Cognitive and Non-cognitive Gender Gap among Children: Evidence from Ethiopia[1]

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ABSTRACT This study aims to trace the roots of the cognitive and non-cognitive gender gap among children in Ethiopia. It is keen to answer what gender gap exists in skills among boys and girls in the diverse socioeconomic and cultural settings of the country. The data comes from the Young Lives Project, a longitudinal study tracking the lives of children in four developing countries. The rich list of variables from the data is framed by the bioecological model of Bronfenbrenner that best explains the development of gender inequalities from childhood to adolescence. The results indicate the existence of gender difference between boys' and girls' cognitive and non-cognitive scores. It is also evident that this difference in achievement scores is heterogeneous in that it differs with different personal characteristics (such as age and gender) in different processes and contexts (socioeconomic status, place of residence, household composition and parental literacy) at different points in time.

KEY WORDS cognitive; non-cognitive; gender gap; bioecological model; Ethiopia

Background and statement of the problem

In recent years, Ethiopia has registered big progress in key human development indicators. However, gender inequalities remain one of the many developmental challenges that the country faces. Employment and education play an important part in explaining gender disparities. Regarding education, primary enrolment has become almost universal; however, as one goes up to higher education levels, especially at the graduate and post-graduate levels, the number of female students gets to be very small compared to that of males. According to the latest educational statistics annual abstract of the Ministry of Education, the net

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enrolment rate at the primary level over the period of five academic years (from 2009/10 to 2013/14) rose from 83.7 % to 95.1 % for boys; while the rate increased from 80.5 % to 90.1 % for girls. According to the same report, female students in 2013/14 accounted for only 28.1 % of students in undergraduate and 19.1 % in the postgraduate programmes (20.1 % at the Masters and 11.4 % at the PhD levels) in public institutions in Ethiopia (MOE 2015). Although the gender gap is not large at the primary level, at the higher levels, it becomes very wide.

In the labour market, opportunities still favour men over females. Even though the economy has demonstrated reductions in unemployment, women have not benefited as much as men. Women account for 23.0 % of the urban unemployment rate while the proportion is 10.5 % for men, according to a report in 2014. Women have significantly higher unemployment rates and they are often confined to the informal sector, which constitutes 36.5 % of employed women (CSA 2014). At the same time, there are few women in decision-making positions, and their political representation is low (Biseswar 2008).

In spite of the new federal constitution that grants equal rights to women and men in all spheres of life, including in marriage, property rights, inheritance, and bodily integrity (EFDRE Constitution 1995), and the revised family code that prohibits harmful traditional practices (EFDRE 2000), traditional customs still dominate marriage practices (Fafchamps and Quisumbing 2002). "The most important determinant of a country's competitiveness is its human talent" (World Economic Report 2013: 31). Women constitute half of the world's population and hence, closing the gender gap that determine ability is critical to the development of a nation.

Starting with children as the means of breaking cycles of poverty and inequality has become increasingly central to international strategies to eradicate poverty (Heckman 2006). This is illustrated by targets levels for children's education, mortality and health as encompassed in the Millennium Development Goals (MDGs), which were recently extended to the Sustainable Development Goals (SDGs) of 2030. With this realization, this study intends to trace the roots of the gender gap among children in the case of Ethiopia.

Relevance of the study

Research has shown that cognitive and non-cognitive skills[2] acquired in childhood determine a person's outcome later in life (Murnane, Willett and Levy 1995; Heckman, Stixrud and Urzua 2006; Bertrand and Pan 2011; Heckman and Rubinstein 2001). Various studies by Heckman and colleagues have shown that these skills are important determinants of socioeconomic success (such as schooling, wages, longevity) as well as social problems (such as crime, teenage pregnancy, high rate of school dropouts) (Heckman 2006; Borghans, Duckworth, Heckman and Ter Weel 2008). In addition, when measured at a younger age,

2 The term "psychosocial skills" and "non-cognitive skills" are used interchangeably in this paper, following (Dercon and Singh 2013). These skills are considered as soft skills, usually contrasted with "hard skills" of cognitive ability in areas such as literacy and numeracy; and they are not measured by commonly administrated cognitive tests (Gutman and Schoon 2013).

these skills are found to explain much of the variation later in adulthood (Murnane, Willett and Levy [1995] and Heckman [2006] can be referred for cognitive skills, and Borghans et al. [2008]; Heckman, Stixrud and Urzua [2006]; Bertrand and Pan [2011]; and Heckman and Rubinstein [2001] for non-cognitive skills).

There are a number of distinct attributes of the proposed study that make it a valuable addition to the current literature. First, the existing related literature on gender inequalities in child well-being has been centred on a very restrictive set of indicators such as nutrition, enrolment in school, and at a later stage, on marriage and labour market participation. Much of the analysis in the current literature employs data on children that come from population censuses, Demographic and Health Surveys (DHS), and household welfare surveys (Dercon and Singh 2013). This can also be evidenced by the global gender gap index, which identifies the relative gaps between women and men in a large set of countries and across four key areas: health, education, economics and politics (World Economic Report 2013). However, studies also suggest that the cognitive and psycho-social gender gap at earlier ages is a determinant for these gaps.

Second, a key limitation of research in these areas is that it is largely US-centric and to some extent Eurocentric, and does not speak to gender differences between males and females raised in different social and educational environments in other cultures (Robinson and Lubienski 2011; Farrington et al. 2012; Fryer and Levitt 2010; Reilly 2012; Contini et al. 2017). Hence, this study intends to bridge the literature gap by identifying the cognitive and psycho-social gender gap in a developing world context.

Early intervention targeted towards the lives of disadvantaged children has been stipulated as an important policy option in current literature (Heckman 2006; Cunha and Heckman 2007). The foundations of skills and abilities are laid at the earlier lives of children and investments that are made early at these stages comparatively pay off more than those that are made at later stages, in addition to the fact that early inputs strongly affect the productivity of later outputs (Heckman 2006; Noboa-Hidalgo and Urzua 2012).

Furthermore, identifying a gender gap in these vital skills at early ages is a valid contribution to policy inputs. Various studies have indicated that the gender gap becomes significant at later ages of childhood (Hardgrove et al. [2014] for cognitive skills and Bertrand and Pan [2011] for psycho-social skills). Hence, examining when gaps occur and the factors that bring about these gaps allows for "policy-relevant insights into which children face particular disadvantages, how children develop, what matters, when it matters, and how policy can support children more effectively" (Young Lives 2015: 1). The purpose of this study is to trace the roots of this problem by investigating the early mechanisms through which inequalities are formed. Using the novel longitudinal data of Young Lives for Ethiopia, this study intends to contribute to the literature and provide policy implications by tracking gender inequalities from the earliest years of children's lives through their adolescence.

The main objective of this study is to understand what characterizes the cognitive and non-cognitive development of children in Ethiopia and to find any gaps between boys' and girls' skill developments. Specifically, the study is keen to answer the following three questions: what gender gap exists in cognitive skills among boys and girls and how does the gap evolve over the course of children's development? What gender gap exists in their

non-cognitive skills and how does the gap evolve over the course of the children's development? And, how do the different socioeconomic and cultural contexts affect children's cognitive and non-cognitive developments?

Theoretical framework

Overview of the bioecological model and its application for the study

The bioecological model of Urie Bronfenbrenner, which is also called the Process, Person, Context, and Time (PPCT) Model, is used to frame this study (Bronfenbrenner and Morris 2006). The model, as the name indicates, deals with the concepts of process, person, context and time; and their dynamic and interactive relationships.

The first concept, process, is an important part of the theory. Bronfenbrenner states that "human development takes place through processes of progressively more complex reciprocal interaction between an active, evolving biopsychological human organism and the persons, objects, and symbol in its immediate external environment" (Bronfenbrenner and Morris 2006: 797). The interaction, he emphasizes, must occur on a fairly regular basis over extended periods of time and called such enduring forms of interaction in the immediate environment as proximal processes (Bronfenbrenner and Morris 2006). Proximal processes are bidirectional indicating that individuals are active in their own development through selective patterns of attention, action and responses with people, objects and symbols within their environment (Smith 2011). The concept of process in this study will look at the interactive relationships a child has with family, school and peers which are important for the child's cognitive and non-cognitive development.

The second element of the model is the person's characteristics that are divided into three types: the demand characteristics; resource characteristics and force characteristics. These characteristics are identified as the most influential in shaping the course of future development through their capacity to affect the direction and power of proximal processes through the life course (Bronfenbrenner and Morris 2006). The demand characteristics are those that are immediate stimulus to another person (such as age, gender, skin colour and physical appearance). Resource characteristics are those that relate partly to mental and emotional resources (such as experience, skill, and intelligence) and also to social and material resources (such as access to good food, housing, caring parents, educational opportunities). The last one, force characteristics are those that invite or discourage reactions from the social environment (such as motivation and persistence) (Bronfenbrenner and Morris 2006; Tudge et al. 2009). As indicated by Bronfenbrenner and Morris (2006: 798), the person characteristics can appear twice in the model "….first as one of the four elements influencing the *form, power, content, and direction of the proximal process*, and then again as *developmental outcomes* – qualities of the developing person that emerge at a later point in time as the result of the joint, interactive, mutually reinforcing effects of the four principal antecedent components of the model".

Context, or the environment, constitutes four distinct systems: micro, meso, exo, and macro, each having direct or indirect influence on a child's development. The microsystem is any environment closest to the child that the child spends a great amount of time engaged

in activities and interactions such as the environments at home, school or peer groups. The mesosystem is the interrelations among the different microsystems. A child spends time in more than one microsystems (could be family and school or family and neighbourhood) and the mesosystem is the relationships among these microsystems that have direct effect on the development of the child. The exosystem has important indirect influence on the development of the child, even if the child does not have a direct encounter with this system. The stressful working conditions of a parent, for instance, as an exosystem will have an indirect effect on the development of the child, even if the child does not directly encounter the system or does not spend time there. The macrosystem, includes the general values or belief systems, cultural characteristics, political situations and changing events and expectations in the larger society. It envelops all the systems, influencing and being influenced by all the systems (Tudge et al. 2009; Krishnan 2010).

The final component of the model is time. Time denotes different aspects such as chronological age and the historical period within which they reside as well as duration and nature of periodicity (Krishnan 2010).

Application of the framework to the study

The model has undergone a continual state of development (Tudge et al. 2009) and has also been referred by Bronfenbrenner as: "…an evolving theoretical system for the scientific study of human development overtime" (Bronfenbrenner and Morris 2006: 793). As indicated by Tudge et al. (2009), who made a review of research employing the theory, most researchers use the earlier versions of the theory or choose specific concepts from it. One of the reasons given by Tudge and his colleagues for scholars not considering seriously the theory in its matured form might be because it is viewed as difficult to translate into empirical works (Tudge et al. 2009). Nonetheless, they further explain that Bronfenbrenner never implied that each and every aspect of the theory (for example, all the person characteristics as well as genetic attributes, the four different contextual systems and the three aspects of time) had to be included. However, such studies should

> focus on proximal processes, showing how they are influenced both by characteristics of the developing individual and by the context in which they occur and showing how they are implicated in relevant developmental outcomes. The simplest research application could examine, for example, the ways in which regularly occurring parent-child interactions vary by an important characteristic of the child (…) and by some relevant aspect of the context (…), with data collected over at least two points in time, choosing some outcome viewed as being relevant to parent-child interaction. (Tudge et al. 2009: 207)

Accordingly, this study uses the mature form of the theory by looking at the interactive process children have with their environments in diverse contexts at different points in their lives to assess their cognitive and non-cognitive gender gaps by using longitudinal data. The person characteristics in this study includes the age, gender, cognitive skills (measured by the PPVT score and math scores), non-cognitive skills (measured by self-esteem and self-efficacy, and educational aspirations) of the children and educational status of their parents. Regarding

context, the microsystem and the macrosystems are considered. The microsystem looks at the cognitive and psychosocial skills of boys and girls in different household compositions: female-headed households and male-headed households. The microsystem also assesses how children's time use (time spent on: studying, household chores, and farm work) affects their cognitive and psychosocial skills. The macrosystem makes possible analysis of the cognitive and non-cognitive gender gap, taking into consideration the socioeconomic status and rural urban settings where the developing children live. The longitudinal nature of the study will help to examine the time aspect of the model. The younger cohort at the age of 5 and 8 and the older cohort at the age of 12 and 15 are examined to analyze the person, process and context aspects at different times. The interactive relationships girls have in relation to the development of their cognitive as well as non-cognitive skills in their families, at school, and in their community at different times in their lives will be assessed using this theoretical framework.

This theory is suitable for the study because of its interdisciplinary nature and it has an integrative focus (that explains the process–person–context–time) for the age periods of childhood and adolescence. In addition, it emphasizes the scientific and practical benefits of a closer linkage between developmental research and public policy in both directions (Bronfenbrenner and Morris 2006).

Methods of the study

Sample design

The study employs data from the Young Lives project, which is designed as a panel study tracking the lives of 12,000 children in four low and middle-income countries: Ethiopia, India, Peru and Vietnam. It is a cohort study following children over 15 years: the younger cohort consisting of 2,000 children born between January 2001 and May 2002, and the older cohort consisting of approximately 1,000 children born in 1994–95 from each country (Young Lives 2013). For this study, the data for Ethiopia for the younger and older cohort will be used.

The Young Lives project selected the children from 20 sentinel sites (or clusters) in each country. In Ethiopia, the twenty study sites were selected in 2001 following a three-stage process based on the national administrative structures. First, the regions the study would take place in were selected purposively, whereby districts with food deficit status were oversampled; their profile captured the country's diversity across regions and ethnicities in both urban and rural areas; and, the cost of tracking the children in future was manageable to reduce attrition rates. Then the woredas (districts) within each region and a kebele (the lowest level of administrative structure) within each woreda as a sentinel site were selected. Finally, from the chosen sites, 100 younger children and 50 older children were randomly selected (Young Lives 2013).

A small attrition rate has been registered since the beginning of the study. It is low compared to other longitudinal studies and is slightly lower for the case of Ethiopia than

the other study countries: 2.2 % for the younger and 8.4 % for the older cohorts (Young Lives 2013).

Data

The survey is conducted every three years (Table 1) and so far, four rounds of data collection have been made. For this study, the data for Ethiopia collected for the younger and older cohorts in the second and third rounds (younger cohort at age 5 and 8; and older cohort at age 12 and 15) are used.

Table 1: Rounds of surveys

Survey	Year	Younger cohort	Older cohort
Round 1	2002	6 to 18 months	7 to 8 years
Round 2	2006	4 to 5 years	11 to 12 years
Round 3	2009	7 to 8 years	14 to 15 years
Round 4	2013	11 to 12 years	18 to 19 years

The survey involves tracking the lives of two cohorts of children as well as their primary caregivers 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 math). The survey also asks the children about their daily activities, their experiences and attitudes, feelings, perceptions, hopes and aspirations for the future. The household data covers 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. The community questionnaire provides in-depth information about the social, economic and environmental context of each community.

The rich list of variables from the data will be framed by the bioecological model of Bronfenbrenner that could best explain the development of gender inequalities from childhood to adolescence. The child data, as well as the household and the community data, will be used to see the process, person, and context of the model. The longitudinal nature of the data will have the great benefit of showing the time aspect of the model.

Cognitive and non-cognitive measures

As a measure of the cognitive ability, the study uses Peabody Picture Vocabulary Test (PPVT) and Cognitive Development Assessment – Quantity (CDA-Q)[3]Test.

> While the former is a test of vocabulary recognition that has been widely used as a general measure of cognitive achievement, the latter is a common test used in assessing cognitive development of young children. More precisely, PPVT is a test of receptive vocabulary adaptable according to age. In PPVT test, a child hears a word ("boat", "lamp", "cow", "goat" etc.) and is then asked to identify which of four figures corresponds with the spoken word. (Woldehana 2011: 133)

According to a technical report by Cueto and Leon (2012: 6), the PPVT test is "individually administered, orally administered, untimed, and norm referenced". The MATH test particularly deals with *number and number sense only*, which are considered as mainly related to basic skills that are essential in todays modern society. The test did not include subjects such as geometry, data and algebra in order to be fair to non schooled children and dropouts as well as students who have not covered the topics yet (Cueto, Leon, Guerrero and Muñoz 2009).

Regarding the measurement of non-cognitive skills, Dercon and Sánchez (2013) used self-esteem and self-efficacy as a set of indicators that have extensively been studied in the field of psychology. The scholars define self-esteem as "related to a person's overall evaluation of her own worth" and self-efficacy as "related to a person's sense of agency or mastery over his life" (Dercon and Sánchez 2013: 428). In addition, Dercon and Sánchez (2013) and Borga (2018) use children own educational aspiration as an indicator of non-cognitive skills. They describe educational aspiration as the ability of a child to set future goals while still being determined to work in the present towards the realization of those goals. Hence, following Dercon and Sanchez (2013), average scores on self-esteem, self-efficacy and educational aspiration are used to measure the psychosocial abilities of children.

Methods of analysis

The primary task of this paper is to investigate the existence of gender-based inequalities among a host of dimensions, and see if these have impacts on children's subsequent cognitive and non-cognitive development. The study employs a rich list of variables that may explain gender inequalities. I compare the means between boys and girls at various ages and also run a multivariate regression analysis after controlling for a series of other possible covariates for the indicators used. This approach allows the identifying of possible causal links between the gender gap and its determinants.

Descriptive statistics and preliminary evidence

The simplest way of identifying a gender gap is by comparing the differences in the means between boys and girls at various ages. This exercise provides us with preliminary evidence

3 CDA-Q test score is referred as Math test score in this study for ease of understanding.

whether or not there is a psychosocial and cognitive gap between boys and girls. In the event of such a gap, the descriptive analysis sheds further light on the possible mechanism and evolution of the gender-based differences. Furthermore, the longitudinal nature of the data allows for monitoring whether gender-based inequalities differ at different ages of the child (such as at early childhood and at adolescence).

More specifically, to answer the first research question the mean test scores of the cognitive ability (measured by the PPVT and the CDA-Q test scores) is compared and tested to see if the difference is statistically significant. Furthermore, differences in achievement scores will be analyzed on several strata: place of residence (urban/rural), socioeconomic status (high/low), household composition (female headed/male headed), and parental literacy (literate/illiterate).

Likewise, to answer the second research question the mean result from the non-cognitive ability measure is compared and tested to see if the difference is statistically significant. Self-esteem, self-efficacy and aspiration are used as non-cognitive indicators. The values for self-esteem and self-efficacy are constructed from different questions that are answered on a Likert scale measuring from 1 to 5. The aspiration question is coded as years of education – ranging from university=15 to adult literacy=5, where children are asked what level of formal education they would like to complete if they had no constraints in life. In addition, differences in these skills will be analyzed on several strata: place of residence (urban/rural), socioeconomic status (high/low), household composition (female headed/male headed), and parental literacy (literate/illiterate).

Regression analysis

A slightly advanced way of depicting the gender gap in different indicators is by running a multivariate regression analysis after controlling for a series of other possible covariates for the indicators used. This approach allows us to identify possible causal links between the gender gap and its determinants.

Following Dercon and Singh (2013), I will run a regression in which the indicator will be regressed as a dummy for gender (1=female) as well as the logarithm of total consumption expenditure, education of the mother, household size, ethnicity/caste, and urban/rural location of residence. The advantage of this approach is that the effect will be narrowed down to general "preference"-based gender bias effects, at least after accounting for socio-economic factors that may induce certain behaviours. For example, if gender bias is only driven by poverty or the lack of an educated caregiver, then any remaining gender bias would disappear. If not, the effects remain unchanged. The results will allow us to see the impact of relatively simple explanations on the persistence of gender effects, as well as suggesting some mediating factors. For example, if the gender effects are reduced once education of the caregiver is controlled for, then this is at least suggestive evidence of how these effects are being perpetuated (even though this is at best suggestive, and not a framework for full causal analysis).

We next lay out a statistical model for cognitive achievement that assumes that children's achievement, as measured by test performance at some particular age, is the outcome of a cumulative process of knowledge acquisition.

The empirical implementation of such a statistical model is challenging for a number of reasons. Todd and Wolpin (2007) identify three problems in regards to this. First, children's innate abilities are not observed; second, datasets have incomplete information on inputs and their histories that may be chosen endogenously with respect to unobserved endowments; and third, measurement error could affect standardized tests of achievement.

To minimize these methodological shortcomings, we adopt the "value-added" econometric specification that relates an achievement outcome measure to contemporaneous measures of the micro and macro systems (discussed in the theoretical framework) histories of inputs and lagged achievement scores.

Findings and discussion

Descriptive statistics

The summary statistics of the data are presented in Table 2. The table depicts the average outcomes of both younger and older cohort children at two different ages from two waves of surveys. Close to 50 % of the sample children are girls. The height-for-age z score measures the nutritional and health endowment of the sample children. It can be seen from the table that the average z-scores are below the WHO standard. The children are also observed to spend quite a large proportion of their time on work activities. The amount of time spent working tends to grow as children get older for the younger cohort. Test score results of achievement measures are observed to increase with age.

The average child resides in a household with an average size of 6 people and with about 3 siblings. The majority of the sample children live with both biological parents. In addition, 19 % of the younger cohort children and 12 % of the older children have their grandparents living in the house.

Gender differences in achievement score

This section presents a simple picture of the gender gap evident in the sample by comparing the difference in the means of achievement scores between boys and girls at various ages. The exercise is repeated for a number of subsamples to see if any gender difference is driven by the different social, economic, and environmental contexts that the child is part of. The plots in Figures 1 and 2 show that there is a clear gender difference in cognitive scores of children measured by PPVT and MATH scores. It is important to note that comparison across years might be difficult as there has been some variation in the use of scales to measure the scores during different years of the surveys. On the other hand, comparing the results across gender, it shows that the gap is in favour of boys in both cohorts at different ages and the gap is more pronounced in MATH scores.

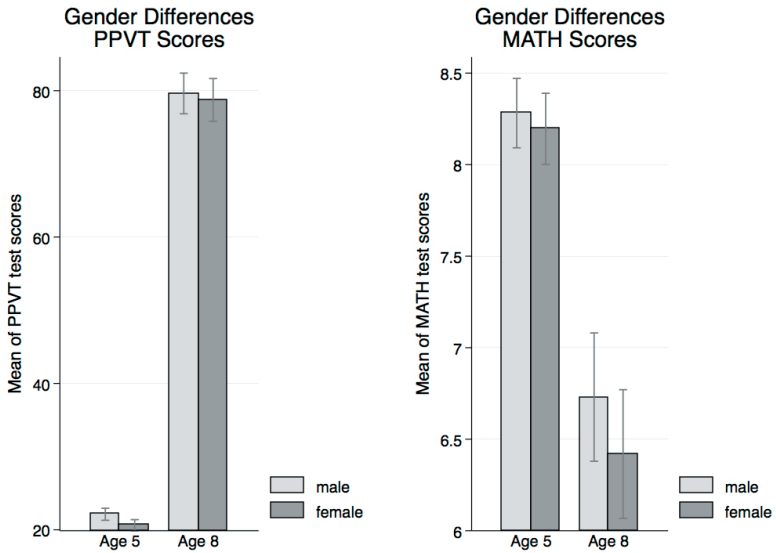
Table 2: Summary statistics (by age)

	Younger cohort		Older cohort	
	Age 5	**Age 8**	**Age 12**	**Age 15**
Child is female	0.459	0.475	0.495	0.489
	(0.499)	(0.500)	(0.500)	(0.500)
Height-for-age z-score	-1.483	-1.189	-1.372	-1.369
	(1.107)	(1.190)	(1.274)	(1.285)
Above average time spent on working	0.372	0.530	0.448	0.372
	(0.484)	(0.499)	(0.498)	(0.484)
Above average time spent on study/play	0.658	0.507	0.602	0.510
	(0.475)	(0.500)	(0.490)	(0.500)
Self-efficacy scores	NA	NA	1.800	3.840
			(0.410)	(0.50)
Self-esteem scores	NA	NA	1.650	3.540
			(0.510)	(0.770)
Educational aspiration	NA	NA	13.280	13.190
			(1.540)	(2.020)
Math test raw score	8.484	6.571	4.917	4.216
	(2.995)	(5.390)	(2.450)	(4.222)
PPVT test raw score	22.86	80.05	76.74	150.4
	(13.78)	(44.52)	(25.99)	(36.59)
Household size	5.889	6.174	6.491	6.357
	(2.038)	(1.974)	(2.040)	(2.119)
Both parents are alive	0.913	0.913	0.817	0.792
	(0.282)	(0.282)	(0.387)	(0.406)
Grandparent present at home	0.192	0.213	0.118	0.103
	(0.394)	(0.418)	(0.322)	(0.304)
Number of siblings living at home	2.865	3.491	3.419	3.306
	(2.062)	(2.132)	(1.903)	(1.873)
Wealth index of the household	0.288	0.334	0.303	0.352
	(0.180)	(0.176)	(0.170)	(0.166)
Resides in urban area	0.429	0.409	0.415	0.417
	(0.495)	(0.492)	(0.493)	(0.493)
N	997	1784	918	959

Notes: Mean coefficients; s.d. in parentheses.
Source: Author's calculation from Young Lives Survey data (rounds 2 and 3)

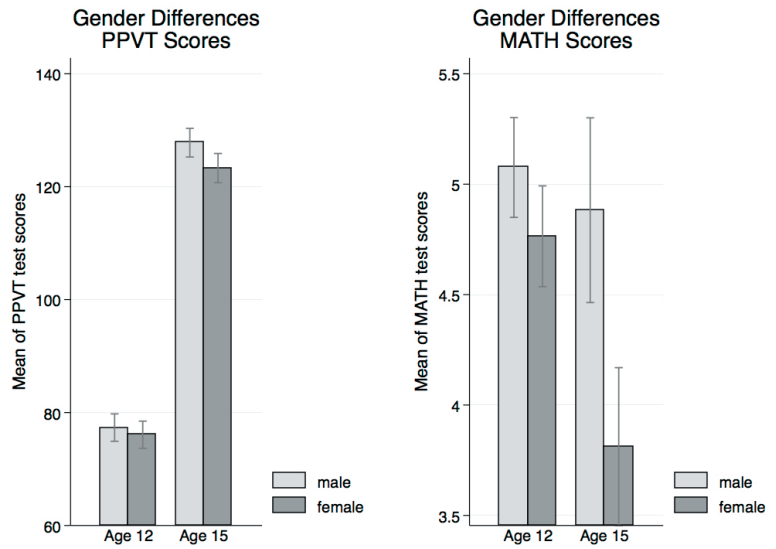
The differences in achievement scores both for cognitive and non-cognitive skills are further analyzed on several strata. Place of residence (urban/rural), socioeconomic status (high/low), household composition (female headed/male headed), and parental literacy are some of the strata considered. In all the subsamples, the gender difference is apparent. A two-sample t-test is used to determine if the two population means are equal. Tables 3a and 3b report the results of these tests showing the average difference of cognitive and psychosocial scores between boys and girls in the younger and older cohorts, respectively, in the third round survey across several strata.

Figure 1: Mean differences in test scores for younger cohorts (by age)



Source: Author's calculation from Young Lives Survey data

Figure 2: Mean differences in test scores for older cohorts (by age)



Source: Author's calculation from Young Lives Survey data

The results from the younger cohort (Table 3a) show that the difference in the cognitive and non-cognitive skills is largely insignificant. However, at older ages (Table 3b) boys consistently score higher in both cognitive skill measures (PPVT and MATH tests) irrespective of the subsample they belong to. Older girls are particularly outperformed by boys in rural settings and in households headed by illiterate parents, as well as those with female heads and households with low socio-economic status. These differences are more prevalent at age 15.

Table 3a: Differences in average test scores by gender, younger cohort at age 8

	Full sample	Urban	Rural	Low SES	High SES	Female headed	Male headed	Illiterate head	Literate head
Self-efficacy	0.0198	0.0389	0.00816	-0.00492	0.0481	0.0559	0.0120	0.0270	0.0186
	(0.0190)	(0.0306)	(0.0241)	(0.0260)	(0.0276)	(0.0421)	(0.0213)	(0.0350)	(0.0226)
Self-esteem	-0.0197	0.0427	-0.0563	-0.0632	0.0316	0.0577	-0.0343	0.000949	-0.0226
	(0.0372)	(0.0542)	(0.0494)	(0.0536)	(0.0480)	(0.0797)	(0.0419)	(0.0696)	(0.0438)
PPVT score	0.884	3.969	-0.536	-0.701	2.496	1.740	1.227	-0.796	2.521
	(2.057)	(3.493)	(1.869)	(2.119)	(3.293)	(4.805)	(2.253)	(2.804)	(2.590)
MATH score	0.311	0.564	0.213	0.155	0.391	0.675	0.264	0.116	0.517
	(0.254)	(0.410)	(0.218)	(0.255)	(0.396)	(0.598)	(0.279)	(0.375)	(0.314)
N	1882	749	1133	1002	880	360	1522	573	1309

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

Table 3b: Differences in average test scores by gender, older cohort at age 15

	Full sample	Urban	Rural	Low SES	High SES	Female headed	Male headed	Illiterate head	Literate head
Self-efficacy	0.0546	0.0957*	0.0318	0.0226	0.0823*	0.103	0.0393	0.0684	0.0504
	(0.0293)	(0.0413)	(0.0395)	(0.0422)	(0.0395)	(0.0545)	(0.0346)	(0.0608)	(0.0334)
Self esteem	0.0365	-0.0280	0.0909	0.0940	-0.0350	0.00862	0.0478	0.163	-0.00256
	(0.0498)	(0.0695)	(0.0682)	(0.0719)	(0.0668)	(0.0864)	(0.0603)	(0.108)	(0.0550)
Aspiration	0.189	0.0577	0.309	0.184	0.158	-0.385	0.407*	0.502	0.0905
	(0.141)	(0.136)	(0.217)	(0.243)	(0.133)	(0.263)	(0.167)	(0.310)	(0.158)
PPVT score	4.286	3.013	6.470*	7.511*	-0.298	5.374	4.328	4.217	4.387
	(2.359)	(2.624)	(3.122)	(3.285)	(2.919)	(4.188)	(2.803)	(4.951)	(2.640)
MATH score	1.114***	1.270*	1.125**	1.463***	0.644	1.797**	0.894*	1.633**	0.954**
	(0.306)	(0.508)	(0.343)	(0.371)	(0.466)	(0.592)	(0.357)	(0.589)	(0.355)
N	974	403	571	500	474	260	714	236	738

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

Regression results

The gender gap is further investigated using a multivariate regression approach controlling for a series of possible covariates for the indicators used. The achievement indicators are regressed on a dummy for gender (1=female) as well as time use of children, wealth index of the household, household size, number of siblings, and urban/rural location of residence. To account for the dynamic aspect of skill formation, the estimations also include lagged

values of the test score (previous test scores at earlier ages) and the control variables. This analysis is made possible by using the panel dimension of the data. As previously mentioned, following Dercon and Singh (2013), it would be possible to see whether gender gaps that existed at the age of 12 still appear at the age of 15 (for the case of older cohorts).

The results for the younger cohort at the age of 12 are presented in Table 4. Column (1), reports the coefficient of the female dummy from OLS regression with no control variables for the cognitive (PPVT and MATH) and non-cognitive (self-esteem and self-efficacy) skill measures. Column (2) controls for child, household and community level covariates (such as children's time use, place of residence, socioeconomic status, and household composition). All the variables (except the dummy variables – gender and urban/rural location) are standardized to have zero mean and unitary variance to ease interpretation of coefficients.

Table 4: OLS estimation of test scores, younger cohort

	PPVT		MATH		Self-efficacy		Self-esteem	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Female dummy	-0.020	-0.034	-0.058	-0.014	-0.048	-0.038	0.024	0.102
	(0.056)	(0.053)	(0.061)	(0.046)	(0.039)	(0.036)	(0.049)	(0.060)
Time on chores		-0.080**		-0.134***		-0.080*		-0.063
		(0.035)		(0.032)		(0.038)		(0.042)
Time on farm work		-0.174***		-0.132***		-0.103**		-0.009
		(0.039)		(0.037)		(0.044)		(0.036)
Time on studying		0.064		0.096**		-0.001		0.008
		(0.052)		(0.037)		(0.052)		(0.037)
Grandparent present		0.016		-0.030		0.030		-0.004
		(0.021)		(0.023)		(0.029)		(0.025)
No. of siblings		-0.062**		-0.058*		0.031		-0.092**
		(0.022)		(0.028)		(0.029)		(0.037)
Urban dummy		0.207**		0.273***		0.001		-0.047
		(0.087)		(0.082)		(0.077)		(0.064)
Wealth index		0.199***		0.213***		0.036		0.235***
		(0.051)		(0.043)		(0.044)		(0.044)
N	1857	1854	1808	1805	1877	1873	1877	1873
R^2	0.001	0.365	0.001	0.450	0.001	0.043	0.001	0.096
BIC	5283.806	4520.486	5143.376	4150.785	5339.686	5339.641	5340.490	5233.223

Notes: Standard errors clustered at the community level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The estimation results in Table 4 show no significant gender effect for the younger children. The sign of the coefficient on the gender dummy, however, is negative in all the models indicating that girls may be underperforming boys. This result is in agreement with the findings of the descriptive analysis in the previous section.

The manner in which the younger cohort children spend their time has a significant effect on their achievement scores. It can be observed that the time children spend on household chores and farm work negatively affects their PPVT and MATH scores and self-efficacy. For the same cohort, time spent on studying has a significant positive effect on their MATH scores.

The number of siblings in families has an influence on children's cognitive and non-cognitive skills. For instance, the greater the number of siblings, the more adverse the effect on their PPVT and MATH scores and on their self-esteem.

Cognitive skills of children are significantly affected by virtue of being located in urban or rural areas. The results indicate that living in urban areas has a significant positive effect on children's PPVT and MATH scores. This is also true for children living in relatively non-poor families, where the wealth index is found to have a significant positive effect on PPVT and MATH scores and self-esteem.

The results for the older cohort at the age of 15 are presented in Table 5. Column (1) reports the coefficient of the female dummy from OLS regression with controls for child, household and community level covariates (such as children's time use, place of residence, socioeconomic status, and household composition). Column (2) reports OLS coefficients from a "value-added" model where we control for past achievement scores and lagged values of covariates (previously accumulated skills, and inputs invested at the age of 12). All the variables (except the dummy variables) are standardized to have zero mean and unitary variance to ease interpretation of the coefficients.

Table 5: OLS estimation of test scores, older cohort

	PPVT		MATH		Self-efficacy		Self-esteem		Aspiration	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Female dummy	-0.268***	-0.299***	-0.249***	-0.198***	-0.152*	-0.152*	-0.032	-0.036	-0.058	-0.068
	(0.062)	(0.065)	(0.068)	(0.069)	(0.074)	(0.079)	(0.100)	(0.100)	(0.058)	(0.058)
Time on chores	-0.008	-0.073	-0.094**	0.018	-0.108**	-0.050	0.012	0.022	-0.177***	-0.136**
	(0.036)	(0.046)	(0.039)	(0.050)	(0.045)	(0.052)	(0.051)	(0.053)	(0.054)	(0.050)
Time on farm work	-0.143***	-0.066	-0.070	0.014	-0.036	-0.028	0.033	-0.052	-0.182**	-0.170**
	(0.044)	(0.052)	(0.042)	(0.027)	(0.047)	(0.037)	(0.043)	(0.051)	(0.072)	(0.064)
Time on studying	0.104**	-0.062	0.191***	-0.020	0.074*	0.035	0.149***	0.002	0.047	-0.060
	(0.049)	(0.043)	(0.044)	(0.050)	(0.039)	(0.058)	(0.050)	(0.051)	(0.043)	(0.040)
Grandparent present	-0.006	-0.077**	-0.009	-0.096**	0.020	-0.052	0.010	0.079*	-0.007	-0.008
	(0.029)	(0.036)	(0.020)	(0.045)	(0.036)	(0.069)	(0.034)	(0.042)	(0.030)	(0.054)
No of siblings	-0.068**	-0.018	-0.057**	0.047	-0.046	0.011	-0.021	-0.092	0.006	-0.009
	(0.024)	(0.081)	(0.026)	(0.075)	(0.046)	(0.063)	(0.040)	(0.083)	(0.045)	(0.085)
Urban dummy	0.217**	0.081	0.146*	-0.031	0.088	0.009	0.003	0.164*	0.083	0.092
	(0.084)	(0.055)	(0.084)	(0.055)	(0.054)	(0.053)	(0.088)	(0.082)	(0.069)	(0.058)
Wealth index	0.191***	0.052	0.113	0.022	0.054	0.100*	0.210**	0.017	0.060	-0.046
	(0.062)	(0.051)	(0.072)	(0.057)	(0.037)	(0.051)	(0.081)	(0.065)	(0.039)	(0.041)
Lagged score		0.206***		0.383***		0.018		-0.103**		0.006
		(0.039)		(0.050)		(0.030)		(0.040)		(0.022)
N	952	789	961	789	962	816	962	817	953	772
R^2	0.289	0.390	0.242	0.405	0.084	0.115	0.099	0.144	0.155	0.153
BIC	2470.45	2002.40	2558.30	1958.99	2728.49	2330.04	2723.72	2358.88	2641.71	2103.03

Notes: Standard errors clustered at the community level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Column (1) presents OLS estimates of current inputs, Column (2) presents OLS results with lagged inputs and lagged test-scores. Coefficients on lagged inputs are not presented for the sake of brevity.

Controlling for the different covariates, older cohort girls significantly underperform boys in achievement scores. For instance, as presented in Table 5, on average, 15-year-old girls score 0.268 std. and 0.249 std. less than boys in PPVT and MATH scores, respectively and holding all variables constant; and 0.299 std. and 0.198 std. less than boys in PPVT and MATH scores when controlling for past achievement scores and lagged values of covariates. This is also the case for one of the non-cognitive measures: where girls at the age of 15 are found to have 0.152 std. less self-efficacy than boys, holding all variables constant and controlling for past achievement scores and lagged values of covariates.

In relation to time use and the cognitive and non-cognitive skills of the older cohorts, a similar trend is observed with the younger cohort children. Time spent on farm work has a significant adverse effect on children's PPVT scores. On the other hand, time spent studying outside of school has a significant positive effect on all the test scores, except aspiration.

Older cohort children's achievements are also affected by the composition of the household. For example, the presence of grandparents and number of siblings in the families are observed to have significant negative effects on the PPVT and MATH scores. Location of the family in urban or rural areas also affects children's achievement scores. Being located in urban areas positively affects older cohorts' PPVT and MATH scores, as well as their self-esteem.

Previously accumulated skills and inputs invested at earlier ages have a positive effect on children's cognitive skills. Lagged scores, from age 12, are found out to have a significant positive effect on the PPVT and MATH scores of children at the age of 15. However, this same variable is seen to significantly affect their self-esteem negatively.

Conclusions

The findings indicate that older girls underperform boys in their cognitive skills. This is observed for both the measures used: PPVT and MATH scores. The gender gap in mathematics in favour of boys is a phenomenon in the developed nations as well (Fryer and Levitt 2010; Robinson and Lubienski 2011; Contini et al. 2017). However, regarding the PPVT score, the results are contrary to the consistent and growing findings from the developed countries, where girls tend to outperform boys in reading literacy (Robinson and Lubienski 2011; Reilly 2012; Legewie and Di Prete 2012). The cognitive gaps in the study are found to be more pronounced with older girls and have been found to be significant even after controlling for different covariates and lagged values.

The study used self-efficacy, self-esteem and educational aspirations as measures of the psychosocial gender gap. Older girls are found to score less on self-efficacy than boys. Consistent with the simple descriptive results, the regression results are also largely statistically insignificant for the self-esteem and aspiration indicators.

The findings from the younger cohort show no significant cognitive and non-cognitive gender gaps. The negative sign of the gender dummy coefficient in all the models, however, suggests that maybe girls are underperforming boys. Various studies indicate different ages when gender gaps in cognitive skills open up (Chatterji 2006; Tach and Farkas 2006; Penner and Paret 2008; Contini et al. 2017). Identifying when the gaps start to open up will have critical policy implications.

The results from the control variables indicate that the different situations children in general live in have significant effects on their cognitive and psychosocial skills development. Irrespective of their gender, children are affected by parental, socioeconomic, and community characteristics. The result also shows that girls are disproportionately affected.

Even though this study is only a preliminary descriptive analysis, and didn't make any causal links, it is possible to see the existence of a clear gender differences between boys' and girls' cognitive and non-cognitive scores. It is also evident that this difference in achievement scores by children is heterogeneous in that it differs with different personal characteristics (such as age and gender) in different processes and contexts (such as socioeconomic status, place of residence, household composition and parental literacy) at different points in time. These findings are in line with the PPCT model in that they indicate the development of a child as shaped by the interaction between the child and the different subsystems of the context that are dynamic in different times.

References

BERTRAND, Marianne and Jessica PAN. 2013. "The Trouble with Boys: Social Influences and The Gender Gap in Disruptive Behaviour." *American Economic Journal: Applied Economics* 5(1): 32–64.

BISESWAR, Indrawatie. 2008. "Problems of Feminist Leadership among Educated Women in Ethiopia: Taking Stock in the Third Millennium." *Journal of Developing Societies* 24(2): 125–158.

BORGA, Liyousew G. 2018. "Children's Own Time Use and its Effect on Skill Formation." *The Journal of Development Studies*: 1–18.

BORGHANS, Lex, Angela Lee DUCKWORTH, James J. HECKMAN and Bas TER WEEL. 2008. "The Economics and Psychology of Personality Traits." *Journal of Human Resources* 43(4): 972–1059.

BRONFENBRENNER, Urie and Pamela A. MORRIS. 2006. "The Bioecological Model of Human Development." Pp. 793–828 in *Handbook of Child Psychology, vol.1: Theoretical Models of Human Development*, 6th ed., edited by William DAMON and Richard M. LERNER. New York: Wiley.

CHATTERJI, Madhabi. 2006. "Reading Achievement Gaps, Correlates, and Moderators of Early Reading Achievement: Evidence from the Early Childhood Longitudinal Study (ECLS). 'Kindergarten to First Grade Sample'." *Journal of Educational Psychology* 98(3): 489–507.

CONTINI, Dalit, Maria Laura DI TOMMASO and Silvia MENDOLIA. 2017. "The Gender Gap in Mathematics Achievement: Evidence from Italian Data." *Economics of Education Review* 58: 32–42.

CSA. 2014. *Key Findings on the 2013 National Labor Force Survey*. The Federal Democratic Republic of Ethiopia Central Statistical Agency: Addis Ababa, Ethiopia.

CUETO, Santiago and Juan LEON. 2012. *Psychometric Characteristics of Cognitive Development and Achievement Instruments in Round 3 of Young Lives*. Young Lives. Retrieved October 19, 2018 (https://www.younglives.org.uk/sites/www.younglives.org.uk/files/YL-TN25_Cueto.pdf).

CUETO, Santiago, Juan LEON, Gabriela GUERRERO and Ismael MUÑOZ. 2009. *Psychometric Characteristics of Cognitive Development and Achievement Instruments in Round 2 of Young Lives*. Young Lives. Retrieved October 19, 2018 (https://www.younglives.org.uk/sites/www.younglives.org.uk/files/YL-TN15-Cueto-Psychometric-Characteristics.pdf).

CUNHA, Flavio and James J. HECKMAN. 2007. "The Technology of Skill Formation." *American Economic Review* 97(2): 31–47.

DERCON, Stefan and Alan SANCHEZ. 2013. "Height in Mid-childhood and Psychosocial Competencies in Late Childhood: Evidence from Four Developing Countries." *Economics & Human Biology* 11(4): 426–432.

DERCON, Stefan and Abhijeet SINGH. 2013. "From Nutrition to Aspirations and Self-efficacy: Gender Bias over Time among Children in Four Countries." *World Development* 45: 31–50.

EFDRE. 1995. *The Constitution of the Federal Democratic Republic of Ethiopia*. Addis Ababa.

EFDRE. 2000. "Revised Family Code of Ethiopia." Federal Democratic Republic of Ethiopia. Addis Ababa: Ethiopia. Retrieved October 15, 2018 (http://www.refworld.org/pdfid/4c0ccc052.pdf).

FAFCHAMPS, Marcel and Agnes R. QUISUMBING. 2002. "Control and Ownership of Assets within Rural Ethiopian Households." *Journal of Development Studies* 38(6): 47–82.

FRYER Jr, Roland G. and Steven D. LEVITT. 2010. "An Empirical Analysis of the Gender Gap in Mathematics." *Applied Economics* 2(2): 210–240.

GUTMAN, Leslie Morrison and Ingrid SCHOON. 2013. *The Impact of Non-cognitive Skills on Outcomes for Young People*. London: Education Empowerment Foundations.

HARDGROVE, Abby, Kirrily PELLS, Jo BOYDEN and Paul DORNAN. 2014. "Youth Vulnerabilities in Life Course Transitions." UNDP Occasional Paper. New York: UNDP. Retrieved October 20, 2018 (http://hdr.undp.org/sites/default/files/hardgrove_boyden_hdr_2014.pdf).

HECKMAN, James J. 2006. "Skill Formation and the Economics of Investing in Disadvantaged Children." *Science* 312(5782): 1900–1902.

HECKMAN, James J. and Yona RUBINSTEIN. 2001. "The Importance of Noncognitive Skills: Lessons from the GED Testing Program." *American Economic Review* 91(2): 145–149.

HECKMAN, James J., Jora STIXRUD and Sergio URZUA. 2006. "The Effects of Cognitive and Non-cognitive Abilities on Labor Market Outcomes and Social Behavior." *Journal of Labor Economics* 24(3): 411–482.

KRISHNAN, Vijaya. 2010. "Early Child Development: A Conceptual Model." Paper presented at the Early Childhood Council Annual Conference 2010, Christchurch, New Zealand. Retrieved October 20, 2018 (https://pdfs.semanticscholar.org/8099/6bed2ef51e4128e5251f98242009888f4028.pdf).

LEGEWIE, Joscha and Thomas A. DIPRETE. 2012. "School Context and the Gender Gap in Educational Achievement." *American Sociological Review* 77(3): 463–485.

MOE. 2015. "Educational Statistics Abstract, 2006 EC (2013/2014)." Education Management Information Systems, Ministry of Education.

MURNANE, Richard J., John B. WILLETT and Frank LEVY. 1995. "The Growing Importance of Cognitive Skills in Wage Determination." *Review of Economics and Statistics* 77(2): 251–266.

NOBOA-HIDALGO, Grace E. and Sergio S. URZUA. 2012. "The Effects of Participation in Public Child Care Centers: Evidence from Chile." *Journal of Human Capital* 6(1): 1–34.

PENNER, Andrew M. and Marcel PARET. 2008. "Gender Differences in Mathematics Achievement: Exploring the Early Grades and the Extremes." *Social Science Research* 37(1): 239–253.

REILLY, David. 2012. "Gender, Culture, and Sex-Typed Cognitive Abilities." *PLoS ONE* 7(7).

ROBINSON, Joseph Paul and Sarah Theule LUBIENSKI. 2011. "The Development of Gender Achievement Gaps in Mathematics and Reading during Elementary and Middle School: Examining Direct Cognitive Assessments and Teacher Ratings." *American Educational Research Journal* 48(2): 268–302.

SMITH, Lindsay. 2011. "Applying the Bioecological Theory of Human Development to Learning: Enhancing Student Engagement in Online Learning." *10th Teaching Matters Annual Conference: Sharing Practice* 5: 1–8.

TACH, Laura Marie and George FARKAS. 2006. "Learning-related Behaviors, Cognitive Skills, and Ability Grouping when Schooling Begins." *Social Science Research* 35(4): 1048–1079.

TODD, Petra E. and Kenneth I. WOLPIN. 2007. "The Production of Cognitive Achievement in Children: Home, School, and Racial Test Score Gaps." *Journal of Human capital* 1(1): 91–136.

TUDGE, Jonathan R.H., Irina MOKROVA, Bridget E. HATFIELD and Rachana B. KARNIK. 2009. "Uses and Misuses of Bronfenbrenner's Bioecological Theory of Human Development." *Journal of Family Theory & Review* 1(4): 198–210.

WOLDEHANNA, Tassew. 2011. "The Effects of Early Childhood Education Attendance on Cognitive Development: Evidence from Urban Ethiopia." *Ethiopian Journal of Economics* 20(1): 113–164.

WORLD ECONOMIC REPORT. 2013. "The Global Gender Gap Report 2013." Retrieved June 5, 2014 (http://www3.weforum.org/docs/WEF_GenderGap_Report_2013.pdf).

YOUNG LIVES. 2013. "Young Lives Survey Design and Sampling in Ethiopia: Preliminary Findings from the 2013 Young Lives Survey (Round 4)." Retrieved November 22, 2016 (http://www.younglives.org.uk/sites/www.younglives.org.uk/files/Ethiopia-SurveyDesign-Factsheet.pdf).

YOUNG LIVES. 2015. "What Can Longitudinal Research Tell Us about Children's Life-Chances?" Retrieved November 2, 2016 (http://www.younglives.org.uk/publications/TN/what-can-longitudinal-research-tell-us-about-childrens-life-chances).

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