is able to capture the impact, if any, the changing socio-economic conditions have had on the endowment–child schooling/work relationship. Finally, the study attempts to address potential bias in estimation of the endowment effect. The bias can arise from simultaneity between test score, which is used as a measure of ability, and current and past investment in schooling, as well as from unobserved household heterogeneities. In an attempt to address these, estimates from a residual method that utilizes the longitudinal nature of the data and a within-household model are presented.

As noted, Ethiopia provides the right context for the study. In the last 15-20 years the country has made major strides in expanding schooling opportunities, particularly at the primary level. After a historically poor record, as of 2011 net primary enrollment rate was 86 per cent compared to a aub-Saharan Africa (SSA) average of 75 per cent. The transformation is not complete, however, and the country faces challenges. Primary completion rates are still low (58 per cent) and there exist inequalities in schooling opportunities and attainment.[4] The country also registers high incidence of child labour even by SSA standards, especially in rural areas, much of which may actually be hidden due to its nature (Cockburn and Dostie 2007; Alvi and Dendir 2011). Policies that attempt to remedy these challenges will benefit from evidence on the pattern of resource allocation by households in response to children's endowment.

The next section describes the data, variables of interest and some bivariate associations. Section 3 presents the empirical framework. Section 4 discusses baseline results, followed by some sensitivity analyses. Section 5 concludes with some policy remarks. The results generally point towards reinforcing investment by Ethiopian households in children's education:

(a) higher ability, as measured by score on an ability test, is positively correlated with a child's enrollment in school;
(b) the likelihood of participating in market work is negatively associated with ability;
(c) conditional on participation, higher ability children work fewer hours;
(d) these associations seem to be present at the supposed beginning, middle and later years of primary education; and

[4] The 2011 primary completion average for SSA is 70 per cent (World Bank's World Development Indicators, accessed June 2013). In a detailed study, World Bank (2005) outlines the gender and rural-urban disparities, which are expected to have somewhat narrowed since.

(e) they also hold firm when ability is measured as a residual, accounting for a feedback effect from schooling, and to the use of an alternate, within-household (between sibling) specification.

2 Data

Data for the study come from the Young Lives (YL) project, a 15-year longitudinal study of childhood poverty at the Department of International Development, University of Oxford. The project involves 12,000 children in four countries: Ethiopia, India (Andhra Pradesh), Peru, and Vietnam. Starting in 2002, the project has followed two cohorts of children in each country: the 'Younger Cohort' of 2000 children aged around one year old in 2002 and the 'Older Cohort' of 1000 children aged around eight years old in 2002. In addition to the first round, so far the project has collected two more rounds of data on these children, in 2006 (aged five and twelve) and 2009 (aged eight and fifteen). The project has the stated aims of understanding the causes and consequences of childhood poverty and thereby informing the development of policies that will reduce it. To fulfill these objectives, the YL study collects extensive information on wide-ranging economic, social and environmental phenomena at the child, household and community levels.

I use data from the Ethiopia part of the YL project. The YL sampling procedure adopted sentinel site surveillance, where the sites were purposefully selected to meet study objectives, such as its poverty-centered focus, and to optimize study sustainability, yet capturing geographical and cultural diversity of the country and urban-rural differences. This was followed by random sampling of households within each site. Accordingly, the sample provides a balanced representation of the Ethiopian geographical, cultural and regional diversity.[5] Furthermore, even though the survey is not nationally representative and cannot be used for monitoring of welfare indicators over time (e.g. as in the Demographic and Health Survey (DHS) and Welfare Monitoring Survey (WMS)), it is noted that the YL sample is an appropriate and valuable medium for the modeling, analysis and understanding of the dynamics of child welfare in Ethiopia (Outes-Leon and Sanchez 2008).

For this particular study the three rounds of data on the 'Older Cohort' of children (henceforth also identified by age at the time of survey: Age 8, Age 12 and Age 15) are used. I focus on the older cohort because their ages during the three surveys span a critical period in children's school status and involvement in household and outside work activities. Children in Ethiopia are expected to start school at age 7 and progress through most of primary school by age 14. The data at ages 8, 12 and 15 therefore provide valuable snapshots of a child's schooling status and progress from beginning through the supposed late years of primary education. However, these are also the ages when parents will arguably assume that children are physically and mentally maturing to be able to commence and increasingly engage in household and/or outside work. In poor households where direct and indirect/opportunity costs of a child's schooling are viewed as considerable, the years covered by the three rounds of data represent a critical period of decision-

[5] The sites were located in five regions/administrative states of the country: Addis Ababa, Amhara, Oromia, Southern Nations, Nationalities and Peoples' Region (SNNP), and Tigray.

making in terms of allocation of resources and children's time use, with significant implications for long-term human capital accumulation of children.

To examine the linkage between children's endowment and household decisions with regard to schooling/work, I make extensive use of the detailed information available at the child and household levels in the three rounds. One of the strengths of the YL study is that the surveys so far have experienced very low levels of sample attrition. Out of the 1,000 older cohort of children that participated in the first round and keeping only observations with non-missing values for all the basic child and household variables, I was able to track 971 children across the three rounds (an attrition rate of 3 per cent). Higher levels of attrition (e.g. due to migration) are often associated with systematic changes in a cohort sample and lead to bias in analysis, but the very low attrition rate in the YL surveys means this is highly unlikely. Summary statistics on the variables of interest are presented in Tables 1a-1c, respectively on basic child and household characteristics, measures of endowment/ability, and child schooling and work.

Table 1a describes the basic child and household characteristics of the final sample. As noted earlier, the YL children are of the same age (even when measured in months) and about half of the sample is composed of females. Parents' years of schooling are very low, with an average of about 2 and 3 years, respectively, for the mother and father. 10-13 per cent of children live with a caregiver who is neither the biological mother nor father (Other caregiver) and about a quarter reside in a female-headed household (Female head). Typically, a child lives in a household with 6.4 members and is expected to have about 3 siblings. On average, 39 per cent of the sample children come from urban areas.

For the purposes of this paper, a child's endowment is measured by her score on a test of cognitive ability or intelligence. The older cohort in the YL study completed two such tests in the three rounds of data collection: the Raven's Colored Progressive Matrices (CPM) in round 1 (age 8) and Peabody Picture Vocabulary Test (PPVT) in rounds 2 and 3 (ages 12 and 15). The Raven's Progressive Matrices measure general, non-verbal reasoning/intelligence using multiple-choice format questions in which the respondent has to identify the missing item that best completes a pattern (Raven, Raven and Court 1998). The CPM contains three sets (A, B and AB), each made up of 12 questions, and the total score is the sum of correct responses from each set. The test is said to be relatively free of cultural bias. Unfortunately in the Ethiopian version, administration of the test ran into difficulties relating to explanation of tasks and time constraints and thus only about a quarter of the sample—all urban children—have test scores available in the dataset. Cueto et al. (2009) note that such difficulties, coupled with further problems encountered in the Peruvian pilot tests for round 2, prompted the abandonment of the CPM, though it may yet be brought back for future rounds.[6]

The PPVT, which was adopted for rounds 2 and 3, is a test widely applied to measure verbal ability/scholastic aptitude and general cognitive development since its inception in 1959. It is

[6] The CPM test was administered to all children belonging to a chosen site/cluster, therefore there is no household-level within-cluster selection bias. However, the chosen sites on average had wealthier households and higher head's and partner's schooling (all at $p < 0.01$) relative to the non-chosen ones. The children were also more likely to be enrolled in school ($p < 0.01$) than those who did not take the CPM, but the former were also more likely to be involved in work ($p = 0.03$).

untimed, does not require reading on the part of the respondent, is relatively easy to administer, and can be completed in about 20-30 minutes. The test is documented to have strong positive correlation with other common measures of intelligence such as the Wechsler and McCarthy Scales (see Campbell 1998; Campbell et al. 2001, among others) although the evidence on the extent to which it is entirely free from cultural bias is contested. The object of the exercise to the test-taker is to identify one picture, among a set of four pictures presented, that corresponds to a word read out by the examiner. The test has gone through many revisions over time and PPVT-III (Dunn and Dunn 1997; Form A) was the version used in YL rounds 2 and 3. The PPVT contains 17 sets of 12 items each, arranged in order of difficulty, and the starting set for a respondent varies depending on his/her age. Progress through (up or down) sets is decided by performance during the test, eventually determining what are known as the Basal and Ceiling Item sets for each individual. Scores are then computed by subtracting the number of errors from the individual's Ceiling Item. Cueto et al. (2009) argue that converting raw scores to [international] standard PPVT scores is possible but not necessarily advised, since the standardization samples are deemed to be different from the YL sample. Moreover, the objective of this study is to examine how differences in ability among a cross-section of same-age children in Ethiopia are related to schooling/work status and outcomes, not measuring their standing vis-à-vis an international norm, and thus the raw score is adopted as a measure of ability. Table 1b shows summary statistics of the raw scores on the CPM and PPVT in the three rounds.

The parental human capital investment decision is viewed from two angles: child schooling and work. Table 1c provides summary statistics on the relevant variables. Schooling is measured primarily by current enrollment, which equals one if the child was enrolled in school at the time of survey, zero otherwise. For comparison, I also define 'Ever enrolled', which shows if the child has ever attended formal school. 67 per cent of children indicated that they had by age 8 and this figure rises to 99 per cent by age 15. 66 per cent of children were in school at the time of survey at age 8, which reaches a peak of 95 per cent at age 12, and falls to 90 per cent at age 15. A child's completed years of schooling as of survey date (Grade completed) measures schooling achievement and is constructed for use in a sensitivity analysis later in the paper. Conditional on ever enrolling in school, the mean for highest grade completed rises from 0.7 at age 8 to almost 6 by age 15.

Table 1c provides summary statistics on child work as well. Child work is measured at the extensive and intensive margins—that is, both as participation in and amount of work. It should be noted that a change in the YL survey questionnaire from round 1 to rounds 2 and 3 meant the latter two rounds have similar, more structured and extensive measures of children's work than round 1. This is mainly due to the inclusion of a detailed children's time use section in rounds 2 and 3, which is absent in round 1. Nonetheless, in round 1 it is possible to establish whether the child performed paid work in the last 12 months. As shown in the table, 3 per cent of children indicated they did. For rounds 2 and 3, the child work measures are based on the detailed information collected about the hours spent by the child on various activities on a typical day during the week prior to the survey. The activities included, among others, work for pay, on family farm or business, and on various chores. Based on the standard definition in the child labour literature, 'Work status' is defined as a dummy variable which equals one if the child reported non-zero hours on paid work (hired or self) or on family farm/business, zero otherwise. In the literature this is identified as market work and as such excludes household chores and related domestic tasks. According to the statistics, at age 12, 48 per cent of the sample children were involved in market work which decreases to about 46 per cent by age 15.[7] Conditional on participation, the number of hours spent on market work on any given day in the week preceding the survey rises from 3.3 at age 12 to 3.8 at age 15. Taking into account the likelihood of engaging in market work, coupled with the reported mean hours, one can obviously conclude that the amount of child labour taking place in Ethiopian households is far from trivial. This paper examines whether parents' decision on the allocation of schooling and labour is influenced by children's endowment/ability.

2.1 Bivariate associations

The possible link between children's endowment and their schooling and work is first illustrated using simple bivariate analysis. Figures 1.1-1.3 present average school enrollment by test score quintile at different ages. Clearly, one can observe a positive trend between the probability of a child ever/currently enrolling in school and her quintile test score. At age 8, for instance, the likelihood of a child in the lowest quintile to have ever been enrolled in school is about 83 per cent, while all children in the top quintile are enrolled in school (this is based on the limited sample of children who took the CPM test). With the almost monotonic relationship between enrollment and test score, the graph at age 12 is probably most supportive of the hypothesis that a child's perceived endowment is indeed a factor in the parents' decision to enroll her in school, assuming such a decision overwhelmingly, if not solely, rests with the parents. Similarly, by age 15 (Figure 1.3), whereas children of all abilities except those in the bottom quintile had been enrolled in school at one time or another, the positive correlation between current enrollment and ability is palpable. A quarter of children of the lowest ability, for example, are out of school by that age, while the corresponding figure for those in the top two quintiles is less than 5 per cent.

Figures 2.1-2.4 present the bivariate associations between child work and score on the PPVT at ages 12 and 15. At both ages, participation in market work declines, almost monotonically, by test score quintile. For instance, children in the bottom quintile of ability have, on average, a more than 60 per cent chance of engaging in market work, while those in the top quintile are less than half as likely. Most of this decline can be attributed to the significant decrease in the likelihood of engaging in family farm/business work, although the drop in participation in paid work associated with most jumps in test score quintile is not insignificant either, albeit from a small base. When it comes to the amount of work, the general trend is also negative, as shown by the mean hours of work by ability at age 12 as well as 15.[8]In sum, the bivariate correlations between children's cognitive test score and work are also strongly suggestive of a child's endowment being a consideration in the parental human capital investment decision.

[7] Although not shown, the interplay between the different types of market work at the two 'ages' is interesting. For instance, the proportion of children who engage in paid work doubles from age 12 to age 15 (4 to 8 per cent), but those who work on the family farm/business actually declines (from about 45 to 39 per cent).

[8] However, when partitioned by type of work there is a rather peculiar increase in hours spent on work for pay (between the third and fifth quintiles) and on family work (between the second and third quintiles) at age 15.

3 Empirical framework

The baseline multivariate framework used to test the relationship between children's endowment and parental human capital investment is given by:

$$H_i = \beta_0 + \beta_1 E_i + \sum_{j=1}^{m} \delta_j Z_{ij} + \varepsilon_i \qquad (1)$$

where H_i is a proxy for human capital investment on child i (school enrollment, work status or work hours), E_i is educational endowment measured by test score, Z_i contains various child and parental/household characteristics, with associated coefficients δ_j, that potentially impact children's status, and ε_i is the regression error term. β_1 measures whether children's human capital status is statistically related to endowment, whereby the sign determines if the latter is being reinforced $(\beta_1 > 0)$ or compensated $(\beta_1 < 0)$.

Equation (1) is estimated separately at the three ages (8, 12 and 15). As noted earlier, score on the CPM is used to measure endowment at age 8, albeit with the smaller sample of the YL children who took the test. The score on the PPVT is used for the latter two rounds. The empirical specification controls for three groups of child and household characteristics in estimating the endowment—investment relationship. The child's sex accounts for potential discriminatory human capital investment behavior along gender lines in poor households in Ethiopia (Appleton 2000).[9] The parental/household controls include parents' schooling, whose effect through improving the quality and efficiency of parent-child time and other complementary inputs, among other channels, has long been established as crucial for children's educational status and outcomes (Haveman and Wolfe 1995; Strauss and Thomas 1995). Whether or not a child lives with her parent as the main caregiver may be particularly pertinent in order to realize these benefits, however, therefore this is controlled for using an indicator variable.

To account for various effects related to household demographics, such as life-cycle position, earnings capabilities and maternal health and experience, I also include head's and caregiver's age, headship status and number of adults residing in the household. The relevant literature has also shown that increased household resources are associated with many desirable schooling outcomes (Behrman and Knowles 1999; Filmer and Pritchett 1999; Dostie and Jayaraman 2006) and decreased child work (Edmonds 2008). For this, a composite index of household wealth and household nondurable expenditure are included as regressors.[10]

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9 As will be seen later, in extended specifications the child's sex is also interacted with test score to check if reinforcing or compensating behavior exhibits gender-based nonlinearities.

10 The reasoning behind including both is that one measures stock (wealth) and the other flow of resources (expenditure). The expenditure variable is not available for round 1 of the YL surveys, therefore only wealth is included in the Age 8 regressions. Specifications that included each separately were estimated but not reported here, but there were no notable changes in estimates. The wealth index is a composite index of housing quality, durables and facilities and takes a value between 0 and 1. See the note under Table 1a for details. A rescaled value (× 5) is included in the regressions.

The last set of control variables account for sibling demographics—sibling size, birth order, number of sisters and infant siblings. Studies have documented that sibling demographics—primarily birth order and sex composition—have important implications to a child's schooling and work status. These are mainly due to cultural influences, changes in parents' experience, health and earnings over time, evolving patterns in between-sibling comparative advantage, and fertility choice (Ejrnaes and Portner 2004; Edmonds 2008). The majority of evidence from developing countries suggests that earlier-born children, particularly females, tend to do worse than their siblings in various human capital measures. Similarly, having more sister siblings is correlated with favorable outcomes (Parish and Willish 1993; Patrinos and Psacharopoulos 1997; Garg and Morduch 1998).

Finally, site/community fixed effects are included in all specifications to control for various supply-side (e.g. school supply, costs and prices) and demand-side (e.g. differential female-male wage rate, youth employment opportunities) factors. A linear probability model (LPM) is adopted for the estimation of the school enrollment and work status regressions since the regular probability models (probit and logit) result in inconsistent estimates in the presence of fixed effects. For the child work hours regressions, which contain a large number of zero values for non-working children, a censored model such as tobit is appropriate. However, tobit estimates also suffer from inconsistency in a fixed effects framework due to the insufficient statistic problem (to condition the fixed effects out of the likelihood function). I report two sets of estimates for the work hours regressions: (1) tobit estimates that exclude the community fixed effects (as a baseline), and (2) estimates using Honoré's (1992) semiparametric least squares censored fixed effects regression model, which does not impose any parametric restrictions on the error term. In all regressions, robust standard errors are employed that account for clustering in sample design, which for the YL surveys is at the site/community level.[11]

4 Results

The results from the estimation of equation (1) are presented in Tables 2-5, respectively for children's school enrollment, participation in market work and work hours. As noted earlier, the estimation is done separately for each round/age.[12]To allow a more informative interpretation of estimates, test score is entered in the regressions as a standardized/z-score (by subtracting the mean from the raw score and dividing by the standard deviation). In addition to a basic specification, an extended specification that allows for nonlinearities in the effect of test score through a squared term and interaction with a child's sex is reported. All the regressions for age

[11] Clustering of standard errors is not done for the regressions at age 8. Due to the reduced sample size, the number of clusters is significantly reduced, and Nichols and Schaffer (2007) argue that clustering does 'more harm than good' when the number of clusters is small. Once the threshold number of clusters (about 20) is met, however, they argue clustering is desirable to allow within-cluster correlation of unknown type, even in a fixed effects model.

[12] The reason why a child fixed effects model is not estimated, at least for the latter two rounds where the same ability test is administered, is because the child's educational endowment, which once formed is presumably a mostly 'fixed characteristic', will be subsumed in the child fixed effect, rendering its effect separately unidentified. That 'endowment' is a mostly formed, fixed child characteristic by ages 12 and 15 seems to be borne out by the data—a Wilcoxon signed-rank test of the PPVT score at ages 12 and 15 yielded p=0.89, which means the null of same distribution cannot be rejected.

8 use a smaller sample of about 236 children, the reason being the limited scope of the CPM test administration in the Ethiopia YL surveys.

Table 2 shows the results pertaining to school enrollment. Controlling for a large array of child, sibling and household characteristics, at all three ages score on a cognitive test has a positive, statistically significant effect on a child's school enrollment. At age 8, a one standard deviation higher score on the CPM test is associated with a 5 to 6 percentage point increase in the probability of a child's enrollment in school. At ages 12 and 15, a unit standard deviation increase in the PPVT score raises the chances of enrolling in school by about 3 to 6 percentage points (the regression estimates at age 8 are generally less well determined than those at ages 12 and 15, likely due to the smaller sample size). This is evidence in support of reinforcing investment in children's schooling—higher ability children are more likely to be enrolled in school, accounting for other factors that potentially affect children's school attendance. This positive endowment effect on school attendance does not seem to vary by a child's sex, although there is some evidence that it may be nonlinear (inverse U-shaped, at age 15).

If children of lower ability are less likely to be in school at any point in time, it may be that they are more likely to be involved in work. The work participation results in Table 3 indicate that this may indeed be the case. Even though there is no relationship between test score and market work status for the sample of urban children who took the CPM in round 1, at ages 12 and 15 there is a statistically significant association between a child's cognitive skills, as measured by score on the PPVT, and her chances of engaging in market work. More precisely, a one standard deviation higher score on the PPVT is associated with a 3 to 5 percentage point decrease in the probability of involvement in market work at age 12. The impact at age 15 is even more substantial, closer to 6 to 9 percentage points, which on the high end amounts to a roughly 20 per cent decrease in the mean probability of a child engaging in market work.

The work amount regressions in Table 4 provide further evidence. For ages 12 and 15 where detailed time use data are recorded, time spent in market activity by a YL child on a typical day in the week preceding the survey is statistically smaller, after accounting for various child and household characteristics, the higher the child's cognitive ability. Based on the marginal effects from the tobit model, a one standard deviation increase in score on the PPVT is correlated with a 10 to 15 minute decrease in the amount of market work.[13] In sum, the work regression results are also supportive of the reinforcement hypothesis—parents may be deciding to send to work children of smaller perceived endowment.

Many of the control variables in the regressions in Tables 2-4 exhibit the expected sign when statistically significant. More household resources are generally associated with higher school enrollment and less child work. Living with a caregiver who is not the biological parent increases the chances of work and decreases that of schooling. Interestingly, larger sibling size is associated with higher probability of attending school but being a later-born child decreases the

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[13] The specifications that employ Honore's semiparametric estimator yield qualitatively similar results, although the estimated coefficients are not easily interpretable due to the unobserved fixed effects that have to be taken into account for final computation (Honoré 1992, 2008).

likelihood (so does having more infant siblings). Male children are significantly more likely to be engaged in market work than females.

4.1 Addressing potential bias

Two concerns arise in the estimation of the endowment effect (β_1) in a specification such as (1). First, the extent to which a child's score on a cognitive test like the CPM or PPVT measures 'pure ability or endowment', and not at least partially reflect schooling level, is questionable. Developers often claim that these tests measure general ability that is correlated with age but not necessarily schooling. If this is not the case, however, it may be that schooling raises test scores, and the estimate thus does not necessarily measure an endowment effect on parental investment. The fact that the dependent variable employed for this study shows status (i.e. enrollment at the time of survey) and not achievement possibly minimizes the bias. But it is reasonable to expect persistence in children's school enrollment and work status (current status is correlated with past), therefore bias arising from reverse causation remains a possibility.

In the context of the present study, this is unlikely to be a major problem in round 1 (age 8) since about 83 per cent of the children who took the CPM test were in grade 1 or less as of survey date. Accordingly, their performance on an ability test is least contaminated by previous schooling and the estimated coefficient is arguably most reflective of a relatively pure endowment effect (notwithstanding potential bias that arises from the selection of sites to conduct the CPM test). The same cannot be said for ages 12 and 15, however, where average completed grade for the sample was 3.3 and 5.6 years, respectively.

I adopt the 'residual method' to address this concern. In lieu of test score, the predicted residual from a regression of test score on a child's schooling is used. Specifically, since the problem is more pertinent to the estimations at age 12 and 15 and taking advantage of the fact that the same cognitive ability test was administered in both rounds, I estimate the following equation:

$$P_{it} = \theta_0 + \theta_1 G_{it} + \sum_{j=1}^{k} \alpha_j X_{ijt} + e_i + u_{it} \qquad (2)$$

P_{it} is raw PPVT score of child i in round/age t (t = 12, 15), G is child's schooling achievement, X captures child and household characteristics that possibly influence test score (e.g. child's age, parent's schooling), and the error term comprises a time-invariant child-specific component (e_i) and a time-varying purely random component (u_{it}). e_i would then be the child-specific, fixed educational endowment.[14] To obtain an estimate of e_i, a pooled OLS model is estimated and for each child a simple average of the residuals over the two rounds is computed.[15] For the purposes of estimating (2), schooling achievement (G) is proxied by a child's completed grade at the time of survey and, in order to consistently estimate θ_1, the predicted value from a regression on

[14] See footnote 12 for corroborating evidence from test score distributions of child endowment likely being a 'fixed characteristic'.

[15] This would also be equivalent to the child fixed effect in a fixed effects model.

various observable child and household characteristics is employed. The results from the schooling and test score regressions are compiled in Tables A1-A4 of the appendix.[16]

The estimation results using the residual method are compiled in Tables 5-7. Higher residual endowment raises the probability that a child is enrolled in school. It also lowers the chances of engaging in work for pay or on the family farm/business. Conditional on participation, higher endowment is also associated with fewer hours of work. In all cases, the endowment effect is highly statistically significant. At age 15, there is further evidence of an inverse U-shaped effect on school enrollment and a U-shaped effect on work participation, both suggesting the presence of a threshold beyond which the endowment effect may change course.[17] However, in sum, to the extent that the residual method yields estimates reflecting a pure endowment effect, the results lend strong credence to the baseline evidence of reinforcement in children's human capital by Ethiopian households.

The second concern regarding the estimates in the baseline specification (1) is typical of cross-sectional models—there is potential bias arising from unobserved child/household heterogeneities that are embedded in the error term. The inclusion of a large set of control variables was intended to minimize such sources of bias. However, confounding effects, for instance those resulting from past parental investment behavior and thus cannot be accounted for by contemporaneous child and household measures, may remain. To more firmly address the issue, I utilize a unique feature of the YL surveys in round 3 (age 15). Specifically in this round, one of the siblings of the YL child, in many cases the most proximate in order of birth, also took the PPVT and his/her score was recorded in the survey. By merging the sibling's performance on the PPVT with information on school attendance and time use in the week prior to the survey, I estimate a household fixed effects regression model of the form:

$$H_{if} = \beta_0 + \beta_1 E_i + \sum_{j=1}^{m} \delta_j Z_{ij} + F_f + \varepsilon_{if} \qquad (3)$$

where H_{if} is the human capital status of child i (YL or her sibling) in household f , $F_f$is the household fixed effect, and the rest of the notations remain the same as in (1). The control variables in Z contain child-specific characteristics only since household covariates will now be subsumed in the household fixed effect. The child-level control variables include dummies for age (in years) and gender. The sibling PPVT scores are entered in the model after being age-wise standardized (by subtracting from a child's raw score the age-specific mean and then dividing by the age-specific standard deviation). After removing YL children with no sibling/s and observations with missing values for important variables, 673 YL child–sibling pairs were identified.[18]

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16 For completeness, the residual method is also applied to round 1/age 8. Here the residual endowment is the predicted residual from a simple cross-sectional regression of CPM score on completed grade at age 8.

17 Due to the non-straightforward nature of computing tobit marginal effects involving interaction terms, the extended specification is not estimated for the work hours regressions using the residual method.

18 An observation is also removed if the sibling from whom information is acquired was aged below 7 or above 16, since the decision calculus guiding their school and work status is likely structurally different from a 7-15 year-old YL child.

The results are presented in Table 8. The estimate on test score can now be interpreted as measuring the impact on a child's status of a between-sibling difference in ability. The results provide further confirmation of reinforcement of initial differences in endowment within the household. A higher ability child is more likely to be in school, less likely to work and works fewer hours than her lower ability sibling. Again there is evidence of nonlinearity in endowment-reinforcing parental investment behavior that was apparent from the earlier results. Furthermore, the results suggest that within a household, the endowment effect on human capital investment may be smaller for female children.

5 Conclusions

The overwhelming evidence that emerges from the analysis in this paper using data on a cohort of children from Ethiopia points towards a pattern of household investment in human capital that complements initial differences in children's educational endowment. The related literature suggests this is largely due to investment behavior that seeks higher future marginal returns correlated with initial endowment.[19] It could also be due to contemporaneous efficiencies in human capital production that apply to the more endowed (e.g. higher ability children are less likely to fail grades or lag behind, etc.). The exact reason why this pattern of investment behavior dominates in Ethiopian households is difficult to say and is beyond the scope of the study.

However, the long-term consequences of reinforcing investment in human capital, or any other kind of endowment-complementing investment for that matter, are clearer. It further accentuates initial differences in endowment, if the type of endowment concerned is dynamic, or in the benefits that accrue with the endowment. If schooling investments are complementing educational ability, they lead to inequalities in earning capabilities that are likely to persist much later into adulthood.

Policy interventions that aim to tackle the problem early on can take different forms. First, an intervention can be targeted at minimizing initial differences in acquired cognitive ability that arise from health-related investments. Studies have shown that deficiencies in prenatal and early life child/mother health and nutrition many times lead to lower levels of cognitive ability in children. For example, using the India YL data, Helmers and Patnam (2011) report that child health at age one influences cognitive ability at age five, and that child health at age one is significantly impacted by parental care during pregnancy and early life.[20]Second, interventions aimed at ensuring enrollment of *all* school-age children in a household (e.g. through a conditional transfer) can effectively circumvent the problem of intra-household differences in

19 Although the focus of their study is not the endowment-investment relationship *per se*, Glick and Sahn (2010) use test score data from 2nd graders in Senegal to measure ability and report a strong correlation with schooling progression seven years later, which they suggest may be due to parental investment driven by higher potential returns.

20 The child health-cognitive ability link may be particularly acute in developing countries. Spears (2012), also using a large dataset from India, finds a slope estimate that is more than twice as steep as in the US. In another recent paper, Akresh et al. (2012b) used rainfall shocks when in utero to instrument for a child's ability, and report that consequent decreases in cognitive ability are associated with lowered school enrollment and increased child work in the long term.

investment in schooling. A similar strategy can help in the child labour area as well though it may be more difficult to enforce. Third, effective remedial programs in schools for lagging or low-ability children can to a certain degree compensate for household actions that widen differences in schooling achievement. Finally, basic intuition about parental concern for children's welfare suggests that distinctly reinforcing allocations are more probable when the household budget constraint is particularly binding, therefore various policies that are generally aimed at alleviating poverty and increasing household resources should also bear fruit in tackling the human capital inequality problem at one of its roots.

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Figures 1.1-1.3: Ability and schooling: some correlations

Figure 1.1: School status by test score quintile, Age 8

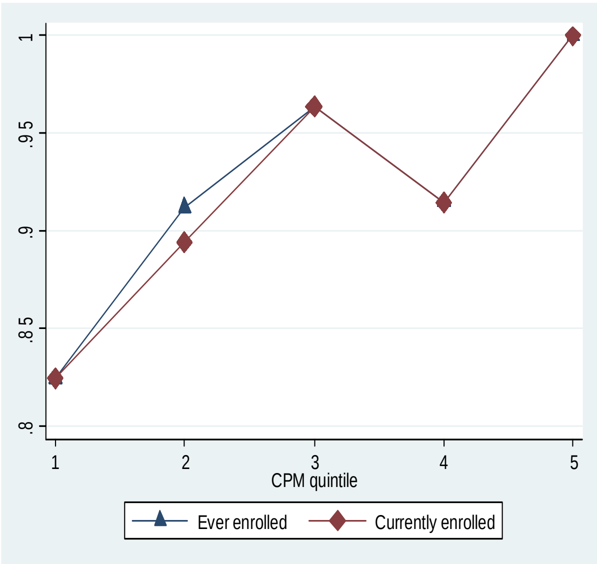


Figure 1.2: School status by test score quintile, Age 12

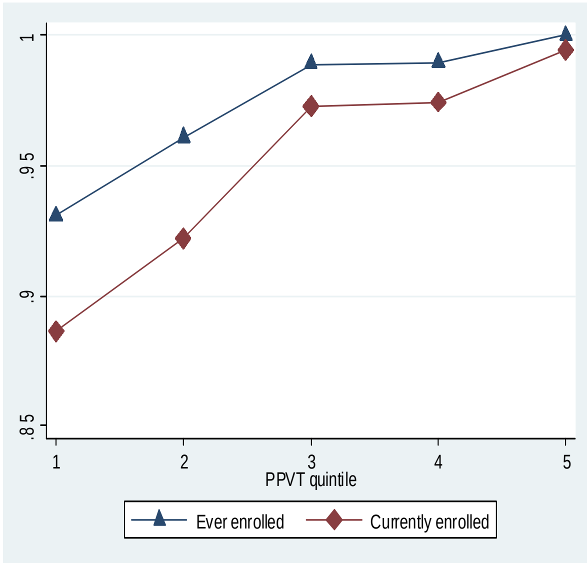
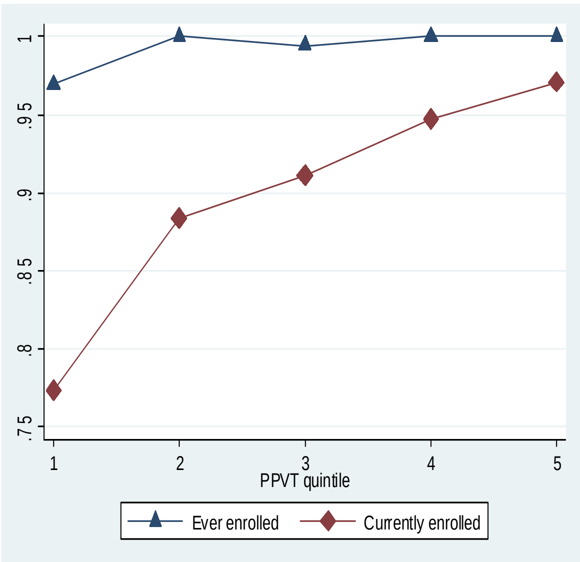


Figure 1.3: School status by test score quintile, Age 15



Source: Compiled by author using data from Young Lives–Ethiopia project

Figures 2.1-2.4: Ability and child work: some correlations

Figure 2.1: Participation in work, by type of work and test score quintile, Age 12

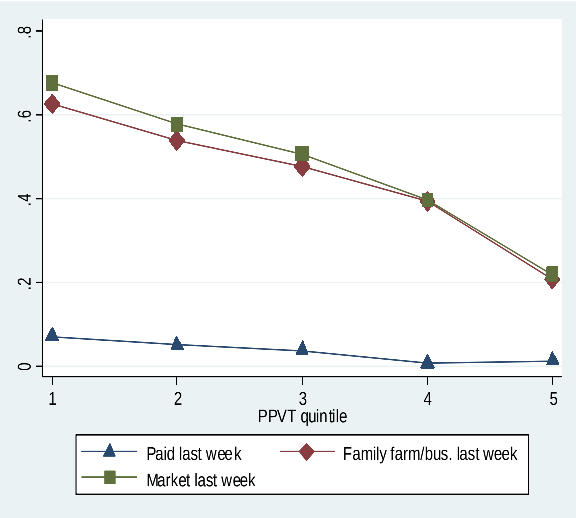


Figure 2.2: Participation in work, by type of work and test score quintile, Age 15

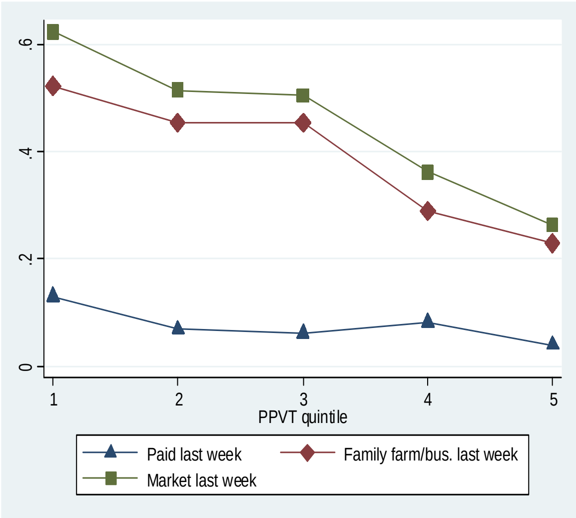


Figure 2.3: Hours of work, by type of work and test score quintile, Age 12

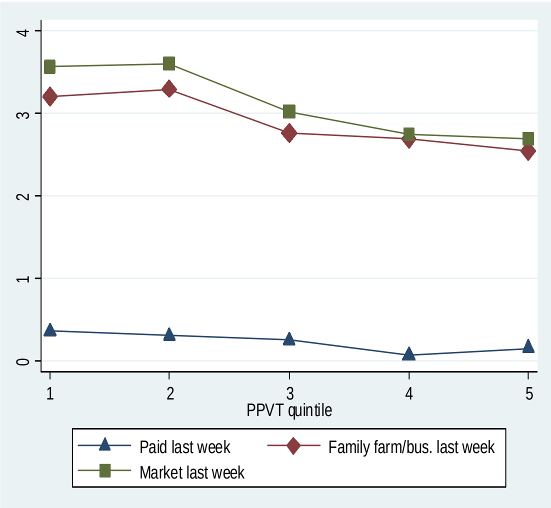
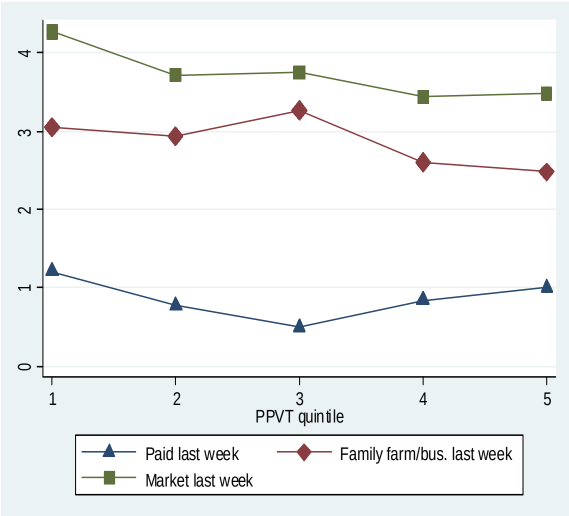


Figure 2.3: Hours of work, by type of work and test score quintile, Age 15



Source: Compiled by author using data from Young Lives–Ethiopia project

Table 1a: Summary statistics: basic child and household variables

	Age 8	Age 12	Age 15
	Mean (Std. dev.)	Mean (Std. dev.)	Mean (Std. dev.)
Female	0.49		
Age in months	94.54(3.49)	144.65(3.81)	179.84(3.60)
Mother's schooling[a]	2.07(3.43)	2.20(3.64)	2.19(3.62)
Father's schooling[a]	3.12(4.13)	3.30(4.42)	3.33(4.41)
Caregiver's age	35.32(9.19)	39.39(9.56)	41.95(9.51)
Head's age	42.72(10.89)	46.62(11.35)	48.72(11.54)
Other caregiver[b]	0.10	0.13	0.13
Female head	0.24	0.26	0.27
Household size	6.47(2.15)	6.52(2.05)	6.35(2.12)
Number of adults	2.85(1.39)	3.51(1.67)	4.44(2.09)
Number of siblings	3.21(2.03)	3.25(1.93)	3.02(1.88)
Number of sisters	1.59(1.31)	1.58(1.30)	1.45(1.26)
Number of children <5	0.76(0.77)	0.59(0.74)	0.47(0.65)
Child's birth order	4.00(2.56)		
Wealth index[c]	0.22(0.17)	0.30(0.17)	0.35(0.17)
House index[d]	0.25(0.19)	0.31(0.20)	0.33(0.19)
Assets index[e]	0.11(0.14)	0.23(0.18)	0.29(0.21)
Services index[f]	0.29(0.27)	0.36(0.26)	0.44(0.23)
Nondurable PCE[g]		4.73(0.58)	4.82(0.57)
Urban	0.35	0.40	0.42
Observations	971		

Notes: [a]Refers to that of biological mother's and father's. The biological mother is also the caregiver for 88 per cent of the base observations. When biological parent/s is/are absent, parents' schooling reflects the caregiver's and partner's (i.e. mother/father figure's) education. Observations that have still missing information for either parent's schooling are assigned a value of zero. [b]Refers to children whose caregiver is neither the biological mother nor the biological father. [c]0-1 index constructed based on component indices for housing quality, consumer durables/assets, and services. See below. [d]0-1 index constructed based on analysis of number of rooms, wall material, roof material and floor material. [e]0-1 index of consumer durables; index constructed based on household ownership of radio, bicycle, television, motorbike, car, mobile phone, landline phone, bedstead, tables, and chairs and sofa. [f]0-1 index of general services; index constructed based on electricity connection, source of drinking water, and type of toilet and cooking fuel/facilities. [g]Log of monthly total real (base 2006) nondurable consumption (food plus nonfood) expenditure per adult.

Source: Compiled by author using data from Young Lives–Ethiopia project

Table 1b: Summary statistics: measures of ability

	Obs.	Min.	Max.	Median	Mean	Std. dev.
Age 8: CPM[a]	236	0	36	16	16.86	6.35
Age 12: PPVT[b]	945	11	127	72	75.88	26.18
Age 15: PPVT	971	38	203	161	151.91	34.26

Notes: Statistics are based on raw scores. [a]CPM-Raven's Colored Progressive Matrices. [b]PPVT—Peabody Picture Vocabulary Test.

Source: Compiled by author using data from Young Lives–Ethiopia project

Table 1c: Summary statistics: children's school enrollment, work status and work hours

	Age 8		Age 12		Age 15	
	Obs.	Mean (SD)	Obs.	Mean (SD)	Obs.	Mean (SD)
Schooling						
Ever enrolled	971	0.67	971	0.97	971	0.99
Currently enrolled	971	0.66	971	0.95	971	0.90
Grade completed	654	0.70(0.85)	945	3.25(1.63)	964	5.55(2.05)
Work[a]						
Work status	970	0.03	970	0.48	970	0.46
Work hours			465	3.28(1.79)	444	3.80(2.38)

Notes: Ever enrolled—dummy for whether the child *ever* attended formal school. Currently enrolled: dummy for whether the child is *currently* (as of survey date) enrolled in school. Grade completed: highest grade completed as of survey date by ever enrolled child. [a]Except for entry for Age 8 (round 1), based on reported child's time-use during a typical day in the week prior to survey date. Work status: equals one if child reported non-zero hours in work for pay or on family farm/business, zero otherwise. Work hours: hours of work for pay or on family farm/business on a typical day in the week prior to the survey; statistics are conditional on participation.

Source: Compiled by author using data from Young Lives–Ethiopia project

Table 2: Children's endowment and school enrollment

	Age 8		Age 12		Age 15	
Female	0.012	0.011	0.026	0.026	0.062***	0.058***
	(0.30)	(0.28)	(1.02)	(1.02)	(2.88)	(3.13)
CPM	0.053**	0.058*				
	(2.27)	(1.91)				
CPM squared		-0.003				
		(0.23)				
PPVT			0.029**	0.039**	0.068***	0.059***
			(2.68)	(2.30)	(4.06)	(3.06)
PPVT squared				-0.012		-0.024**
				(1.06)		(2.10)
Female × CPM		-0.010				
		(0.24)				
Female × PPVT				-0.024		-0.034
				(1.09)		(1.13)
Mother's schooling	0.006	0.006	-0.000	0.000	-0.005*	-0.005
	(1.06)	(1.04)	(0.09)	(0.04)	(1.81)	(1.63)
Father's schooling	0.001	0.001	-0.001	-0.001	0.002	0.001
	(0.19)	(0.12)	(0.88)	(0.87)	(0.70)	(0.66)
Caregiver's age	0.004	0.004	-0.000	-0.057	0.001	0.001
	(1.40)	(1.37)	(0.21)	(1.90)	(0.49)	(0.59)
Head's age	0.000	0.000	0.001	0.001	0.002	0.002
	(0.02)	(0.06)	(0.95)	(0.99)	(1.22)	(1.25)
Other caregiver	-0.067	-0.068	-0.056*	-0.057*	-0.053*	-0.049
	(1.04)	(1.05)	(1.84)	(1.90)	(1.75)	(1.69)
Female head	0.041	0.042	0.024	0.024	0.012	0.010
	(0.85)	(0.87)	(0.97)	(0.98)	(0.37)	(0.33)
Number of adults	-0.005	-0.005	-0.009	-0.008	-0.002	-0.002
	(0.30)	(0.29)	(1.35)	(1.23)	(0.44)	(0.55)
Number of siblings	0.032	0.033	0.011*	0.011*	0.018**	0.018***
	(1.46)	(1.48)	(1.92)	(1.84)	(2.10)	(2.00)
Number of sisters	-0.036	-0.036	-0.001	-0.002	-0.007	-0.007
	(1.45)	(1.45)	(0.13)	(0.24)	(0.56)	(0.54)
Number of children <5	-0.013	-0.012	-0.018**	-0.017*	-0.014	-0.015
	(0.40)	(0.38)	(2.10)	(2.03)	(1.20)	(1.21)
Child's birth order	-0.018	-0.019	-0.007*	-0.007*	-0.014***	-0.014***
	(1.59)	(1.60)	(1.78)	(1.74)	(2.79)	(2.73)
Household wealth	0.032	0.034	0.022	0.024	0.047***	0.049***
	(0.90)	(0.91)	(1.18)	(1.31)	(3.30)	(3.47)
Nondurable PCE			-0.010	-0.010	0.025	0.027
			(0.60)	(0.56)	(1.08)	(1.19)

Constant	0.705***	0.705***	0.952***	0.959***	0.591***	0.600***
	(5.95)	(5.92)	(11.93)	(11.84)	(4.37)	(4.60)
Community fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	236	236	945	945	971	971
F-stat.	1.33	1.16	2.09	3.46	6.98	6.64
Prob. > F	0.191	0.303	0.065	0.005	0.000	0.000

Notes: Dependent variable: School enrollment. Coefficients from a linear probability model are reported. |t| ratios are shown in parentheses and are based on standard errors that are robust to arbitrary heteroscedasticity and clustering at the site/community level (except for Age 8/round 1). *****-** shows significance at 1%; ****-**shows significance at 5%; ***-**shows significance at 10%.

Source: Compiled by author using data from Young Lives–Ethiopia project

Table 3: Children's endowment and participation in work

	Age 8[a]		Age 12		Age 15	
Female	-0.028	-0.027	-0.246***	-0.245***	-0.402***	-0.401***
	(0.92)	(0.89)	(5.03)	(5.38)	(6.97)	(7.63)
CPM	0.013	-0.004				
	(0.71)	(0.18)				
CPM squared		0.001				
		(0.13)				
PPVT			-0.033*	-0.051*	-0.061***	-0.090***
			(1.77)	(1.92)	(3.21)	(4.01)
PPVT squared				0.015		0.008
				(0.97)		(0.70)
Female × CPM		0.041				
		(1.21)				
Female × PPVT				0.041		0.075**
				(1.38)		(2.12)
Mother's schooling	-0.006	-0.006	-0.001	-0.001	-0.006	-0.007
	(1.37)	(1.42)	(0.11)	(0.19)	(1.01)	(1.15)
Father's schooling	0.002	0.003	-0.004	-0.004	0.001	0.001
	(0.49)	(0.73)	(1.03)	(1.04)	(0.11)	(0.14)
Caregiver's age	0.004	0.004	-0.004***	-0.004***	-0.000	-0.001
	(1.55)	(1.62)	(3.38)	(3.38)	(0.19)	(0.31)
Head's age	-0.003	-0.003*	0.005***	0.005***	0.002	0.002
	(1.53)	(1.69)	(3.48)	(3.40)	(1.31)	(1.42)
Other caregiver	0.029	0.035	0.086**	0.087**	-0.002	-0.007
	(0.56)	(0.67)	(2.58)	(2.59)	(0.07)	(0.22)
Female head	-0.089**	-0.090**	-0.054	-0.055*	0.001	0.003
	(2.29)	(2.30)	(1.65)	(1.72)	(0.05)	(0.14)
Number of adults	-0.005	-0.005	0.011	0.010	0.005	0.005
	(0.39)	(0.38)	(1.30)	(1.18)	(0.65)	(0.69)
Number of siblings	-0.014	-0.015	-0.002	-0.002	-0.004	-0.003
	(0.77)	(0.81)	(0.16)	(0.13)	(0.45)	(0.27)
Number of sisters	0.018	0.020	0.030**	0.032**	0.003	0.000
	(0.91)	(1.00)	(2.49)	(2.52)	(0.27)	(0.02)
Number of children <5	-0.007	-0.006	-0.009	-0.009	-0.011	-0.011
	(0.30)	(0.25)	(0.48)	(0.47)	(0.40)	(0.38)
Child's birth order	0.003	0.004	-0.003	-0.003	-0.003	-0.003
	(0.30)	(0.44)	(0.57)	(0.55)	(0.37)	(0.47)
Household wealth	-0.077***	-0.076***	-0.057*	-0.060**	-0.030	-0.032
	(2.69)	(2.60)	(1.98)	(2.16)	(1.06)	(1.14)
Nondurable PCE			0.050	0.050	-0.053**	-0.053**
			(1.61)	(1.60)	(2.50)	(2.59)

Constant	0.273***	0.270***	0.357**	0.350**	0.887***	0.887***
	(2.89)	(2.85)	(2.34)	(2.34)	(6.54)	(6.75)
Community fixed	Yes	Yes	Yes	Yes	Yes	Yes
Observations	236	236	944	944	970	970
F-stat.	1.43	1.35	6.00	7.80	8.55	39.14
Prob. > F	0.141	0.171	0.000	0.000	0.000	0.000

Notes: Dependent variable: Participation in work. Coefficients from a linear probability model are reported. |t| ratios are shown in parentheses and are based on standard errors that are robust to arbitrary heteroscedasticity and clustering at the site/community level (except at Age 8). ***shows significance at 1%; **shows significance at 5%; *shows significance at 10%. [a]For Age 8/round 1, participation in work during the 'year prior to the survey' is considered, whereas for Ages 12 and 15 (rounds 2 and 3) it refers to participation on 'a typical day in the week preceding the survey date'.

Source: Compiled by author using data from Young Lives–Ethiopia project

Table 4: Children's endowment and work hours

	Age 12		Age 15	
	Tobit[a]	Honoré [b]	Tobit[a]	Honoré [b]
Female	-0.885***	-2.249***	-1.516***	-3.991***
	(11.33)	(7.91)	(16.24)	(10.22)
PPVT	-0.175***	-0.525***	-0.277***	-0.577***
	(4.12)	(3.35)	(5.65)	(4.45)
Mother's schooling	-0.012	-0.026	-0.025	-0.089
	(0.77)	(0.55)	(1.34)	(1.49)
Father's schooling	-0.015	-0.090**	0.004	-0.010
	(1.24)	(2.25)	(0.23)	(0.15)
Caregiver's age	-0.015**	-0.021	-0.004	-0.004
	(2.29)	(1.08)	(0.46)	(0.20)
Head's age	0.012**	0.005	0.008	0.006
	(2.02)	(0.33)	(1.19)	(0.43)
Other caregiver	0.360**	1.105**	0.090	0.378
	(2.27)	(2.11)	(0.57)	(0.96)
Female head	-0.198	-0.511	0.064	0.294
	(1.60)	(1.33)	(0.48)	(0..88)
Number of adults	0.068**	0.037	0.034	0.047
	(2.19)	(0.44)	(1.18)	(0.48)
Number of siblings	-0.034	-0.111*	-0.001	-0.045
	(1.00)	(1.85)	(0.02)	(0.35)
Number of sisters	0.090**	0.160	-0.017	-0.108
	(2.37)	(1.47)	(0.35)	(0.79)
Number of children <5	0.005	-0.033	-0.034	-0.141
	(0.09)	(0.28)	(0.46)	(0.64)
Child's birth order	0.001	0.091**	-0.003	0.014
	(0.06)	(2.14)	(0.14)	(0.13)
Household wealth	-0.180***	-0.168	-0.174*	-0.301
	(2.47)	(0.53)	(1.82)	(1.30)
Nondurable PCE	0.105	0.364	-0.220**	-0.734*
	(1.19)	(1.08)	(2.14)	(1.80)
Urban	-0.803***		-0.372***	
	(5.53)		(2.54)	
Community fixed effects	No	Yes	No	Yes
Observations	944	944	970	970
F (Chi^2) stat.	19.50	412.12	18.61	882.58
Prob. > F (Chi^2)	0.000	0.000	0.000	0.000

Notes: Dependent variable=hours of work. [a]Marginal effects (conditional) from a tobit model are reported. |z| ratios based on robust standard errors are shown in parentheses. The tobit regressions also included regional dummies and a constant. [b]Coefficients from Honoré's (1992) semiparametric censored fixed effects model are reported. |z| ratios based on bootstrapped standard errors are shown in parentheses. ***shows significance at 1%; **shows significance at 5%; *shows significance at 10%.

Source: Compiled by author using data from Young Lives–Ethiopia project

Table 5: Children’s endowment and school enrollment: endowment measured as residual

	Age 8		Age 12		Age 15	
Female	-0.001	-0.001	0.029	0.029	0.050**	0.050***
	(0.01)	(0.02)	(1.07)	(1.12)	(2.16)	(2.65)
Residual CPM	0.009***	0.010***				
	(5.50)	(2.57)				
Residual CPM squared		-0.000				
		(0.09)				
Residual PPVT			0.002***	0.002***	0.003***	0.003***
			(5.12)	(2.65)	(5.11)	(3.69)
Residual PPVT squared				-0.000		-0.003 $\times 10^{-2}$*
				(0.83)		(1.89)
Female × Residual CPM		-0.002				
		(0.30)				
Female × Residual PPVT				-0.000		-0.001
				(0.26)		(1.21)
Mother’s schooling	0.007**	0.007**	0.001	0.001	-0.003	-0.003
	(2.23)	(2.13)	(0.89)	(0.89)	(1.18)	(1.39)
Father’s schooling	0.000	0.000	-0.000	-0.000	0.003	0.003
	(0.07)	(0.06)	(0.10)	(0.15)	(1.53)	(1.34)
Caregiver’s age	0.004***	0.004**	-0.000	-0.000**	0.001	0.001
	(2.48)	(2.36)	(0.05)	(0.15)	(0.71)	(0.72)
Head’s age	0.000	0.000	0.001	0.001	0.001	0.001
	(0.02)	(0.07)	(0.90)	(0.90)	(1.23)	(1.26)
Other caregiver	-0.068	-0.070	-0.058**	-0.056	-0.065**	-0.058**
	(1.09)	(1.10)	(2.26)	(2.20)	(2.03)	(1.93)
Female head	0.039	0.039	0.011	0.011	0.011	0.011
	(0.99)	(0.99)	(0.53)	(0.55)	(0.39)	(0.38)
Number of adults	-0.005	-0.005	-0.008	-0.008	-0.002	-0.002
	(0.39)	(0.36)	(1.42)	(1.43)	(0.44)	(0.48)
Number of siblings	0.033	0.033	0.010**	0.011**	0.017**	0.019**
	(1.42)	(1.31)	(1.94)	(2.04)	(2.12)	(2.39)
Number of sisters	-0.036***	-0.037***	-0.001	-0.001	-0.005	-0.005
	(2.83)	(2.74)	(0.07)	(0.11)	(0.41)	(0.45)
Number of children <5	-0.011	-0.011	-0.018***	-0.018**	-0.018	-0.019
	(0.35)	(0.35)	(2.46)	(2.32)	(1.45)	(1.56)
Child’s birth order	-0.018*	-0.019*	-0.008**	-0.007**	-0.015***	-0.014***
	(1.86)	(1.71)	(2.16)	(2.00)	(2.88)	(3.03)
Household wealth	0.034	0.034*	0.020	0.020	0.052***	0.052***
	(1.59)	(1.67)	(1.07)	(1.03)	(4.03)	(4.05)

Nondurable PCE			-0.009	-0.008	0.031*	0.031
			(0.50)	(0.45)	(1.65)	(1.61)
Constant	0.704***	0.705***	0.941***	0.942***	0.547***	0.559***
	(14.38)	(13.31)	(14.30)	(13.76)	(4.58)	(4.61)
Community fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	236	236	971	971	971	971
Community effects	Yes	Yes	Yes	Yes	Yes	Yes
Chi^2-stat.	5003.3	1794.19	62.66	84.68	109.15	91.95
Prob. > Chi^2	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Dependent variable=school enrollment. Coefficients from a linear probability model are reported. |z| ratios are shown in parentheses and are based on bootstrapped standard errors clustered at the site/community level. *******shows significance at 1%; ******shows significance at 5%; *****shows significance at 10%.

Source: Compiled by author using data from Young Lives–Ethiopia project

Table 6: Children's endowment and participation in work: endowment measured as residual

	Age 8		Age 12		Age 15	
Female	-0.031	-0.030	-0.241***	-0.241***	-0.391***	-0.392***
	(0.81)	(0.71)	(5.17)	(5.23)	(7.22)	(7.83)
Residual CPM	0.002	-0.001				
	(1.01)	(0.46)				
Residual CPM squared		0.000				
		(0.44)				
Residual PPVT			-0.002***	-0.002**	-0.002**	-0.001**
			(2.62)	(2.01)	(2.06)	(1.96)
Residual PPVT squared				-0.000		0.006 $\times 10^{-2}$***
				(0.81)		(2.77)
Female × Residual CPM		0.006***				0.001
		(2.54)				(0.86)
Female × Residual PPVT				-0.001		0.001
				(0.60)		(0.86)
Mother's schooling	-0.006	-0.005	-0.002	-0.002	-0.007	-0.007
	(1.06)	(1.05)	(0.59)	(0.61)	(1.20)	(1.14)
Father's schooling	0.002	0.002	-0.005	-0.005	-0.001	-0.000
	(0.60)	(0.75)	(1.17)	(1.22)	(0.19)	(0.06)
Caregiver's age	0.004	0.004	-0.004***	-0.004***	-0.001	-0.000
	(1.27)	(1.32)	(3.03)	(3.37)	(0.27)	(0.23)
Head's age	-0.003	-0.003	0.005***	0.005***	0.002	0.002
	(1.04)	(1.19)	(3.73)	(3.76)	(1.37)	(1.38)
Other caregiver	0.028	0.034	0.083***	0.087***	0.006	-0.006
	(1.07)	(1.28)	(2.65)	(2.73)	(0.17)	(0.18)
Female head	-0.089*	-0.090*	-0.037	-0.036	-0.001	-0.002
	(1.71)	(1.74)	(1.19)	(1.17)	(0.04)	(0.07)
Number of adults	-0.005	-0.005	0.010	0.010	0.005	0.005
	(0.98)	(1.13)	(1.49)	(1.41)	(0.61)	(0.61)
Number of siblings	-0.014	-0.015	-0.003	-0.002	-0.003	-0.006
	(0.83)	(0.87)	(0.23)	(0.18)	(0.26)	(0.54)
Number of sisters	0.018	0.020	0.031***	0.030***	0.001	0.003
	(0.95)	(1.11)	(3.06)	(2.92)	(0.11)	(0.22)
Number of children <5	-0.007	-0.006	-0.008	-0.008	-0.008	-0.007
	(0.35)	(0.35)	(0.47)	(0.47)	(0.36)	(0.29)
Child's birth order	0.003	0.004	-0.004	-0.004	-0.003	-0.004
	(0.31)	(0.42)	(0.72)	(0.64)	(0.34)	(0.45)
Household wealth	-0.077**	-0.077**	-0.058**	-0.059***	-0.035	-0.034
	(2.11)	(1.99)	(2.36)	(2.34)	(1.49)	(1.44)

Nondurable PCE			0.053*	0.055**	-0.060***	-0.061***
			(1.81)	(1.99)	(3.03)	(3.07)
Constant	0.271***	0.269*	0.354***	0.354***	0.934***	0.909***
	(1.84)	(1.84)	(2.50)	(2.50)	(8.27)	(8.13)
Community fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	236	236	970	970	970	970
Chi^2-stat.	168.98	805.26	127.98	228.39	160.83	287.75
Prob. > Chi^2	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Dependent variable=participation in work. Coefficients from a linear probability model are reported. |z| ratios are shown in parentheses and are based on bootstrapped standard errors clustered at the site/community level. ***shows significance at 1%; **shows significance at 5%; *shows significance at 10%. [a]For Age 8/round 1, participation in work during the 'year prior to the survey' is considered, whereas for Ages 12 and 15 (rounds 2 and 3) it refers to participation on 'a typical day in the week preceding the survey date'.

Source: Compiled by author using data from Young Lives–Ethiopia project

Table 7: Children's endowment and work hours: endowment measured as residual

	Age 12		Age 15	
	Tobit[a]	Honoré [b]	Tobit[a]	Honoré [b]
Female	-0.869***	-2.197***	-1.471***	-3.864***
	(9.34)	(8.20)	(15.20)	(10.33)
PPVT	-0.009***	-0.021***	-0.007***	-0.024***
	(4.17)	(4.38)	(3.79)	(3.32)
Mother's schooling	-0.021	-0.062	-0.027	-0.102*
	(1.35)	(1.31)	(1.33)	(1.66)
Father's schooling	-0.016	-0.089**	-0.005	-0.032
	(1.29)	(2.29)	(0.25)	(0.47)
Caregiver's age	-0.016**	-0.025	-0.005	-0.009
	(2.26)	(1.45)	(0.62)	(0.45)
Head's age	0.013**	0.012	0.009	0.008
	(2.17)	(0.77)	(1.19)	(0.60)
Other caregiver	0.334**	1.139**	0.138	0.440
	(1.96)	(2.19)	(1.08)	(1.11)
Female head	-0.128	-0.380	0.042	0.349
	(0.93)	(1.06)	(0.28)	(1.09)
Number of adults	0.061**	0.029	0.037	0.046
	(2.11)	(0.37)	(1.07)	(0.46)
Number of siblings	-0.046	-0.148***	0.010	-0.043
	(1.44)	(2.72)	(0.26)	(0.34)
Number of sisters	0.110***	0.224**	-0.029	-0.124
	(2.65)	(2.29)	(0.55)	(0.90)
Number of children <5	0.009	-0.018	-0.007	-0.072
	(0.17)	(0.17)	(0.08)	(0.31)
Child's birth order	0.003	0.088**	-0.004	0.017
	(0.16)	(2.01)	(0.15)	(0.16)
Household wealth	-0.161**	-0.175	-0.231***	-0.347
	(2.29)	(0.53)	(2.90)	(1.50)
Nondurable PCE	0.111	0.367	-0.259***	-0.776**
	(1.48)	(1.13)	(2.73)	(1.95)
Urban	-0.919***		-0.442***	
	(6.37)		(4.14)	
Community fixed effects	No	Yes	No	Yes
Observations	970	970	970	970
Chi^2	700.42	701.70	601.95	1109.97
Prob. > Chi^2	0.000	0.000	0.000	0.000

Notes: Dependent variable=hours of work. ***shows significance at 1%; **shows significance at 5%; *shows significance at 10%. [a]Marginal effects (conditional) from a tobit model are reported. |z| ratios are shown in parentheses and are based on bootstrapped standard errors clustered at the site/community level. The tobit regressions also included regional dummies and a constant. [b]Coefficients from Honoré's (1992) semiparametric censored fixed effects model are reported. |z| ratios based on bootstrapped standard errors are shown in parentheses.

Source: Compiled by author using data from Young Lives–Ethiopia project

Table 8: Children's endowment, school enrollment and work: household fixed effects estimates using sibling pairs

	School enrollment[a]		Work status[b]		Work hours[c]	
Female	0.057***	0.053***	-0.430***	-0.425***	-3.936***	-3.909***
	(2.80)	(2.59)	(15.97)	(15.91)	(11.66)	(10.92)
PPVT	0.046***	0.056***	-0.046**	-0.051*	-0.611***	-0.060
	(2.90)	(2.78)	(2.20)	(1.91)	(3.29)	(0.23)
PPVT squared		-0.023**		0.039***		0.437***
		(2.15)		(2.75)		(2.93)
Female × PPVT		-0.067***		0.084***		-0.094
		(3.28)		(3.16)		(0.28)
Constant	0.329***	0.347	0.687***			
	(2.96)	(3.13)	(4.73)			
Age dummies	Yes	Yes	Yes	0.654***	Yes	Yes
				(4.53)		
HH fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1346	1346	1343	1343	1343	1343
F stat. (Chi^2)	5.78	6.14	24.09	22.16	165.04	200.23
Prob. > F (Chi^2)	0.000	0.000	0.000	0.000	0.000	0.000

Notes: [a,b]Coefficients from a linear probability model are reported. [c]Coefficients from Honoré's (1992) semiparametric censored fixed effects model are reported. |t| ratios are shown in parentheses. ***shows significance at 1%; **shows significance at 5%; *shows significance at 10%.

Source: Compiled by author using data from Young Lives–Ethiopia project

APPENDIX

Table A1: Predicting children's educational endowment, Age 8

	CPM
Female	0.544
	(0.39)
Mother's schooling	-0.043
	(0.24)
Father's schooling	0.278*
	(1.68)
Female × Mother's schooling	0.269
	(1.48)
Female × Father's schooling	-0.623***
	(3.09)
Completed grade[a]	0.656
	(0.27)
Constant	16.030***
	(10.75)
Observations	236
Chi^2	18.37
Prob. > Chi^2	0.005
Adjusted R^2	0.032

Notes: Dependent variable: raw CPM score. OLS estimates are reported. |z| ratios are shown in parentheses and are based on bootstrapped standard errors. [a]predicted from the regression in Table A3 below.

Source: Compiled by author using data from Young Lives–Ethiopia project

Table A2: Predicting children's educational endowment, Ages 12 and 15

	PPVT
Female	-5.979***
	(3.66)
Age	35.623**
	(2.07)
Age squared	-0.730
	(1.15)
Mother's schooling	0.063
	(0.24)
Father's schooling	0.570***
	(2.70)
Female × Mother's schooling	0.972***
	(2.47)
Female × Father's schooling	-0.583*
	(1.81)
Completed grade[a]	12.000***
	(21.81)
Constant	-284.444***
	(2.46)
Observations	1916
Chi^2	5271.94
Prob. > Chi^2	0.000
Adjusted R^2	0.694

Notes: Dependent variable: raw PPVT score. Coefficients from a pooled OLS model (Ages 12 and 15) are reported. |z| ratios are shown in parentheses and are based on bootstrapped standard errors. [a]predicted from the regression in Table A4 below.

Source: Compiled by author using data from Young Lives–Ethiopia project

Table A3: Predicting children's completed grade, Age 8

	Grade
Female	-0.037
	(0.53)
Mother's schooling	0.040***
	(2.71)
Father's schooling	-0.004
	(0.36)
Female × Mother's schooling	0.004
	(0.18)
Female × Father's schooling	0.011
	(0.71)
Caregiver's age	0.005
	(1.44)
Other caregiver	-0.077
	(0.75)
Number of siblings	0.036*
	(1.71)
Number of children <5	-0.053
	(1.27)
Child's birth order	-0.028
	(1.51)
Household wealth	0.124**
	(2.02)
Constant	0.416**
	(1.97)
Community dummies	Yes
Observations	971
F-statistic	22.01
Prob. > F	0.000
R^2	0.342

Notes: Dependent variable: completed grade in school. OLS estimates are reported. |t| ratios based on robust standard errors are shown in parentheses.

Source: Compiled by author using data from Young Lives–Ethiopia project

Table A4: Predicting children's completed grade, Age 12 and 15

	Grade
Female	0.219**
	(2.34)
Age	0.888
	(0.90)
Age squared	-0.024
	(0.66)
Mother's schooling	0.029
	(1.56)
Father's schooling	0.037***
	(2.48)
Female × Mother's schooling	0.014
	(0.61)
Female × Father's schooling	-0.007
	(0.37)
Caregiver's age	0.009**
	(2.10)
Other caregiver	-0.363***
	(2.85)
Number of siblings	0.040
	(1.49)
Number of children <5	-0.148**
	(2.31)
Child's birth order	-0.016
	(0.83)
Household wealth	0.205***
	(2.72)
Nondurable PCE	0.375***
	(4.41)
Constant	-5.715
	(0.87)
Community × Round dummies	Yes
Observations	1942
F-statistic	52.67
Prob. > F	0.000
R^2	0.524

Notes: Dependent variable: Completed grade in school. Coefficients from a pooled OLS model (Ages 12 and 15) are reported. |t| ratios based on robust standard errors are shown in parentheses.

Source: Compiled by author using data from Young Lives–Ethiopia project