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The Role of Early Intervention on Childhood Skill Formation

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Dissertation

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Abstract

In the first chapter, I use time use data from a longitudinal survey (covering Ethiopia, India and Vietnam), to examine how the amount of time children spend on different activities impacts their acquisition of cognitive and noncognitive skills. Modeling the skill formation production function of children and extending the set of inputs to include the child's own time inputs, the study finds that child involvement in work activities (paid or nonpaid) are associated with a reduction in both cognitive and noncognitive achievements. The results imply an indirect adverse effect of child work on skill development through the reduction of hours of study.

In the second chapter, using a unique longitudinal survey from Ethiopia, we investigate whether resource constrained parents reinforce or attenuate differences in early abilities between their children. To overcome the potential endogeneity associated with measures of endowment, we construct a measure of human capital at birth that is plausibly net of prenatal investment. Furthermore, we estimate a sibling fixed-effect model to reduce the bias due to unobserved family-specific heterogeneity. We find 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. Health inputs, on the other hand, are allocated in a compensatory manner.

The third chapter examines the causal effects of an exogenous change in family policy in Ethiopia on women empowerment and the allocation of resources towards child health. Empowerment is formalized as an unobserved latent variable based on a large set of questions pertaining to women's autonomy and decision making power. Exploiting the time and regional variation in the implementation of the law, the study finds that the policy change enables women to acquire more education and decision making power as well as increasing their assertiveness towards family planning and against domestic violence. In addition, more decision power in the hands of women is found to positively impact investments in the health and nutrition of children. Contrary to the predictions of the traditional unitary household model, the findings suggest that "distribution factors" that do not enter the individual preferences may affect outcomes for individuals and emphasize the role of intrahousehold heterogeneity. The results are robust to a battery of validity and specification checks.

Abstrakt

První kapitola je věnována zkoumání množství času, který děti stráví při různých aktivitách, a dopadu na utváření kognitivních a nekognitivních schopností. K danému účelu byla využita data z longitudinálního šetření, zahrnujícího Etiopii, Indii a Vietnam. Vytvořením modelu produkční funkce utváření schopností dětí, kde strávený čas při různých aktivitách představuje vstupní proměnnou, bylo zjištěno, že děti zapojené do pracovních činností (placené i neplacené) vykazují zhoršení kognitivních i nekognitivních schopností. Výsledky naznačují nepřímý vedlejší vliv dětské práce na rozvoj schopností v důsledku snížení počtu hodin věnovaných studiu.

V druhé kapitole byl na základě longitudinálního šetření z Etiopie prozkoumán vliv omezených zdrojů rodičů na rozdíly mezi dětmi. Z důvodu možné endogenity spojené s měření nadání je vytvořena míra 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. Bylo zjištěno, že rodiče prohlubují nerovnost vzdělání, jelikož děti bez dědičných nemocí jsou častěji přijímány k předškolní docházce, zapsány k základnímu vzdělání a vykazují vyšší výdaje na vzdělání. V kontrastu s výdaji na vzdělaní jsou výdaje na zdraví, které jsou alokovány kompenzačně.

Třetí kapitola zkoumá kauzální vliv exogenních změn rodinné politiky v Etiopii na posílení ženských práv a vynakládání zdrojů na zdraví dětí. Posílení ženských práv je formálně považováno za nepozorovanou latentní proměnnou založenou na velkém množství faktorů souvisejících se samostatností a pravomocemi žen. S využitím rozdílů v čase a regionálních rozdílů v implementaci práva bylo zjištěno, že změny v rodinné politice umožňují ženám získávat vyšší vzdělání, více rozhodovat a zlepšovat schopnost asertivně přistupovat k rodinnému plánování a bránit se proti domácímu násilí. Dále byl zjištěn pozitivní vliv rostoucích rozhodovacích pravomocí žen na investice do zdraví a výdaje na výživu dětí. V protikladu k tradičnímu unitárnímu modelu domácnosti předkládaná zjištění naznačují, že „distribuční faktory“, které neovlivňují individuální preference, mohou ovlivnit výsledky jednotlivců a zvýšit roli heterogenity uvnitř domácnosti. Výsledky lze považovat za robustní, byla provedena řada ověření validity a specifikace modelů.

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All errors remaining in this text are entirely mine.

Czech Republic, Prague — Liyousew G. Borga
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Introduction

This dissertation consists of three essays investigating how innate abilities, parental investment, time use patterns, and policy interventions affect the acquisition and development of cognitive and noncognitive skills as well as health capital of children.

Recent research in the fields of human capital, health, neuroscience, and psychology has found that cognitive and non-cognitive stimulation in early life are critical for long-term skill development as key brain pathways for subsequent learning and lifelong capabilities begin to form during the early stages of life (Gertler et al. 2014; Noboa-Hidalgo and Urzua 2012; Cunha and Heckman 2008; Shonkoff and Phillips 2000). Hence, early childhood is a crucial time for interventions that benefit a child in physical, intellectual and social dimensions. Returns to investments made in early childhood are comparatively superior to investments made later in life for the mere reason that beneficiaries have a longer time to reap the rewards (Berlinski, Galiani, and Gertler 2009).[1]

Studies on skill formation and human capital development have shown that children's early achievements are strong predictors of a variety of outcomes later in life. Many major economic and social problems such as crime, teenage pregnancy, obesity, high school dropout rates, and adverse health conditions are traced in the literature to low levels of skill and ability in society (Heckman 2006). Hence, understanding what determines the abilities of individuals at early stages of life is critical for the design of public policy aimed at improving labor market outcomes. High-quality

[1]This statement is true under the assumption that the returns to investment in early childhood are greater than the returns to other potential investments made later in life (such as bequests).

early intervention helps to meet the diverse needs of young children during the crucial early years of life and to enhance their readiness for schooling, and improves later school achievements (Carneiro and Heckman 2003). In addition, investment in early childhood has a strong multiplier effect through which investment in the later years is more productive, as it is less costly than trying to rectify early disadvantages (Noboa-Hidalgo and Urzua 2012; Heckman 2006).

Even though there is a consensus among researchers regarding the importance of early life, there are still uncertainties about the type and timing of interventions and on how the gains are produced. Using longitudinal data from developing countries, this dissertation aims to contribute to the on-going debate by presenting empirical evidence on three vital intervention channels: children's own time use, parental responsive investment, and intrahousehold resource allocation.

The first chapter stresses the role of self-investment by children in shaping their cognitive and noncognitve development. I use time diary data from a longitudinal survey covering three developing countries (Ethiopia, India and Vietnam), to study how the amount of time children spend on different activities impacts their acquisition of cognitive and noncognitive skills. A large body of literature discusses how child development responds to supply-side interventions, parental investment and other exogenous inputs. However, the literature is scant on the role of children's self-investment on their development outcomes, particularly in a developing country set-up.

This paper contributes to the literature by providing empirical evidence on the role of children's own time-use. Modeling the skill formation production function of children and extending the set of inputs to include the child's own time inputs, the study finds that child involvement in work activities (paid or nonpaid) are associated with a reduction in both cognitive and noncognitive achievements. The results imply an indirect adverse effect of child work on skill development through the reduction of hours of study. This work is forthcoming in the Journal of Development Studies.

The second chapter studies the effect of differences in early health and cognitive endowments on later outcomes, as well as the extent to which parental responsive behaviour shapes the health and cognitive endowment of children. 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. Understanding how parents respond when faced with endowment differ-

ences among their children is far from obvious. Economic theory suggests that the pattern of parental investment can be neutral, compensating or reinforcing, depending on efficiency concerns and the degree of parents' aversion to inequality between children. The empirical evidence, however, is not conclusive on the direction of response by parents to their children's early endowments.

In a joint work with Myroslav Pidkuyko, we first propose a simple model that allows for household production and sibling interactions. We posit that conflict between siblings causes reallocation in favor of more dominant siblings. We then use a unique longitudinal survey from Ethiopia to investigate whether resource constrained parents reinforce or attenuate differences in early abilities between their children, and whether parental investment behavior varies across socioeconomic status. 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. Health inputs, on the other hand, are allocated in a compensatory manner. That is, while the allocations of health inputs compensate for initial differences, educational input allocations reinforce such differences. We also find that the size of the estimated parental response depends on the endowment measure used in the analysis. Parental perceptions of the health of their children are found to matter most in shaping their investment decisions than actual anthropometric and test score measures.

This paper offers several contributions to the existing literature. First, it uses direct measures of children's health and cognitive endowment as well as parental investments in the human capital of their children. Second, the study considers multiple dimensions of child endowment. Third, to overcome the potential endogeneity associated with measures of child endowment, we construct a measure of human capital at birth that is plausibly net of prenatal investments. Furthermore, to eliminate the bias due to unobserved family-specific heterogeneity, a sibling fixed-effects model is estimated by taking within-family differences in endowment and responsive investments.

The third chapter is concerned with the analysis of the dynamics behind decision-making within the household and its effects on children's development outcomes. Women empowerment is closely linked to positive outcomes for families and societies. The intrahousehold resource allocation literature also suggests that resources in the hands of women have a larger positive impact on outcomes for children. This chapter examines how a pro-female legislation that strengthened the rights of women and their

access to services affects household bargaining and resource allocation. It investigates the causal effects of this plausibly exogenous policy change on women empowerment and the allocation of resources towards child health.

Using a difference-in-differences approach, we exploit regional variation in the timing of the implementation of this new family code. Any effect due to the legal change can also serve as a test of the different theoretical household models in the literature. The paper adds value to the growing literature in intrahousehold resource allocation by making two important contributions. First, the concept of "empowerment" is formalized as an unobserved latent variable based on a large set of questions pertaining to women's autonomy and decision making power. Second, the paper finds an empirical counterpart to empowerment by exploiting the exogenous variation provided by institutional changes.

The results suggest that the revised family code has a positive and significant effect on increasing the empowerment indicators of women. In addition, more decision power in the hands of women is found to positively impact investments in the health and nutrition of children. The results also provide evidence to reject the unitary household model, as changes in bargaining power induced by external factors imply changes in household outcomes. These results highlight the importance of considering dynamic household interactions when evaluating the impact of public policies.

Chapter 1

Children's Own Time Use and its Effect on Skill Formation

Liyousew G. Borga[1]

Abstract

Using time use data from a longitudinal survey (covering Ethiopia, India and Vietnam), I examine how the amount of time children spend on different activities impacts their acquisition of cognitive and noncognitive skills. Modeling the skill formation production function of children and extending the set of inputs to include the child's own time inputs, the study finds that child involvement in work activities (paid or nonpaid) are associated with a reduction in both cognitive and noncognitive achievements. The results imply an indirect adverse effect of child work on skill development through the associated reduction of hours of study.

[1]This work is forthcoming in the Journal of Development Studies. The data used in this study come from Young Lives, a 15 year study of the changing nature of childhood poverty in Ethiopia, India (Andhra Pradesh), Peru and Vietnam. Young Lives is funded by UK aid from the Department for International Development (DFID), with co-funding by the Netherlands Ministry of Foreign Affairs and Irish Aid. The views expressed here are those of the author and not necessarily those of Young Lives, the University of Oxford, DFID or other funders. Financial support from the Charles University Grant Agency - GAUK (578314) is gratefully acknowledged. I wish to thank Patrick Gaule, Stapan Jurajda, Alan Krueger, Alex Mas, Cecilia Rouse, Orley Ashenfelter, Randy Filer, and seminar participants at CIREQ Montreal, DIAL Paris, Princeton University and SSPC Porto for their helpful comments. All remaining errors are mine. Email: lborga@cerge-ei.cz

1.1 Introduction

Using time diary data from a unique longitudinal survey, the present study examines how the amount of time children spend on different activities that are related to the acquisition of cognitive and noncognitive skills actually impact their development outcomes. In particular, the study addresses the questions: (*i*) what is the effect of time allocation across a wide range of alternative activities on achievement scores (*ii*) is there a trade-off between these activities, (*iii*) does the time children spend on their own become more important as they grow into adolescence, and (*iv*) to what extent does child involvement in work activities (such as domestic chores, activities for pay outside of the household, and tasks on family business) lead to reductions in achievement outcomes?

The human capital literature has empirically demonstrated that high quality, early intervention helps to meet the diverse needs of young children during the crucial early years of life, enhances their readiness for schooling and improves later school achievements (Carneiro and Heckman 2003; Cunha and Heckman 2008). Skills measured at early ages are strongly correlated with subsequent life outcomes such as educational attainment, labor market outcomes and psychosocial skills (Keane and Wolpin 1997; Cameron and Heckman 2001; Heckman, Stixrud, and Urzua 2006). There is also evidence that supports the notion that cognitive and noncognitive skills are shaped during the early stages of the life cycle and can be influenced by early interventions (Cunha and Heckman 2008; Doyle et al. 2009). Even though there is consensus among researchers regarding the critical nature of early life, little is known about the potentially enormous implications of these findings in the developing country context (Grantham-McGregor et al. 2007). There are also uncertainties about the type and timing of intervention and how the gains are produced (Noboa-Hidalgo and Urzua 2012).

A large body of literature discusses how child development responds to supply side interventions (Currie 2001); school inputs (Todd and Wolpin 2007); parental investment (Carneiro and Heckman 2003); and maternal employment (Ermisch and Francesconi 2005). However, the role of the child's own investment has received very little attention. Most previous time use research on children's activities has focused on the time parents spend interacting with children, rather than on how the children themselves spend their time.

It is imperative to shift attention to how children spend their time since this tells us something about which lever of intervention we need to pull to reach them. Time use is arguably a more subtle indicator of how children's outcomes are shaped by their roles and responsibilities. Children's time use pattern is also informative of what is likely to matter for thier wellbeing, since where they spend their time will also determine the friends they make, the activities they take part in, and the risks they may be exposed to. Studies have shown that the human and social capital of childhood are built over time and through the activities in which children engage, as well as the quality of the resources and social interactions that surround them (Bianchi and Robinson 1997).

There is general agreement that children should not be doing any work that is clearly harmful, hazardous, or morally objectionable. However, in developing countries, child labor is still one of the most pervasive development problems. Child labor can potentially hinder skill formation by crowding out time devoted to education. In developing countries, most children's work takes place outside the formal employment sector. Much of it is found in the informal economy and, for girls, at home. The degree to which children's work interferes with school attendance and achievement outcomes can vary greatly depending on the institutional structure of the sector of work and also on the structure of the school day (Ravallion and Wodon 2000; Bhalotra and Tzannatos 2003; Heady 2003; Assaad, Levison, and Dang 2005). Studies have shown that many children who attend school also work on a farm or the street in developing countries (Akabayashi and Psacharopoulos 1999). However, it is not clear theoretically or empirically from the existing related literature, to what extent child work actually leads to the reduction of human capital development, especially when the children are engaged in household production (Akabayashi and Psacharopoulos 1999).

There are only a few empirical economics papers that investigate the role of time use on children's skill acquisition. A study by Cardoso, Fontainha, and Monfardini (2010) documents the link between time allocation by parents and by youngsters without analyzing the possible influence on skill formation. Agee, Atkinson, and Crocker (2011) analyze the link between time use and skill formation considering three home inputs (the time children spend reading, doing homework, and staying with family). Their study, however, does not distinguish between time spent by the children on their own and time spent with adult supervision. Fiorini and Keane (2014) study

the effect of time allocation across a wide range of alternative activities using time diaries and document the cognitive and noncognitive implication of time allocation by children on a sample of Australian children. Del Boca, Monfardini, and Nicoletti (2017) compare the impacts of time investments by parents and children on child cognitive outcomes of adolescents in the United States. Their analysis is limited to the cognitive skills of older children.

Almost all of the studies that cover developing countries investigate the causes and consequences of child labor with particular emphasis on its link with schooling (Ravallion and Wodon 2000; Skoufias et al. 2001; Bourguignon, Ferreira, and Leite 2003). One exception is a study by (Akabayashi and Psacharopoulos 1999), which investigates the degree to which there is a trade-off between child labor and human capital formation of children from a Tanzanian household survey. Their analysis, however, is constrained by the fact that they use children's reading and mathematical skills as observed by household representatives as indicators of their human capital stock.

This paper, therefore, seeks to fill this gap in the literature by exploring the impact of time investment in different activities by children on their cognitive and psychosocial outcomes. To the author's knowledge, this is a first attempt to show the link between children's and adolescents' own time allocation and their skill acquisition in a developing country setup. The study builds on earlier literature (Todd and Wolpin 2007; Fiorini and Keane 2014) by empirically testing an achievement production function that allows achievement at a given age to depend on the history of inputs as well as heritable endowments. The study contributes to identifying this effect by presenting evidence from three countries, two cohorts and multiple achievement measures.

The results indicate that child involvement in work activities leads to a reduction in both cognitive and noncognitive achievement. For instance, an extra hour a week that an eight year old child spends working at a family farm or business instead of at school would reduce her cognitive test scores by 0.14, 0.13 and 0.04 standard deviations in Ethiopia, India and Vietnam respectively. Time spent studying outside school, on the other hand, is found to be more productive in terms of skills acquisition. These findings suggest that a reallocation of children's time towards studying and school by substituting away from the less productive work activities would complement the development of both cognitive and noncognitive skills. An hour a week spent on

studying outside of school in Ethiopia is shown to have an effect on cognitive skills equivalent to one additional year of parental education. Comparing the effect of young children's own time allocation with that of adolescents, it is shown that the time input in work related activities by children in the younger cohort affects their test scores much more than the time input by children in the older cohort. The results are all robust to different identification assumptions.

1.2 Methodology

The empirical analysis is based on a model of the production function for skill formation in the spirit of (Todd and Wolpin 2003) and (Cunha and Heckman 2008), but also adds investments made by the children themselves in addition to family and school inputs. The model specifies cognitive and noncognitive skills as a function of current and past inputs combined with the child's genetic endowment of mental capacity to produce cognitive and psychosocial outcomes.

An achievement production function, hence, relates cognitive or noncognitive achievement θ of child i residing in household j at age a with a vector of all inputs applied at any time up until age a, and the child's endowed mental capacity as

$$\theta_{ij,a} = f\{\theta_{ij,a-1}, X^f_{ij,a}, X^c_{ij,a}, X^e_{ij,a}, \mu_{ij,0}\}, \tag{1.1}$$

where $\theta_{ij,a-1}$ is previous period achievement, X^f_{ija} and X^c_{ija} represent parent-chosen inputs and their histories, and the child's own investments respectively; X^e_{ija} denotes exogenous inputs and their histories; and μ_{ij0} is the child's endowed mental capacity.

1.2.1 Empirical Specification

The empirical implementation of the production function in equation 1.1 is difficult since heritable endowments are unobservable, and inputs may be chosen endogenously with respect to unobserved endowments and prior realisations of achievement. This arises from the fact that parental input choices are often made consulting child specific endowments, and in either a compensatory or reinforcing manner. The subsequent paragraphs discuss the different alternative econometric methods used in the literature to overcome this challenge and their associated benefits and drawbacks.

Linearizing the achievement production function in equation 1.1, a benchmark specification of the production function of skills relates an achievement measure solely to contemporaneous measures of inputs as

$$\theta_{ija} = \alpha + \gamma X^c_{ija} + \phi X^f_{ija} + \delta X^e_{ija} + \beta \mu_{ij0} + \varepsilon_{ija}. \tag{1.2}$$

The implicit assumptions here are that only contemporaneous inputs matter for the production of current skills; current inputs capture the entire history of inputs as they are unchanging over time; and contemporaneous inputs are unrelated to unobserved ability (Todd and Wolpin 2003). These strong assumptions can be relaxed by estimating a more robust, value added specification that includes a lagged (baseline) achievement measure ($\theta_{ij,a-1}$) taken to be a sufficient statistic for unobserved input histories and endowment of mental capacity. Assuming the baseline achievement measure was conducted at period $a-1$, the model is specified as

$$\theta_{ija} = \alpha + \gamma X^c_{ija} + \phi X^f_{ija} + \delta X^e_{ija} + \nu \theta_{ija-1} + \varepsilon_{ija}. \tag{1.3}$$

This specification requires the effect of both observed and unobserved inputs as well as the endowed ability to declines with age.

It is possible, however, to relax the assumption that the effect of observed inputs decline with age by including additional regressors on lagged inputs if such information is available in the data. This helps enrich the value added specification by incorporating observable lagged inputs in addition to the baseline achievement measure.[2] Such a cumulative model can be specified as

$$\begin{aligned}\theta_{ija} = \alpha + \gamma_1 X^c_{ija} + \gamma_2 X^c_{ij,a-1} + \phi_1 X^f_{ija} + \phi_2 X^f_{ij,a-1} + \delta_1 X^e_{ija} \\ + \delta_2 X^e_{ij,a-1} + \nu \theta_{ij,a-1} + \varepsilon_{ija}.\end{aligned} \tag{1.4}$$

The assumption required for this model is that any omitted inputs and measurement error in test scores are uncorrelated with included inputs. Under this assumption, the limitation of equation 1.4 is that behaviour in the choice of inputs may induce correlations between the observable inputs and unobserved child endowments.

One way to get around the problem of endogeneity and further refine the empirical implementation is to specify fixed effect estimation models. These specifications of the

[2]For a detailed derivation and in-depth analysis of this model, see (Todd and Wolpin 2003).

achievement production function allow input choices to be endogenous with respect to unobserved endowments. This study takes advantage of the fact that observations on achievement outcomes and on inputs for a given child at different ages are available in the dataset to estimate a within child, fixed effects (FE) model.

Differencing the achievement scores at two different ages, a and $a-1$, provides

$$\begin{aligned}\Delta\theta_{ija} = \Delta\gamma_1 X^c_{ija} + \Delta\gamma_2 X^c_{ij,a-1} + \Delta\phi_1 X^f_{ija} + \Delta\phi_2 X^f_{ij,a-1} \\ + \Delta\delta_1 X^e_{ija} + \Delta\delta_2 X^e_{ij,a-1} + \Delta\beta_a \mu_{ij0} + \Delta\varepsilon_{ija},\end{aligned} \tag{1.5}$$

where ΔZ denotes the difference of the variable Z between two time periods (such as a and $a-1$, and $a-1$ and $a-2$). For a consistent estimation of equation 1.5, it is assumed that the impact of the endowment on achievement is independent of age, so that $\Delta\beta_a = (\beta_a - \beta_{a-1}) = 0$. It is also necessary to assume that later input choices are orthogonal to prior own achievement outcomes (Todd and Wolpin 2007).

1.2.2 Model Selection

Each of the above specifications attempts to handle the problem of endogeneity in a different way, relying on different maintained assumptions. Researchers employ different mechanisms to choose the best model that provides a robust result. (Todd and Wolpin 2007) address the model selection problem by applying cross validation criteria to find the model that performs best according to an out of sample, root mean squared error (RMSE) criterion. Cunha and Heckman (2008) propose an identification strategy that utilizes cross equation covariance restrictions. Rather than choose a model of the best fit, Fiorini and Keane (2014) avoid the problem of model selection by trying to determine whether a ranking of inputs exists that is robust across the whole range of the most popular models used in the literature. They argue that any criterion one might use to choose the "best" model would necessarily be controversial. The present study follows the approach of Fiorini and Keane (2014) and focuses on finding an estimator-robust ranking of the time inputs.

The present study uses six independent samples – three countries, two cohorts – to estimate cognitive and noncognitive production functions. Results from the estimators discussed above (contemporaneous, value added, cumulative, and within child fixed effects) are then presented given the assumptions under which each of these estimators identifies the production function. Consistent results from these independent samples

is believed to reinforce the validity of the findings from these alternative methods. The sensitivity of the results to functional form assumptions is checked by re-estimating all models using specifications which allow for a nonlinear effect of the time inputs.

1.3 Data and Preliminary Evidence

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.[3] In each study country, the *Young Lives* 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 1994-1995.[4]

This longitudinal survey consists of a survey of all 12,000 children and their primary caregivers every three years in three main elements: a child questionnaire, a household questionnaire, and a community questionnaire. The child questionnaire records detailed time use data for all family members, anthropometric measures of children and their caregivers, and test scores of the children for school outcomes (language comprehension and maths). The survey also asks the children about their daily activities, their experiences and attitudes, feelings, perceptions, hopes and aspirations for the future. The household level data cover topics such as household composition, livelihood and assets, socio-economic status, social capital, economic changes and recent life history. This is supplemented with additional questions that cover caregiver perceptions, attitudes, and aspirations for their child and the family. In depth information about the social, economic and environmental context of each community is provided by the community questionnaire.

Attrition in the samples is very low in all four countries for both younger and older cohort surveys. Attrition rates ranged from 2.2 percent (Vietnam) to 5.7 percent (Ethiopia) in the younger cohort, and from 2.4 percent (Vietnam) to 5.1 percent (Peru)

[3] Access to the data and permission to use them for this study is granted by the UK Data Service. The last round of the survey has not yet been publicly archived by the survey administrators. Data from Peru is not considered in this study as a large part of the time diary data was recorded with error.

[4] The data are clustered and cover 20 sites in each country across rural and urban areas. Sites were chosen purposively to reflect the diverse socioeconomic conditions within the study countries and therefore are not statistically representative for the country: comparisons with representative datasets like the DHS samples do show, however, that in each of the countries, the data contain a similar range of variation as nationally representative datasets (Barnett et al. 2012).

in the older cohort (Barnett et al. 2012).

1.3.1 Cognitive and Noncognitive Measures

The cognitive measures used in this study are a child's score on two standard achievement tests: namely, the Peabody Picture Vocabulary Test (PPVT) and a mathematics achievement test (MATH). The PPVT is a widely used test of receptive vocabulary. In the PPVT, the recipients hear a word (for example 'boat', 'lamp', 'cow' 'goat', and so forth) in their mother tongue and are then asked to identify which of four pictures corresponds with the spoken word. The test is individually and orally administered, untimed, and norm-referenced. It offers both raw and standard scores. The quantitative achievement score in the MATH test measures various numerical abilities appropriate for the age of the children.

In the case of the noncognitive indicators, self esteem and self efficacy dimensions are chosen. These dimensions have been validated in the psychology literature and are correlated with economic and social outcomes later in life (Dercon and Sánchez 2013). Self esteem summarizes the overall evaluation of a child's own worth. Self efficacy is related to a child's sense of agency or mastery over her own life. To measure these indicators, average scores were constructed based on the children's answers to a number of statements rated on a Likert-type scale. These questions include personality measures such as *friendliness*, *pride*, *determination*, *social trust*, and *group membership*. Answers to these statements (based on the respondents' degree of agreement or disagreement - ranging from strong agreement to strong disagreement) are used to construct individual average scores on self efficacy and self esteem.

1.3.2 Pattern of Time Use

The time use diary documents the activities of the children over a 24 hour period on one randomly chosen weekday. For each child the diaries report the type of activity, where the activity took place, whether the child was supervised, and if the child chose to perform the activity. These activities are then grouped into the following eight major groups that are presumed to affect the children's skills acquisition: Caring for others (younger siblings, the elderly, ill household members); domestic chores (fetching water or firewood, cleaning, cooking, shopping); tasks at the family business (farm, cattle herding, other family business); activities for pay outside of household; at

school; studying outside of school (including extra tutoring, and studying at home); play time/general leisure, and sleep.[5]

1.3.3 Other Variables of Interest

In addition to the key outcome variables, a host of explanatory and control variables such as community level measures, place of residence, household socio-economic characteristics (family size, wealth index, parental education, and social capital), and child specific measures (gender, birth order, anthropometry, child health, and social networks) are also included in the study. The wealth index is made up of indicators from three dimensions: housing quality (characteristics of roof, wall, floor and number of rooms per person), ownership of consumer durables (such as radio, TV, fridge, bike, car) and access to services (electricity, drinking water, flush toilet and type of fuel used for cooking). The index ranges from 0 (worst) to 1 (best) possible outcomes in the three selected dimensions. Table 1.1 presents descriptive statistics of these additional variables using the wave 3 data for both cohorts.

Table 1.1: Descriptive Statistics of Major Indicators (Wave 3 data)

Variable	Ethiopia		India		Vietnam	
	mean	sd	mean	sd	mean	sd
Older Cohort						
Child is female	0.488	0.500	0.506	0.500	0.506	0.500
Both parents are alive	0.793	0.406	0.882	0.323		
Grandparents present at home	0.103	0.304	0.227	0.419	0.159	0.366
Number of siblings	3.306	1.870	1.740	1.373	1.434	1.161
Wealth index of the household	0.350	0.167	0.522	0.174	0.623	0.184
Height for age z-score of child	-1.371	1.286	-1.661	1.056	-1.427	0.914
Household size	6.352	2.120	5.051	1.909	4.542	1.357
Resides in urban area	0.414	0.493	0.564	4.958	0.194	0.395
Younger Cohort						
Child is female	0.472	0.499	0.465	0.499	0.488	0.500
Both parents are alive	0.914	0.281	0.960	0.197	0.973	0.161
Grandparents present at home	0.210	0.416	0.624	0.613	0.450	0.588
Number of siblings	3.540	2.152	1.880	1.442	1.442	1.181
Wealth index of the household	0.329	0.175	0.514	0.178	0.608	0.189
Height for age z-score of child	-1.200	1.200	-1.425	1.182	-1.100	1.073
Household size	6.194	1.980	5.441	2.264	4.613	1.391
Resides in urban area	0.397	0.489	0.930	7.184	0.212	0.409

[5]Detailed description of the time use pattern of the sample children is presented in the appendix

1.4 Estimation Results and Discussion

The main objective of this study is to estimate the effect of alternative overall time allocations on children's skill development instead of examining the role of only one or two time inputs in isolation.[6] The empirical models specified in equations 1.2, 1.3, 1.4, and 1.5 (contemporaneous, value added, cumulative, and within child fixed effects respectively), were estimated for all of the outcome variables. As each estimation method relies on different maintained assumptions, it is important to see a consistent trade-off among activities that is robust across different estimation methods. Thanks to the rich longitudinal data that we employed, we were able to estimate alternative specifications, which are robust in the presence of unobserved endowments and endogeneity of input choices.

The present study uses six independent samples - three countries, two cohorts - to estimate cognitive and noncognitive production functions. Consistent results from these independent samples is believed to reinforce the validity of the findings from these alternative methods. The sensitivity of the results to functional form assumptions is checked by re-estimating all models using specifications which allow for a non-linear effect of the time inputs.

Tables 1.2 through 1.8 report estimation results conducted for two outcome variables measuring cognitive skills (PPVT and MATH) and two outcome variables measuring noncognitive skills (self esteem and self efficacy). Results are reported by country and separately for younger and older cohort samples. The figures reported in all of the tables are the standardized regression coefficients. The contemporaneous test scores and inputs are measured when the younger cohort children are 8 years of age and the older cohort 15 years old; while the lagged test scores and inputs are measured when the children are 5 and 12 years old respectively.

1.4.1 Cognitive Outcome

The first research question the study attempts to address asks whether or not time allocation of children across a wide range of alternative activities has any effect on achievement score, and if there is a trade-off among these activities. Tables 1.2-1.7,

[6]See (Fiorini and Keane 2014) for a simple illustration of how analyzing few inputs in isolation conveys only partial and potentially misleading information as one cannot characterize the trade-off between inputs.

report summarized versions of the results to aid the exposition in this section. Since the time inputs are collinear, the category "time spent at school" is omitted. As a result, the effect of the remaining included inputs is to be interpreted relative to this category. Several alternative estimations (that are not presented here, for space considerations) are also run to check that the reported coefficients are independent of which time input is the omitted category. The findings generally confirm the preliminary evidence presented in the previous section, where involvement in work activities was shown to be inversely related with improved achievement in cognitive skills.

The results indicate that time spent performing non-paid tasks on domestic farm/business and paid activities outside of the household are less productive in terms of skill production than the omitted category of time spent at school. For instance, according to the value added specification, an extra hour spent on paid work by a 15 year old child would reduce PPVT (MATH) test scores by 0.1 (0.01) standard deviations in Ethiopia, 0.13 (0.09) in India, and 0.11 (0.18) in Vietnam. Similarly, the results suggest that one more hour a week spent on the family farm or business instead of at school would reduce PPVT (MATH) scores of an eight year old child by 0.14 (0.13) standard deviations in Ethiopia. Time spent studying outside school (including extra tuition) are found to be more productive (in-terms of both PPVT and MATH test scores) for the Ethiopian sample of older cohort children. These coefficients are mostly statistically insignificant for MATH test scores in the Indian and Vietnamese samples. Domestic chores are found to be negatively related to MATH achievement scores while their impact is mixed on PPVT scores. Time spent sleeping and on leisure activities, in almost all instances, is found to be less productive than time spent at school. This is to be expected, however, as one cannot logically increase test scores by substituting all sleep and leisure time with school time.

The coefficients reported in tables 1.2-1.7 do not show whether time spent in one activity has a statistically different effect from time spent in a different activity. To this end, an informal assessment of whether rankings of time inputs are consistent across models is conducted by ranking the time input coefficients from most to least productive (Fiorini and Keane 2014). This approach allows us to gauge the extent to which our results are sensitive to the particular econometric method used. Figures A.3 - A.6 in the appendix show the results of this exercise. The main finding from this informal assessment is that, even though there are some differences across the different samples, the effects of time inputs is consistent for almost all the models used.

The fixed effects estimates, however, yield different results for the PPVT production function as some of the activities were found to be positively correlated with test scores contrary to our prior. The ranking of time input coefficients indicates that in Ethiopia and India, irrespective of the model used, time spent studying is ranked top (most productive) for the PPVT production function, followed by time spent at school. Paid and non-paid activities are ranked bottom in all three countries.

The importance of time allocation by children is amplified when it is put in perspective relative to some background variables. In the Ethiopian sample, for example, the result suggests that an hour a week spent studying outside of school has an equivalent effect on cognitive skills as one additional year of parental education. Both variables produce a 0.08 standard deviation increase in the PPVT test scores. Similarly, an extra hour a week that a child spends caring for others is equally pernicious to PPVT scores as having one more sibling in the household.

Comparing the estimation results for the younger and older children, it can be seen that the time investments by children in the younger cohort (aged 8) affect their test scores much more than the time input by their older counterparts (aged 15). The time inputs spent on work related activities resulted in larger negative effects on the younger children's test outcomes. These findings support the notion that returns on investments in early childhood are larger than those on investments at later stages.

The lagged test scores, included as a measure of the correlation between the contemporaneous and lagged test (controlling for other covariates), help us to assess whether a lower score in the present period may imply reduced cognitive achievements in the future. The coefficients for the lagged test are always very significant for all the samples considered, suggesting a very high persistence in the test score results. The coefficients of the other lagged inputs are also found to be mostly significant. These results showed the importance of both contemporaneous and lagged inputs in the production of current achievement, of allowing for unobserved child specific endowments and of allowing for endogeneity of inputs with respect to time varying components of children's achievement.

The estimation results also report the role of several control variables used in the study.[7] Among these covariates are the child's gender, height-for-age z-score, wealth index, household composition, parental education and place of residence. Female children are found to consistently score lower in both cognitive skill tests. The wealth

[7]The full list of estimation results is available from the author on request

index and the child's nutritional status, measured by height-for-age z-scores, also seem to matter, as almost all the estimation results produce highly significant positive coefficients. The same pattern is observed regarding place of residence, as urban dwellers perform better than their rural counterparts. Having more siblings is shown to adversely affect both PPVT and MATH scores of the younger cohort children. The presence of a grandparent in the household seem to produce mixed results that are mostly statistically insignificant. Maternal education is found to be highly significant in most of the samples considered. All the estimators suggest that an additional year of mothers' education results in a 0.07 - 0.12 standard deviations increase in both PPVT and MATH test scores.

Table 1.2: Cognitive Production Function (PPVT): Ethiopia

	CT	VA	CUM		FE
			$Time_t$	$Time_{t-1}$	
Older Cohorts					
Sleep	-0.029	-0.017	-0.013	0.026	-0.201***
	(0.036)	(0.034)	(0.035)	(0.035)	(0.040)
Caring for others	-0.097**	-0.080**	-0.046	-0.091***	0.137***
	(0.038)	(0.038)	(0.039)	(0.033)	(0.041)
Domestic chores	0.004	0.047	0.062	-0.078**	0.269***
	(0.038)	(0.037)	(0.040)	(0.036)	(0.045)
Non-paid activities	-0.148***	-0.110**	-0.074	-0.121***	0.133**
	(0.045)	(0.044)	(0.046)	(0.045)	(0.054)
Paid activities	-0.122***	-0.095**	-0.074*	-0.075	0.127***
	(0.043)	(0.043)	(0.040)	(0.046)	(0.033)
Studying (outside school)	0.083**	0.094***	0.106***	-0.027	0.204***
	(0.038)	(0.036)	(0.038)	(0.033)	(0.044)
Own time	-0.063	-0.037	-0.036	-0.089**	0.115***
	(0.038)	(0.037)	(0.037)	(0.035)	(0.038)
Lagged Test Score		0.243***		0.220***	
		(0.036)		(0.036)	
Number of observations	812	791		789	891
Adjusted R^2	0.303	0.347		0.358	0.260
Younger Cohorts					
Sleep	-0.048**	-0.033	0.021	0.002	-0.194***
	(0.021)	(0.021)	(0.029)	(0.032)	(0.035)
Caring for others	-0.099***	-0.089***	-0.068**	-0.054*	-0.027
	(0.019)	(0.020)	(0.033)	(0.030)	(0.026)
Domestic chores	-0.061***	-0.061***	-0.089***	-0.056*	0.169***
	(0.021)	(0.021)	(0.030)	(0.030)	(0.035)
Non-paid activities	-0.142***	-0.135***	-0.146***	-0.071**	-0.046
	(0.026)	(0.025)	(0.035)	(0.035)	(0.034)
Paid activities	-0.017	-0.022	-0.033***	-0.031***	-0.032*
	(0.013)	(0.015)	(0.005)	(0.005)	(0.017)
Studying (outside school)	0.075**	0.085***	0.078**	0.055	0.259***
	(0.029)	(0.029)	(0.036)	(0.054)	(0.043)
Own time	-0.171***	-0.148***	-0.149***	-0.153***	-0.163***
	(0.024)	(0.024)	(0.036)	(0.056)	(0.050)
Lagged Test Score		0.200***	0.139***	0.139***	
		(0.027)	(0.032)	(0.032)	
Number of observations	1,640	1,600		857	1,886
Adjusted R^2	0.376	0.408		0.414	0.497

Notes: *** p<0.01, ** p<0.05, * p<0.1; robust standard errors in parentheses. Coefficients are standardized to have mean 0 and standard deviation 1. Controls include: gender of child, grandparent present at home, number of siblings, urban dummy, wealth index, height-for-age z-score, and parental education in years. Column names refer to estimation results from different models: CT - Contemporaneous; VA- Value-added; CUM.- Cumulative; FE- Fixed effects. $Time_t$ and $Time_{t-1}$ correspond to inputs at age 15 and 12 for older cohort children and at age 8 and 5 for the younger cohort children respectively.

Table 1.3: Cognitive Production Function (MATH): Ethiopia

	CT	VA	CUM		FE
			$Time_t$	$Time_{t-1}$	
Older Cohorts					
Sleep	-0.094***	-0.051	-0.040	-0.056*	-0.006
	(0.035)	(0.033)	(0.035)	(0.033)	(0.031)
Caring for others	-0.084***	-0.035	-0.022	-0.069**	-0.005
	(0.031)	(0.030)	(0.031)	(0.032)	(0.029)
Domestic chores	-0.070*	-0.012	-0.003	-0.063*	-0.055*
	(0.036)	(0.034)	(0.035)	(0.032)	(0.032)
Non-paid activities	-0.057	-0.007	0.021	-0.122***	0.025
	(0.044)	(0.041)	(0.043)	(0.042)	(0.040)
Paid activities	-0.059*	-0.007	0.009	-0.037	-0.055**
	(0.032)	(0.030)	(0.030)	(0.023)	(0.023)
Studying (outside school)	0.215***	0.170***	0.163***	0.048	0.055
	(0.053)	(0.048)	(0.048)	(0.040)	(0.036)
Own time	-0.109***	-0.063*	-0.067**	-0.025	-0.062**
	(0.037)	(0.034)	(0.034)	(0.034)	(0.028)
Lagged Test Score		0.415***		0.385***	
		(0.032)		(0.032)	
Number of observations	818	791		789	891
Adjusted R^2	0.236	0.371		0.380	0.035
Younger Cohorts					
Sleep	-0.072***	-0.069***	-0.043	-0.110***	0.164***
	(0.021)	(0.020)	(0.030)	(0.033)	(0.035)
Caring for others	-0.090***	-0.087***	-0.064**	-0.098***	0.104***
	(0.019)	(0.019)	(0.030)	(0.031)	(0.031)
Domestic chores	-0.116***	-0.112***	-0.104***	-0.117***	0.068*
	(0.020)	(0.020)	(0.032)	(0.028)	(0.039)
Non-paid activities	-0.131***	-0.128***	-0.131***	-0.079**	-0.005
	(0.021)	(0.022)	(0.029)	(0.031)	(0.040)
Paid activities	-0.007	-0.001	-0.026***	-0.011	0.023
	(0.012)	(0.012)	(0.007)	(0.022)	(0.015)
Studying (outside school)	0.107***	0.112***	0.103***	-0.006	0.245***
	(0.027)	(0.027)	(0.035)	(0.046)	(0.042)
Own time	-0.196***	-0.185***	-0.206***	-0.169***	0.274***
	(0.021)	(0.021)	(0.031)	(0.053)	(0.050)
Lagged Test Score		0.120***		0.107***	
		(0.019)		(0.027)	
Number of observations	1,598	1,587		858	1,886
Adjusted R^2	0.470	0.480		0.491	0.113

Notes: *** p<0.01, ** p<0.05, * p<0.1; robust standard errors in parentheses. Coefficients are standardized to have mean 0 and standard deviation 1. Controls include: gender of child, grandparent present at home, number of siblings, urban dummy, wealth index, height-for-age z-score, and parental education in years. Column names refer to estimation results from different models: CT - Contemporaneous; VA- Value-added; CUM.- Cumulative; FE- Fixed effects. $Time_t$ and $Time_{t-1}$ correspond to inputs at age 15 and 12 for older cohort children and at age 8 and 5 for the younger cohort children respectively.

Table 1.4: Cognitive Production Function (PPVT): India

	CT	VA	CUM		FE
			$Time_t$	$Time_{t-1}$	
Older Cohorts					
Sleep	-0.196***	-0.129***	-0.125***	-0.054**	-0.232***
	(0.032)	(0.031)	(0.031)	(0.025)	(0.029)
Caring for others	-0.056*	-0.039	-0.036	-0.011	-0.014
	(0.029)	(0.028)	(0.029)	(0.021)	(0.029)
Domestic chores	-0.045	-0.020	-0.023	-0.051*	0.147***
	(0.033)	(0.030)	(0.031)	(0.028)	(0.031)
Non-paid activities	-0.179***	-0.144***	-0.094***	-0.079***	0.041
	(0.032)	(0.031)	(0.033)	(0.026)	(0.035)
Paid activities	-0.185***	-0.130***	-0.080**	-0.110***	0.127***
	(0.036)	(0.033)	(0.035)	(0.027)	(0.033)
Studying (outside school)	0.019	-0.022	-0.015	-0.063*	0.195***
	(0.048)	(0.044)	(0.046)	(0.035)	(0.043)
Own time	-0.098***	-0.101***	-0.088***	-0.068**	0.072**
	(0.036)	(0.034)	(0.034)	(0.029)	(0.032)
Lagged Test Score		0.383***		0.370***	
		(0.033)		(0.035)	
Number of observations	846	831		821	801
Adjusted R^2	0.354	0.471		0.484	0.244
Younger Cohorts					
Sleep	-0.091***	-0.089***	-0.044*	-0.090***	-0.149***
	(0.027)	(0.027)	(0.027)	(0.025)	(0.026)
Caring for others	-0.033*	-0.034*	-0.013	-0.018	0.025
	(0.019)	(0.019)	(0.018)	(0.017)	(0.019)
Domestic chores	-0.054**	-0.054**	-0.009	-0.015	0.161***
	(0.022)	(0.023)	(0.023)	(0.022)	(0.023)
Non-paid activities	-0.030***	-0.028***	-0.026***	-0.006**	-0.015
	(0.009)	(0.009)	(0.009)	(0.003)	(0.011)
Paid activities	-0.041	-0.052	-0.045	0.051***	-0.014
	(0.044)	(0.042)	(0.042)	(0.002)	(0.027)
Studying (outside school)	0.047	0.062*	0.084***	-0.004	0.313***
	(0.032)	(0.033)	(0.032)	(0.028)	(0.032)
Own time	-0.036	-0.024	0.039	-0.113***	0.163***
	(0.031)	(0.031)	(0.030)	(0.026)	(0.027)
Lagged Test Score		0.195***		0.203***	
		(0.025)		(0.026)	
Number of observations	1,870	1,787		1,613	1,563
Adjusted R^2	0.141	0.172		0.202	0.293

Notes: *** p<0.01, ** p<0.05, * p<0.1; robust standard errors in parentheses. Coefficients are standardized to have mean 0 and standard deviation 1. Controls include: gender of child, grandparent present at home, number of siblings, urban dummy, wealth index, height-for-age z-score, and parental education in years. Column names refer to estimation results from different models: CT - Contemporaneous; VA- Value-added; CUM.- Cumulative; FE- Fixed effects. $Time_t$ and $Time_{t-1}$ correspond to inputs at age 15 and 12 for older cohort children and at age 8 and 5 for the younger cohort children respectively.

Table 1.5: Cognitive Production Function (MATH): India

	CT	VA	CUM		FE
			$Time_t$	$Time_{t-1}$	
Older Cohorts					
Sleep	-0.174***	-0.107***	-0.106***	-0.050*	-0.181***
	(0.031)	(0.029)	(0.029)	(0.026)	(0.030)
Caring for others	-0.062***	-0.058***	-0.054***	0.002	-0.043*
	(0.019)	(0.018)	(0.019)	(0.026)	(0.025)
Domestic chores	-0.089***	-0.050*	-0.055**	0.000	0.026
	(0.027)	(0.026)	(0.027)	(0.025)	(0.030)
Non-paid activities	-0.151***	-0.078***	-0.084***	0.015	-0.044*
	(0.021)	(0.020)	(0.022)	(0.018)	(0.025)
Paid activities	-0.197***	-0.092***	-0.095***	0.003	-0.043
	(0.031)	(0.029)	(0.031)	(0.024)	(0.031)
Studying (outside school)	0.061	0.048	0.030	0.029	0.146***
	(0.048)	(0.042)	(0.042)	(0.030)	(0.046)
Own time	-0.102***	-0.090***	-0.088***	-0.036	0.013
	(0.029)	(0.027)	(0.028)	(0.026)	(0.030)
Lagged Test Score		0.387***		0.385***	
		(0.024)		(0.026)	
Number of observations	952	939		927	801
Adjusted R^2	0.381	0.485		0.482	0.096
Younger Cohorts					
Sleep	-0.236***	-0.234***	-0.207***	-0.047**	-0.126***
	(0.027)	(0.027)	(0.028)	(0.022)	(0.025)
Caring for others	-0.066***	-0.080***	-0.060***	-0.026	0.042*
	(0.021)	(0.022)	(0.022)	(0.019)	(0.025)
Domestic chores	-0.094***	-0.097***	-0.064***	-0.027	0.072***
	(0.024)	(0.023)	(0.024)	(0.019)	(0.023)
Non-paid activities	-0.044	-0.030	-0.018	0.008***	0.003
	(0.045)	(0.050)	(0.047)	(0.003)	(0.019)
Paid activities	-0.011	-0.019	-0.019	0.024***	-0.010
	(0.015)	(0.013)	(0.014)	(0.002)	(0.018)
Studying (outside school)	0.002	0.001	0.004	-0.018	0.202***
	(0.031)	(0.030)	(0.031)	(0.024)	(0.029)
Own time	-0.224***	-0.210***	-0.169***	-0.173***	0.199***
	(0.032)	(0.032)	(0.033)	(0.025)	(0.028)
Lagged Test Score		0.222***		0.222***	
		(0.022)		(0.023)	
Number of observations	1,873	1,863		1,676	1,563
Adjusted R^2	0.218	0.259		0.294	0.122

Notes: *** p<0.01, ** p<0.05, * p<0.1; robust standard errors in parentheses. Coefficients are standardized to have mean 0 and standard deviation 1. Controls include: gender of child, grandparent present at home, number of siblings, urban dummy, wealth index, height-for-age z-score, and parental education in years. Column names refer to estimation results from different models: CT - Contemporaneous; VA- Value-added; CUM.- Cumulative; FE- Fixed effects. $Time_t$ and $Time_{t-1}$ correspond to inputs at age 15 and 12 for older cohort children and at age 8 and 5 for the younger cohort children respectively.

Table 1.6: Cognitive Production Function (PPVT): Vietnam

	CT	VA	CUM		FE
			$Time_t$	$Time_{t-1}$	
Older Cohorts					
Sleep	-0.053	-0.053	-0.045	-0.079*	-0.053*
	(0.037)	(0.035)	(0.034)	(0.044)	(0.031)
Caring for others	-0.003	0.007	0.003	-0.049*	-0.050*
	(0.029)	(0.027)	(0.028)	(0.028)	(0.030)
Domestic chores	0.049	0.020	0.031	-0.060*	0.017
	(0.037)	(0.032)	(0.033)	(0.036)	(0.030)
Non-paid activities	-0.187***	-0.122**	-0.080	-0.150***	0.096**
	(0.053)	(0.048)	(0.052)	(0.051)	(0.046)
Paid activities	-0.099*	-0.107**	-0.090*	0.068	-0.025
	(0.052)	(0.051)	(0.050)	(0.046)	(0.034)
Studying (outside school)	-0.035	-0.004	0.017	-0.168***	0.031
	(0.063)	(0.057)	(0.057)	(0.059)	(0.048)
Own time	-0.099**	-0.036	-0.026	-0.194***	-0.010
	(0.047)	(0.042)	(0.041)	(0.061)	(0.036)
Lagged Test Score		0.370***		0.356***	
		(0.043)		(0.045)	
Number of observations	796	762		761	789
Adjusted R^2	0.355	0.424		0.437	0.125
Younger Cohorts					
Sleep	-0.046*	-0.012	-0.004	-0.014	-0.035
	(0.025)	(0.027)	(0.028)	(0.025)	(0.022)
Caring for others	0.003	0.010	0.008	0.002	-0.001
	(0.023)	(0.024)	(0.026)	(0.022)	(0.022)
Domestic chores	0.022	0.040	0.047*	-0.028	0.199***
	(0.024)	(0.025)	(0.027)	(0.021)	(0.022)
Non-paid activities	-0.048**	-0.034	-0.013	0.014***	-0.001
	(0.022)	(0.022)	(0.028)	(0.004)	(0.018)
Paid activities	0.025***	0.026	0.024	0.000	0.024
	(0.008)	(0.016)	(0.017)	(0.000)	(0.022)
Studying (outside school)	0.181***	0.166***	0.155***	0.063***	0.418***
	(0.031)	(0.032)	(0.035)	(0.024)	(0.021)
Own time	0.044	0.076**	0.097***	-0.068**	-0.069***
	(0.032)	(0.034)	(0.037)	(0.031)	(0.024)
Lagged Test Score		0.254***		0.261***	
		(0.025)		(0.027)	
Number of observations	1,598	1,421		1,282	1,289
Adjusted R^2	0.307	0.348		0.340	0.700

Notes: *** p<0.01, ** p<0.05, * p<0.1; robust standard errors in parentheses. Coefficients are standardized to have mean 0 and standard deviation 1. Controls include: gender of child, grandparent present at home, number of siblings, urban dummy, wealth index, height-for-age z-score, and parental education in years. Column names refer to estimation results from different models: CT - Contemporaneous; VA- Value-added; CUM.- Cumulative; FE- Fixed effects. $Time_t$ and $Time_{t-1}$ correspond to inputs at age 15 and 12 for older cohort children and at age 8 and 5 for the younger cohort children respectively.

Table 1.7: Cognitive Production Function (MATH): Vietnam

	CT	VA	CUM		FE
			$Time_t$	$Time_{t-1}$	
Older Cohorts					
Sleep	-0.092***	-0.050	-0.045	-0.058	-0.122***
	(0.035)	(0.034)	(0.034)	(0.036)	(0.038)
Caring for others	-0.079***	-0.064**	-0.071**	-0.022	-0.185***
	(0.029)	(0.027)	(0.028)	(0.028)	(0.033)
Domestic chores	-0.073**	-0.060**	-0.048*	-0.102***	0.049
	(0.030)	(0.027)	(0.027)	(0.034)	(0.037)
Non-paid activities	-0.202***	-0.127***	-0.099**	-0.116***	-0.064
	(0.042)	(0.040)	(0.043)	(0.041)	(0.044)
Paid activities	-0.219***	-0.181***	-0.166***	-0.011	-0.092**
	(0.044)	(0.043)	(0.042)	(0.021)	(0.040)
Studying (outside school)	-0.081	-0.064	-0.035	-0.163***	-0.046
	(0.067)	(0.062)	(0.063)	(0.056)	(0.068)
Own time	-0.246***	-0.186***	-0.175***	-0.147***	-0.328***
	(0.045)	(0.042)	(0.042)	(0.054)	(0.052)
Lagged Test Score		0.364***		0.345***	
		(0.034)		(0.036)	
Number of observations	813	809		806	789
Adjusted R^2	0.372	0.458		0.464	0.454
Younger Cohorts					
Sleep	-0.003	-0.001	-0.018	0.018	-0.027
	(0.028)	(0.028)	(0.030)	(0.023)	(0.025)
Caring for others	0.013	0.008	0.003	0.001	0.023
	(0.027)	(0.028)	(0.029)	(0.023)	(0.027)
Domestic chores	0.018	0.020	0.011	-0.019	0.184***
	(0.028)	(0.028)	(0.029)	(0.023)	(0.026)
Non-paid activities	-0.039	-0.031	-0.043	-0.038***	0.006
	(0.029)	(0.029)	(0.038)	(0.006)	(0.021)
Paid activities	0.025*	0.030*	0.026	0.024	0.025
	(0.015)	(0.016)	(0.017)	(0.022)	(0.033)
Studying (outside school)	0.070**	0.043	0.039	0.092***	0.393***
	(0.032)	(0.032)	(0.036)	(0.022)	(0.023)
Own time	0.062*	0.058	0.078*	-0.050	0.032
	(0.037)	(0.038)	(0.041)	(0.033)	(0.028)
Lagged Test Score		0.174***		0.198***	
		(0.027)		(0.029)	
Number of observations	1,671	1,621		1,451	1,289
Adjusted R^2	0.246	0.274		0.281	0.594

Notes: *** p<0.01, ** p<0.05, * p<0.1; robust standard errors in parentheses. Coefficients are standardized to have mean 0 and standard deviation 1. Controls include: gender of child, grandparent present at home, number of siblings, urban dummy, wealth index, height-for-age z-score, and parental education in years. Column names refer to estimation results from different models: CT - Contemporaneous; VA- Value-added; CUM.- Cumulative; FE- Fixed effects. $Time_t$ and $Time_{t-1}$ correspond to inputs at age 15 and 12 for older cohort children and at age 8 and 5 for the younger cohort children respectively.

1.4.2 Noncognitive Outcome

Noncognitive skills are associated with positive outcomes for young people, according to a large body of research (see Almlund et al. (2011) for a review of the related literature). Personality skills such as self-control and school engagement are correlated with academic and labor market outcomes, and reduced crime (Almlund et al. 2011). However, robust evidence of a causal relationship is quite limited in the literature. Less is known about the mechanisms through which one develops noncognitive skills. Thus, it is likely that the results presented in this section could be informative of an underlying relationship between the time investments of children and the formation of noncognitive skills. It proved extremely difficult, however, to compare and contrast the findings with the literature. The possible implications of children's own time investments on the acquisition of noncognitive skills has received little attention within the human capital formation literature in economics. In the only other study that showed the link between time investments and noncognitive skills, (Fiorini and Keane 2014) find noncognitive skills to be insensitive to the allocation of children's time. Instead they find that noncognitive skills are strongly influenced by parenting style, specifically effective discipline and warmth.[8]

Table 1.8 shows the results for the noncognitive measures. These psychosocial indices are constructed such that a higher score means better noncognitive competency. Because of the age period in which the sampled children are observed, the noncognitive tests were considered only for the older cohort sample. Involvement in paid activities and time spent on caring for others as well as on family business are found to be counterproductive in building self esteem and self efficacy skills of children in Vietnam. For instance, an extra hour a week that a child invests on paid activities instead of at school is found to reduce both her self esteem (self efficacy) by about 0.07 (0.6), 0.09 (0.08) and 0.15 (0.22) standard deviations in Ethiopia, India and Vietnam respectively. These results are largely consistent across the different cumulative estimators.

[8] Fiorini and Keane (2014) conducted their studies on a sample of Australian children. As indicated in table A.1 the patterns of time allocation of the children in their sample are quite different from those considered in this paper.

Table 1.8: Noncognitive Production Function

	Self-esteem			Self-efficacy		
Ethiopia	**CT**	**VA**	**CUM**	**CT**	**VA**	**CUM**
Sleep	0.139***	0.141***	0.124***	-0.034	-0.036	-0.038
	(0.041)	(0.041)	(0.043)	(0.038)	(0.038)	(0.038)
Caring for others	0.004	0.008	0.018	0.002	0.002	0.023
	(0.038)	(0.038)	(0.041)	(0.043)	(0.043)	(0.044)
Domestic chores	0.020	0.017	0.020	-0.058	-0.057	-0.053
	(0.048)	(0.048)	(0.049)	(0.044)	(0.044)	(0.045)
Non-paid activities	0.033	0.037	0.019	-0.052	-0.054	-0.052
	(0.052)	(0.051)	(0.053)	(0.054)	(0.054)	(0.057)
Paid activities	-0.074**	-0.074**	-0.058	-0.068*	-0.069*	-0.041
	(0.037)	(0.037)	(0.039)	(0.036)	(0.036)	(0.037)
Studying (outside school)	0.139***	0.131***	0.131***	0.056	0.054	0.035
	(0.048)	(0.048)	(0.048)	(0.053)	(0.053)	(0.054)
Own time	-0.078*	-0.074*	-0.078*	-0.059	-0.059	-0.058
	(0.041)	(0.040)	(0.042)	(0.045)	(0.045)	(0.045)
Lagged Test Score		-0.119***	-0.105***		-0.010	0.014
		(0.036)	(0.036)		(0.035)	(0.036)
Number of observations	819	819	817	819	818	816
Adjusted R^2	0.100	0.112	0.115	0.071	0.070	0.077
India	**CT**	**VA**	**CUM**	**CT**	**VA**	**CUM**
Sleep	0.034	0.036	0.048	-0.094***	-0.097***	-0.099***
	(0.039)	(0.039)	(0.039)	(0.033)	(0.034)	(0.033)
Caring for others	-0.035	-0.035	-0.049	-0.092**	-0.095**	-0.106**
	(0.030)	(0.030)	(0.033)	(0.044)	(0.043)	(0.044)
Domestic chores	0.077**	0.078**	0.089***	-0.068*	-0.066*	-0.056
	(0.033)	(0.033)	(0.032)	(0.036)	(0.036)	(0.036)
Non-paid activities	-0.030	-0.028	0.007	-0.144***	-0.145***	-0.071*
	(0.042)	(0.042)	(0.045)	(0.044)	(0.045)	(0.043)
Paid activities	-0.094**	-0.094**	-0.061	-0.080**	-0.081**	-0.052
	(0.039)	(0.039)	(0.041)	(0.038)	(0.039)	(0.041)
Studying (outside school)	0.007	0.007	0.013	0.052	0.050	0.048
	(0.052)	(0.052)	(0.052)	(0.047)	(0.047)	(0.047)
Own time	-0.033	-0.032	-0.035	-0.121***	-0.122***	-0.135***
	(0.037)	(0.037)	(0.036)	(0.042)	(0.042)	(0.041)
Lagged Test Score		-0.013	-0.011		0.012	0.025
		(0.037)	(0.037)		(0.035)	(0.034)
Number of observations	951	951	939	951	950	938
Adjusted R^2	0.034	0.033	0.050	0.129	0.128	0.143
Vietnam	**CT**	**VA**	**CUM**	**CT**	**VA**	**CUM**
Sleep	-0.105**	-0.106**	-0.099**	-0.173***	-0.172***	-0.164***
	(0.045)	(0.044)	(0.044)	(0.041)	(0.041)	(0.042)
Caring for others	-0.124***	-0.120***	-0.122***	-0.016	-0.017	-0.017
	(0.032)	(0.033)	(0.033)	(0.038)	(0.039)	(0.040)
Domestic chores	-0.059	-0.058	-0.041	-0.138***	-0.138***	-0.126***
	(0.042)	(0.042)	(0.042)	(0.038)	(0.039)	(0.038)
Non-paid activities	-0.174***	-0.171***	-0.162***	-0.162***	-0.165***	-0.148***
	(0.055)	(0.055)	(0.058)	(0.047)	(0.047)	(0.049)
Paid activities	-0.151***	-0.152***	-0.135**	-0.222***	-0.224***	-0.208***
	(0.055)	(0.055)	(0.055)	(0.045)	(0.046)	(0.046)
Studying (outside school)	-0.166*	-0.163*	-0.140	-0.034	-0.039	-0.028
	(0.091)	(0.091)	(0.090)	(0.073)	(0.074)	(0.075)
Own time	-0.109**	-0.104**	-0.091*	-0.207***	-0.210***	-0.199***
	(0.052)	(0.052)	(0.052)	(0.048)	(0.048)	(0.048)
Lagged Test Score		-0.060	-0.059		0.002	0.021
		(0.037)	(0.037)		(0.035)	(0.036)
Number of observations	813	812	809	813	808	805
Adjusted R^2	0.046	0.047	0.061	0.142	0.140	0.142

Notes: *** p<0.01, ** p<0.05, * p<0.1; robust standard errors in parentheses. Coefficients are standardized to have mean 0 and standard deviation 1. Controls include: gender of child, grandparent present at home, number of siblings, urban dummy, wealth index, height-for-age z-score, and parental education in years. Column names refer to estimation results from different models: CT - Contemporaneous; VA- Value-added; CUM.- Cumulative. Lagged test scores are measured at age 12.

1.4.3 Heterogeneity and Sensitivity Checks

A few more estimations were conducted to explore whether the results in the previous section are heterogeneous across subgroups. The samples were split by gender, place of residence and household wealth index. A re-estimation of all the models for boys and girls separately did not produce large differences between boys and girls. Summary tables for these estimations are reported in the appendix (tables A.4 - A.9). The results are similar to those obtained using the whole sample. When we re-estimate all the models separately by wealth status (below/above average wealth index) and by place of residence (urban/rural), engaging in work activities results in negative cognitive outcomes in urban areas (compared to the whole sample and the rural sub sample). There are no noticeable differences between households with below (above) average wealth status.

As a sensitivity check, the robustness of the results was further tested to functional form assumptions by re-estimating all the models using specifications which allow for a non-linear effect of the time inputs (such as logarithmic form and including second degree polynomials in time inputs).[9] The replicated estimation for the log form of test scores gave results that are very similar to the original linear regressions for both PPVT and MATH outcomes. When the models are re-estimated using a second degree polynomial in the time inputs, the results yield slightly improved adjusted R^2 and coefficients that are marginally larger in magnitude.

1.5 Conclusion

A large body of literature discusses how child development responds to supply side interventions, parental investment and other exogenous inputs. However, the literature is scant on the role of children's self-investment on their development outcomes, particularly in a developing country setup. Exploiting a unique dataset from three developing countries, this study presents compelling empirical evidence of the existence of a possible trade-off among time inputs of children in determining their cognitive and noncognitive development. The study employs a time use data reflecting how children spend a given representative week to present a much richer specification of the achievement production function in which the effects of all time

[9]These results are not reported here, but can be obtained from the author on request.

inputs are examined simultaneously.

The results indicate that child involvement in work activities leads to a reduction in cognitive achievement, while time spent at school, and studying outside school (including extra tuition) are found to be more productive in terms of skill acquisition. Performing paid activities and working in family businesses are negatively related to cognitive outcomes. Spending one more hour a week in school rather than doing paid activities has the same positive effect on cognitive skill as one additional year of parental education. Time spent on household chores has mixed effects on cognitive scores. The results are mostly consistent for all the samples considered (both young and older cohorts in the three study countries).

The study also compared the effect of young children's own time allocation with that of adolescents. Looking at the estimation results for the younger and older children, it was shown that the time input in work related activities by children in the younger cohort affected their test scores much more than work-related time input by the children in the older cohort. These findings support the notion that returns on investments in early childhood are larger than those made at later stages.

The findings for the noncognitive skill indicators largely corroborate those of cognitive skills. Time allocation on alternative activities has a different effect on self esteem and self efficacy outcomes in different countries. In the Vietnamese sample, involvement in paid activities and time spent on caring for others as well as at the family business are found to be counterproductive to building self esteem and self efficacy skills.

A host of control variables were used in the estimations to account for potential endogeneity problems. Of these covariates, the coefficients for lagged test are always very significant, suggesting a very high persistence in the test score results. Female children are found to consistently score lower in both cognitive skill tests. Higher wealth index and residence in urban areas, as well as better height-for-age z scores are all associated with better test scores. For the younger cohort sample, a higher number of siblings is linked to reduced PPVT and MATH scores.

The findings indicate the need for carefully reexamine children's activities and a potentially to reallocate time and other inputs. The fact that the study uses data from developing countries representing three different societies makes the evidence quite compelling. However, further studies are required to make an in-depth investigation of the detrimental consequences of child labor on the skill acquisition of children.

Appendix A

A.1 Data

A.1.1 Study Context

The research focuses on three developing countries - Ethiopia, India (in the states of Andhra Pradesh and Telangana), and Vietnam. According to the *Younglives* data team,[1] these countries were chosen to reflect a wide range of cultural, economic, geographical, political and social contexts. They face some of the common issues experienced by developing countries, such as high debt burden, post-conflict reconstruction, and adverse environmental conditions such as drought and floods. In the past decade, however, all of these countries have experienced consistent economic growth. Despite their considerable strides towards economic growth, unresolved challenges of poverty and high levels of social and economic inequality remain.

Ethiopia is a low income country but has reported economic growth averaging around 11 percent annually since 2003, with the proportion of the population living in poverty falling to around 30 percent from around 45 percent ten years previously. Since 2005 Ethiopia has been implementing the Productive Safety Net Programme (PSNP), which helps chronically poor people to withstand shocks by addressing their short-term consumption needs and protecting their assets from further depletion. Ethiopia has a National Plan of Action for Children accompanied by a series of nutrition, health and education strategies. The country has made great strides in increasing primary

[1] http://www.younglives.org.uk

enrollment through successive Education Sector Development Programmes, although secondary enrollment lags and there are significant challenges regarding the quality of education (Pells and Woodhead 2014).

Andhra Pradesh is the fifth-largest state in India. An estimated one in three people in the state live below the poverty line and have been badly hit by inflation and rising food prices, following the global economic crisis. The government has sought to address these challenges through a series of programmes aimed at improving children's development and tackling high levels of malnutrition. The Right to Education Act was implemented in 2010 and provides free and compulsory education to all children aged six to 14. Its key objectives include monitoring and improving the quality of elementary education; and reducing gaps between social groups and by gender (Pells and Woodhead 2014).

Vietnam has instigated a series of economic reforms, transitioning to a market-orientated economy. Living conditions have steadily improved and the number of people living in poverty has fallen substantially. However, the country was badly affected by the global recession in 2009. Food prices increased and exports went down. There are widening gaps between rich and poor: while the number of people living below the official poverty line continues to decline from 16 percent in 2006 to 11 percent in 2010, almost half of the ethnic minority population are still poor. Over a quarter (28 percent) of Viet Nam's 92 million population is below the age of 18. Enrollment rates at primary school are 97 percent, although boys are more likely than girls to drop out of secondary school early (Pells and Woodhead 2014).

A.1.2 Time Use Pattern

Figure A.1 plots the average weekly time allocation by children. Some notable patterns are evident in figure A.1. First, Indian and Vietnamese children at the age of five spend almost the entire weekly hours on sleep, leisure and school, while their Ethiopian counterparts engage in some domestic work activities. This is mainly due to the rather low enrollment in preschool education in Ethiopia. This gap diminishes starting at age eight when children are enrolled in primary education. Second, the time allocations across alternative activities remain largely unaltered for the older cohort between the ages of 12 and 15. In addition, a similar pattern of time use is witnessed by the younger cohort children at age eight. This is a clear indication that children in all the

study countries start participating in domestic chores and work activities from as early as eight and continue through their adolescent years.

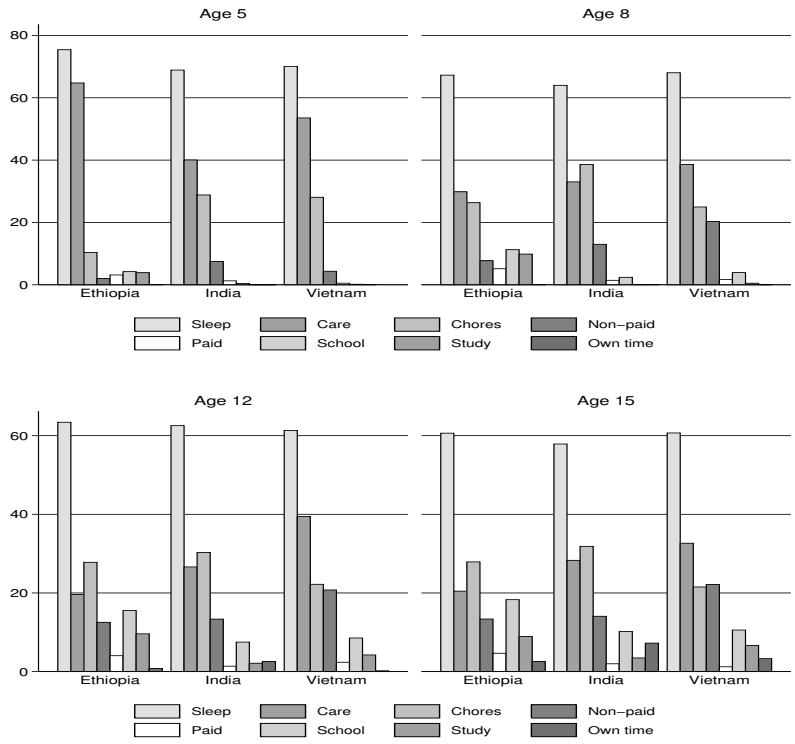

Figure A.1: Weekly Time Allocation, by Age and Country

This pattern is in contrast to what is observed in time diary data from developed countries. Table A.1 illustrates this difference by comparing the major activities reported in the *Young Lives* data with two other time diary surveys from the United States and Australia. Work related activities such as tending to younger siblings or ailing older members of the family, domestic chores, tasks on the family business (farm), and in some instances paid work outside of the house are features of a routine daily activity for a child in a developing country but none are reported as a category in the time diary data from the United States (Child Development Supplement of the Panel Study of Income Dynamics) and Australia (Longitudinal Study of Australian Children).

There is also a clear socioeconomic heterogeneity in the time allocation pattern of both younger and older cohort children. As can be seen from figure A.2, a large amount of heterogeneity is apparent in time allocated to work activities, in which children from poor families spend relatively more hours on work and less on leisure and studying. These differences appear across all the three countries and become more

Table A.1: Comparison of Children's Time Allocation

Young Lives	Australia - LSAC[1]	USA - CDS[2]
Sleep	Sleep	Reading
School	Day Care/School	Homework
Studying (outside of school)	Educational activities	Playing
Leisure	Other Educ. activities	Arts and crafts
Caring for others	General Care (parents)	Sport
Domestic chores	General Care	Attending performances
Tasks on family farm	Media	Attending museums
Paid activities	Social activities	Religious activity

Notes: [1]Longitudinal Study of Australian Children, source (Fiorini and Keane 2014); [2]Child Development Supplement of the Panel Study of Income Dynamics, source (Del Boca, Monfardini, and Nicoletti 2017).

pronounced with age. Young children in Ethiopia spend more time either engaged in domestic chores or on their own. This pattern is more pronounced for poorer households and rural dwellers. One possible reason for this is the short supply of preschool and daycare facilities in the country (Woldehanna et al. 2011).

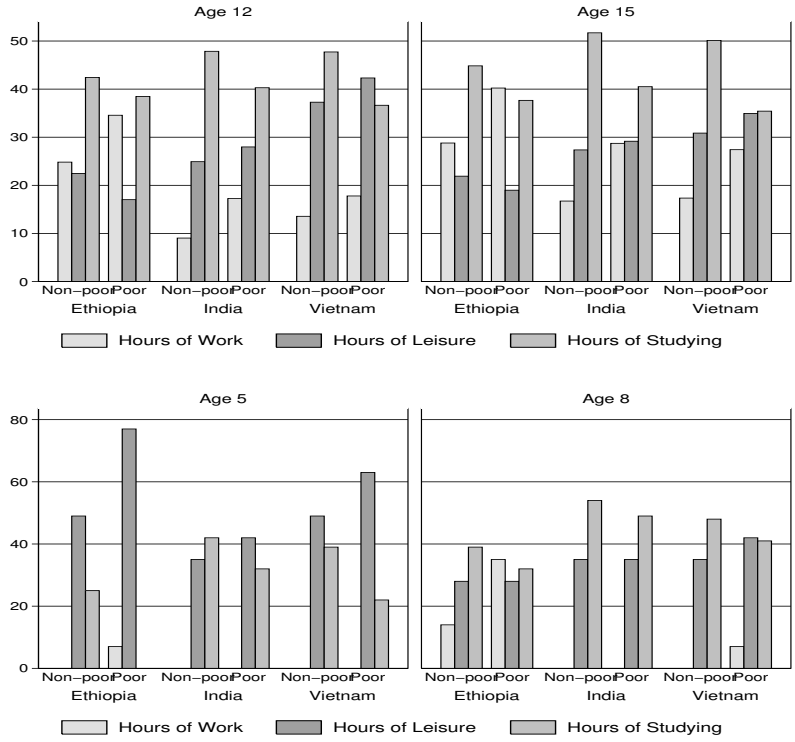

Figure A.2: Weekly Time Allocation, by Wealth Index and Country

Table A.2 reports the difference between the average number of hours in each activity by gender and place of residence. The columns labeled 'Male' depict the difference in average weekly hours of time spent on the specific activity by gender, where a positive magnitude indicates that boys spend more hours on that activity

than girls. Similarly, the columns labeled 'Rural' show the differences between urban and rural children, where a positive difference indicates more hours worked by rural dwellers. Girls spend more time than boys in activities performed at home such as caring for others and household chores (14.6 hours more in Ethiopia, 10.3 more in India, and 4 hours more in Vietnam). On the other hand, boys are busier performing tasks on the family farm (business), spending on average 9.8, 3.7, and 2.4 more hours than girls in Ethiopia, India, and Vietnam respectively. Children residing in urban areas enjoy more leisure, study and school hours than their rural counterparts in all three countries.

Table A.2: Differences in Average Time by Gender and Place

	Ethiopia		India		Vietnam	
	Male	Rural	Male	Rural	Male	Rural
Sleep	-0.16	0.80	0.36	-0.05	3.23***	-1.28
Care	-2.97***	1.34**	-2.39***	0.77	-0.79**	-0.14
Chores	-11.62***	2.50***	-8.01***	3.74***	-2.28***	0.98
Farm/Buisness	12.17***	9.82***	0.25	3.66***	2.42*	7.56***
Paid	1.03	0.38	0.71	2.50	0.41	2.12
School	-2.00**	-5.54***	3.263**	-5.17***	-1.60*	-2.54**
Study	0.83	-3.51***	1.59*	-2.87***	-4.06***	-6.29***
Leisure	3.73***	-3.39***	2.90**	-0.57	3.62***	1.71
N	971		962		921	

Notes: Two sided t test for $H_0 : Difference = 0$; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; "Male" denotes the difference in average weekly hours of time spent on the specific activity by gender, "Rural" shows the difference between urban and rural children.

As one can observe from the numbers in figure A.1, the children in the study sample spent several hours a week performing work activities. There is general agreement that children should not be doing any work that is hazardous to their wellbeing. However, there is less agreement about work that is not deemed problematic. Should children not work at all, or does work in moderation help to develop skills, confidence, and good habits?

Table A.3 provides descriptive evidence on the link between time spent on work activities and children's cognitive and noncognitive outcomes. Though the degree to which children's work interferes with their skill development is not easily readable, the preliminary evidence indicates that work activities are associated with reduced achievement test scores. The table depicts the differences between average test scores of children that spend higher than average time on work activities and those spending a lower than average time. The results show that children working more hours score

lower in all of the achievement tests.

Table A.3: Differences in Average Test Scores by Time Inputs

	Ethiopia		India		Vietnam	
			Older Cohorts			
PPVT	-0.670***	(-10.61)	-0.947***	(-13.86)	-0.616***	(-8.83)
MATH	-0.475***	(-7.35)	-0.978***	(-14.97)	-0.754***	(-11.25)
Self esteem	-0.327***	(-4.99)	-0.171*	(-2.37)	-0.380***	(-5.4)
Self efficacy	-0.283***	(-4.3)	-0.682***	(-9.86)	-0.463***	(-6.63)
Aspiration	-0.266***	(-4.02)	-1.117***	(-17.32)	-0.949***	(-14.6)
Observations	972		963		921	
			Younger Cohorts			
PPVT	-0.789***	(-18.42)	-0.181***	(-3.81)	-0.146**	(-3.01)
MATH	-0.802***	(-18.56)	-0.161***	(-3.4)	-0.101*	(-2.16)
Observations	1875		1899		1824	

Notes: Two sided t test for $H_0 : Difference = 0$; t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; test scores are standardized to have mean 0 and standard deviation 1.

A.2 Ranking of Time Input Coefficients

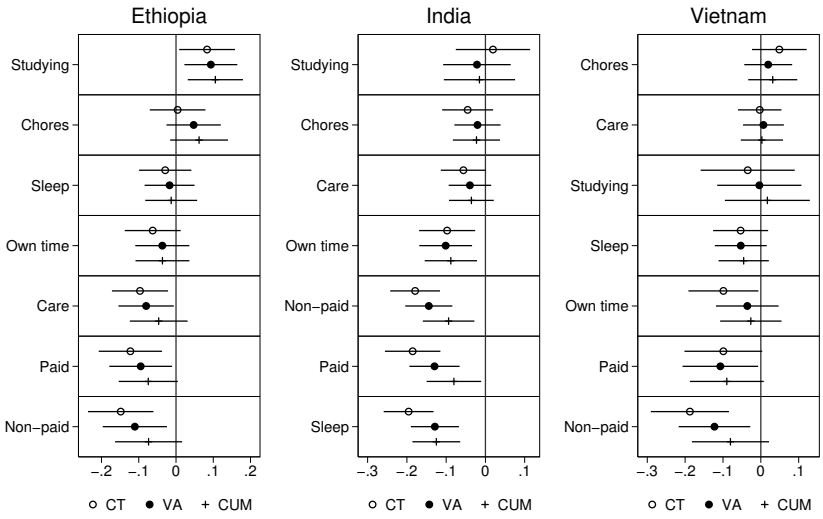

Figure A.3: Ranking of Time Input Coefficients, Older Cohorts: PPVT

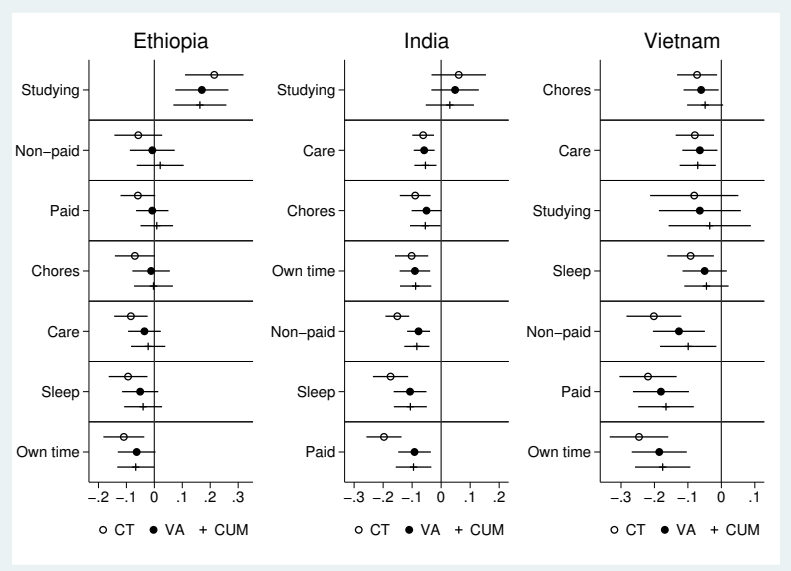

Figure A.4: Ranking of Time Input Coefficients, Older Cohorts: MATH

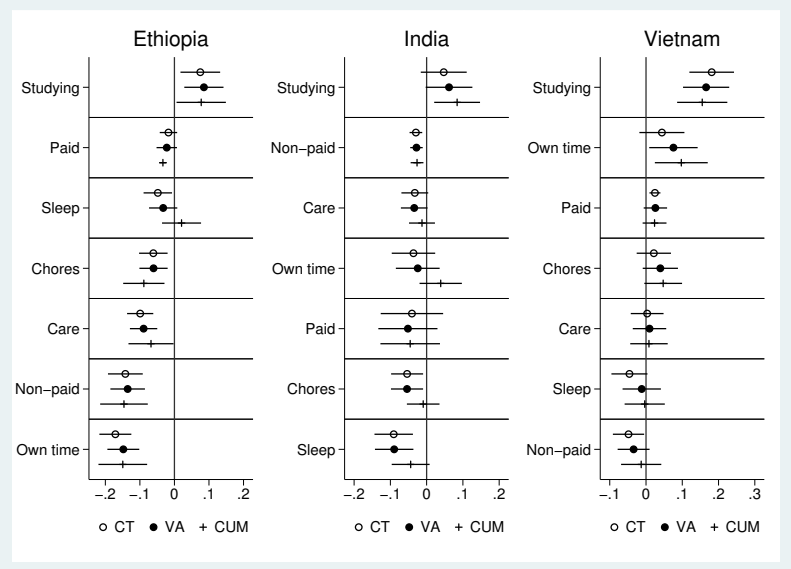

Figure A.5: Ranking of Time Input Coefficients, Younger Cohorts: PPVT

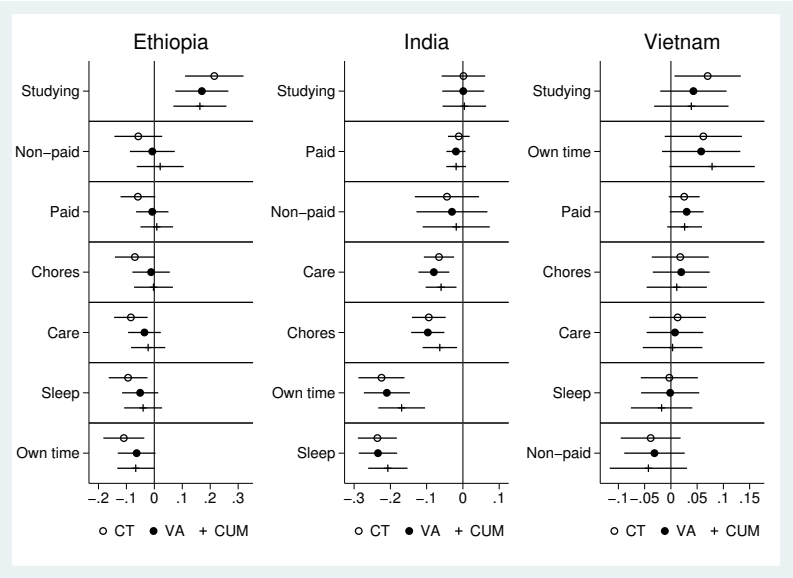

Figure A.6: Ranking of Time Input Coefficients, Younger Cohorts: MATH

A.3 Heterogeneity and Non-linearity Checks

Heterogeneity Check

Table A.4: Cognitive Production Function: Older Cohort, Ethiopia

	Gender		Urbanicity		Wealth	
	Female	Male	Urban	Rural	Poor	Non-poor
Sleep	-0.0435	-0.0184	-0.107*	0.0289	0.0286	-0.0960*
	(0.0524)	(0.0510)	(0.0437)	(0.0543)	(0.0575)	(0.0422)
Care	-0.128*	-0.0230	-0.0801	-0.0749	-0.0442	-0.124*
	(0.0552)	(0.0587)	(0.0430)	(0.0587)	(0.0586)	(0.0483)
Chores	-0.0674	0.0871	-0.0385	0.0258	0.00280	-0.0240
	(0.0496)	(0.0624)	(0.0483)	(0.0625)	(0.0601)	(0.0499)
Non-paid work	-0.0702	-0.165**	-0.398***	-0.0423	-0.0803	-0.250***
	(0.0839)	(0.0564)	(0.114)	(0.0586)	(0.0625)	(0.0669)
Paid work	-0.121	-0.115	-0.158	-0.0826	-0.0745	-0.219*
	(0.0647)	(0.0602)	(0.0925)	(0.0505)	(0.0533)	(0.107)
Study	0.0879	0.0836	-0.0223	0.213**	0.183**	-0.00392
	(0.0558)	(0.0551)	(0.0415)	(0.0687)	(0.0687)	(0.0424)
Own time	-0.0146	-0.0898	-0.116*	-0.0376	-0.0111	-0.130**
	(0.0617)	(0.0493)	(0.0466)	(0.0561)	(0.0597)	(0.0473)
N	390	422	340	472	406	406

Notes: *** p<0.01, ** p<0.05, * p<0.1; robust standard errors in parentheses. Coefficients are standardized to have mean 0 and standard deviation 1. Controls include: gender of child, grandparent present at home, number of siblings, urban dummy, wealth index, height-for-age z-score, lagged test scores, and parental education in years.

Table A.5: Cognitive Production Function: Younger Cohort, Ethiopia

	Gender		Urbanicity		Wealth	
	Female	Male	Urban	Rural	Poor	Non-poor
Sleep	-0.0434	-0.0497	-0.115**	0.0185	0.0132	-0.0976**
	(0.0308)	(0.0292)	(0.0410)	(0.0211)	(0.0252)	(0.0335)
Care	-0.0924***	-0.105**	-0.0783	-0.0649**	-0.0652**	-0.132**
	(0.0263)	(0.0322)	(0.0458)	(0.0203)	(0.0220)	(0.0408)
Chores	-0.0602*	-0.0659*	-0.131**	-0.00262	-0.00128	-0.131***
	(0.0290)	(0.0315)	(0.0500)	(0.0214)	(0.0239)	(0.0370)
Non-paid work	-0.113*	-0.141***	-0.365***	-0.0615*	-0.0806**	-0.251***
	(0.0508)	(0.0318)	(0.0929)	(0.0264)	(0.0300)	(0.0511)
Paid work	0	-0.0159	-0.0399	-0.00420	-0.0144	0
	(.)	(0.0133)	(0.0260)	(0.0135)	(0.0123)	(.)
Study	0.0784	0.0755*	0.0283	0.150***	0.0951*	0.0776
	(0.0490)	(0.0368)	(0.0496)	(0.0336)	(0.0375)	(0.0442)
Own time	-0.157***	-0.184***	-0.261***	-0.105***	-0.117***	-0.237***
	(0.0355)	(0.0321)	(0.0524)	(0.0235)	(0.0279)	(0.0399)
N	773	867	658	982	851	789

Notes: Same as Table A.4 above

Table A.6: Cognitive Production Function: Older Cohort, India

	Gender		Urbanicity		Wealth	
	Female	Male	Urban	Rural	Poor	Non-poor
Sleep	-0.229***	-0.196***	-0.110	-0.203***	-0.138**	-0.245***
	(0.0429)	(0.0494)	(0.0726)	(0.0361)	(0.0471)	(0.0429)
Care	-0.0496	-0.184	-0.00613	-0.0590*	-0.00953	-0.125**
	(0.0293)	(0.121)	(0.126)	(0.0300)	(0.0327)	(0.0478)
Chores	-0.0132	-0.137*	-0.118	-0.0439	-0.0273	-0.0767
	(0.0415)	(0.0575)	(0.0886)	(0.0374)	(0.0449)	(0.0549)
Non-paid work	-0.115**	-0.218***	-0.152***	-0.172***	-0.157***	-0.174***
	(0.0444)	(0.0435)	(0.0440)	(0.0347)	(0.0460)	(0.0402)
Paid work	-0.204***	-0.163**	-0.131	-0.201***	-0.160***	-0.164**
	(0.0527)	(0.0511)	(0.0772)	(0.0396)	(0.0461)	(0.0626)
Study	0.0570	-0.0478	-0.0940	0.0333	0.136	-0.0823
	(0.0670)	(0.0699)	(0.0979)	(0.0548)	(0.0736)	(0.0587)
Own time	-0.0201	-0.238***	-0.199*	-0.0776	-0.0421	-0.170***
	(0.0496)	(0.0507)	(0.0823)	(0.0398)	(0.0495)	(0.0479)
N	429	417	159	683	441	405

Notes: Same as Table A.4 above

Table A.7: Cognitive Production Function: Younger Cohort, India

	Gender		Urbanicity		Wealth	
	Female	Male	Urban	Rural	Poor	Non-poor
Sleep	-0.0445	-0.126**	-0.174**	-0.0681*	-0.0713*	-0.110*
	(0.0354)	(0.0404)	(0.0609)	(0.0304)	(0.0310)	(0.0477)
Care	-0.0369	-0.00789	-0.0516	-0.0145	-0.00617	-0.0473
	(0.0209)	(0.0364)	(0.0618)	(0.0192)	(0.0181)	(0.0456)
Chores	0.000356	-0.115**	-0.0613	-0.0555*	-0.0193	-0.0836*
	(0.0294)	(0.0352)	(0.0537)	(0.0247)	(0.0259)	(0.0396)
Non-paid work	-0.00371	-0.0391***	0	-0.0256**	-0.0216**	-0.0428
	(0.00587)	(0.0117)	(.)	(0.00914)	(0.00800)	(0.0356)
Paid work	-0.0713***	-0.0000358	0.00627	-0.0413	-0.0922***	0.134
	(0.0134)	(0.0687)	(0.0271)	(0.0481)	(0.0211)	(0.0817)
Study	0.104*	0.0178	-0.0366	0.0745*	0.127**	-0.0115
	(0.0434)	(0.0455)	(0.0697)	(0.0372)	(0.0392)	(0.0524)
Own time	0.00327	-0.0505	0.0580	-0.0677*	-0.0238	-0.0354
	(0.0423)	(0.0450)	(0.0741)	(0.0343)	(0.0293)	(0.0666)
N	875	995	471	1386	942	928

Notes: Same as Table A.4 above

Table A.8: Cognitive Production Function: Older Cohort, Vietnam

	Gender		Urbanicity		Wealth	
	Female	Male	Urban	Rural	Poor	Non-poor
Sleep	-0.0487	-0.0664	0.0885	-0.0934*	-0.112	-0.0342
	(0.0551)	(0.0514)	(0.0643)	(0.0435)	(0.0577)	(0.0445)
Care	-0.0229	0.0405	0.0604	-0.0115	-0.00875	-0.0198
	(0.0336)	(0.0605)	(0.0597)	(0.0329)	(0.0518)	(0.0361)
Chores	0.0199	0.0812	0.0819	0.0484	-0.00182	0.0739
	(0.0441)	(0.0616)	(0.0683)	(0.0412)	(0.0567)	(0.0476)
Non-paid work	-0.227**	-0.155*	0.404***	-0.206***	-0.215**	-0.00243
	(0.0833)	(0.0739)	(0.112)	(0.0597)	(0.0731)	(0.0635)
Paid work	-0.132	-0.0748	-0.226**	-0.112	-0.0757	-0.122
	(0.0814)	(0.0708)	(0.0789)	(0.0573)	(0.0695)	(0.0823)
Study	-0.0606	-0.0266	0.252**	-0.0850	-0.150	0.0939
	(0.0809)	(0.101)	(0.0913)	(0.0759)	(0.120)	(0.0685)
Own time	-0.184**	-0.0339	0.0305	-0.107*	-0.143	0.00451
	(0.0661)	(0.0680)	(0.0992)	(0.0532)	(0.0733)	(0.0545)
N	409	387	154	642	349	447

Notes: Same as Table A.4 above

Table A.9: Cognitive Production Function: Younger Cohort, Vietnam

	Gender		Urbanicity		Wealth	
	Female	Male	Urban	Rural	Poor	Non-poor
Sleep	-0.0616	-0.0386	-0.00303	-0.0740**	-0.0306	-0.0720*
	(0.0393)	(0.0328)	(0.0549)	(0.0286)	(0.0338)	(0.0355)
Care	-0.00759	0.0267	-0.172	0.00962	-0.0160	0.0260
	(0.0281)	(0.0428)	(0.0919)	(0.0242)	(0.0241)	(0.0497)
Chores	0.00946	0.0296	0.152	0.00298	-0.0132	0.0694
	(0.0328)	(0.0355)	(0.0933)	(0.0255)	(0.0282)	(0.0406)
Non-paid work	-0.0207	-0.0517*	0	-0.0498*	-0.0528**	0.0617
	(0.0458)	(0.0242)	(.)	(0.0222)	(0.0200)	(0.139)
Paid work	0.0239***	0.0251*	0	0.0236**	0.0281***	-0.0227***
	(0.00413)	(0.0126)	(.)	(0.00826)	(0.00459)	(0.00671)
Study	0.134**	0.217***	0.265***	0.134***	0.113**	0.207***
	(0.0459)	(0.0435)	(0.0692)	(0.0351)	(0.0412)	(0.0421)
Own time	0.0220	0.0573	-0.00328	0.0226	-0.00595	0.0853
	(0.0452)	(0.0444)	(0.0558)	(0.0367)	(0.0358)	(0.0474)
N	777	821	316	1282	727	871

Notes: Same as Table A.4 above

Non-Linearity Check

Table A.10: Cognitive Production Function: Non-linear model

	Ethiopia		India		Vietnam	
	PPVT	MATH	PPVT	MATH	PPVT	MATH
Sleep	-0.00287	-0.0173	-0.116***	-0.0884**	-0.0110	-0.0664
	(0.0388)	(0.0398)	(0.0336)	(0.0313)	(0.0345)	(0.0403)
Care	-0.00142	0.00307	-0.0397	-0.0155	0.00699	-0.110**
	(0.0408)	(0.0411)	(0.0339)	(0.0292)	(0.0265)	(0.0374)
Chores	0.0709	-0.00636	0.0205	-0.0188	0.0716*	-0.0572
	(0.0426)	(0.0483)	(0.0343)	(0.0315)	(0.0359)	(0.0336)
Non-paid	-0.0416	0.0648	-0.0986*	-0.111**	-0.115	-0.104*
	(0.0456)	(0.0506)	(0.0386)	(0.0411)	(0.0704)	(0.0520)
Paid	-0.0521	0.0256	-0.0531	-0.151**	-0.0498	-0.163**
	(0.0426)	(0.0470)	(0.0396)	(0.0474)	(0.0537)	(0.0512)
Study	0.0750*	0.137**	0.00117	0.0312	-0.000962	-0.102
	(0.0362)	(0.0443)	(0.0488)	(0.0422)	(0.0622)	(0.0664)
Leisure	-0.0224	-0.0438	-0.0722*	-0.0863*	-0.0405	-0.193***
	(0.0381)	(0.0386)	(0.0362)	(0.0349)	(0.0502)	(0.0522)
N	784	651	817	833	790	788

Notes: *** p<0.01, ** p<0.05, * p<0.1; robust standard errors in parentheses. Coefficients are standardized to have mean 0 and standard deviation 1. Controls include: gender of child, grandparent present at home, number of siblings, urban dummy, wealth index, height-for-age z-score, and parental education in years.
Dependent variable is natural logarithm of test scores

Chapter 2

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

Liyousew G. Borga[1] and **Myroslav Pidkuyko**[2]

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.

[1]The data used in this study come from Young Lives, a 15-year study of the changing nature of childhood poverty in Ethiopia. Young Lives is funded by UK aid from the Department for International Development (DFID), with co-funding by the Netherlands Ministry of Foreign Affairs and Irish Aid. The views expressed here are those of the authors and not necessarily those of Young Lives, the University of Oxford, DFID or other funders. Myroslav Pidkuyko acknowledges financial support by the Economic and Social Research Council UK [grant number ES/J500094/1]. L. Borga acknowledges financial support from the Charles University Grant Agency - GAUK [grant number 230316].

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2.1 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, Rosenzweig, and Taubman 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, Pollak, and Taubman 1982; Griliches 1979). Other studies have mainly focused on family responses to specific measures of health endowments, such as birth weight (Datar, Kilburn, and Loughran 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 so-

cioeconomic 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 2.2 we summarize

the related literature. Section 2.3 presents the conceptual framework about sibling rivalry and the intrahousehold investment decision. Section 2.4 describes the empirical identification strategy. Section 2.5 describes the survey data used in the analysis, and Section 2.6 presents the main results and discussions as well as robustness tests. Section 2.7 concludes.

2.2 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.[3]

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 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)

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

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, Kilburn, and Loughran 2010; Hsin 2012; Aizer and Cunha 2012; Del Bono, Ermisch, and Francesconi 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, Eberhard, and Neilson 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, Loken, and Neilson 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, Loken, and Neilson (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, Eberhard, and Neilson (2010), on the other hand, find evidence of compensating behaviour for birth cohorts in Chile. Aizer and Cunha (2012) and Datar, Kilburn, and Loughran (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, Edlund, and Palme (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. (2014, 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 2014). 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 2014).

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.

2.3 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, Pollak, and Taubman (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.

2.3.1 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

$$u(c,q) = \frac{c^{1-\lambda}-1}{1-\lambda} + \frac{q^{1-\lambda}-1}{1-\lambda}, \tag{2.1}$$

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

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

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

$$q_i = I_i^{\sigma_1} s_i^{\sigma_2} q_i^0, \tag{2.2}$$

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

$$c + I = y + hp, \tag{2.3}$$

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

2.3.2 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

$$p_i^* = 1 - \frac{\gamma_i Q}{I}, \tag{2.4}$$

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 (2.4) 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.

2.3.3 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

$$\frac{du}{ds_i} = c^{-\lambda} f_i'(-1) + q^{-\lambda} \frac{1}{r} \left(\alpha_1 q_1^r + \ldots \alpha_n q_n^r\right)^{\frac{1}{r}-1} r \alpha_i q_i^{r-1} \frac{dq_i}{ds_i} = 0. \tag{2.5}$$

Consider two children, i and j, for whom equation (2.5) 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

$$\frac{du}{dI} = c^{-\lambda}(-1) + \sum_{i=1}^{n} \frac{dq}{dq_i}\frac{dq_i}{dI_i}\frac{dI_i}{dI} = c^{-\lambda}(-1) + \sum_{i=1}^{n} \frac{dq}{dq_i}\frac{dq_i}{dI_i}p_i = 0. \tag{2.6}$$

In other words, the simplified equation (2.7)

$$c^{-\lambda} = \sum_{i=1}^{n} \frac{dq}{dq_i}\frac{dq_i}{dI_i}p_i \tag{2.7}$$

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 (2.5)) 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).

2.3.4 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 (2.2) 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 (2.5) 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.

2.4 Empirical Strategy

2.4.1 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:

$$I_{if} = \varphi_0 + \varphi_1 SIB_{if} + \alpha_0 X_{if} + \alpha_1 Z_{if} + \varepsilon_{if} \tag{2.8}$$

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:

$$\begin{aligned} I_{if} = \varphi_0 + \varphi_1 SIB_i + \varphi_2 FEM_i + \varphi_3 SIB_i \times FEM_i \\ + AGE_i + AGE_i \times FEM_i + H_i + \varepsilon_i \end{aligned} \tag{2.9}$$

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.

2.4.2 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 3.3 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 3.3 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:

$$I_{if} = \beta_0 + \beta_1 e_{if} + \beta_2 e_{-if} + \alpha_0 X_{if} + \gamma_f + \phi_i + \varepsilon_{if} \tag{2.10}$$

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.

2.4.3 Potential Threats to Identification

Ordinary least squares (OLS) estimation of equation (2.10) 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:

$$\Delta I_{if} = \Delta\beta_1 e_{if} + \Delta\beta_2 e_{-if} + \Delta\alpha_0 X_{if} + \Delta\phi_i + \Delta\varepsilon_{if} \tag{2.11}$$

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:

$$Y_{if}^{k} = \beta_0^k + \beta_1^k Z_{if} + \beta_2^k W_{if} + e_i + \epsilon_{if} \tag{2.12}$$

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.

2.4.4 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.

$$I_{if} = \beta_0 + \beta_1 e_{if} + \beta_2 e_{-if} + \beta_3 e_{if} \times Z_{if} + \beta_4 e_{-if} \times Z_{if} + \alpha_0 X_{if} + \gamma_f + \phi_i + \varepsilon_{if} \tag{2.13}$$

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.

2.5 Data and Measurement

2.5.1 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.[4]

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

[4]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.

Monitoring Survey (WMS) samples show that the data contain a similar range of variation as nationally representative datasets (Barnett et al. 2012; 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. 2012). 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 the first three rounds also concludes that the attrition was highly unlikely to bias research inferences (Barnett et al. 2012).

2.5.2 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.[5] Assignable expenditures include clothes, footwear, school uniform,

[5]The 12 month recall has the disadvantage of recall bias but this is likely to be outweighed by

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 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 B.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.

the advantage of more complete reporting compared to diary-based data collection that only records expenditures over a few weeks.

2.6 Results and Discussion

2.6.1 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 3.3 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 2.1 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 2.1 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 2.1: 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 3.3 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 2.1 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.

2.6.2 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 2.4.3, 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 2.12 for each measures of endowment and report the coefficients in Table B.3. In subsequent discussions we refer to the predicted residual measure as residual endowment.

Table 2.2: 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)
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)
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 2.2 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 2.2, 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.

Table 2.3: 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)
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 $\geq$ 5 different food groups eaten in the last 24 hours. Standard errors clustered at community level in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Estimation results of parental investment in health inputs are reported in Table 2.3. 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 2.4 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 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.

Table 2.4: 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. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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

Table 2.5: 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 B.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.

2.7 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. 2014).

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.

Appendix B

Table B.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
Had serious illness/injury at age 1	0.30	0.46
Had serious illness/injury at age 5	0.21	0.41
Longterm health problem	0.10	0.30
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
Immunised against measles[d]	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

[d] The last completed vaccine a child received

Table B.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 B.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.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Chapter 3

Children of the Empowered: Intrahousehold Bargaining and Resource Allocation

Liyousew G. Borga[1]

Abstract This study examines the causal effects of an exogenous change in family policy in Ethiopia on women's empowerment and allocation of resources towards child health. Empowerment is formalized as an unobserved latent variable. Exploiting the time and regional variation in the implementation of the law, the study finds that the policy change enables women to acquire more education and decision making power as well as increasing their influence on family planning and assertiveness against domestic violence. In addition, more decision power in the hands of women is found to positively impact investments into the health and nutrition of children. Contrary to the predictions of the traditional unitary household model, the findings suggest that "distribution factors" that do not enter individual preferences may affect outcomes for individuals and emphasize the role of intrahousehold heterogeneity. The results are robust to a battery of validity and specification checks.

[1]I wish to thank Patrick Gaule, Stapan Jurajda, Randy Filer, and seminar participants at CERGE-EI and SAEe-2016 in Bilbao for their helpful comments. All remaining errors are mine. Email: lborga@cerge-ei.cz

3.1 Introduction

Studies have shown that women's empowerment is closely linked to positive outcomes for families and societies (Duflo 2012). Key development outcomes depend on women's autonomy and their command over favorable intrahousehold allocations of resources (Doss 2013). The intrahousehold resource allocation literature also suggests that resources in the hands of women have a larger positive impact on outcomes for children (Duflo 2003; Pitt et al. 2003; Imai et al. 2014). Maternal disadvantage, on the contrary, has a substantial adverse effect on infant health, which in turn affects long term outcomes (Aizer and Currie 2014). In addition, women's bargaining power may also affect household production and labor supply decisions (Hallward-Driemeier and Gajigo 2015). While intuitively plausible, it has been difficult from a policy perspective to clearly identify which levers to pull to increase women's bargaining power and achieve better outcomes.

The dynamics behind decision-making within the household has been a focus of both the theoretical and empirical literature over the past few decades. Household economic theory has traditionally treated the household as the appropriate unit of decision-making, in which family members behave as though they maximize a unique utility function subject to a common budget constraint (Becker 1973). Subsequent theoretical work developed bargaining models in which individual members of the family derive utility from their own consumption of commodities and public goods; and the decision making process is seen as a cooperative negotiation (Manser and Brown 1980; McElroy and Horney 1981; McElroy 1990; Chiappori 1992; Browning and Chiappori 1998). Bargaining is affected by an outside option or the extra-household environmental parameters (EEPs) such as marriage laws, gender ratio, and even religion and customs (McElroy and Horney 1981; McElroy 1990).

This paper studies how pro-female legislation (that exogenously strengthened the rights of women and their access to services) affects household bargaining and resource allocation. The primary goal of the present study is not to simply test the predictive success of a particular model of household decision making, but rather to provide empirical evidence from Ethiopia on the effect of the *Revised Family Code* on improving women's autonomy and whether there is a causal relationship between maternal empowerment and improved child health. The hypothesis is that the change in the institutional environment induces a redistribution of bargaining power within

households, which in turn leads to changes in the allocation of time and resources including investment into the human capital of children. Utilizing the different regional timing of the implementation of the *Revised Family Code*, the effect of the law is measured clear from other underlying trends.

The extant empirical literature on female empowerment is limited by two major challenges: measuring the increasingly sophisticated and nuanced conceptualization of empowerment, and finding an exogenous empirical counterpart to empowerment. Despite the strong and growing interest in the issue, there are no robust indicators for measuring power and decision-making within households. Female empowerment is generally assessed by a woman's ability to make household decisions relative to her husband's ability to do so. Since this ability is fundamentally unobservable, indicators that are correlated with high female autonomy such as education, contraceptive use, physical mobility, economic security, and asset-ownership are considered as proxies in most empirical studies. In their study of the relationship between various indicators of power and reproductive behaviors, Beegle, Frankenberg, and Thomas (2001) conclude that women's bargaining power is not adequately summarized by a single indicator but spans multiple aspects of a couple's life.

This paper contributes to the related literature first by treating *empowerment* as an unobserved latent variable. We follow the approach of Pitt, Khandker, and Cartwright (2006) and model empowerment by fitting a factor analysis model to compute latent scores which are then used as dependent variables in the second part of the analysis. This approach allows us to construct a non arbitrary measure from a host of indicators that summarize access to resources, labour market outcomes, time-use, and subjective measures.

Second, we exploit a variation provided by institutional change that serves as an exogenous redistribution of bargaining power within households in favor of women. We use a difference-in-difference estimation technique to evaluate the effect of the reform and its subsequent implications for child health. We verify the robustness of the results by using a panel of enumeration areas that are matched into adjacent pairs that straddle regional boundaries. This research design addresses concerns about omitted variables, which vary smoothly across regional boundaries.

Importantly, the empirical evidence presented here is from a socially, culturally and economically diverse country. Ethiopia is home to a complex variety of nationalities, peoples, and linguistic groups. Women and girls in Ethiopia are strongly

disadvantaged. Early marriage and childbearing, a high value placed on large families, female genital mutilation, gender based violence and forced marriage are some of the harmful traditional practices experienced by girls and women across different ethnic and religious groups. Since attitudes towards women are usually deeply rooted in the culture, ex-ante, it is not obvious that changing the family law can have a meaningful impact on women's empowerment.

We find evidence against the predictions of the unitary household model, as changes in bargaining power induced by external factors imply changes in household outcomes. The results suggest that the revised family code has a positive and significant effect in increasing the empowerment indicators of women. The reform has increased the "education", "decision making role in the household", and "probability of women working in professional occupational categories". The legal change has also improved women's attitudes regarding domestic violence and their knowledge of and access to family planning services. The results also show that the reform has only a limited impact on child health.

The remainder of the paper is organized as follows. A brief literature review is presented in section 3.2 followed by an outline of the theoretical framework of the study in section 3.3. Section 3.4 describes the institutional background. The data used and the empirical strategy employed are described in section 3.5 and the main results are presented in 3.6.

3.2 Literature Review

Empirical work on intrahousehold issues focuses on two major areas of study: testing household models and the efficiency of household allocations; and understanding and explicitly analyzing intrahousehold bargaining.[2] Research into the role of government policies pertaining to marriage in shaping household resource allocation, however, is quite limited and narrowly focused on divorce laws in developed countries. This section briefly reviews three main strands of the economic literature on household behavior and intrahousehold allocation. The first strand relates to the dynamics behind decision-making within the household, with particular emphasis on changes associated with laws or programs. The second dimension pertains to the definitions

[2]See Doss (2013) for a complete review of the intrahousehold literature

and measurement of women's empowerment or relative bargaining power. The third, and more empirical question deals with how women's empowerment or relative bargaining power affects child health and nutritional status.

3.2.1 Theoretical Models of the Household

Early research in economics models the household as maximizing a single, well defined utility function subject to a household budget constraint (Becker 1981). This *unitary model* assumes that the household makes decisions as one individual. All income is pooled, and there is no bargaining. Due to the pooled budget constraint, the empirical prediction of the model is that if total income is held constant, a change in the sources of income would have no effect on demands. Similarly, a marginal increase in one source of income has the exact same effect on demands as a marginal increase in any other source of income. Subsequent research shows that this model suffers from two fundamental weaknesses. First, the conditions required for the existence of such behavior within the household are quite restrictive. Second, because it does not show transactions between individuals, it is of no use for studying issues such as intrahousehold inequality and household formation or dissolution (Dauphin 2001). There is also a considerable empirical evidence refuting the unitary household model (Alderman et al. 1995; Lundberg, Pollak, and Wales 1997; Quisumbing and Maluccio 2003).

New game theoretical models have been developed in which household members bargain over decisions. This *non-unitary model* framework consists of collective models, cooperative bargaining models, and noncooperative bargaining models. The collective model hypothesizes that each member of the household has his/her own preferences and the decisions made are Pareto-efficient. In the bargaining models, the two bargaining individuals derive their individual utility from their own consumption of commodities and public goods. The bargaining process is affected by an outside option (threat point) or extra-household environmental parameters. The individual's outside option is the welfare that he or she would receive if he or she were not a member of the household.

Lundberg and Pollak (1993) develop the "separate spheres" model in which the threat point is a non-cooperative equilibrium with the household. They show that shifts in intrahousehold allocation can be caused by simply making cash transfers

(i.e. for child allowances) to a mother instead of to a father, which can imply different equilibrium distributions. The threat point is, therefore, generalized as a function of "distribution factors", variables that affect the household members' bargaining position but not preferences or the joint budget set. The components of this function could include divorce laws, the gender ratio in the marriage market and other social factors (Chiappori, Fortin, and Lacroix 2002).

Several studies have examined the effects of changes in divorce law and alimony rights on families and intrahousehold allocation. Using a bargaining model and taking advantage of an exogenous change in state divorce laws in the United States, Gray (1998) analyzes the response of women's labor supply to unilateral divorce laws. Stevenson and Wolfers (2006) exploit the same variation in the timing of divorce law reforms across the U.S. to evaluate how unilateral divorce changed family violence and rate of suicide and spousal homicide. Rangel (2006) shows that an exogenous policy change extending alimony rights and obligations to cohabitating couples in Brazil increased the bargaining power of cohabitating women and increased investments in the education of their children. Martinez (2013) finds that a law change that increased child support rights for children of nonmarried couples in Chile decreased the probability and actual hours of work for men, while increasing the probability of school attendance for children. Brassiolo (2016) studies a major and unexpected reduction in divorce costs in Spain to estimate the causal effects on domestic violence and finds a decline in spousal conflict as a consequence of the reform.

3.2.2 Measuring Women's Empowerment

The concept of women's empowerment is a multidimensional notion with disagreements about its definition and measurement. Unlike many other indicators of human behavior, women's empowerment is not directly measurable. The way in which different dimensions of empowerment relate to each other has also become increasingly intricate. The large number of empowerment indicators collected in most household surveys suggests that women's empowerment is a multifaceted issue. In addition to empowerment, the concept of bargaining power has increasingly received attention in the intrahousehold resource allocation literature. Given that the empirical specifications for women's empowerment and those for relative bargaining power overlap significantly, these two terms are used in this paper interchangeably.

Early empirical works focused on shares of income as a proxy for relative power. The argument is that if women control the money that they earn, then they may have the ability to directly influence household decisions. In a cooperative bargaining framework, even the potential to earn money increases women's outside options and gives them more bargaining power (Doss 2013). However, since income (whether employment or transfer income) is generally an endogenous variable, establishing a causal relationship between women's bargaining power and measured outcomes proves difficult. Other measures that serve as good proxies for bargaining power in the literature include women's labor-force participation (Jensen 2012), the ownership of and control over assets (Friedemann-Sánchez 2006), education (Thomas 1994), and women's own perceptions of appropriate social norms (Anderson and Eswaran 2009; Agarwal 1997).

Recent literature tries to exploit some "natural experiments" where a change in policy or some factor outside of the control of the household or community is used as an experiment to reveal the impact of the intervention on outcomes. [3]

3.2.3 Women's Empowerment and Child Outcomes

A growing body of literature argues that women are more likely than men to invest in household goods such as on small livestock, improved nutrition, children's education, and clothing (Quisumbing and Maluccio 2003; Rubalcava, Teruel, and Thomas 2009; Schady and Rosero 2008). Given women's role as primary caregivers of children, particularly in underprivileged communities and in developing countries, it is reasonable to assume that their empowerment would influence the their children's outcomes. Previous studies that have examined the relationship between women's empowerment on children's health status have found that women's bargaining power affects the intrahousehold resource allocation pattern supporting children's health and development (Zereyesus et al. 2015; Imai et al. 2014; Fafchamps, Kebede, and Quisumbing 2009).

Even though, it appears that women's autonomy is positively related to improved child health and nutritional outcomes, the evidence in most cases could potentially suffer from biases stemming from the fact that more autonomous women differ from

[3]For instance, Rangel (2006) considers a change in marriage law in Brazil; Roy (2015) evaluates a change in inheritance law in India; while Duflo (2003) considers changes in sources of income that are outside of the control of household decision making.

less empowered women in ways that are not always quantifiable (Duflo 2012; Imai et al. 2014).

3.3 Theoretical Framework

This section motivates the empirical strategy outlined in section 3.5, by summarizing the key insights from the marriage market and bargaining models. Consider a household that consists of a wife, w, a husband, h; and a certain number of children, k, who are considered to be "a public good" by both parents. We assume parents care about the quality of children (i.e. children are not decision-makers). Let $\mathbf{x}$ represent the consumption vector (including leisure), and x_j be the j^{th} person's consumption, $(j = w, h)$, and q be the quality of children (health status or education level of children). Let $\mathbf{z}$ and ε denote vectors of observed and unobserved characteristics of the household, respectively. The j^{th} person's utility is given by $U_j(x_j, q; \mathbf{z}, \varepsilon)$. q is determined by children's quality production function, $q = Q(\mathbf{x}, \mathbf{z}, \varepsilon)$, which summarizes an implicit relationship between child outcomes and inputs into child quality.

The household's objective function is given by:

$$\max_{x_w, x_h, q} U^H = \lambda U_w(x_w, q; \mathbf{z}, \varepsilon) + (1 - \lambda) U_h(x_h, q; \mathbf{z}, \varepsilon) \tag{3.1}$$

where $\lambda \in (0, 1)$ represents the "bargaining power" of the wife in the household.[4] The higher her bargaining power, the greater the weight her utility function carries in the household's maximization problem. It is recognized in this model that λ may in turn, depend on other variables. If, for instance, the wage rate for female workers rises, λ may rise. If the wife brings a lot of inherited wealth into the household, λ could be higher (Basu 2006). The value of λ may also depend on "distribution factors" – a set of factors influencing the weight each individual receives in the household welfare function.

The household maximizes its objective function subject to its time $(\bar{L})$ and budget constraints. Let w be the market wage, Y represents the aggregated non-labor income,

[4]Equation 3.1 is equivalent to the unitary model household utility function $U = U(x, q; \mathbf{z}, \varepsilon)$ when one individual is the dictator (i.e., λ is 0 or 1) or when the couple have identical preferences, $U_h = U_w$. Solving this household maximization problem yields demand functions that depend only on prices and total income, i.e., $x_i = f^i(p^h, p^w, Y)$ for $i = h, w$.

and $\mathbf{p}$ the vector of prices ($\mathbf{p} = (p; w^w; w^h)$); the household's constraint becomes:

$$\mathbf{px} = (w^w + w^h)\bar{L} + Y \tag{3.2}$$

The maximization of the household utility function subject to the budget constraint gives (household) market demand functions:

$$\mathbf{x} = X(\lambda; \mathbf{p}, \mathbf{z}, \varepsilon) \tag{3.3}$$

By the same token, the optimal q^* (health quality of the child) depends on parameters such as x, λ, p and Y (i.e., $q^* = q^*(\lambda, Y, \mathbf{p}, \mathbf{z})$).

This general (non-unitary) characterization treats household decisions as the outcome of interactions and negotiations. The "bargaining power", λ, may reflect women's empowerment represented by female education and labor force participation.[5] Family policies influencing the economic status of individuals also affect the allocation of resources of households via bargaining power. Assuming that the mother is more likely than the father to value q, a stronger bargaining power of the mother (i.e. the higher λ) leads to a better health and nutritional outcomes.

3.4 Institutional Background

Situated in the Horn of Africa, Ethiopia is at the crossroads between the Middle East and Africa. Thus, throughout its long history, Ethiopia has been a melting pot of diverse customs and cultures. Today, it embraces a complex variety of nationalities, peoples, and linguistic groups. At present, Ethiopia is administratively structured into nine regional states – Tigray, Affar, Amhara, Oromiya, Somali, Benishangul Gumuz, Southern Nations Nationalities and Peoples (SNNP), Gambela, and Harari – and two city administrations, Addis Ababa and Dire Dawa Administration Councils.

In Ethiopia, 80 percent of the population resides in rural areas and women provide the majority of the agriculture labor in these communities. Although they represent 49.8 percent of the population and contribute mainly to food production and other economic activities, they have not shared the fruits of development equally with their male counterparts. Women's access to resources and community participation are usu-

[5] Basu (2006) treats λ as an endogenous variable in a collective bargaining model, arguing that λ may be affected by changes in the household's choice of $\mathbf{x}$.

ally mediated through men, either their fathers or husbands. Rights such as access to land, credit and other productive resources are difficult for women to attain. They also experience multiple forms of other deprivations such as longer working days, women specific ill health, low levels of education relative to men, and lack of adequate representation in leadership and decision making positions. According to the Ethiopian Demographic and Health Survey, in 2011 almost a quarter of Ethiopian women do not make decisions on most individual and family issues. Traditional attitudes, beliefs and practices that reinforce harmful gender roles contribute to constrain women's participation in social development. Early marriage and childbearing, female genital mutilation and gender-based violence, forced marriage, wife inheritance, and a high value placed on large families all impose huge negative impacts on Ethiopian women. Although the primary school enrollment rate of girls in Ethiopia has become almost universal in the last decade, the majority remain unable to transition to secondary and tertiary school due to distance, personal security and economic challenges (CSA 2011).

Women and girls in Ethiopia are strongly disadvantaged compared to boys and men in several areas. Manifestations of discrimination against women are numerous and acute: The morbidity rate of 75.5 percent for women, against 25.5 percent for men; the maternal mortality of 590/100,000 live births; and adult HIV prevalence of 1.9 percent for women, against 1.0 percent for men, are indicators of persisting gender inequalities in the area of health and life expectancy (CSA 2011). The 2005 National Labor Force Survey reveals that women represent 47 percent of the labor force in Ethiopia, with highly unequal participation: 68.5 percent of employed women were unpaid family workers and 24.8 percent were self-employed in informal jobs (CSA 2005).

The Revised Family Code (2000)

The 1960 Civil Code of Ethiopia, which encompasses most areas of the civil law, was the first modern and comprehensive legal instrument. The Civil Code maintained the age-old tradition of dispute settlement by personal arbitrators, normally older men within the family or community selected by the disputants. These arbitrators, unfamiliar with or unsympathetic to the new laws, continued to apply old customary laws that are mostly unfavorable to women (Kumar and Quisumbing 2012). Under the civil code, fault was taken into account in determining the allocation of property in

divorce. Thus, the innocent spouse could be awarded more than half (or even all of) the marital property. While the Civil Code gave women equal rights to property acquired during marriage, it also gave the head of the household the power to administer the property upon divorce. In a predominantly patriarchal society in which almost all household heads are men, the Civil Code ensured that women did not fully realize their rights (Hallward-Driemeier and Gajigo 2015).

In July 2000, the Revised Family Code (RFC) was passed, updating the 1960 Family Code. This new Code gives equal rights to spouses during the conclusion, duration, and dissolution of marriage. It also requires equal division of all assets between the husband and wife upon divorce. Under the RFC, the old civic code has been replaced by no-fault divorce. The new law covers most areas of family relations, such as marriage, divorce, inheritance, paternity, adoption and child welfare. The role of family arbitrators has also changed significantly. The position of women in marriage has been significantly improved under the new legislation. Among the key amendments made in the RFC, i) women were given the authority to administer common marital property, ii) a spouse could no longer deny permission for the other to work outside the home, iii) more authority has been given to courts to settle disputes arising in cases of divorce and inheritance (replacing the biased family arbitrators), iv) the legal marriage age was raised from 15 to 18 years.[6]

Although this reform now applies nationally, there was some regional variation in implementation because the Ethiopian Federal Constitution gives full sovereignty to regional states. Between 2000 and 2005, Amhara, Oromiya, and Tigray regions (out of nine regions in Ethiopia) as well as the two city administrations (Addis Ababa and Dire Dawa) implemented the code. Afar, Benishangul Gumuz, Gambella, Harari and Southern Nations Nationalities and Peoples (SNNP) regions implemented the law late. As of 2011, all regions now apply the RFC (Hallward-Driemeier and Gajigo 2015; Kumar and Quisumbing 2012).

[6]Federal *Negarit Gazetta* Extra Ordinary Issue No. 1/2000: The Revised Family Code Proclamation No. 213/2000

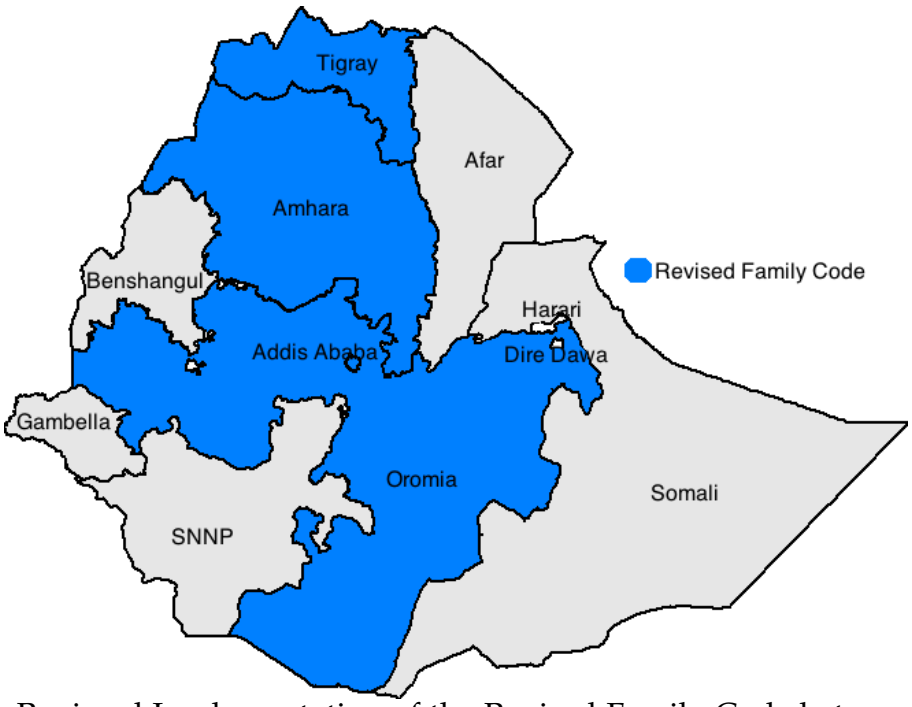

Figure 3.1: Regional Implementation of the Revised Family Code between 2000 and 2005

3.5 Empirical Strategy

3.5.1 Data

The data used in this paper are from three rounds of the Ethiopian Demographic and Health Surveys (DHS) which are nationally representative surveys of reproductive aged women, conducted in 2000, 2005 and 2011. The DHS covers a wide range of topics including household and respondent characteristics, women's decision making power, education and employment. The surveys covered 15,367, 14,070, and 16,515 women (15-49 years old) in 2000, 2005 and 2011 respectively.[7] The individual women's dataset provides information on demographic characteristics such as birth date, ethnicity, religion, location, marital status, education attainment, wealth and autonomy in household decision making.

The nutritional and health status of children is measured as Z scores of height-for-age (stunting), weight-for-age (underweight) and weight-for-height for children under age five. These measures are standardized by developing the Z-score, Z_{ij}, for each child,

[7]The household and individual response rates for the DHS surveys are quite high. For instance, in the 2011 round, the household response rate was 98 percent. In the interviewed households, the response rate of eligible women for individual interview was 95 percent.

j, in the sample and each anthropometric indicator, i, such that $Z_{ij} = (V_{ij} - V_{Mi})/\sigma_{Mi}$; where V_{ij} is the observed value for the i^{th} indicator of the j^{th} child, and V_{Mi} and σ_{Mi} are the median and the standard deviation of the i^{th} indicator in the reference population (WHO 2006). When Z_{ij} for any child is more than 2 standard deviations below V_{Mi}, then that child is considered stunted (for i equals height-for-age) or wasted (for i equals weight-for-height).

Table 3.1 presents the summary statistics. In 2011, the average years of education attained by women in the sample was 3.3 years. On average, age at first marriage was 16.7; and 57 percent of women were married and gave birth to an average 2.8 children. The average height-for-age (weight-for-age) z-score of the sample children (49 percent of whom are female) is 1.6 (1.4) standard deviations below the reference population.

Table 3.1: Desciptive Statistics

	2000	2005	2011
Current age	28.13	27.90	27.70
	(9.639)	(9.445)	(9.220)
Education in single years	1.977	2.639	3.286
	(3.640)	(4.080)	(4.361)
Total children ever born	2.875	2.834	2.757
	(3.065)	(2.990)	(2.970)
Age at first marriage	16.17	16.28	16.65
	(3.495)	(3.847)	(3.917)
Married	0.599	0.600	0.574
	(0.490)	(0.490)	(0.495)
Knows no contraceptive method	0.205	0.177	0.0534
	(0.403)	(0.382)	(0.225)
Using modern contraceptive method	0.0689	0.109	0.169
	(0.253)	(0.312)	(0.375)
Currently working	0.555	0.308	0.343
	(0.497)	(0.462)	(0.475)
Current age of child	2.012	1.994	2.029
	(1.414)	(1.434)	(1.430)
Height-for-age Z-score	-2.048	-1.723	-1.595
	(1.734)	(1.972)	(1.808)
Weight-for-age Z-score	-1.695	-1.380	-1.362
	(1.355)	(1.502)	(1.330)
Child is female	0.491	0.490	0.486
	(0.500)	(0.500)	(0.500)

Notes: S.D in parentheses

3.5.2 Measuring Empowerment

Women's empowerment is a multi-dimensional concept that poses many challenges in conceptualization and measurement (Duflo 2012; Kabeer 1999). The literature

contains a range of terms, concepts and data that may be relevant for assessing empowerment. Concepts such as “autonomy", “agency", “bargaining power", and “gender equality" have all been interchangeably used in the literature to define and measure empowerment. There are, however, some key overlapping terms that are most often included when defining empowerment: options, choice, control, and power. These terms refer to women’s ability to make decisions and affect outcomes of importance to themselves and their families.[8]

Women’s empowerment is not directly measurable. The behaviors and attributes that signify empowerment are often context specific. Empirical investigations of women’s empowerment have employed a wide range of indicators to capture its multidimensionality. The two most often used indicators in the empirical literature are those measuring domestic decision-making, and those measuring either access to, or control over resources. Studies have also employed “exogenous" measures that influence household bargaining power such as assets at marriage, inheritance or divorce laws, and non-labor income (Malhotra et al. 2005).

In the present paper, empowerment is considered a latent variable since it is not directly observable and is most appropriately measured through multiple observable indicators. This approach has several advantages over simple summation of indicators that assigns an arbitrary or equal weight to each component. Latent variable models attempt to explain complex relations between several variables by simple relations between the variables and an underlying unobservable, i.e. latent structure. Formally, we have a collection $X = (X_1, \ldots, X_p)$ of observable manifest variables and a collection $Y = (Y_1, \ldots, Y_q)$ of latent variables which are unobservable and which "explain" the dependence relationships between the manifest variables. For our index of women’s empowerment, we used over 25 manifest variables reflecting five key dimensions of women’s autonomy: education, fertility choice, attitude towards violence, employment, and decision making power.

- **Education:** educational attainment, literacy and access to information
- **Fertility:** (lack of) knowledge and access to family planning
- **Violence:** whether the woman believes it is ever justified for a husband to beat

[8]See Malhotra et al. (2005) for a comprehensive review of the major strands of theoretical, methodological and empirical literature on empowerment from the fields of economics, sociology, anthropology, and demography.

her

- **Occupation:** employment in professional/ technical/ management occupational categories
- **Decision:** autonomy of the wife's decision-making
- **Empowerment:** general empowerment encompassing all of the thematic groups

Based on the idea that unobserved latent variables account for the dependencies among the observed indicators, a latent variable model is estimated by first measuring latent variables through observed indicators (i.e. measurement model). A factor analysis model is then fitted to compute latent scores (factor scores). Standard methods of performing factor analysis assume that the variables are continuous and follow a multivariate normal distribution. Since most of the indicator variables used in the present study are dichotomous or ordinal, the factor analysis is performed using a polychoric correlation matrix. The "empowerment" factor, however, is estimated from continuous factor analysis over the five (continuous) different types of latent empowerment factors itemized. The resulting correlation matrix is reported in table 3.2. Almost all of the elements are statistically significant with signs conforming to our prior hypothesis. Education, occupation, decision making autonomy and the composite empowerment index are all positively correlated with each other and negatively correlated with attitudes towards violence and fertility which are negatively coded.

Table 3.2: Correlation Matrix of Latent Empowerment Factors

	Education	Violence	Fertility	Occupation	Decision	Empowerment
Education	1					
Violence	-0.246***	1				
Fertility	-0.281***	0.166***	1			
Occupation	0.287***	-0.0998***	-0.160***	1		
Decision	0.100***	-0.0473***	-0.163***	-0.0488***	1	
Empowerment	0.701***	-0.341***	-0.399***	0.695***	0.0230	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

3.5.3 Identification Strategy

To study the effects of the revised law on maternal employment, the paper utilizes a difference-in-differences (DD) approach that exploits the temporal and spatial variation

in the roll out of the reform. The identification strategy is essentially based on the reform in family law which constitutes a natural experiment to identify the causal effect of an improved legal environment on women's empowerment. The main identifying assumption of the model is that, in the absence of the reform, the average unobserved characteristics of early implementing and late implementing regions would change over time in the same way. The difference-in-differences approach also requires that there is no selection into implementing regions, and there are no other changes in family laws in Ethiopia around the time of the reform.

The model estimates the impact of the policy change on a variable of interest by comparing the change in that variable for regions that implemented the law early (Treated) to the same change in regions that implemented late (Control). The following is the basic individual-level equation for this analysis:

$$Y_{it} = \beta_0 + \beta_1 Treated_i + \beta_2 Post_t + \delta Treated_i * Post_t + \alpha X_{it} + \epsilon_{it} \tag{3.4}$$

where i indexes women, and t indexes period. $Post = 1$ if the observation is from the period after the reform, and $Treated = 1$ if the woman lives in the treated region. X denotes a set of controls.

We also followed the approach of Dube, Lester, and Reich (2010) and make comparisons among local enumeration areas that are contiguous and similar, except for having implemented the reform at different times. Using the spatial data available in the DHS survey, we are able to perform this analysis on matched adjacent cluster-pairs that lie on regional boundaries. This strategy allows us to control for time-varying shocks shared by a pair of contiguous areas.

3.5.4 Validity Checks

The difference-in-differences method accounts for unobserved differences between women in different years as well as between women from treatment and comparison regions in the same year. The identifying assumption is that the trend in key indicators of women's empowerment in the years preceding the reform would have been the same in the treatment regions as in the comparison regions, in the absence of the revised family code. Under this assumption, the parameter of interest δ gives the average causal effect of the reform on women residing in the treatment area in the

post-reform period, compared to the control regions.

One potential threat to the validity of the identifying assumption comes from aggregate shocks that have a differential impact across treatment and control groups. Although the key assumption of parallel trends between the treatment and control group cannot be tested directly, there are different ways to examine its validity.

We consider a number of validity checks to verify the identifying assumption of the DD approach. First, we verify that the selection of regions into those that implemented the reform earlier and those that implemented it later is not driven by the outcomes of interest. As table 3.3 below shows, the differences in the means of key variables across early and late reforming areas are not statistically different.

Table 3.3: Difference of Pre-Reform Means Across Key Variables

	Difference	
Current age of respondents	0.373	(0.426)
Education in single years	-1.334	(1.162)
Total children ever born	0.422	(0.400)
Age of respondent at 1^{st} birth	-0.019	(0.425)
Age at first marriage	0.245	(0.797)
Partner's age	-1.645	(0.744)
Respondent not working	0.107	(0.065)
Married	0.128	(0.071)
Using modern family planning method	-0.031	(0.028)

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Second, we check if there is a clear difference in the trends in education, marital age and attitudes towards domestic violence between the early implementing regions and the later implementing areas. The treatment regions implemented the law change between 2000 and 2005, while the control regions implemented the law between 2005 and 2011. Ideally, there would be data showing the trends several years before the law change, but since we only have one data point prior to the reform, the focus will therefore be on the slopes when both groups are under the same conditions; and across different age cohorts between the two groups.

As can be seen in figure 3.2, the educational attainment of women across age cohorts between the early implementing and later implementing areas are similar prior to the reform taking effect. Age at first marriage also has the same trend by age cohorts in both treatment and control regions. Figure 3.3 depicts the trend in average years of education, age at first marriage and attitude towards domestic violence on data gathered at three points of time, connected by a linear line. The plots show

that the slope for the implementing regions between 2000 and 2005 is similar to the slope in the non-implementing regions between 2005 and 2011. This shows that the effect is similar when the law is introduced. An interesting pattern observed from the figure is that the mean age at first marriage is lower in the implementing regions than in the non-implementing regions, while average years of education is higher in the implementing regions.

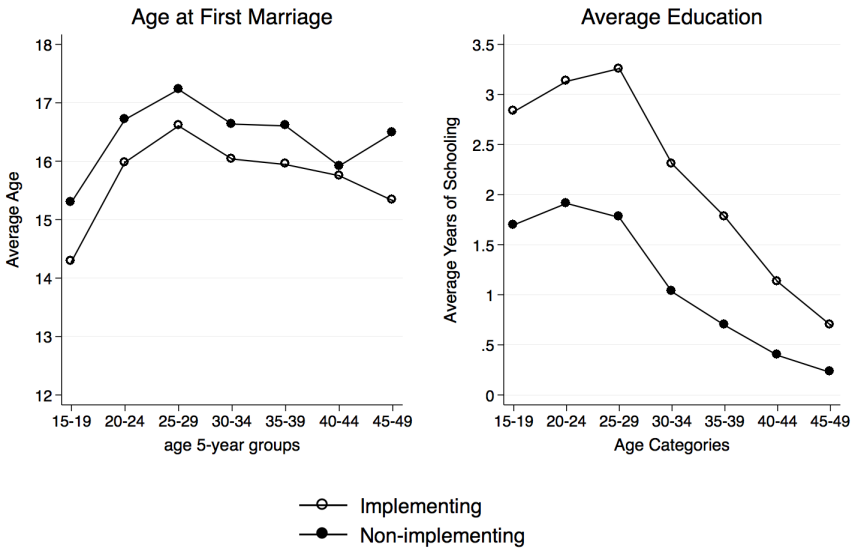

Figure 3.2: Pre-Reform Education and Age at First Marriage by Cohort

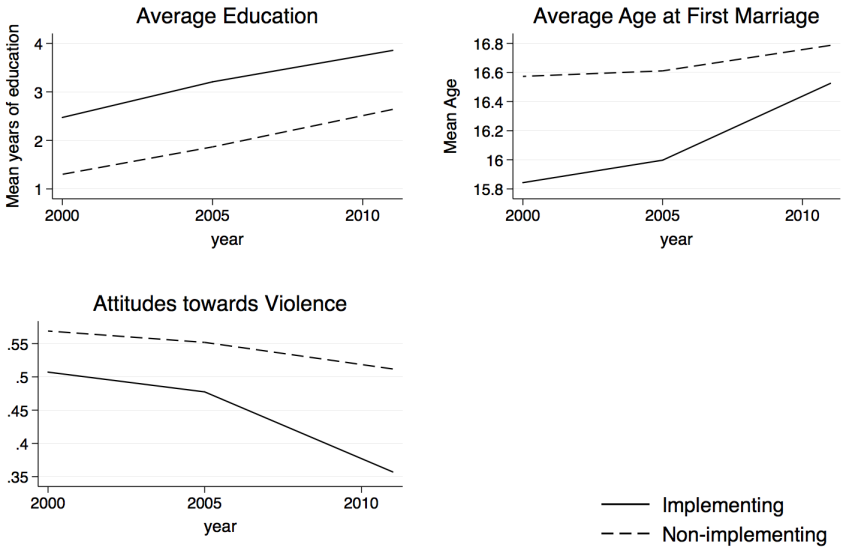

Figure 3.3: Time trend of average outcomes in treatment and control regions

We also use regression analysis to investigate whether there is evidence to reject

the hypothesis that the trends were parallel before the change in the law. We followed Havnes and Mogstad (2011) and Duflo (2001) in interacting the *Post* variable with a set of pre-reform regional characteristics to allow for different underlying trends in women's empowerment depending on the pre-reform characteristics of the region. Placebo tests are also run on dependent variables that are not assumed to be directly affected by the law change.

There are also a few selection issues to consider. There may be some time variant factors that induce regions to self select into implementing the law early. Similarly, whether or not individual women will be treated could be manipulated by the subjects themselves. Women inclined to strengthening their autonomy may be more likely to move to a region where the law is in effect. To verify that there is no selective migration between regions, we restrict the sample to observations of subjects whose *de jure* and *de facto* residence did not change between 2000 and 2011.

Inference based on the difference-in-differences merits extra care, as the approach utilizes individual level data but estimates the effects of treatment that varies at a group level. A consequence of this is that, within group correlation of errors can lead to very misleadingly small standard errors, and increase the likelihood of rejecting the null hypothesis (Cameron and Miller 2015). In their influential paper, Bertrand, Duflo, and Mullainathan (2004) demonstrate the importance of using cluster-robust standard errors in difference-in-differences settings. Furthermore, they suggest that clustering should be on the state level assuming error independence across states. Since the number of regions in our sample is small, we follow the recommendation of Cameron and Miller (2015) in using bootstrapped inference based on re-sampling new samples out of the data in a way that preserves key features of the original sampling scheme.

3.6 Results

This section presents our main results based on difference-in-difference estimations. The outcome of interest in the first subsection is women's empowerment as measured by five thematic factors and a composite empowerment factor. The analysis in the subsequent subsection focuses on variations in child health and nutritional outcomes.

3.6.1 Effects on Empowerment: Full Sample

Table 3.4 presents the estimated difference-in-differences coefficients of the five empowerment indicators using least-squares regressions. All estimations control for religion, place of residence, wealth index, and household characteristics. Standard errors are bootstrapped and clustered at regional level. The estimated empowerment factors have been scaled to have unit variance and zero mean to aid in the interpretation of the regression coefficients. Panels B through D in table 3.4 divide the sample by marital status, place of residence and religion, in order to disentangle any heterogeneity found in the baseline results.

The results suggest that the revised family code has a positive and significant effect in increasing the education and decision making of women (Table 3.4, Panel A). The passing of the reform has increased the “education" factor score of treated women by 0.12 standard deviations, and their “decision making role in the household" by 0.34 standard deviations. The results are in agreement with the notion that increasing the age of marriage gives women more time to invest in their education.

Column (2) of Table 3.4 reports estimations run to see whether there was a change in the norms regarding violence against women, specifically against wives. The reform has improved women’s attitudes regarding domestic violence as their approval of violent behavior declined by 0.10 standard deviations. Column (3) shows that, the reform has also significantly affected women’s knowledge and practice of family planning methods. The factor score “fertility" which measures the lack of information, knowledge and access to contraception methods declined by the 0.13 standard deviation following the reform for treated women.

In addition, the reform brought by the new family law had a statistically significant effect in increasing the probability of women working in professional occupational categories (Column (4)). This result, however, is driven by non-married women (table 3.4, panel B). A possible reason for this result is that single women may be delaying marriage and pursuing economic opportunities; hence, the law would seem to change single women’s expectations of their role within marriage.[9]

We also find that the law has different effects based on place of residence. Panel C of table 3.4 shows that, for women residing in urban areas, the effect of the family law has no significant effect for most of the indicators. On the other hand, the family

[9]This conjecture is also posed by Hallward-Driemeier and Gajigo (2015) where they also backed it up with data that shows a declining trend of early marriage.

Table 3.4: Effect of the Reform on women's empowerment

	(1) Education	(2) Violence	(3) Fertility	(4) Occupation	(5) Decision	(6) Empowerment
Panel A. Full Sample						
Post × Reform	0.118**	-0.099**	-0.133**	0.070	0.343***	0.078
	(0.038)	(0.036)	(0.050)	(0.038)	(0.088)	(0.043)
N	29326	29399	29437	29437	5654	29288
Adj. R^2	0.46	0.06	0.15	0.14	0.13	0.43
Panel B. By Marital Status						
Married						
Post × Reform	0.091*	-0.097**	-0.213***	0.038	0.128	0.109*
	(0.035)	(0.038)	(0.062)	(0.038)	(0.106)	(0.047)
N	17578	17613	17641	17641	3336	17550
Adj. R^2	0.44	0.06	0.26	0.13	0.07	0.41
Not Married						
Post × Reform	0.106*	-0.107	-0.092	0.133*	0.321	0.073
	(0.053)	(0.061)	(0.052)	(0.056)	(0.326)	(0.052)
N	11748	11786	11796	11796	2318	11738
Adj. R^2	0.39	0.06	0.17	0.11	0.17	0.41
Panel C. By Place of Residence						
Urban						
Post × Reform	0.084	-0.114	-0.069	0.167*	0.264*	0.104
	(0.099)	(0.063)	(0.074)	(0.082)	(0.109)	(0.071)
N	8921	8955	8966	8966	2708	8910
Adj. R^2	0.08	0.04	0.01	0.01	0.21	0.07
Rural						
Post × Reform	0.081**	-0.064	-0.224***	0.035	0.194	0.122*
	(0.029)	(0.044)	(0.060)	(0.041)	(0.143)	(0.051)
N	20405	20444	20471	20471	2946	20378
Adj. R^2	0.04	0.01	0.10	0.04	0.12	0.14
Panel D. By Religion						
Muslim						
Post × Reform	0.079	-0.199**	-0.269***	0.004	-0.256	-0.004
	(0.044)	(0.064)	(0.073)	(0.054)	(0.170)	(0.065)
N	9863	9875	9893	9893	1725	9845
Adj. R^2	0.34	0.03	0.18	0.13	0.10	0.32
Christian						
Post × Reform	0.109*	-0.004	-0.062	0.077	0.496***	0.087
	(0.043)	(0.039)	(0.057)	(0.049)	(0.094)	(0.052)
N	18690	18749	18769	18769	3749	18670
Adj. R^2	0.47	0.08	0.11	0.15	0.18	0.47

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Notes: estimations are based on OLS on Eq. (3.4), with the controls including age, wealth index, household size, place of residence, and partner characteristics. The regressions also include year and regional fixed effects. Bootstrapped standard errors (clustered at the state level) in parentheses.

law has a significant effect in increasing rural women's empowerment as measured by improved "education", "fertility" and overall "empowerment" indicators. This is also a plausible result; we would expect the effects to be lesser for urban women as they are more likely to be already better educated, better informed about their rights, and to have better access to resources.

Panel D of table 3.4 divides the sample by religion. Christianity and Islam are the main religions; about half of the sample are Orthodox Christians, one-third are Muslims, and about 18 percent are Protestants. The results suggest that Muslim women were significantly less likely to justify wife-beating following the reform as indicated by a 0.20 standard deviation decline in the factor score. Similarly, knowledge of and access to fertility measures also improved (by 0.27 standard deviations) for Muslim women. These findings imply that violations against women's rights may be a manifestation of misinterpretations of religious tenets.

The results provide a clear indication that the changes in the Revised Family Code increased the bargaining power of women as measured by several indicators that cover diverse aspects of women's lives. The results are also consistent with the extant literature in which changes in divorce laws are found to have improved women's bargaining power (Rangel 2006) and to reduce spousal violence (Brassiolo 2016).

Contiguous Border Counties Sample

In this section, we present results based on a panel of enumeration areas matched into adjacent "county-pairs" that straddle regional boundaries. The sample consists of counties that lie on regional borders in year 2000. Counties are then matched into adjacent pairs.[10] This identification strategy has been used most recently by Dube, Lester, and Reich (2010) to estimate local labor market effects of minimum wages.

The Demographic and Health Survey (DHS) data has geo-located survey locations. However, to protect the confidentiality of respondents, the geographic data is randomly displaced. The displacement process moves the latitude and longitude to a new location under set parameters. Urban locations are displaced 0-2 kilometers while rural locations are displaced 0-5 kilometers with every 100^{th} point displaced 0-10

[10]Note that the same enumeration area can be in multiple pairs. Therefore the same area is included multiple times, which induces correlations in the unobservables across county-pairs. To adjust for potential cross-pair correlations that may bias the standard errors, we performed a multi-way cluster correction suggested by Cameron, Gelbach, and Miller (2011).

kilometers. Internal studies have shown that the random geographic displacement does not have an effect on analyses conducted at the proper scale, i.e. DHS Region. Since the displacement is random, any error introduced to the data should not be significant (Perez-Heydrich et al. 2013).

Table 3.5: Effect of the Reform on women's empowerment

	(1) Education	(2) Violence	(3) Fertility	(4) Occupation	(5) Decision
Post × Reform	0.089***	-0.114***	0.075	0.148***	0.223***
	(0.022)	(0.028)	(0.064)	(0.029)	(0.030)
Controls	Yes	Yes	Yes	Yes	Yes
Border county pair fixed effects	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	24048	24125	24163	24163	24163
Adjusted R^2	0.36	0.04	0.10	0.03	0.12

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Notes: Controls include age, wealth index, household size, place of residence, and partner characteristics. Standard errors, clustered at the border county pair level, in parentheses.

Table 3.5 presents estimates of the effect of the Revised Family Code on different empowerment indicators based on the contiguous county pair sample. All estimations control for religion, place of residence, wealth index, and household characteristics. The estimated empowerment factors have been scaled to have unit variance and zero mean to aid in the interpretation of the regression coefficients.

The results are similar to the findings of the previous subsection. The magnitudes of the estimated effects, however, are slightly lower than in the case of the full sample. The passing of the reform has increased the "education" factor score of treated women by 0.09 standard deviations, and their "decision making role in the household" by 0.22 standard deviations. Attitudes towards domestic violence also improved, as tolerance of "violence" is found to decrease by 0.15 standard deviations. We find no statistically significant effect of the law on knowledge and access to family planning services.

3.6.2 Effects on Child Health

Policies designed to benefit one specific group can have consequential effects on other groups. The Revised Family Code was mainly created to improve women's economic and social lives, and the results presented in the previous section have shown that the policy availed more bargaining power to women. We want to further investigate whether the same policy reform has the potential to increase investments in household goods that women value by increasing their bargaining power within the marriage.

Given women's role as primary caregivers of children, in the Ethiopian context, it is reasonable to assume that their empowerment would influence the health status of their children.

In this section, we test whether mothers' empowerment, as measured by the latent factor scores, is associated with better child health measured by the nutritional status of children.[11] Following WHO guidelines (WHO 2006) we measure nutritional status as Z scores of height-for-age (stunted), weight-for-height (wasted) and weight-for-age (underweight). We classify, as per the common practice, children with a Z score of height-for-age below -2 as "stunted", a Z score of weight-for-height below -2 as "wasted", and a Z score of weight-for-age below -2 as '"underweight".

The results, reported in Table 3.6 suggest that the reform has a mild positive impact on improving the height-for-age z scores of children, but no significant impact on weight-for-age and weight-for-height. A child residing in the early reforming regions is 12 percentage points less likely to be stunted. The results largely remain unchanged after controlling for the empowerment indicators of the mother. A child whose mother is relatively empowered tends to have better nutritional status in some cases. On the other hand, the lack of women's empowerment, represented by a tolerant attitude towards domestic violence, is statistically positively associated with the undernourishment of children.[12]

These results highlight two important issues. First, the fact that the height-for-age indicator was significantly affected by the reform is an indication that, while wasting related problems may be addressed effectively with time, stunting related problem, may be more challenging to address. The height-for-age index provides an indicator of linear growth retardation and cumulative growth deficits in children. Stunting reflects the failure to receive adequate nutrition over a long period of time and is affected by recurrent and chronic illness. Height-for-age, therefore, represents the long-term effects of malnutrition in a population and is not sensitive to recent, short-term changes in dietary intake. The weight-for-height index, on the other hand, measures body mass in relation to body height or length; it describes current nutritional status.

Second, the results further highlight that child nutritional investments are not significantly impacted by the shift in intrahousehold bargaining induced by the legal

[11]The DHS sample collects complete anthropometric data for children under the age of five only. Hence, the analysis in this section is limited to children under five.

[12]Separate regression, not shown here, were run by stratifying the sample by gender and birth order to detect any heterogenious effects. The results showed that there are no differential effects.

Table 3.6: Effect of the Reform on Child Health

	(1) Stunted	(2) Wasted	(3) Underweight
Panel A. Baseline Specification			
Post × Reform	-0.120***	0.160	0.002
	(0.043)	(0.109)	(0.086)
Panel B. Controlling for Education			
Post × Reform	-0.141***	0.164	-0.021
	(0.047)	(0.116)	(0.091)
Education	-0.179***	-0.139***	-0.234***
	(0.030)	(0.040)	(0.027)
Panel C. Controlling for Violence			
Post × Reform	-0.064	0.253**	0.037
	(0.058)	(0.104)	(0.093)
Violence	0.034***	0.047**	0.035*
	(0.011)	(0.018)	(0.018)
Panel D. Controlling for Occupation			
Post × Reform	-0.128***	0.145	-0.014
	(0.038)	(0.116)	(0.088)
Occupation	-0.044	-0.065	-0.108**
	(0.044)	(0.071)	(0.054)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$.

Notes: Controls include age (both mothers and children), birth order of the child, wealth index, household size, religion, place of residence, and paternal characteristics. The regressions also include year and regional fixed effects. Bootstrapped standard errors (clustered at the state level) in parentheses. Sample size=18,556.

change. This implies that, fathers also value the well being of their children. Supporting evidence for this is found in the DHS sample, which also gathered information on attitudes towards wife beating. Women and men were asked whether a husband is justified in beating his wife in various circumstances. Neglecting the children was cited as the most justifiable reason.[13]

3.6.3 Robustness Checks

Time Trend

Following Duflo (2001) and Havnes and Mogstad (2011), we interact the *Post* variable in Equation 3.4 with a large set of pre-reform regional and community characteristics. Share of professional jobs occupied by women, share of women who were working in the pre-reform period, distance from the regional capital, and other indicators of economic activities in the regions are considered. This allows for different underlying trends in maternal employment, depending on the pre-reform characteristics of the region. Estimates from this specification conform well to the results from the baseline specification.

Selective Migration

In order to address the concern raised by a potential selective migration of women from treatment regions to control regions or vice versa, we restricted our sample to women who reported to having lived at the same residence for more than five years. Almost 60 per cent of the women in the sample always lived in the same residence, while a further 28 per cent have lived at least for five years. This resulted in reduction of our sample size by about 12 per cent. The results remained both qualitatively and quantitatively similar to the full sample case.

Placebo Outcome

We run a few placebo estimations to test the validity of the identifying assumption. We replaced our outcome variable, Y, by another outcome variable, Y', that is not supposed to be affected by the reform. If the DD estimation using Y' as an outcome is

[13] 31 per cent of the sampled women agree that a husband is justified to beat his wife if she neglects the children; and 30 percent of interviewed men agreed with the statement.

non-zero, then it is likely that the DD estimate for Y could be biased as well. We chose availability of electricity in the household and ownership of a radio or some type of vehicle as placebo outcomes (Table 3.7). None of these estimations were statistically significant, supporting our claim that the main results are not driven by unobserved common shock or trend.

Table 3.7: Effect of the Revised Family Code on Placebo Outcomes

	has electricity	has radio	has a vehicle
Post×Reform	-0.007	0.033	-0.005
	(0.019)	(0.019)	(0.010)
Observations	28469	28470	29437
Adjusted R^2	0.80	0.35	0.04

Standard errors (clustered at state level) in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

3.7 Conclusions

This paper examines the effects of changes in family law in Ethiopia on women's empowerment indicators and whether a shift in the balance of bargaining power within the household translates into investments in child health. Using a difference-in-difference approach, we exploit the regional variation in the timing of the implementation of the new family code in Ethiopia. Any effects arising from the legal change can also serve as a test of the different theoretical household models in the literature.

The paper adds value to the growing literature in intrahousehold resource allocation by making two important contributions. First, the concept of "empowerment" is formalized as an unobserved latent variable based on a large set of questions pertaining to women's autonomy and decision making power. Second, the paper finds an empirical counterpart to empowerment by exploiting the exogenous variation provided by institutional changes.

The results suggest that the revised family code has a positive and significant effect in increasing the empowerment indicators of women. The reform has increased the "education" factor score of treated women by 0.12 standard deviations, and their "decision making role in the household" by 0.34 standard deviations. It also increased the probability of women working in professional occupational categories. The reform

has also improved women's attitudes regarding domestic violence, as their approval of violent spousal behavior declined by 0.10 standard deviations.

The paper also tests whether women's empowerment as a result of the policy change influenced the health status of their children. The results show that the reform has a mild positive impact on improving the height-for-age z scores of children, but no significant impact on weight-for-age and weight-for-height.

The results also provide evidence to reject the unitary household model, as changes in bargaining power induced by external factors imply changes in household outcomes. These results highlight the importance of considering dynamic household interactions when evaluating the impact of public policies. Even though the policy change does not have a direct impact on the income of women, household incentives and outcomes changed.

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