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Whoever Has Will Be Given More: Child Endowment and Human Capital Investment[☆]

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Abstract

Using a unique longitudinal survey from Ethiopia, we investigate whether resource constrained parents reinforce or attenuate differences in early abilities between their children. We propose a simple model that allows for sibling interactions. To overcome the endogeneity associated with measures of endowment, we construct a measure of human capital at birth that is plausibly net of prenatal investment. We estimate a sibling fixed-effect model to account for bias due to unobserved family-specific heterogeneity. We find that parents reinforce educational inequality: inherently healthy children are more likely to attend preschool, be enrolled in elementary school, and have more expenses incurred towards their education. Health inputs are allocated in a compensatory manner.

JEL codes: D13, I14, I24, J13
Keywords: Cognitive ability, Health Endowment, Intrahousehold Allocation, Sibling Rivalry

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1. Introduction

A large body of human capital literature studies how parents allocate specific investments among their children in response to the onset of a child's human capital endowment. Economic theory suggests that the pattern of parental investment can be neutral, compensating or reinforcing depending on efficiency concerns and parents' aversion to inequality between children (Becker and Tomes, 1976; Behrman, 1988). Under the assumption that marginal returns to investing are higher for better-endowed children than they are for lesser-endowed children, efficiency concerns will induce parents to reinforce early ability differences by investing more in more able children. Equity concerns, on the other hand, might drive parents to act in a compensatory manner by investing relatively more in their low ability children.

The empirical evidence is not conclusive as regards the direction of response by parents to their children's early endowments. Some earlier empirical studies from developing countries find evidence of reinforcing behavior (Rosenzweig and Wolpin, 1988; Rosenzweig and Schultz, 1982; Behrman et al., 1994), whereas studies from the developed world rely on adult outcomes such as completed education as a proxy for parental investments and found that parents compensate for differences in their children's endowments (Ashenfelter and Rouse, 1998; Behrman et al., 1982; Griliches, 1979). Other studies have mainly focused on family responses to specific measures of health endowments, such as birth weight (Datar et al., 2010; Aizer and Cunha, 2012; Rosenzweig and Zhang, 2009), and have found evidence in line with Becker and Tomes's (1976) efficiency arguments. A couple of recent studies highlight that family investment responses vary by socioeconomic status (Hsin, 2012; Restrepo, 2011).

Even though a large number of studies examine how child endowments influence parental investment in the human capital of children, two important factors are yet to be adequately addressed: multiple dimensions of endowments and heterogeneity in investment responses. Models of human capital formation posit that child endowment could include dimensions of health, cognitive abilities and non-cognitive skills (Heckman, 2007). Recent empirical work, however, has afforded little attention to multi-dimensionality in investments and capacity. Empirical evidence on whether parental investment behaviour varies across socioeconomic status (SES) is still lacking.

The question of whether parental investment responses differ by parental socioeconomic status and household composition is equally vital, as recent evidence indicates that poorly endowed children fare worse in the long run relative to their better-endowed siblings (Currie and Moretti, 2007; Aizer and Cunha, 2012). In the face of labor and capital constraints, children may become rivals and the relative genders and ages of siblings can be central in determining the outcomes of these rivalries, creating human capital differences between siblings (Garg and Morduch, 1998).

In the present study, we propose a simple model that combines household production and sibling interactions. The model allows us to explain how siblings affect the allocation of a child's time between work and school, as well as parental investment towards their education and health. We posit that conflict between siblings causes reallocation in favor of more dominant siblings, oftentimes more able, older siblings or boys. We then empirically examine the nature of the association between children's cognitive and health endowment and parental investment in human capital development using a unique longitudinal survey from Ethiopia. We also explore within-household gender and sibling differences in child labor, domestic work, and schooling of young children.

In particular, the study asks: (i) Do parents reinforce or compensate for early ability differences between children? (ii) Does birth order and sibling composition play a role in children's allocation of time? (iii) Do parents respond differently to endowment differences with respect to cognitive ability and health shocks? (iv) Does parental behaviour vary by family socioeconomic status (SES)?

Consistent with predictions of a household production model in which older children work more because they are better at household production, we find a strong relationship between sibling composition and child labor. The estimates suggest that increasing birth order is positively related to both market and domestic work; thus, older children in the household spend more time in these activities than their siblings, with some observable differences across genders.

In addition, with regard to intrahousehold resource allocation, the results indicate that parents adopt a reinforcing strategy and are driven by efficiency concerns when investing in educational inputs; but they follow a compensatory strategy in the case of health inputs, suggesting that they are more concerned about equity. These findings are consistent with other studies that have examined the effects of multiple measures of child endowments on parental investments.

The remainder of the paper is organised as follows. In Section 2 we summarize the related literature. Section 3 presents the conceptual framework about sibling rivalry and the intrahousehold investment decision. Section 4 describes the empirical identification strategy. Section 5 describes the survey data used in the analysis, and Section 6 presents the main results and discussions as well as robustness tests. Section 7 concludes.

2. Review of Related Literature

Understanding how parents respond when faced with endowment differences among their children is far from obvious; a fact reflected in the considerably growing literature that studies intrahousehold resource allocation. Recent studies have combined insights from an earlier theoretical literature on household resource allocation (Becker and Tomes, 1976) with improved identification strategies to capture causal effects of early life health shocks.[1]

There are a few fundamental methodological questions that plague attempts to measure intrahousehold resource allocation and establish a causal link between early endowments and parental response thereto. First, there has not always been a valid measure of the endowment of children that reflects exogenous differences. Birth weight has most often been used as a proxy measure of endowment, albeit with limitations. It is not clear how much of the difference in birth weight is due to child endowment and how much of it is driven by prenatal investment.

Second, just as with child endowments, it has proved difficult to find an unambiguous measure of parental investment that reflects a behavioural response to ability differences. Completed years of parental education, breastfeeding, preschool enrolment, and time spent with children have all been used as possible indicators of parental investment. The problem with these indicators is that their outcomes can be influenced by factors unrelated to parental

[1] See Currie and Almond (2011); Almond and Mazumder (2013) for a comprehensive review of the theoretical and empirical literature.

decision making. For instance, children can influence their schooling, and breastfeeding and parental time with children may be governed by unobserved circumstances (Almond and Mazumder, 2013). The third and perhaps the most daunting challenge is devising a valid method that identifies a causal relationship between parental response and child ability.

A review of the current state of the literature by Almond and Mazumder (2013) identifies three most-often used types of methodological approaches: family fixed effects, twin fixed effects, and natural experiments. The family fixed effects approach relates sibling differences in endowment to parental investment responses (Datar et al., 2010; Hsin, 2012; Aizer and Cunha, 2012; Del Bono et al., 2012). The main concern with this approach is its reliance on the assumption that there are no sibling specific unobserved differences that could influence the endowment differences as well as the subsequent parental response.

The twin fixed effects approach works well in controlling for such potential confounders. For this reason, the method has been often utilised in the empirical literature (Currie and Almond, 2011; Royer, 2009; Bharadwaj et al., 2010). This approach, however, is limited since postnatal investment decisions are different for twins than for singletons, and parental favouritism in response to endowment differences is hard to identify.

Different natural experiments have also been employed in the related literature. Among these methods are: exposure to an influenza epidemic (Kelly, 2011), regression discontinuity around low birth weight (Bharadwaj et al., 2013), tropical diseases and timing of investment (Venkataramani, 2012), and in-utero iodine supplements (Adhvaryu and Nyshadham, 2014).

The findings of these papers regarding parental responses to endowments, however, is far from conclusive. Using twin fixed effects on data from the US, Currie and Almond (2011) and Royer (2009) report finding no effects of birth weight differences on parental investment behaviour. Bharadwaj et al. (2013) use data from Chile and Norway to implement a regression discontinuity design around the 1500 grams birth weight cutoff and find no evidence of preferential parental investment. Bharadwaj et al. (2010), on the other hand, find evidence of compensating behaviour for birth cohorts in Chile. Aizer and Cunha (2012) and Datar et al. (2010) for the US, Akresh et al. (2012) for rural Burkina Faso and Rosenzweig and Zhang (2009) for China, use a family fixed effects framework and find evidence of reinforcing behaviour. Similarly, using in-utero exposure to radiation in Sweden and in-utero iodine supplementation in Tanzania as natural experiments, Almond et al. (2009) and Adhvaryu and Nyshadham (2014), respectively, find reinforcing responses by parents.

Few other studies find mixed evidence in favor of both compensating and reinforcing behaviour. This is mainly the case when researchers consider a multidimensional measure of endowment. Yi et al. (2015); Ayalew (2005); Hsin (2012) and Restrepo (2011) all find compensating responses to health shocks and reinforcement of investment to cognitive endowment.

Our paper offers several contributions to the existing literature. First, it uses a direct measure of children's health and cognitive endowment as well as parental investments in the human capital of children. Second, the study considers multiple dimensions of child endowment. Children's birth weight, anthropometric measures at the age of one, and health shocks suffered before the age of one are used to measure children's health stock. Cognitive development assessment tests administered at the age of five are used to gauge child cognitive ability. In addition to observed investment indicators (such as breastfeeding, inoculations, preschool enrolment, and educational and medical expenses) parental perceptions of their children's health and educational performance are also considered. Third, the study analyses how parental investment in the human capital of children differs by parental socioeconomic heterogeneity.

Further, alternative estimation methods are employed to address the problem of endogeneity. We control for a possible correlation between unobserved prenatal and postnatal behaviour, and construct a measure of human capital at birth that is plausibly net of maternal investments during the prenatal period. Alternatively, using measures of maternal prenatal investments, it is possible to estimate a health production function and calculate the residual, which arguably consists of the child's endowment and an idiosyncratic child specific error term.

It is also worth mentioning that this study is in a developing country context, in which resource constraints on investments in children are likely more binding than in developed countries. Ethiopia is one of the poorest countries in Africa, with a population close to 100 million. Despite international commitments and sustained economic growth, the United

Nations still ranks Ethiopia 174 out of 187 countries in terms of human development. Forty four percent of children under 5 are stunted (short for their age), 11 percent are wasted (thin for their height), and 38 percent are underweight. Even though primary school enrolment is almost universal, literacy levels are still low and only 18 percent of older children have completed primary school by age 15 (UNDP, 2016). On top of that, almost 84 percent of children are engaged in some form of work and almost 2.8 million children are missing from school entirely (Woldehanna et al., 2011).

Over 30 percent of Ethiopians survive on less than 1.25 USD a day (UNDP, 2016). Eighty-five percent of Ethiopians are dependent on agriculture for their livelihood, but rises in food prices and regular droughts mean that many families are unable to buy or grow enough food to feed themselves (Woldehanna et al., 2011). For resource constrained households trying to maximise the returns to their human capital investments, parents' decisions will depend on their perceptions about the potential returns to schooling for a given child and that child's ability (Akresh et al., 2012). Hence, understanding the behavioural response of parents is critical for developing policy prescriptions to improve child wellbeing.

3. Conceptual Framework

Early models of household utility maximisation identify various mechanisms that influence the households' socio-economic choices and decision making processes. Household production models suggest that households maximise their welfare given their resource constraints (see Behrman (1997) for an extensive discussion).

One of the choices that households make is human capital investment into children through the distribution of resources. The seminal work of Becker and Tomes (1976) laid the foundation for the study of parental allocation of resources to children with different endowments. They propose a *wealth model* in which parents are assumed to maximise the total wealth of each child through bequests and investment in education. Under this model, parents invest in a child's human capital until the marginal rate of return on the investment equals the market rate of interest. Hence, in their model, parents allocate child-specific parental investments in a manner that reinforces specific endowments; i.e., parents invest more in children with larger endowments to achieve "efficiency". Parents will then use transfers (e.g., inter vivos, gifts) to achieve “equity" in income distribution.

Behrman et al. (1982), qualified this model by incorporating the effect of inequality aversion. Their *Separable Earnings Transfer (SET)* model proposes that parents potentially have separate preferences over the distribution of earnings and wealth across their children. Hence, depending on the level of aversion, the investment decision could be neutral, compensating or reinforcing. For example, the SET model predicts that if the marginal returns to investment were greater for children with greater endowments, parents would adopt a compensating or reinforcing strategy, depending on whether equity or productivity concerns are dominant.

In a model with credit constraints but without household production, Garg and Morduch (1998) show that gender and sibling composition affect parental investment decisions. Edmonds (2006) proposes a model showing that, regardless of the presence of credit constraints, the existence of household production implies that the age and sex composition of siblings affects a child's labor supply. In the present study, we extend these models by allowing household interactions in which children are active participants in their own formation.

We consider a simple model in which parents (represented as a single household) care about their own consumption and the quality of their children. They choose their level of consumption, level of investment into their children, and how the children allocate their own time. We assume that children can either study, and improve the level of their cognitive skills (quality) or they can work at home and contribute to the overall income of the household. Parental investment in children also increases the children's level of cognitive skills, but it decreases the level of household consumption. We also assume that parents only allocate the total investment to all children, and the children determine the level of individual investment via conflict. We now formalise the parental utility maximisation problem, and attempt to provide testable empirical predictions.

3.1. Parental Investment and Home Production

Suppose that parents obtain utility directly from consumption and the quality (or cognitive ability) of their n children, represented by the isoelastic utility function

$$u(c,q) = \frac{c^{1-\lambda}-1}{1-\lambda} + \frac{q^{1-\lambda}-1}{1-\lambda}, \tag{1}$$

which is separable in consumption c and overall child quality q. λ is the aversion parameter such that $\lambda = 1$ represents the case of log-utility. The overall child quality, q, in turn, is the CES aggregator of the individual child's quality

$$q = (\alpha_1 q_1^r + \ldots \alpha_n q_n^r)^{\frac{1}{r}},$$

where $q_i,\ i = 1, \ldots, n$ is the cognitive ability or quality of the individual child. The parameter r allows us to determine whether children are considered "gross complements" ($r < 0$) or "gross substitutes" ($r > 0$). α_is represent the share of an individual child in parents' utility. The cognitive level of each child depends on how much time children spend studying (either at school or in home education), on the investment they receive from parents, and on the initial level of their cognitive ability. Formally, we assume that the production function of a child's quality is given by

$$q_i = I_i^{\sigma_1} s_i^{\sigma_2} q_i^0, \tag{2}$$

where s_i determines how much time a child spends studying (instead of working), q_i^0 is some initial given quality of a child (at birth). σ_1 and σ_2 are chosen so that the more time children spend on study (s_i) the higher their cognitive ability becomes, and the more likely it is that they will receive greater parental investment. I_i is parental investment in child i, and is given by

$$I_i = p_i I,$$

where p_i is share of investment each child i gets from parents and is determined within children via conflict.

We also assume that children are endowed with a total of 1 unit of time, which they can allocate to studying or to working. The time constraint of child i is

$$s_i + l_i = 1.$$

The child's working time contributes to the home-production of the household. Formally, let hp denote home-production of a single good, that is produced with some production function f with children's labor (l_i) as an input:

$$hp = f(l_1, \ldots, l_n),$$

Assume that households earn some fixed income y and they decide to allocate it between consumption c or investment into children I. Parents can also sell or consume the home production good hp. Without loss of generality we can assume that the price of the home-produced good is 1. Therefore, the household's budget constraint is

$$c + I = y + hp, \tag{3}$$

In the next subsection we formally define how the individual share of investment p_i is determined between children.

3.2. *Sibling Rivalry*

Suppose that parents decide to invest a total of I investment to all children, and suppose that children must exert some effort so that a share of I is allocated to them. Following Havnes (2010), denote by F_i the effort level of an individual child. The share of investment p_i is determined as

$$p_i = \frac{F_i}{\sum_{j=1}^{n} F_j},$$

so that each child gets his relative share of effort she exerted. Suppose that children care directly about how much of the investment they get from parents, but exerting effort is costly for them. Let this cost be γ_i. Then, the utility function of child i is given by

$$V_i = p_i I - \gamma_i F_i.$$

The optimal share p_i is expressed as

$$p_i^* = 1 - \frac{\gamma_i Q}{I}, \tag{4}$$

where $Q = \sum_{j=1}^{n} F_j$ is the intensity of the conflict. Havnes (2010) also formally outlined how much effort children need to exert. Using the fact that $\sum_{j=1}^{n} p_i = 1$, we can sum equation (4) over individual children to get

$$Q = Q(n, \overline{\gamma}, I) = \frac{I}{\overline{\gamma}} \frac{n-1}{n},$$

which determines the total intensity of the conflict as a function of the number of children n, parental investment I and mean cost of effort across children $\overline{\gamma}$. Havnes (2010) calls this the extent of conflict. Finally, following Mehlum and Moene (2002), the optimal fighting effort of child i satisfies

$$F_i^* = Q(n, \overline{\gamma}, I) \left[1 - \frac{n-1}{n} \frac{\gamma_i}{\overline{\gamma}} \right],$$

which shows that the effort an individual child exerts is proportional to the extent of conflict and is decreasing in the child's advantage relative to the average among all children.

3.3. Parental Maximization Problem

We can now set up the parental maximization problem in which they take p_i's as given and determined by children:

$$\max_{I, c, \{s_i\}_{i=1}^{n}} u(c, q),$$

s.t.

$$c + I = y + f(1 - s_1, \ldots, 1 - s_n),$$

$$q_i = (p_i I)^{\sigma_1} s_i^{\sigma_2} q_i^0.$$

The FOC with respect to s_i is

$$\frac{du}{ds_i} = c^{-\lambda} f_i'(-1) + q^{-\lambda} \frac{1}{r} (\alpha_1 q_1^r + \ldots \alpha_n q_n^r)^{\frac{1}{r}-1} r \alpha_i q_i^{r-1} \frac{dq_i}{ds_i} = 0. \tag{5}$$

Consider two children, i and j, for whom equation (5) above holds. After some simplification, we get the following ratio

$$\frac{f_i'}{f_j'} = \frac{\alpha_i}{\alpha_j}\left(\frac{q_i}{q_j}\right)^r \frac{s_j}{s_i}.$$

Suppose that child i is better endowed than child j, so that $q_i > q_j$, and suppose that $r > 0$ - children are "gross substitutes". Also, suppose that parents care more about the better endowed child, so that $\alpha_i > \alpha_j$. Then, the model implies that if child j, who is not as able as child i is more productive at home ($f_i' < f_j'$), then child j will spend less time studying and more time working than child i,

$$s_j < s_i.$$

The FOC of the parental maximisation problem with respect to I is

$$\frac{du}{dI} = c^{-\lambda}(-1) + \sum_{i=1}^{n} \frac{dq}{dq_i}\frac{dq_i}{dI_i}\frac{dI_i}{dI} = c^{-\lambda}(-1) + \sum_{i=1}^{n} \frac{dq}{dq_i}\frac{dq_i}{dI_i} p_i = 0. \tag{6}$$

In other words, the simplified equation (7)

$$c^{-\lambda} = \sum_{i=1}^{n} \frac{dq}{dq_i}\frac{dq_i}{dI_i} p_i \tag{7}$$

implies that marginal investment is set equal to marginal consumption of the parents, so that parents optimise in terms of their overall investment. Sibling rivalry, however, implies that the allocation within children will be determined by the outcome of the conflict. Thus, if the assumptions of the FOC (in equation (5)) hold, and parents prefer to invest more in more able children, then the allocation is efficient from the parents' perspective, as better endowed children receive more investment from the parents (as long as better endowed children incur less cost in conflict - that is, γ_i is lower). If, on the other hand, the better endowed children perform worse in the conflict, then they will receive less investment from their parents, which would be inefficient from the parents' perspective. If parents would rather equalise the quality of their children and invest equally in all of them, then again, the conflict creates inefficiency, since children of different abilities (depending on how they perform in the conflict) would receive different amounts of investment ($p_i \neq p_j$ unless there is no sibling rivalry or the costs of engaging in conflict are different).

3.4. Example: Two Siblings

In this subsection, we seek to understand the implications of the model above for a simple case of a two-sibling family. We first specify some of the parameters of the parental maximisation problem. We fix the value for the risk-aversion of the household (λ) at 2, which is between the commonly accepted values of 1 and 3. Without loss of generality we fix the households' income y at 1. The initial cognitive endowment of both children (q_1^0 and q_2^0) is fixed at 1. The evidence on what is more important for a child's cognitive development - sending the child to school (choosing the level of s_i's) or buying him books to study (choosing I_i's) is conflicting. For the purpose of this example we assume that both are equally important for the child and set the parameters of the equation (2) to $\sigma_1 = \sigma_2 = 0.5$. Finally, we specify the production function for a home-produced good hp as a simple Cobb-Douglas function $f(1-s_1, 1-s_2) = (1-s_1)^{\theta}(1-s_2)^{1-\theta}$. These assumptions are summarised in Assumption 1.

Assumption 1. *Let* $\lambda = 2$, $\sigma_1 = \sigma_2 = 0.5$. *Fix* y, q_1^0, q_2^0 *at 1. Also, let* $f(1-s_1, 1-s_2) = (1-s_1)^{\theta}(1-s_2)^{1-\theta}$.

Consider the benchmark scenario in which both children are equally productive at home ($\theta = 0.5$), and there is no conflict ($p_1 = p_2 = 0.5$). Since both children are "equal" in terms of cognitive level, we set the share of individual children in parents' utility (α_1 and α_2) to 0.5. Whether the children are "gross complements" or "gross substitutes" does not matter for the benchmark case. Given the aforementioned values of parameters, we solve for the optimal level of parental consumption c^B, the optimal level of investment I^B (with I_1^B and I_2^B representing the level of investment to child 1 and child 2, respectively) and children's time allocation s_1^B and s_2^B. Since the actual values are not informative, we instead focus on the change of these values when we change the parameters of the model. The following propositions summarise several different scenarios based on parameter specifications. We denote by c^* the optimal level of parental consumption that arises for each parameter specification scenario, I^* (with I_1^* and I_2^* representing the level of investment to child 1 and child 2, respectively) is the optimal level of investment in each scenario, and let s_1^* and s_2^* denote the optimal level of children's time allocation.

Proposition 1. *Let* $p_1 = p_2 = 0.5$ *and let* $\theta > 0.5$ *(one child is better at home production). Also, suppose Assumption 1 holds. Then,*

$$c^* = c^B, \quad s_1^* < s_1^B, \quad s_2^* > s_2^B,$$
$$I^* > I^B, \quad I_1^* > I_1^B, \quad I_2^* > I_2^B.$$

Proposition 1 states that the total investment increases, the more productive child spends less time studying and more time working, while the less productive child studies more, and the total consumption of the household remains the same.

Proposition 2. *Let* $p_1 = p_2 = 0.5$ *and let* $\theta > 0.5$ *(one child is better at home production). Also, let* $\alpha_1 > 0.5$*. Finally, suppose Assumption 1 holds. Then, independently whether* $r > 0$ *or* $r < 0$*,*

$$c^* = c^B, \quad s_1^* > s_1^B, \quad s_2^* < s_2^B,$$
$$I^* > I^B, \quad I_1^* > I_1^B, \quad I_2^* > I_2^B.$$

Proposition 2 analyses the case when child 1 is more productive at home ($\theta > 0.5$) but has a higher share in the parents' utility ($\alpha_1 > 0.5$). Independently of whether children are "gross substitutes" with $r > 0$ or "gross complements" with $r < 0$, and despite being more productive at home, child 1 studies more, while the less productive child studies less (in order to compensate for being less productive). Also, the total investment increases and the total consumption of the household remains the same.

Suppose now that the children are engaged in conflict. We exogenously choose $p_1 > 0.5$ and $p_2 < 0.5$ so that child 1 is stronger in conflict.

Proposition 3. *Let* $p_1 = p_2 = 0.5$ *and suppose* $\theta = 0.5$*. Also, suppose Assumption 1 holds. Then, when* $r > 0$

$$c^* > c^B, \quad s_1^* > s_1^B, \quad s_2^* < s_2^B,$$
$$I^* > I^B, \quad I_1^* > I_1^B, \quad I_2^* < I_2^B.$$

When $r < 0$

$$c^* < c^B, \quad s_1^* < s_1^B, \quad s_2^* > s_2^B,$$
$$I^* > I^B, \quad I_1^* > I_1^B, \quad I_2^* < I_2^B.$$

Proposition 3 implies the following. When children are "gross substitutes", relative to the no-conflict case, parents increase their investment, but their time is not allocated equally. The stronger child receives more parental investment, while the weaker child is given less. The stronger child also studies more while the weaker child works more. When children are "gross complements", the stronger child still gets more investment from the parents, but he now studies less while the weaker child studies more.

Proposition 4. *Let* $p_1 = p_2 = 0.5$ *and suppose* $\theta > 0.5$. *Also, suppose Assumption 1 holds. Then, when* $r > 0$

$$c^* < c^B, \quad s_1^* > s_1^B, \quad s_2^* > s_2^B,$$
$$I^* > I^B, \quad I_1^* > I_1^B, \quad I_2^* < I_2^B.$$

When $r < 0$

$$c^* < c^B, \quad s_1^* < s_1^B, \quad s_2^* > s_2^B,$$
$$I^* > I^B, \quad I_1^* > I_1^B, \quad I_2^* < I_2^B.$$

Proposition 4 can be summarised in the following way. Suppose that the stronger child (child 1) is also more productive at home ($\theta > 0.5$). The total investment increases, with the stronger child receiving the bigger share, while the weaker child getting less. In case of substitutability, both children study more, while in case of complementarity, the weaker child now studies more, and the stronger child (that is more productive at home) now studies less in order to compensate for less work being done by the weaker child.

Proposition 5. *Let* $p_1 = p_2 = 0.5$ *and suppose* $\theta < 0.5$. *Also, suppose Assumption 1 holds. Then,* *when* $r > 0$

$$c^* > c^B, \quad s_1^* > s_1^B, \quad s_2^* < s_2^B,$$
$$I^* > I^B, \quad I_1^* > I_1^B, \quad I_2^* < I_2^B.$$

When $r < 0$

$$c^* < c^B, \quad s_1^* > s_1^B, \quad s_2^* > s_2^B,$$
$$I^* > I^B, \quad I_1^* > I_1^B, \quad I_2^* < I_2^B.$$

Proposition 5 states that when the stronger child is less productive at home ($\theta < 0.5$), in case of substitutability, the stronger and less productive child will study more and receive more investment, while the weaker and more productive child will receive less investment and will work more. In case of complementarity, both children study more, while the stronger child is the only one that receives more investment.

Proposition 6. *Let* $p_1 = p_2 = 0.5$ *and suppose* $\theta > 0.5$ *and* $\alpha > 0.5$*. Also, suppose Assumption 1 holds. Then, when* $r > 0$

$$c^* > c^B, \quad s_1^* > s_1^B, \quad s_2^* < s_2^B,$$
$$I^* > I^B, \quad I_1^* > I_1^B, \quad I_2^* < I_2^B.$$

When $r < 0$

$$c^* < c^B, \quad s_1^* > s_1^B, \quad s_2^* < s_2^B,$$
$$I^* > I^B, \quad I_1^* > I_1^B, \quad I_2^* < I_2^B.$$

Proposition 6 analyses the final case, when the stronger child is not only less productive ($\theta < 0.5$), but also has a greater share of parental utility ($\alpha_1 > 0.5$). As equation (5) predicts, the stronger child will study more and receive more investment from parents, while the weaker and more productive child will study less (as a result he will work more) and receive less investment from parents (the effect is stronger in case of substitutability, $r > 0$, than in case of complementarity, $r < 0$).

In summary, both the theoretical prediction and the empirical evidence are mixed regarding how parental investments are allocated in response to child endowment differences. There is no consensus on whether the efficiency motive or the equity concern govern parents' behavioural responses. This study aims to contribute to this growing literature by studying child health and cognitive endowments in a developing country and by analysing a measure of financial, time and behavioural investments, which has not been adequately studied before.

4. Empirical Strategy

4.1. Sibling Composition and Child Outcomes

A natural place to start investigating the role of intrafamily resource allocation is by looking at how birth order, sex composition and age spacing affect children's human capital indicators. The literature has recognised that sibling structure is an important determinant of schooling, health and child labor patterns among children in a household (Parish and Willis, 1993; Garg and Morduch, 1998; Morduch, 2000; Edmonds, 2006; Dammert, 2010). Understanding sibling composition effects is relevant for policy, as sibling differences in long-term outcomes can emanate from varying investments in early childhood.

Studies of sibling rivalry in human capital typically use the number of siblings a child has and their gender composition to explain different child outcomes (such as school attendance or attainment) as follows:

$$I_{if} = \varphi_0 + \varphi_1 SIB_{if} + \alpha_0 X_{if} + \alpha_1 Z_{if} + \varepsilon_{if} \tag{8}$$

where I_{if} is investment measure for child i in household f, SIB_{if} is a proxy for birth order, sex composition or age gap, X_{if} denotes a vector of individual characteristics such as age and gender that might influence parental investments, and Z_{if} is a vector of household characteristics. ε_{if} is a random, idiosyncratic error term.

This simple specification can still be modified to account for different sibling composition relationships by adding specific interaction as follows:

$$I_{if} = \varphi_0 + \varphi_1 SIB_i + \varphi_2 FEM_i + \varphi_3 SIB_i \times FEM_i + AGE_i + AGE_i \times FEM_i + H_i + \varepsilon_i \tag{9}$$

where AGE_i is a vector of dummies for each child in the investigated age range (e.g. 6-15) that takes on a value of 1 for child i's age and H_i is a household fixed effect. The term SIB represents the sibling composition variable of interest. Hence, we can run separate regressions to document the effects of birth order, the number of younger (older) siblings, as well as the gender of these younger (older) siblings. The total effect (within the household) of the relevant sibling composition variable on child status is thus given by φ_1 for males and by $\varphi_1 + \varphi_3$ for females. The age-female interaction allows for the age effect to vary by sex.

Assigning age rank based on the child's birth order among resident siblings, for example, the relationship between birth order and child outcomes can be analysed. The coefficient of age rank is interpreted as the average change in the outcome associated with increasing age rank within a household due to the inclusion of the fixed effect and age-gender interaction terms.

4.2. Child Ability and Responsive Investments

Having established the role siblings play in determining parental human capital investment decisions, we then move on to expand on the sibling rivalry model in equation 8 to control for the child's (and her siblings') ability and the home environment that might influence intrahousehold allocation decision. The empirical approach is based on the underlying economic model discussed in section 3 in which health, educational, and other types of postnatal parental investments (I) made at a particular point in time in child i belonging to family f depend on the child's own endowment (e_i), the endowments of other siblings present in the family at the time of investment in child i (e_{-if}), and other time-varying child and family characteristics (X_{if}) that influence parental investments. The average birth endowment of siblings present in the household is measured by e_{-if}; and the endowment of each of child i's siblings present in the home at a particular time is assumed to have the same effect on investment in child i.

A linear specification of this model takes the following form:

$$I_{if} = \beta_0 + \beta_1 e_{if} + \beta_2 e_{-if} + \alpha_0 X_{if} + \gamma_f + \phi_i + \varepsilon_{if} \tag{10}$$

where γ_f is the household fixed effect that captures all characteristics about the household that are constant across siblings; ϕ_i represents unobserved child-specific factors capturing the child's individual endowment and other unobserved determinants of investments that vary across siblings within a family; and ε_{if} is an idiosyncratic error term not captured by a child's own ability, e_{if}, or her sibling's ability, e_{-if}.

This within-family estimate compares a child's own ability to the average ability of all the other children in the household to examine if parents make the same comparison when making human capital investment decisions. The effect of other siblings' endowments on investments in child i is of interest because it is likely to impact the amount of investment parents make in child i. The coefficients β_1 and β_2, respectively, give an estimate of the impact of child i's own ability and her sibling's ability on investment in child i. β_1 measures whether parents invest more or less in children with higher endowments compared with children with lower endowments. β_2 measures the effect of within-family differences in the endowments of other siblings present in the household at the time of the investment.

A positive (negative) sign on β_1 would indicate that parental investments are reinforcing (compensating). A positive (negative) sign on β_2 would indicate that parents invest more (less) in children who have siblings with higher endowments present in the household at the time of the investment. Two alternative measures of sibling ability are widely used in the related literature: absolute and relative measures. Absolute measures use the highest sibling ability to provide insight into the role of the level of sibling ability in a household. The average level of sibling ability is also informative of parental decision-making in the presence of sibling rivalry for limited resources.

4.3. Potential Threats to Identification

Ordinary least squares (OLS) estimation of equation (10) could potentially yield biased estimates if either (i) $E(e_{if}, \gamma_f) \neq 0$ or (ii) $E(e_{if}, \phi_i) \neq 0$. A violation of condition (i) could arise if there are unobservable household characteristics that simultaneously explain why some families are more likely to raise healthy, well-educated, children. For instance, parents who care a lot about child quality might have better-endowed children, and may also invest more in their children after birth. In this case, γ_f would be correlated with birth endowments and OLS estimates would be biased. In turn, a violation of condition (ii) could arise if child-specific unobservables might be correlated with its endowment.

To eliminate the bias due to unobserved family-specific heterogeneity, the following model is specified by taking within-family differences:

$$\Delta I_{if} = \Delta\beta_1 e_{if} + \Delta\beta_2 e_{-if} + \Delta\alpha_0 X_{if} + \Delta\phi_i + \Delta\varepsilon_{if} \tag{11}$$

where $\Delta K = K_{if} - \bar{K}_f$, $K \in \{I, e, X, \varepsilon\}$ and $\bar{K}$ is the within family mean of K_i.

A potential bias could still emanate from the sibling-specific unobserved heterogeneity ($\Delta\phi_i$) that remains in the error term. Child endowment differences across siblings may be endogenous due to prenatal investment. One alternative to address this concern is to control for prenatal investments in the child using indicators such as month of first prenatal care visit and any shocks the mother suffered during pregnancy, since these are choices that are correlated with endowment and postnatal investments.

In specifications where endowment is measured at an older age (e.g. test scores in primary school), it is likely that these results already embody a significant component of prior parental investment. The child who has been benefiting from greater parental investment will appear to have a greater endowment at this stage. In addition, if there is some serial correlation in parental behaviour, the child is likely to continue to receive more substantial investments. This will generate an upward bias in the estimated coefficients.

In order to reduce this bias the study adopts the "residual method", where the unexplained part of estimated health (cognitive) production function is taken as the child's genetic ability endowment (Rosenzweig and Wolpin, 1988; Aizer and Cunha, 2012). This method is used to construct a residual component that can be thought of as an endowment measure that is net of key prenatal and early investments. In this approach an equation such as the following is estimated:

$$Y_{if}^k = \beta_0^k + \beta_1^k Z_{if} + \beta_2^k W_{if} + e_i + \epsilon_{if} \tag{12}$$

where the superscript k denotes the production function of interest (health, cognitive), the dependent variable Y is the health (cognitive) status indicator, Z includes individual specific exogenous variables (e.g., sex and age), W represents child-specific as well as parental endogenous variables that affect child outcomes directly (e.g., incidence of illness, age of the mother, whether the mother reports she was trying to conceive the child). The error term is composed of a child-specific age invariant component (e_i) and a pure random component (ϵ_{if}). The measure of endowment (e_i) is computed by averaging the error terms over time for each individual. It is equivalent to the individual fixed component of a simple fixed-effect estimator.

4.4. Socioeconomic Status and Intrahousehold Resource Allocation

One of the objectives of this paper is to investigate whether there are differences in investment behaviour by socioeconomic status (SES). If low SES parents are more resource-constrained, they may be more likely to invest in a better endowed child, reinforcing early ability differences. For high SES families, however, it is not clear which investment strategy they would choose. On the one hand, they have the resources to afford a compensatory strategy that equalises their children's outcomes. On the other hand, they are more likely to reinforce early child ability by investing more in the human capital of the more able child and giving more gifts and transfers to the less able child. As a result, wealthier parents will reinforce using human capital investments but compensate with non-human capital transfers. Hence, the socioeconomic heterogeneity in parental responses to early child investments is very much an empirical question.

One can analyse this issue by estimating an investment equation in which the endowment measures are interacted with indicators of SES such as household wealth index, caregivers' education level and urban (rural) residency.

$$\begin{aligned} I_{if} = \beta_0 + \beta_1 e_{if} + \beta_2 e_{-if} + \beta_3 e_{if} \times Z_{if} + \\ \beta_4 e_{-if} \times Z_{if} + \alpha_0 X_{if} + \gamma_f + \phi_i + \varepsilon_{if} \end{aligned} \tag{13}$$

where Z_{if} is the indicator of SES (e.g. mother's education, wealth index). A positive β_3 indicates that high SES parents invest more in high ability children than do lower SES parents.

5. Data and Measurement

5.1. Data

The data for this study are from the *Young Lives Project*, a study tracking the lives of children in four countries: Ethiopia, India (Andhra Pradesh district), Peru and Vietnam. In each study country, the *Young Lives* (hereinafter YL) surveys involve tracking 3,000 children in two cohorts. The younger cohort consists of 2,000 children who were born between January 2001 and May 2002. The older cohort consists of approximately 1,000 children from each country born in 1994-95. Currently, three survey waves are available: the baseline round in 2002 and two followup waves in 2006-7 and 2009.[2]

The survey contains one 'panel' or 'index' child per family (which determines the panel dimension of the survey), but also collects detailed information on other family members in the household. During the surveys, the index children were aged 6-20 months, 4-6 and 7-8 years of age, respectively. The present study uses data from the Ethiopia part of the project.

The data are clustered and cover 20 sites in each country across rural and urban areas. The sampling procedure adopted sentinel site surveillance, where the sites were purposefully selected to meet study objectives, such as its poverty-centered focus, and to reflect the diverse socio-economic conditions within the study countries. This was followed by random sampling of households within each site. Even though the samples are not statistically representative for the country, comparisons with representative datasets like the Demographic and Health Survey (DHS) and Welfare Monitoring Survey (WMS) samples show that the data contain a similar range of variation as nationally representative datasets (Barnett et al., 2013; Outes-Leon and Sanchez, 2008).

Attrition rates between rounds are very low by international standards. In the Ethiopian sample, only 4.4% of the children were lost or dropped out between the first two rounds in total, and a further 1.5% between rounds two and three (Barnett et al., 2013). Further assessment of the attrition based on two alternative child welfare models by Outes-Leon and Dercon (2008) found that attrited households are not systematically different from the retained households based on observable characteristics. The Cohort Profile Report of

[2]The Younglives survey team completed fieldwork for the Round 4 survey and have recently released preliminary findings. Following data cleaning, the data is expected to be archived for use very soon.

the first three rounds also concludes that the attrition was highly unlikely to bias research inferences (Barnett et al., 2013).

5.2. Measurement Variables

The measures of postnatal investments considered in this study are the health and educational investments that parents make in their children's early years. The focus on investments in early childhood is motivated by empirical evidence that early investment is a critical determinant of outcomes over the life course (Currie and Almond, 2011).

The child's weight, measured at ages 1, 5 and 8, are used as proxies for his/her own health endowments and use anthropometric data of a younger sibling present in the household at the time of investment as a measure of sibling endowment. Cognitive endowments of the child and his/her sibling are measured by the score on a test of cognitive ability. The index children in the YL study completed the Peabody Picture Vocabulary Test (PPVT) in rounds 2 and 3 (at ages 5 and 8). In the third round of the survey, 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.

Parental human capital investment is viewed from three angles: direct monetary expenditures on the education and health of the child, basic postnatal health related investments (e.g., balanced meals provided, last completedvaccine a child received), schooling (preschool enrolment until the age of 5 and primary education by age 8), and child work. The household questionnaire collects data on expenditures within the last 12 months.[3] Assignable expenditures include clothes, footwear, school uniform, school fees, private classes, books, transportation to school, doctors, medicine and entertainment. Schooling is measured primarily by current enrolment, which equals one if the child was enrolled in school at the time of survey, and zero otherwise. A child's completed years of schooling as of the survey date (grade completed) measures schooling achievement and is constructed as an alternative schooling investment measure.

The YL survey questionnaires in rounds 2 and 3 contain a separate section on children's

[3]The 12 month recall has the disadvantage of recall bias but this is likely to be outweighed by the advantage of more complete reporting compared to diary-based data collection that only records expenditures over a few weeks.

time use, which collected detailed information on 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 household chores. Using of this information, one can measure child work, both at the extensive and intensive margin. Based on the standard definition in the child labor literature, the extensive margin of 'Work status' is defined as a dummy variable that equals one if the child reported non-zero hours on paid work (hired or self) or on family farm/business, zero otherwise. Conditional on participation, the number of hours spent on market work is used to measure the intensive margin of child work.

The YL survey also collects information on the demographic characteristics of all household members. Among these variables, the following are used in the study: child's age (month and year of birth), gender and birth order; mother's age, parental educational attainment in years, household total size, number of siblings, and urban/rural status.

The means and standard deviations of the parental investment and other explanatory variables are reported in Table A.1 in the appendix. About half of the sample is composed of females. Parents' years of schooling are very low, with an average of about 3 and 5 years for the mother and father respectively. On average, a child lives in a household with 6 members and is expected to have about 5 siblings. Caregivers to about 66 percent of the one-year-old children report that they consider their children to be of similar or better health relative to other children of the same age. This number increases to close to 90 percent by the time the children reach the age of 5. However, about 30 percent on average report that their children had experienced serious illness in their first year.

6. Results and Discussion

6.1. Sibling Composition and Child Outcomes

In this section, we consider the relationship between sibling composition and child outcomes even when parents care equally about their children, and make investments in their children based solely on expected economic returns. OLS estimations that show the effect of sibling composition and birth order on child outcomes are marred by potential endogeneity problems. Unobserved factors such as parental preferences for large families and child labor may drive the correlation between sibling composition and child labor. Causality could also run the other way, where resource constrained families respond by increasing the number of children they bear, so that children's contribution to home production supplements the family income. Hence, in this section, we will mainly focus on documenting the statistical association between different activities of children and sibling composition without fully addressing the endogeneity of household composition. By including household fixed effects in the estimations, however, we are able to account for time and child invariant unobserved household characteristics that affect all children in the same household similarly.

The theoretical and empirical literature has identified several mechanisms through which sibling composition may affect children's outcomes. Biological factors imply that younger children have older mothers, which might have a negative effect on birth weight. Since birth weight is correlated with ability and access to resources, children born later may fare worse (Dammert, 2010). In credit constrained households where siblings compete with each other for scarce resources, older siblings may be forced to leave school early to help provide resources for the family, while younger children go to school longer (Morduch, 2000). As family income grows over the life cycle, younger siblings might benefit from higher parental earnings and savings (Parish and Willis, 1993).

The model in Section 3 predicts sibling differences in parental responsive investment as a result of child endowment differences and comparative advantage in household production. There is some empirical evidence that supports our prediction. Edmonds (2006) shows that regardless of the presence of credit constraints, the existence of household production implies that the age and sex composition of siblings affects a child's labor supply. If the return to education is the same for two children in a household, the older child will tend to work more because she has a comparative advantage in household production. In addition to birth order, sibling sex composition plays a vital role (Garg and Morduch, 1998). If, for instance, both children have equal productivities in household production, but the return to education for boys is greater than the return to education for girls, we will observe boys performing less work and receiving more education. Furthermore, if parents are more altruistic toward their sons than their daughters, the total investments in sons' schooling will be larger (Dammert, 2010).

Table 1 reports results from linear regressions of children's work status (weekly hours worked) on gender and different sibling environments. We refer to the household questionnaire to draw information on all children between the ages of 6 and 17 years. We consider three sibling composition indicators: relative birth order, number of siblings, and number of younger siblings. Relative birth order is defined as $(birthorder - 1)/($*number of siblings)*. Thus, the oldest relative order equals one and the youngest relative order equals zero. Relative birth order is used instead of absolute birth order to account for greater variations due to larger families (Ejrnæs and Pörtner, 2004). All specifications control for age, mothers' education, household size, wealth index and place of residence (rural dummy). All regressions also include a dummy for each age rank and their interactions with the female dummy.

The results in Panel A of Table 1 suggest that higher position in the birth order is positively related to increased hours of work; implying that older children in the household spend up to a total of 11 hours more per week in work activities than their younger siblings. The results also show that all of the interacted terms on the Female $\times$ Relative birth order are significant, rejecting the hypothesis that the effects of age rank are the same for boys and girls. The estimates suggest that higher position in the birth order is positively related to both market and domestic work; thus, older children in the household spend more time in these activities than their younger siblings, with some observable difference across gender. Older girls are found to spend six hours more on domestic work and five hours less on market work per week.

Table 1: Estimation of Children's Activities on Sibling Composition

A.	Total Hours	Domestic Work	Market Work
Female	0.230	13.02***	-12.77***
	(3.244)	(2.352)	(2.922)
Relative birth order	10.88***	7.143***	3.736**
	(1.408)	(1.002)	(1.309)
Female × Relative birth order	0.739	5.723***	-4.999**
	(1.786)	(1.419)	(1.576)
Observations	5246	5247	5246
Adjusted R^2	0.316	0.315	0.312

B.	Total Hours	Domestic Work	Market Work
Female	3.531	6.194*	-2.661
	(3.485)	(2.697)	(3.081)
Relative birth order	11.28***	6.602***	4.679***
	(1.402)	(1.001)	(1.306)
Female × Relative birth order	0.122	6.969***	-6.857***
	(1.775)	(1.412)	(1.577)
Number of siblings	2.187***	0.118	2.071***
	(0.377)	(0.326)	(0.317)
Female × Number of siblings	-0.704*	1.497***	-2.199***
	(0.335)	(0.311)	(0.317)
Observations	5246	5247	5246
Adjusted R^2	0.322	0.321	0.321

C.	Total Hours	Domestic Work	Market Work
Female	2.075	8.708***	-6.621*
	(3.344)	(2.507)	(2.992)
Relative birth order	5.425***	7.317***	-1.896
	(1.635)	(1.196)	(1.522)
Female × Relative birth order	2.474	1.339	1.119
	(2.025)	(1.661)	(1.767)
Number of younger siblings	2.475***	-0.292	2.768***
	(0.494)	(0.399)	(0.468)
Female × Number of younger siblings	-0.959	2.326***	-3.284***
	(0.519)	(0.476)	(0.498)
Observations	5246	5247	5246
Adjusted R^2	0.321	0.321	0.320

Standard errors clustered at household level in parentheses. Relative birth order is defined as $(birthorder - 1)/(number\ of\ siblings)$. Higher values of birth order are assigned to older children among resident siblings. Controls include mother's years of education, household wealth index, household size, rural dummy, age and age gender interactions.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

These results are consistent with the model in Section 3 that generates sibling differences in child work status as a result of comparative advantage in household production. Proposition 1 states that if one child is better at home production (for example the older child), then this child will spend more time working while the younger child spends more time studying.

Panel B and C in Table 1 show results from estimation of child outcomes on the number of siblings and the number of younger siblings respectively. We observe a strong correlation between the number of younger siblings other than child i in the household and the number of hours per week children spend on different work activities. There is also a clear gender divide in the amount and type of work children perform. An increase in the number of younger siblings by one is associated with an increase of market work for boys by almost three hours, with statistically insignificant effects on hours of domestic chores. Girls, on the contrary, experience a 2.3 hours increase in their domestic work and a 3.3 hours decrease in their market work activities.

These results are in line with previous research in a developing country context. Rosenzweig and Schultz (1982) argue that in rural India, daughters bear a larger proportion of housework than sons do when the expected employment of women in the labor market is relatively low. Using data from Nepal, Edmonds (2006) remarks that any difference could arise because of the comparative advantage of birth order as well as a gender bias towards specific types of work. Dammert (2010) finds that in Nicaragua and Guatemala, older boys spend more time engaged in market and domestic work, whereas older girls spend more time in domestic work than their younger siblings. She also finds girls to be more sensitive to changes in family composition.

6.2. Child Ability and intrahousehold Allocation

In this section we present estimation results of how parental investments respond to child endowments. We consider several measures of parental investment and different measures of child endowment. The first measure of endowment we consider is height-for-age, normalised to a Z-score. Height-for-age is widely used in the literature as a measure of endowment and a summary indicator of physical robustness, and it is correlated with a range of physical and cognitive indicators (Leight, 2010). The second endowment measure we take into account is parents' perceptions of their child's healthiness compared to their peers. This indicator is chosen based on the assumption that parents know more about their children's endowment, and whether their perception is correct or not, it is likely to inform and affect their decisions about investments in their children (Akresh et al., 2012).

We also take into account that height-for-age may be endogenous because it reflects maternal prenatal investments. Hence, as explained in section 4.3, we use instead the residual from a health production function that includes a host of prenatal characteristics. Cognitive endowments of the child and his/her sibling are measured by their score on two tests of cognitive ability: the Peabody Picture Vocabulary (PPVT) test and the Cognitive development assessment (CDA) test. To account for the potential bias from using cognitive test scores, we once again employ the "residual method". Following (Rosenzweig and Wolpin, 1988) and (Aizer and Cunha, 2012), we estimated equation 12 for each measures of endowment and report the coefficients in Table A.3. In subsequent discussions we refer to the predicted residual measure as residual endowment.

Table 2: Child's Own Endowment and Educational Investment

	Attended Preschool	School Enrolment	Educational Expenses
A. *Health Endowment*			
Parental Perception: Better than peers	0.095**	-0.007	0.178*
	(0.031)	(0.025)	(0.063)
Height-for-age z-score	0.008	0.013*	0.015
	(0.009)	(0.007)	(0.027)
Residual health endowment	0.086**	-0.017	0.167*
	(0.030)	(0.027)	(0.064)
Sibling health	0.000	0.009	0.024
	(0.002)	(0.007)	(0.016)
Observations	1835	1804	1455
B. *Cognitive Endowment*			
PPVT Score	0.005**	0.001	0.017***
	(0.002)	(0.002)	(0.004)
CDA Score	0.024***	0.008	0.066***
	(0.006)	(0.004)	(0.015)
Residual PPVT Score	0.000	0.000	0.013**
	(0.001)	(0.002)	(0.004)
Sibling PPVT score	0.000	0.001	0.002*
	(0.000)	(0.000)	(0.001)
Observations	1786	1761	1427

Each cell corresponds to a different regression of the outcome (indicated in each column) on endowment indicators. Marginal effects from *probit* estimations are reported in the first two columns. Coefficients from OLS estimation of the natural logarithm of annual educational expenses reported the last columns. Standard errors clustered at community level in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2 reports estimates of the effect of a child's own endowment on parental educational investments. The results suggest that parents reinforce educational inequality, as inherently healthy children are more likely to attend preschool, be enrolled in elementary school, and have more expenses incurred towards their education. We find a positive relationship between what parents think about their child's health and their preschool attendance. The likelihood of a child to be enrolled in preschool increases by 10 percentage points and educational expenses by 18 percent when their parents believe (perceive) that their children are better endowed. This finding is confirmed even when the endowment is measured by the residual method. Higher residual ability raises the probability that a child is enrolled in preschool.

These results are consistent with the predictions of our theoretical model. Considering better health endowment gives as an upper hand in child conflict, Proposition 3 holds as the stronger child receives more parental investment, while the weaker child receives less.

Cognitive endowment also increases the likelihood of attending preschool (table 2, panel B), although the magnitude of the estimated coefficient is quite low. School enrolment decisions are not affected by any of the endowment indicators; probably due to the fact that most public schools in Ethiopia are tuition free and the country is achieving universal primary education.

Estimation results of parental investment in health inputs are reported in Table 3. The results suggest that, when it comes to health inputs, parents compensate the inherently weaker child. Children whose parents perceive them as weak are six percentage points more likely to receive complete vaccinations. They also receive 28 percent more expenses incurred towards their health. Children that suffer early health shocks are also more likely to be immunised. We did not find any evidence linking children's cognitive endowments and parental health investment. We do, however, observe a marginal positive link between higher PPVT score and being provided with balanced meals. The presence of a better endowed sibling does not seem to alter the direction of parental investment response.

In addition to educational and health inputs towards the human capital production of children, we have also considered whether parents consider their children's abilities in making decisions about the allocation of a child's time. The results, reported in Table 4 show that more able children spend slightly fewer hours in work activities. A one point increase in the PPVT score is associated with a decline in weekly hours of market work by 21 minutes. The health endowment of the child seems to have no effect on parental decisions

Table 3: Child's Own Endowment and Health Investment

	Completed Vaccination	Balanced Meal	Medical Expenses
A. *Health Endowment*			
Parental Perception: Worse than peers	0.057*	0.003	0.277*
	(0.027)	(0.036)	(0.131)
Child suffered early health shock	0.083*	-0.038	0.316
	(0.035)	(0.028)	(0.157)
Residual health endowment	-0.020	0.022	-0.053
	(0.025)	(0.032)	(0.086)
Sibling health	0.002	0.005	0.006
	(0.003)	(0.005)	(0.017)
B. *Cognitive Endowment*			
PPVT score	0.000	0.006**	0.004
	(0.001)	(0.002)	(0.005)
Residual PPVT score	-0.001	0.006**	0.003
	(0.001)	(0.002)	(0.006)
Observations	1835	1476	1837

Each cell corresponds to a different regression of the outcome (indicated in each column) on endowment indicators. Marginal effects from *probit* estimations are reported in the first two columns. Coefficients from OLS estimation of the natural logarithm of annual medical expenses reported in the last column. Balanced meal is a dummy variable (= 1) if ≥ 5 different food groups eaten in the last 24 hours. Standard errors clustered at community level in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

regarding how their children spend their time. When we control for sibling abilities, we find that the presence of a sibling with higher cognitive ability reduces the hours the index child does by 40 minutes and market hours by 55 minutes a week.

To estimate how parental human capital investments respond to child endowments within a family, we regress our measures of educational and health investments as well as time allocation decisions on different measures of health and cognitive endowments including household fixed effects. This approach allows us to partially address the potential bias arising from unobserved child or household characteristics that may be evident in the specifications discussed so far. Due to data limitations, we are not able to measure medical expenses (investment) towards the siblings of the panel child in our sample. We do, however, observe educational expenses, school enrolment status and time-use information. Estimates in Table 5 are from a household fixed effects models that include additional covariates intended to control for sibling-specific differences in parental resources available for investment in children. The estimates on the endowment indicators can now be interpreted as the impact

Table 4: Child Endowment and Weekly Hours of Child Work

	Total Hours	Market Hours	Total Hours	Market Hours	Total Hours	Market Hours
Parental perception of child health:						
Better than peers	-0.266	-2.200				
	(0.837)	(1.962)				
Worse than peers	0.690	-1.094				
	(0.956)	(1.392)				
PPVT score			-0.015	-0.205*	-0.016	-0.174*
			(0.036)	(0.081)	(0.044)	(0.088)
PPVT score of sibling					-0.040***	-0.055***
					(0.009)	(0.016)
Observations	1806	1806	1761	1761	1412	1412

Each column represents coefficients from separate *tobit* regression of the outcome (indicated in each column title) on endowment indicators and a set of controls that include mother's years of education and age at birth, household wealth index, household size, rural dummy, marital status, number of siblings and birth order. Standard errors clustered at community level in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

on a child's status of a between-sibling difference in ability.

Table 5: Child Ability and Parental Investment: Household Fixed Effects Estimates

	Total Hours	Market Hours	Domestic Hours	School Expenses	School Enrolment
Height-for-age z-score	0.751	0.406	0.345	-0.154	0.023*
	(0.434)	(0.377)	(0.308)	(1.774)	(0.009)
Observations	2579	2579	2580	3013	3014
Adjusted R^2	0.247	0.251	0.325	0.001	0.223
PPVT score	-0.065*	-0.076**	0.011	1.016*	0.004***
	(0.027)	(0.022)	(0.019)	(0.454)	(0.001)
Observations	2547	2547	2548	2968	2969
Adjusted R^2	0.264	0.293	0.331	0.024	0.270

Each cell corresponds to a different regression of the outcome (indicated in the column title) on endowment indicators, female dummy and dummies for age in completed years, as well interaction terms of gender and endowment measures. Coefficients from a linear probability model are reported for school enrolment. Standard errors clustered at community level in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results lend further support to the evidence in the baseline regressions of household investment that reinforces differences in children's perceived ability. A higher ability child (measured by a higher PPVT score) is likely to work fewer hours than a lower ability sibling. Such a child is also more likely to be enrolled in school, and to have more expenses directed towards her education. Parental investments, however, were on average not statistically different between children who have better height-for-age z scores and their less healthy counterparts.

One of the objectives of this paper is to investigate whether investment behaviour varies by parental education and income. We estimated an investment equation in which the endowment measures are interacted with indicators of household wealth index, and mothers' education level. The estimates in Table A.2 in the appendix show that the response of educational investment to a higher ability child is modestly increasing in income. Together with the main effect, these estimates imply that educational investments in children are slightly reinforcing in high-income families. Investment differences across families by maternal education are statistically insignificant. We also do not detect any heterogeneity in a child's own time allocation.

7. Conclusions

In this study, we examine whether parents choose to invest differentially in their children in response to a child's health and cognitive endowment. Parental response to early child ability differences may be more important in a developing country context, in which resource constraints on investments in children are likely more binding than in developed countries. In the absence of formal insurance, social security and pension systems, resource constrained parents may base their intrahousehold allocation decisions on efficiency rather than on equity concerns.

We propose a simple model that extends household production models by allowing for sibling interactions. The model helps us explain how siblings affect the allocation of a child's time between work and schooling, as well as parental investment into their education and health. We posit that conflict between siblings causes reallocation in favor of the child with higher cognitive and health endowment.

The results indicate that parents invest more in the education of children with better health and cognitive abilities, which suggest they adopt a reinforcing strategy and are driven by efficiency concerns. We have also found evidence that parents invest more health inputs in inherently weaker children. Hence, parents follow a compensatory strategy in the case of health inputs, suggesting that they are more concerned about equity. Such behaviour is justified from the perspective of the resource constrained households considered in our sample. Health inputs often involve a question of survival while inputs towards education do not. These findings are consistent with other studies that have examined the effects of multiple measures of child endowments on parental investments (Ayalew, 2005; Yi et al., 2015).

Our findings are robust to using alternative objective measures of cognitive ability and health endowments (including parental perceptions) and to addressing potential feedback effects between observed investment and measures of ability. The results also hold even after we include controls for sibling-specific heterogeneity in parental resources.

The study also considers the relationship between sibling composition and child labor. The estimates suggest that a higher position in the birth order is positively related to both market and domestic work; thus, older children in the household spend more time in these activities than their younger siblings, with some observable difference across genders. Older girls are found to spend six hours more on domestic work and five hours less on market work per week. The results also suggest a strong correlation between the number of younger siblings in the household and number of hours per week children spend on different work activities with a clear gender divide. These results are consistent with predictions of a household production model where older children work more because they are better at household production (Edmonds, 2006; Dammert, 2010; Garg and Morduch, 1998).

Our findings have some important policy implications. First, the role of the family must be considered when designing public policies to remedy the effects of early inequality. As parents invest more educational human capital in the more able children, demand-side policies, such as conditional cash transfers or school feeding programs, might be more effective than supply side interventions. Second, we have highlighted the role of home production in explaining sibling differences in child labor. Hence, even demand side policies (such as conditional transfers) that target children should take into account the impact of domestic work, family size, and sibling composition.

References

Adhvaryu, A. and Nyshadham, A. (2014). Endowments at birth and parents' investments in children. *The Economic Journal*.

Aizer, A. and Cunha, F. (2012). The production of human capital: Endowments, investments and fertility. Technical report, National Bureau of Economic Research.

Akresh, R., Bagby, E., De Walque, D., and Kazianga, H. (2012). Child ability and household human capital investment decisions in burkina faso. *Economic Development and Cultural Change*, 61(1):157–186.

Almond, D., Edlund, L., and Palme, M. (2009). Chernobyl's Subclinical Legacy: Prenatal Exposure to Radioactive Fallout and School Outcomes in Sweden. *The Quarterly Journal of Economics*, 124(4):1729–1772.

Almond, D. and Mazumder, B. (2013). Fetal origins and parental responses. *Annual Review of Economics*, 5(1):37–56.

Ashenfelter, O. and Rouse, C. (1998). Income, Schooling, And Ability: Evidence From A New Sample Of Identical Twins. *The Quarterly Journal of Economics*, 113(1):253–284.

Ayalew, T. (2005). Parental preference, heterogeneity, and human capital inequality. *Economic Development and Cultural Change*, 53(2):381–407.

Barnett, I., Ariana, P., Petrou, S., Penny, M. E., Galab, S., Woldehanna, T., Escobal, J. A., Plugge, E., Boyden, J., et al. (2013). Cohort profile: the young lives study. *International journal of epidemiology*, 42(3):701–708.

Becker, G. S. and Tomes, N. (1976). Child Endowments and the Quantity and Quality of Children. *Journal of Political Economy*, 84(4):S143–62.

Behrman, J. R. (1988). Nutrition, health, birth order and seasonality: Intrahousehold allocation among children in rural india. *Journal of Development Economics*, 28(1):43–62.

Behrman, J. R. (1997). Intrahousehold distribution and the family. *Handbook of population and family economics*, 1:125–187.

Behrman, J. R., Pollak, R. A., and Taubman, P. (1982). Parental preferences and provision for progeny. *The Journal of Political Economy*, pages 52–73.

Behrman, J. R., Rosenzweig, M. R., and Taubman, P. (1994). Endowments and the allocation of schooling in the family and in the marriage market: the twins experiment. *Journal of Political Economy*, pages 1131–1174.

Bharadwaj, P., Eberhard, J., and Neilson, C. (2010). Do initial endowments matter only initially? the persistent effect of birth weight on school achievement. *Department of Economics, UCSD*.

Bharadwaj, P., Loken, K. V., and Neilson, C. (2013). Early Life Health Interventions and Academic Achievement. *American Economic Review*, 103(5):1862–91.

Currie, J. and Almond, D. (2011). Human capital development before age five. *Handbook of labor economics*, 4:1315–1486.

Currie, J. and Moretti, E. (2007). Biology as Destiny? Short- and Long-Run Determinants of Intergenerational Transmission of Birth Weight. *Journal of Labor Economics*, 25:231–264.

Dammert, A. C. (2010). Siblings, child labor, and schooling in nicaragua and guatemala. *Journal of Population Economics*, 23(1):199–224.

Datar, A., Kilburn, M., and Loughran, D. (2010). Endowments and parental investments in infancy and early childhood. *Demography*, 47(1):145–162.

Del Bono, E., Ermisch, J., and Francesconi, M. (2012). Intrafamily resource allocations: a dynamic structural model of birth weight. *Journal of Labor Economics*, 30(3):657–706.

Edmonds, E. V. (2006). Understanding sibling differences in child labor. *Journal of Population Economics*, 19(4):795–821.

Ejrnæs, M. and Pörtner, C. C. (2004). Birth order and the intrahousehold allocation of time and education. *Review of Economics and Statistics*, 86(4):1008–1019.

Garg, A. and Morduch, J. (1998). Sibling rivalry and the gender gap: Evidence from child health outcomes in ghana. *Journal of Population Economics*, 11(4):471–493.

Griliches, Z. (1979). Sibling models and data in economics: Beginnings of a survey. *The Journal of Political Economy*, pages S37–S64.

Havnes, T. (2010). Sibling rivalry over parental care. intra-household conflict and child investment.

Heckman, J. J. (2007). The economics, technology, and neuroscience of human capability formation. *Proceedings of the national Academy of Sciences*, 104(33):13250–13255.

Hsin, A. (2012). Is biology destiny? birth weight and differential parental treatment. *Demography*, 49(4):1385–1405.

Kelly, E. (2011). The scourge of asian flu in utero exposure to pandemic influenza and the development of a cohort of british children. *Journal of Human Resources*, 46(4):669–694.

Leight, J. (2010). Sibling rivalry: Ability and intra-household allocation in gansu province, china. *University of Pennsylvania*.

Mehlum, H. and Moene, K. (2002). Battlefields and marketplaces. *Defence and Peace Economics*, 13(6):485–496.

Morduch, J. (2000). Sibling rivalry in africa. *American Economic Review*, pages 405–409.

Outes-Leon, I. and Dercon, S. (2008). Survey attrition and attrition bias in young lives. *Young Lives Technical Note*, 5.

Outes-Leon, I. and Sanchez, A. (2008). An assessment of the young lives sampling approach in ethiopia. *Young Lives Technical Note*, 1:1–37.

Parish, W. L. and Willis, R. J. (1993). Daughters, education, and family budgets taiwan experiences. *Journal of Human Resources*, pages 863–898.

Restrepo, B. (2011). Who compensates and who reinforces? parental investment responses to child endowment shocks. *Work. Pap., Ohio State Univ., Columbus*.

Rosenzweig, M. R. and Schultz, T. P. (1982). Market opportunities, genetic endowments, and intrafamily resource distribution: Child survival in rural india. *The American Economic Review*, pages 803–815.

Rosenzweig, M. R. and Wolpin, K. I. (1988). Heterogeneity, intrafamily distribution, and child health. *Journal of Human Resources*, pages 437–461.

Rosenzweig, M. R. and Zhang, J. (2009). Do population control policies induce more human capital investment? twins, birth weight and china's "one-child" policy. *The Review of Economic Studies*, 76(3):1149–1174.

Royer, H. (2009). Separated at girth: Us twin estimates of the effects of birth weight. *American Economic Journal: Applied Economics*, 1(1):49–85.

UNDP (2016). Human development for everyone.

Venkataramani, A. S. (2012). Early life exposure to malaria and cognition in adulthood: evidence from mexico. *Journal of health economics*, 31(5):767–780.

Woldehanna, T., Gudisa, R., Tafere, Y., Pankhurst, A., and Lives, Y. (2011). *Understanding Changes in the Lives of Poor Children: Initial Findings from Ethiopia: Round 3 Survey Report*. Young Lives, Department of International Development, University of Oxford.

Yi, J., Heckman, J. J., Zhang, J., and Conti, G. (2015). Early health shocks, intra-household resource allocation and child outcomes. *The Economic Journal*, 125(588):F347–F371.

Appendix A.

Table A.1: Descriptive Statistics

Variable	Mean	Std.dev
Family Characteristics		
Child is female	0.47	0.50
Rural dummy	0.60	0.49
Household size	6.19	1.98
Number of siblings	4.84	2.13
Father's years of education	4.66	4.21
Mother's years of education	2.84	3.80
Caregiver depression (prenatal)	0.34	0.47
Marital status: Permanent partner	0.86	0.35
Wealth index (at age 1)[a]	0.21	0.17
Wealth index (at age 5)[a]	0.28	0.18
Wealth index (at age 8)[a]	0.33	0.18
Child Health Endowment		
Normal birth weight	0.43	0.49
Low birth weight	0.30	0.46
High birth weight	0.27	0.45
Height-for-age z-score at age 1	-1.58	1.96
Height-for-age z-score at age 5	-1.45	1.13
Height-for-age z-score of younger sibling[c]	-1.49	2.86
Healthier than peers at age 1[b]	0.38	0.48
Less healthier than peers at age 1[b]	0.24	0.43
Healthier than peers at age 5[b]	0.36	0.48
Less healthier than peers at age 5[b]	0.09	0.29
Child Cognitive Endowment		
PPVT score at age 5	21.42	12.39
PPVT score at age 8	79.20	44.24
PPVT score of younger sibling[c]	63.54	60.17
Math test score at age 5	8.24	3.01
Math test score at age 8	6.58	5.39
Early Childhood Parental Investments		
Birth Attended by professional	0.22	0.42
Had antenatal care	0.51	0.50
Pregnancy was wanted	0.62	0.48
Child was breastfed	0.98	0.13
Ever enrolled in preschool	0.25	0.43
Completed vaccination	0.96	0.20
Annual educational expenditure at age 5	246.01	580.29
Annual medical expenditure at age 5	135.72	461.40
Hours per day spent on work activities at age 5	1.19	2.26
Hours per day spent on work activities at age 8	4.00	2.71

[a] Index constructed based on component indices for housing quality, consumer durables, and services (0 to 1)
[b] Based on caregivers' perception of the healthiness of their child
[c] Younger siblings were 4-6 years old at the time of measurement

Table A.2: Child Endowment and Investments by Socioeconomic Status

	Educational Expenses		Hours of Work	
	(1)	(2)	(3)	(4)
PPVT	0.006	0.006	-0.131	-0.131
	(0.007)	(0.006)	(0.083)	(0.083)
Wealth index	1.837*	1.397	-34.705***	-34.277***
	(0.745)	(0.745)	(8.002)	(8.226)
Mother's years of education	0.078***	0.106***	-0.450*	-0.477
	(0.016)	(0.026)	(0.177)	(0.293)
PPVT × Wealth index	0.031*	0.049*	0.347	0.329
	(0.014)	(0.017)	(0.209)	(0.224)
PPVT × Mother's education		-0.001		0.001
		(0.001)		(0.008)
Constant	2.483***	2.501***	28.857***	28.844***
	(0.370)	(0.371)	(4.955)	(4.973)
N	1427	1427	1761	1761
Adj. R^2	0.482	0.482		

Each column corresponds to a different regression of the outcome (indicated in the column title) on endowment indicators and a set of controls that include gender, marital status, mother's age, household size, rural dummy, number of siblings and birth order. OLS estimation of the natural logarithm of annual educational expenses reported in columns (1) and (2). Columns (3) and (4) represent coefficients from separate *tobit* regressions. Standard errors clustered at community level in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.3: Predicting Health and Cognitive Endowment

	(1) Health	(2) PPVT	(3) CDA
Wealth index	0.199	13.154**	2.641*
	(0.156)	(4.047)	(0.947)
Caregiver depression	-0.065*		
	(0.031)		
Age of mother	0.000		
	(0.002)		
Mother's education	0.025***	0.637**	0.091**
	(0.006)	(0.191)	(0.028)
Household size	0.002	0.039	-0.026
	(0.005)	(0.198)	(0.042)
Marital status: Permanent partner	-0.009	-0.605	0.020
	(0.041)	(0.862)	(0.297)
Rural dummy	0.014	0.294	-0.056
	(0.073)	(1.477)	(0.422)
Child is female	0.013	-0.693	0.150
	(0.020)	(0.531)	(0.139)
Birth attended by professional	0.055		
	(0.045)		
Antenatal visits during pregnancy	0.016		
	(0.027)		
Wanted to have the child	0.025		
	(0.027)		
Difficult pregnancy	0.085*		
	(0.032)		
Female × Mother's education		0.022	-0.048
		(0.235)	(0.030)
Height-for-age z-score		-0.099	0.097*
		(0.169)	(0.037)
Early health shock		-0.048	-0.199
		(0.591)	(0.124)
Number of siblings living at home		0.070	0.023
		(0.242)	(0.058)
Child is first born		-0.149	-0.183
		(0.764)	(0.170)
Time spent working		-0.059	0.014
		(0.092)	(0.038)
Constant	0.173	16.039***	7.280***
	(0.130)	(2.049)	(0.685)
Observations	1745	1760	1787
Adjusted R^2	0.082	0.231	0.164

Standard errors clustered at community level in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Abstrakt

S použitím unikátního longitudinálního šetření v Etiopii zkoumáme zda rodiče používají své omezené zdroje tak, že zvýrazňují nebo naopak zmenšují rozdíly ve schopnostech dětí. Navrhujeme jednoduchý model zahrnující interakci sourozenců. Z důvodu možné endogenity spojené s měřením nadání jsme zkonstruovali míru lidského kapitálu při narození, která by měla být očištěna od vlivu prenatálních investic. Ve snaze snížit zkreslení odhadu v důsledku nepozorovaných specifických odlišností jednotlivých rodin byl využit fixed-effect model pro sourozence. Zjistili jsme prohlubující vliv rodičů na nerovnost vzdělání. Děti bez dědičných nemocí častěji nastupují k předškolní docházce, jsou zapsány k základnímu vzdělání a vykazují vyšší výdaje na vzdělaní. Výdaje na zdraví jsou alokovaný kompenzačně.

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