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Impact of Different Types of Schooling on Achievement in the School System: Evidence from Ethiopia

Obiageri Bridget Azubuike

2015 No. 67

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WORKING PAPER

Impact of Different Types of Schooling on Achievement in the School System: Evidence from Ethiopia

Obiageri Bridget Azubuike

Dissertation submitted in partial fulfilment of the requirements for the Degree of Master of Science in Economics
University of Sussex

2015 No. 67

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About the Author

OBIAGERI BRIDGET AZUBUIKE is currently a quantitative research assistant at the Oxford Department of International Development. She has a Masters in Economics from the University of Sussex and a BSc in Economics and Statistics from University of Benin in Nigeria. She is interested in International Development, Child Right Advocacy and research in Economics of Education. As part of her MSc dissertation she analysed the impact of different types of schools on achievement for primary school children in Ethiopia.

This paper is one of a series of policy-oriented research papers on privatisation in education jointly commissioned by the Privatisation in Education Research Initiative (PERI) and Young Lives using school survey data from the Young Lives longitudinal study of childhood poverty in Ethiopia, India, Peru and Vietnam. The findings of these diverse studies reflect on the manner and extent to which the varied supply of schooling types and private tutoring influences the pivotal role education has to play in societal development and building sustainable futures for all.

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About Young Lives

Young Lives is a longitudinal study of childhood poverty following the lives of 12,000 children in Ethiopia, India, Peru and Vietnam over 15 years. It is funded by UK aid from the Department for International Development (DFID) and co-funded by the Netherlands Ministry of Foreign Affairs from 2010 to 2014 and by Irish Aid from 2014 to 2015. The full text of Young Lives publications and more information about its work is available on the Young Lives website: **www.younglives.org.uk**

Young Lives
An International Study of Childhood Poverty

Abstract

Educational achievement of pupils attending primary schools are different depending on the type of school they attend. This paper examines how these achievements vary by school type and the role that school inputs play in pupils' educational achievement. Using data from the Young Lives project, this study finds that while individual and household characteristics the children enrol into school with are key drivers of educational achievement, school factors explain a large share of the educational achievement gaps of primary school pupils in Ethiopia. This paper concludes that targeted policies which aim to reduce individual and household gaps prior to primary school enrolment are very important but more importantly policies that encourage an enabling environment for quality learning to thrive will also play an important role in improving learning outcomes for primary school children in Ethiopia.

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Acronyms

CSAE	Centre for the Study of African Economics
EFA	Education for All objectives
ERHS	Ethiopia Rural Household Survey
ESDP	Ethiopian Ministry of Education Sector Development Program
ES-SS	Education Sub-Sample Survey
GDP	Gross Domestic Product
GEQIP	General Education Quality Improvement Package
MDGs	Millennium Development Goals
MOE	Ethiopian Ministry of Education
NGO	Non- Governmental Organisation
NOE	National Organisation for Examinations
PSLCE	Primary School Leaving Certificate Examination
SES	Social Economic Status

Preface

The Purpose of this research is to examine the impact of school type on achievement of primary school pupils in Ethiopia. Individual, household and school factors of pupils have been investigated to provide an understanding of the roles they play in their academic achievement.

This research is a response to a call for research papers (2014) by Privatisation in Education Research Initiative (PERI) and the Young Lives Project. The main source of data for this work comes from the Young Lives project, a 15-year study of the changing nature of childhood poverty in India (Andhra Pradesh), Ethiopia, Peru and Vietnam (www.younglives.org.uk). And so I thank the Young Lives team for supporting this research and for providing very useful feedback on the previous draft of this paper.

I am very grateful to my supervisor, Professor Andy McKay for his exceptional guidance and support throughout the period of this research. I sincerely appreciate useful discussions with Professor Barry Reilly on the methods of this research. I also appreciate the contributions of my friends to the completion of this project.

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Finally, I dedicate this project to the Almighty God in whom my strength lies.

Map 1—*Map of Ethiopia*

Map No. 4188 Rev. 5 UNITED NATIONS
March 2012

Department of Field Support
Cartographic Section

Source: Map No 4188 Rev. 5 United Nations. March 2012, http://www.un.org/depts/Cartographic/map/profile/horne.pdf

1. Introduction

1.1 Education and Development

The role of education in the process of Economic Development has long been studied by economists and education has been found to play a crucial role in the development process of developed economies. (Glewwe and Ilias, 1996) argue that education is both an end in itself and a means to many ends. The role of education goes beyond the economic impact, it is also important for human and social development. Educated people are able to make informed decisions about their health, education provides people with cognitive skills, scientific knowledge and social skills. Education is also closely linked to labour productivity and (Ashenfelter and Rouse, 1998) provides evidence that higher education leads to higher earnings, thus education or level of schooling can be used to understand wage differentials among employees. The consensus is that education is multifaceted and very important especially for low and middle income countries with economic development in sight.

In light of the above, the present paper believes that quality education is very important if any economy must reap the benefits of having educated citizens. Quality Education is one that provides learners with the capabilities, skills and knowledge required to become economically productive and it is this achievement that drive the advocacy for education. In past decades, the issue of high level illiteracy in developing countries led to international advocacy and increased support for access to education, for example, Education for All (EFA) and Millennium Development Goals (MDGs). Because of these perceived benefits of education as well as the international advocacy for increased access to education, demand for education has increased and governments' are increasing expenditure in their education sectors through introduction of educational targeted policies and investments in provision of schools among other things.

The current issues in many developing countries in general and Ethiopia in particular is that increased access has not necessarily transformed into the desired outcomes. The increased enrolment rates have raised concerns about the quality of Education, hence we see a shift from the focus on quantity of education to quality of education and an understanding of the factors that determine these educational achievements is the central question of this research. The way schools carry out the task of educating their pupils is very important in the educational achievement process but a pupil's individual and household characteristics also play a very crucial role in this outcome.

1.2 Justification of the Research

This research aims to contribute to the literature on factors that determine educational achievement and one can argue that these factors also determine progression through school because to the extent that students remain in school and perform well on tests and assessments, they will be promoted and other things being equal will attain the required literacy skill and other skills required to be educated. The research will attempt to explain the role of school type in explaining achievement of students, while there exist a voluminous literature on the factors that determine enrolment into schools (chapter

two) in developing countries in general and even specifically for Ethiopia, quantitative studies on achievement in Ethiopia is still scarce and specifically for understanding the role of different school types which is the aim of this study.

Ethiopia provides a unique case for examining the factors that determine educational achievement, and how school types explain the differences in achievements of primary school students. Following the international advocacy for increased access to education in developing countries, through the Education for All (EFA) and Millennium development Goals (MDGs), countries like Ethiopia have seen increased enrolments into school and increased government policies to drive enrolment according to (MOE; ESDP-IV, 2010:6). Ethiopia has made significant progress in education and access at all level of the education system increased at a rapid rate under the ESDP III of 2005-2006. While enrolment rates improve significantly, there is still major concern for educational achievement in Ethiopia. The number of illiterate youths in Ethiopia in 2010 were 7.1million (UNESCO, 2012) and this raises the question of how much education children are receiving despite increased access to education. Dom 2010 via (Rolleston et al., 2013) posits that these achievements by developing countries to widen access is likely drive down learning indicators as relatively disadvantaged children enrol into school. Hence the focus of current government policies in Ethiopia are geared towards ensuring student completion and achievement.

The Young Lives study on which this research is built provides detailed information about individual, household and school characteristics. While most of the research on education examines schools in two forms, private and public, the Young lives data provide information on community schools, faith schools, NGO schools as well as government and private schools offering this research the opportunity to further investigate their roles in the educational outcomes of children in Ethiopia.

1.3 Research Questions

This research will focus on measuring the educational achievement of primary school pupils in Ethiopia and investigate the role of school type, individual and household factors. Hence the specific research questions are as follows;

1. What factors determine educational achievement?
2. To what extent does educational achievement differ by school type?
3. If differential patterns exist what factors might explain these differences in educational achievement?
4. Is there a gender differential in educational achievement?

1.4 Ethiopia at a Glance

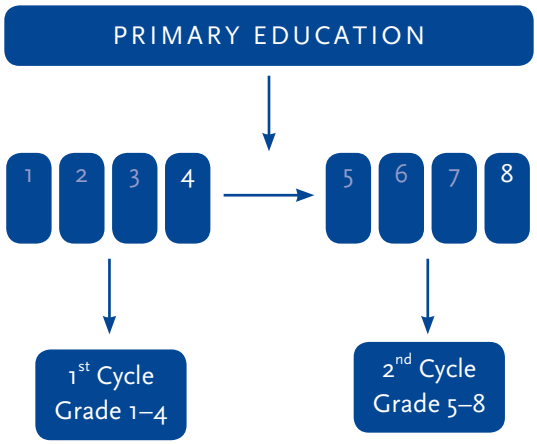
Ethiopia is located in the North Eastern part of Africa. It is bounded in the North by Eritrea and Djibouti, in the East and South East by Somalia, in the South West by Kenya, and in the West and North by Sudan. Ethiopia's population in 2013 was approximately 94.10 million (World Bank, 2014) making it the second most populous nation in Africa after Nigeria. There are more than 80 spoken languages in Ethiopia and about 22 are

used as media of instructions in schools. Traditional agriculture and pastoralist practices employ about 80% of the population and the GDP (current US$) in 2013 was $46.87 billion and 29.6% of the population live below the national poverty line (World Bank, 2014). The agricultural sector is the main driver of the Ethiopian economy and provides income for majority of the population. The sector contributes about 50% to total GDP, generates about 90% of export earnings and supplies about 70% of the country's raw material requirement for large and medium sized industries that are agro-based (MOE ESDP-IV,[1] 2010:8).

1.5 The Ethiopian Primary Education System

Figure 1 provides a graphical illustration of the structure of the primary education system in Ethiopia as the research focus is on primary education in Ethiopia. The Ethiopian academic year runs from September to July,[2] Primary Education lasts for 8 years and consists of two cycles;

Figure 1—*Structure of the Ethiopian Primary Education System*



Source: Ethiopian Federal Ministry of Education (2012)

First Cycle Primary Schools, Grades 1–4: Children enter primary school at various ages because of the agrarian nature of the economy where a number of them are involved in farming for a while before they enrol into school but the official primary admission age is 7 years, primary education is free and compulsory. Net enrolment rates into the first cycle primary schools increased from 86.6% in 2010 to 95.5% in 2013 (MOE, 2012). At the end of the first cycle of primary school, children are expected to proceed to the second cycle based on their academic performance, current national policy requires that promotion is based on students' continuous assessment results for the first three grades of primary and this will determine the entry age into the second cycle.

1. Ethiopian Ministry of Education Sector Development Program IV.
2. Ethiopia uses its own calendar. The year begins in September and the Ethiopian year is seven or eight years behind the Gregorian year, depending on the time of year. In this paper, when years are used they refer to the Gregorian calendar not the Ethiopian calendar.

Second Cycle Primary Schools, Grades 5–8: Net enrolment rates into the second cycle was 46.4% in 2010 and increased to 47.3% in 2013 (MOE, 2012) which gives an indication that in Ethiopia not all children that enrolled in the first cycle progress to the second cycle of primary education. Admission to first and second cycle primary schools is open to all students and at the end the second cycle of primary school pupils sit for PSLCE- Primary School Leaving Certificate Examination which determines progression to secondary school.

The current trends of enrolment in Ethiopia shows an increase in enrolment in education at different levels of education especially primary education, in a bid to achieve the EFA-Education for All objectives and Millennium Development Goals (MDGs), countries such as Ethiopia have made significant progress to increase access to primary education, but the (MOE ESDP-IV, 2010) reports that "the gains to access are of little meaning if they are not accompanied by improved student learning." The major challenge of quality education especially at the primary level is that of completion, repetition and drop-out rates are also very high mostly in the first cycle (MOE ESDP-IV, 2010). Promotion is based on continuous assessment. Children can be required to repeat a grade if their teachers doubt that they have accomplished enough of the learning goals for the year. "However, if teachers are supporting students properly, all students should be able to complete each grade" (Orkin, 2011:4).

In 2012, 22.7% of pupils that enrolled in grade 1 dropped out of school before reaching grade 2 and 9% repeated grade 1 in the same year at the national level thereby reducing the number of students who survive to grade 5 which is the second cycle (MOE, 2012). The survival rate to grade 5 according (MOE, 2012) is calculated by estimating the percentage of pupils that complete grade 4 (first cycle of primary education) which is a requirement to attain a basic level of literacy. Repetition has a negative impact on a student's achievement as well as dropping out of school (even for those who return), hence the Ethiopian Ministry of Education under Education Sector Development Program IV (ESDP IV) launched the GEQIP-General Education Quality Improvement Package (2009-2013) which focuses on improving educational quality. The GEQIP is structured around certain components of educational quality which include the development of teachers and leaders' curriculum, textbook and assessment, school planning and improvement of school resources used among others (MOE ESDP-IV, 2010). This study agrees that quality education should be the centre of educational policies in Ethiopia and hence understanding the determinants to educational achievement is the core of this research.

Primary Schools in Ethiopia are divided into government and non-government schools in terms of ownership. Government primary schools are administered and controlled by the government while non-government schools are administered by institutions other than the government and may include religious institutions, NGO's, the private sector and communities (NOE, 2014:7). Since 1994, Ethiopia has used a 'self-contained system' in the first four grades of primary school and this policy means that one teacher teaches all subjects to a class (Orkin, 2011). At the end of primary school, students are expected to have achieved skills in mathematics, in literacy and science among other subjects.

This study relies on quantitative data from the Young Lives Longitudinal study of childhood poverty and is organised into six chapters. Chapter one gives an introduction and chapter two presents the empirical literature on education. The data and empirical methodology

are highlighted in chapter three, the descriptive analysis of the variables used in the regressions is covered in chapter four, chapter five presents the results of the study and the paper concludes in chapter six with a summary and policy recommendations.

2. Literature Review

The literature on education have come a long way in explaining the rationale behind investment in education, most of which stems for the conventional human capital theory. According to Glewwe (2002), in the 1950's and 1960's economist such as Gary Becker, Jacob Mincer, T.W. Schultz amongst others emphasized the role of education in the development of the economy (Becker, 1975). The Theory of Human capital supports the view that formal education is highly instrumental and necessary to improve the productive capacity of a population. 'Education increases the productivity and efficiency of workers by increasing the level of cognitive stock of economically productive human capability, which is a product of innate abilities and investment in human beings' (Olaniyan and Okemakinde, 2008:479). The research literature on education have also long agreed that educated persons are more motivated, healthier, more productive and contribute more to economic growth than less educated people (Glewwe, 2002).

In the context of developing countries, the current research reviews the determinants of enrolment and proceeds to review the factors responsible for educational achievements in developing countries in general.

2.1 School Enrolment Literature

In examining the factors that determine enrolment and demand for education in developing countries, researchers investigate the importance of socio-economic characteristics such as household income and its impact on enrolment. In general, because of the direct and indirect costs of sending a child to school, the research literature has found income and household wealth to be an important determinant of investment in human capital and thus enrolment into school see Becker (1975), Jacoby and Skoufias (1997) & Jensen (2000).

(Grimm, 2011) uses the income elasticity of school enrolment to explain the importance of household income on demand for education in the Sub-Saharan African context, using a natural experiment for children in Burkina Faso, the study found strong and robust effects of income on school enrolment, results from the study revealed that a decline in income by ten percent causes a fall in enrolment rates of boys between the ages of six and sixteen years by about 2.8% points. (Jacoby, 1994) reveals that income shocks and borrowing constraints negatively impact school attendance for children in Peru.

Household wealth and income is significant but there exist other household characteristics that determine school enrolment especially in developing countries and they are centred on the parents' willingness and ability to send their children to school. (Weir, 2011) analysed the impact of parental attitudes towards education for children in Ethiopia using data from ERHS[3] which surveyed 1,477 households in eighteen villages in Ethiopia and ES-SS[4] to supplement limited information in the ERHS. Parental attitudes to education

3. Ethiopia Rural Household Survey (ERHS) was conducted by the Department of Economics, Addis Ababa University, in collaboration with the Centre for the Study of African Economies (CSAE), Oxford, in 1994.

4. ES–SS: Education Sub-Sample Survey.

reveals the willingness of parents to invest in the human capital of their children, what is interesting to note is that economic factors (such as wealth) and demographic factors (such as location) which also determine school enrolment are factors that form parents attitude towards schooling. After controlling for other determinants of enrolment, (Weir, 2011) concludes that parental attitudes are consistent with enrolment and parents with positive attitudes towards education were more likely to have one or more of their school aged children enrolled in school.

The previously existing gaps in the literature of school enrolment was as a result of relying on those factors that could easily be measured such as wealth, (although they are key determinants of demand for education) and leaving factors such as attitude as unobservable. According to (Weir, 2011) parental attitudes are measurable and found that differences in attitudes explains enrolment decisions of households in Ethiopia. Other studies on school attendance have found that urban location, gender, and parental education are important determinants of school attendance see, (Connelly and Zheng, 2003; Al-Samarrai and Reilly, 2000).

Gender differences in school attendance have been discussed in the literature and some of these differences exists as a result the opportunity cost of sending girls to school in developing countries as opposed to investing in the human capital of boys (Yueh, 2001). According to (Lahiri and Self, 2007), one of the most undeniable bias against females in developing countries is in the area of education. As explained by (Kingdon, 2002), one of the explanations for this bias in education of females is due to labour market discrimination against women and this in turn leads to girls facing lower "economic incentives" to invest in education. Although gender inequality issues still exist in school enrolment, current trends in education enrolment in Ethiopia show that the gender gaps in school enrolment are reducing (MOE, 2012).

The current study focuses on school achievement but recognizes that factors which largely explain achievement are also likely to drive enrolment and according to (Chudgar and Quin, 2012), children do not randomly enrol into different schools, school attendance reflects parents choices amongst other things which may in turn determine a child's educational achievement. Educational achievement in this case is defined as the outcome of education i.e. the extent to which a student has achieved his/her educational goals. The factors that influence achievement have been categorised into individual characteristics, household characteristics and school factors (see Aslam and Kingdon, 2011).

2.2 Educational Achievement Literature

The educational achievement literature have mostly adopted the education production function as the theory behind explaining the determinants of children's academic achievements, where the child is the raw material and household characteristics are factors that enhance the raw material. The school factors are seen as input into the production function and the finished product (output) is the achievement usually measured by test scores. The theory behind the educational production function pioneered from the input-output analysis of the "Coleman Report" a study of Equality of Education. Economists adopted the Coleman Report to study the determinants of educational achievements and the relationship estimated became known as the "Educational Production Functions" (Hanushek, 1979: 352).

Individual Characteristics

One of the frequent individual determinant of educational achievement as recognised by the research literature is the health of a child as well as nutrition see (Aturupane et al., 2011). Illness and mal-nutrition could lead to frequent absenteeism which in turn could impact a child's educational outcome negatively, (Zhao and Glewwe, 2010) in their study using height-for-age Z-score[5] as a measure of nutritional status of children in China, found it to have significant explanatory power on a child's educational attainment. Children who are frequently ill will also be unable to spend time studying.

Innate ability of a child usually measured by IQ tests in the research literature has been long viewed as an important element of children's scholastic achievement (Jensen, 1969). Empirical studies on educational achievement that have not provided a measure of students ability risk producing biased estimates because the estimated coefficients of observed learning efficiencies will be correlated with their unobserved components which are in the error term (e). As a proxy for innate ability, (Kingdon, 1996) used Raven's Progressive Matrices test[6] and found it to be one of the most significant determinants of achievement scores for students of class 8 between the ages of 13 and 14 across various schools in India. The result of the study suggests that a one point increase in the Ravens test increases the student's achievements test by 0.36points on average and ceteris paribus. Other measures have been used to capture ability in the research literature for example instrumental variable approach and family fixed effects (see Glewwe, 2002: 447). Although, there may be no perfect measure for innate ability the understanding that it is an important component of educational achievement provides some guidance for empirical estimations.

Examining the role of gender in educational achievement, (Rose, 2003) finds that significant gender gaps exists in achievement for children in Ethiopia, and the gender gap in achievement increases as children progress through school the evidence suggests that boys in general achieve higher than girls and this gap is wider in mathematics compared to all other subjects. This gender difference will in turn be investigated in the current research.

Household factors

Household characteristics have been identified in the literature as important for explaining school achievement. According to (Jones et al., 2005), wealth obviously determines investment in education, it also determines educational attainment of a child because children whose parents are able to continue bearing the cost of keeping them in school are more likely to complete school. The literature on child labour and education also suggest that child work is as a result of children having to support their families while at the same time attending school because their parents have limited income sources and (Alvi and Dendir, 2011) finds that market work for children in Ethiopia directly and negatively impacts educational achievement. One way to examine the impact of household wealth on achievement could be through absenteeism that arises through child work as a result of parent's inability to fully support their families.

5. Height-for-age Z-score is defined as the number of standard deviations that a person's height is away from the median height of a reference population of healthy children of the same age and sex.

6. Raven's Progressive Matrices is a nonverbal group test typically used in educational settings. It is designed to measure the test-taker's reasoning ability.

Hanushek and Lavy (1994, cited in Jones et al 2005:6) argues that "children with greater opportunities to earn income are likely to be taken out of school and involved in work if parents need additional income."

Parent's education is another household characteristics that explain enrolment into school as well as educational achievement. Jones et al., (2005) argues that children who have educated parents are more likely to learn because of their environment which tends to be more "intellectually stimulating." In general educated parents are able to assist children with school work and encourage them to perform well in school and this is closely linked to parent's attitudes to education. It is a general consensus in the educational literature on developing countries that parents' education matter for achievement but the effects are mixed when trying to separate the effect of mothers' education from fathers' education. Although majority agree that mothers' education are more significant, others argue on the side of fathers' education see (Uysal and Dincer, 2010; Aturupane et al., 2011; Glick and Sahn, 2010). Hanushek and Lavy (1994 cited in Jones et al, 2005) argues that while fathers' education has a positive impact on a student's performance, the impact of the mothers' education was found to be insignificant.

Household structure is also a good predictor of educational attainment especially in developing countries (Woldehanna et al., 2005) is of the opinion that for children in Ethiopia, there exist a negative relationship between birth order and school and attendance. (Alvi and Dendir, 2011) also finds that later born children are less likely to attend school in rural parts of Ethiopia, hence this may suggest that younger siblings wait for their older siblings to complete school before they can start theirs or as (Jones et al., 2005) posits, they might be paying for the education of their older siblings. (Woldehanna et al., 2005) argues that children from smaller families are more likely to perform better in school than those from larger families. This may suggest that parents have more time to invest in each child's education because they are fewer. But this may reflect their choice of a smaller household in other to allocate enough resources to each member of the family and not necessarily a direct link from family size to educational achievement.

School Characteristics

The quality of the school a child attends to a large extent determines the academic performance of the child and school quality can be measured by school resources, class size, quality of teachers and principal characteristics. All the above are in fact linked with educational achievement but cannot explain achievement in isolation. In a review of educational literature by Hanushek (1997, cited in Wossmann, 2001:4) one of the reporting criteria for quality research to be included in the review is that each study must have an inclusion of some measure of family background in addition to a measure of school resource on educational achievement.

(Wossmann, 2001) provides evidence of the link between school resources and educational achievement and argues that in general there exist a positive resource effect only at very low levels of resource endowment which is the case with many developing countries. Previous studies have reported a weak relationship between school resources and performance but investigated this link for developed countries such as the US where resource inputs are already high and the results may be revealing a diminishing marginal returns because resources are up to a point that an increase in school resources adds little or no effect to students' performance.

Going further, teacher quality plays a crucial role in student achievement and could be measured by teacher's motivation, teaching experience, teaching qualification and teacher's education and ability. Hanushek and Rivkin (2006 via Renu and Sudipa, 2012:4) argue that teachers represents the most significant school related factor that explains academic achievement of students. They also argue that school quality is central to a child's performance and the most important factor is teacher quality but (Aslam and Kingdon, 2011) finds that of all the school and teachers characteristics only teacher absence significantly explains language achievement for children in Pakistan, but for mathematics the same students performed better when taught by teachers with more experience and qualification.

(Wössmann, 2003) finds that teacher's experience is a positive determinant of a student's performance as well teacher's qualification. Other teacher characteristics identified in the study were teacher's age and gender, having a female teacher as opposed to a male one was found to lead to statistically significant higher scores for students. While age was found to negatively impact test scores. (Aslam and Kingdon, 2011) also found that a student's standardised mark in a subject taught by a female teacher is 0.5 standard deviations lower than if the same student were taught by a male teacher. Female students, however, considerably benefit from being taught by same-sex teachers because their standardised mark increases by about 0.2 standard deviations similar findings of teachers' gender and students' achievement can be found in (Glick and Sahn, 2010).

One challenge in the empirical literature with measuring the role of teachers, has to do with the unobservable teacher characteristics that determine achievement such as teachers ability and motivation, if more motivated teachers put more effort into teaching the results may be biased upward (endogeneity) and the unobservable teacher characteristics will potentially influence the pupils achievement. One way to reduce this bias as in (Aslam and Kingdon, 2011) is including variables such as teacher education in the regression and may reduce the bias if we suppose that people with higher motivation also have higher education levels. The consequence therefore is that the teacher variables cannot be confidently interpreted as completely free of endogeneity bias, although this is true, not capturing the teachers' characteristics in the educational achievement function may have more serious implications for the result.

Classroom resources are school factors that also explain students' achievement levels. Factors such as class size and text books available for pupil's use were found to impact pupil's achievement in Tilak (1989) cited in Jones et al. (2005). (Uysal and Dincer, 2010) found a small but positive effect of student teacher ratio (class size), and the coefficient on the squared term is negative thus indicating that a large class size may positively impact on a pupils achievement up to a certain threshold and then impact becomes negative after that point. School management factors such as principal's level of education and experience have also been identified in the research literature as factors that determine students' achievement see (Aturupane et al., 2011; Glick and Sahn, 2010). Vegas (2002 via Jones et al., 2005) claims that a student's educational achievement is more significantly explained by school management than observable teacher characteristics such as experience which is in contrast to Hanushek and Rivkin (2006) via Renu and Sudipa (2012).

This section has reviewed the educational achievement literature specifically for the case of developing countries. The issues that arise in some of the studies rest on the one-

sided nature of their research, some focus on household-individual factors that explain achievement and leave out important school related characteristics mainly because of unavailability of data which is one of the challenges of research on developing countries. Some others focus on school-related factors and can only account for a few individual characteristics of the pupils (see Glewwe, 2002) and attempt to attenuate this limitations with sophisticated econometric methods. The current literature has the advantage of a wealth of observable individual, household, teacher, principal, school and class information that will to a large extent isolate the drivers of educational achievement and give an understanding of the role of school type in this process without the need for overly sophisticated econometrics.

3. Data and Methodology

3.1 Data Source and the Young Lives Project

The data used for this study is secondary data that comes from the Young Lives project. Young Lives is an international study of childhood poverty, involving 12,000 children, their care givers and selected community representatives in four countries over 15 years. The countries covered in the Young Lives project are Ethiopia, India, Vietnam and Peru. Young Lives uses a comparative dual-cohort study to combine data collection using mixed-methods at child, household and community levels since 2002. The design of the Young Lives study is that of longitudinal research design which involves the collection of data over a long period of time to facilitate the analysis of patterns of change and drivers of this change. The study provides a robust way to analyse causal pathways with less ambiguity than cross sectional studies.

The Young Lives project was initially conceived of as a cohort study based primarily on child, household and community data and these data have been collected in five data rounds conducted at approximately three year intervals. The sample includes two cohort of children born in 2001/2002 and in 1994/1995. In 2002, the younger cohort (index children) of 2000 were between the ages of 6 and 18months and the older cohort[7] of 1000 children were between the ages of 7.7 and 8.5 years. The Young Lives household survey data set has been used by various researchers in many studies on childhood poverty, childhood health and psychology, school enrolment and educational outcomes amongst others see (Galab et al., 2005; Woldehanna et al., 2005; Orkin, 2011; Frost and Little, 2014; Cueto et al., 2014). In the context of educational research, the Young Lives household survey inherently possess some limitations because the schools attended by the children are not observed and hence very little can be said about school inputs in the educational outcomes of children.

In 2010, a series of nested school surveys were introduced (Boyden and James, 2014:18) with the understanding that the information about schools, teachers, classes and peers that can be collected at the level of the household is limited. The School survey contains information for a range of school types (public and private) and includes indicators of school quality, teaching methods, teacher training, school infrastructure amongst others. The data is divided into pupil level data that contains information of the pupils' personal and household characteristics, teacher level data which contains information of the teacher, principal level data, school level data and class level data. The nested school survey was like the household survey conducted in Ethiopia, India, Vietnam and Peru, the survey includes a sub-sample of the Young lives household survey children and more children who have not been surveyed at the household and community level.

The Ethiopian nested school survey that was carried out in 2012–2013 is the focus of this study, data is available for about 11,990 pupils who were surveyed at the school level, but also asked individual and household questions that provide considerable child level and household level information. The school survey sample included 549 Young

7. The older cohort of children were included in the study design as means of testing the suitability of instruments and questions used for the younger children when they reach the same age.

Lives household survey children from the younger cohort sample. This study uses the Ethiopian nested school survey, for all pupils in grades 4 and 5 (some grade 3 pupils) in schools within the Young Lives sentinel sites. The data were collected from 20 sentinel sites in five regions Addis Ababa, Oromia, Tigray, Amhara and SNNP, these regions account for 96% of Ethiopia's population (see Jones et al., 2005:12). The Ethiopia school survey was designed to take place in two waves, the first at the beginning of the school year, with a second wave of follow-up tests to assess progress towards the end of the same school year (www.younglives.org.uk).

Having recognized that longitudinal research designs are more appealing in social research, this study uses the school survey data which contains rich information about individual, household and school level characteristics for children in the sample. The issue of selectively then arises because an understanding of factors that influence educational achievement for Ethiopian children who are already in school excludes those who are not enrolled, it would have been desirable to correct for the selection into school, but data restrictions did not allow this. A brief discussion on determinants of enrolment for Ethiopian children is carried out under Table A1.3 in the Appendix.

The household surveys which provides information about the children from when they were between 6 and 8 months can only be matched to the school level information for about 549 pupils, and focusing the analysis on a smaller sample size reduces the statistical power of the results hence a larger sample of 11,990 pupils who also have significant household level information in the school survey which is a more balanced sample is ideal to answer questions relating to issues around school quality and educational achievement while controlling for individual and household characteristics which is the emphasis of this research.

3.2 Attrition and Non Response

Attrition is defined as a reduction in the number of participants in the survey between data collection periods. Since the Young Lives School survey employed a test and re-test design at the beginning and end of the school year, the problem of attrition became an issue at the time of the taking the re-tests. The data set contained initial 13,724 observations for all pupils in the school survey sample site. Of these 13,724 initial sample size, 11,779 sat for the first literacy test and 11,790 sat for the mathematics test, the reason cited for this missing observations in the data was absenteeism. There were also a number of missing values at the item level reported at different points in the survey due to non-response or questions not applicable to specific individuals. During the retests, the sample size in literacy further reduced to 10, 055 while the maths test sample size was 10,063. Because the outcome of interest in this study is the final test score of the pupils, the observations without these final test score variables are automatically excluded from the analysis. If the model answers questions for only those who sat for the final test, and if choosing to write the final test was not a random decision then we have another issue of selectivity, an attempt will be made to address this issue by understanding factors that differentiate those whose sit for the final test and those who don't. (See chapter five).

In order to maximise the use of available information, an attempt was made to treat missing observations (other than final test scores) with mean imputation technique see (Little, 1992). Where the independent variables with missing data points were substituted

with mean values, the results of this imputation were slightly different from the results without the mean imputation which raised concerns about the validity of the results hence the model with imputed values were dropped and the results reported here make use of all the available information without any imputation but recognises that the number of observations in the final results reduced by about 20% of the original sample size.

3.3 Methodology

The outcome of interest are achievement variables which are test scores in Language and Mathematics, this study will employ the use of a multiple regression framework to analyse the data. As discussed earlier, this study adopts the education production function framework, the school is treated as the firm and school characteristics treated as inputs, the output is then the test scores. The test scores are continuous variables and Ordinary Least Square (OLS) strategy is used to measure educational achievement of pupils where the aim is to identify the contribution of each explanatory variable to explaining the variation in the dependent variable (the next chapter contains a detailed descriptive analysis of the data). The analytical strategy will proceed to analyse learning achievement of pupils through test scores. The achievement (education production function) regressions are two single equation models;

1. Base model: the first model seeks to determine how much of the variation in educational achievement can be explained by individual and household variables after controlling for the type of schools which are government school, private school, community school, NGO school and faith school.
2. School factors: This model takes into account all other school related variables (input) that explain educational achievement.

The equations are of the following forms;

$$A_i = \alpha_1 + \beta_j X_{ij} + \theta_k T_{ik} + e_i \quad (1)$$

$$A_i = \alpha_1 + \beta_j X_{ij} + \theta_k T_{ik} + \gamma_m S_{im} + e_i \quad (2)$$

Where *A* is the achievement score defined as the raw test score of a student in math or language and *i* represents the *i*th student. β, denotes a vector of unknown parameters for individual and household variables (for all *j* characteristics), θ and γ denotes a vector of unknown parameters for school type and school related variables to be estimated and *e* is the error term.

The second stage of analysis employs the use of Oaxaca-Blinder (OB) mean decomposition strategy to decompose the regression results and differences in educational achievements by school type and by gender. The OB decomposition techniques were introduced by Oaxaca (1973) and Blinder (1973) whose methodology was employed to decomposed gender gaps in wage differentials and has been subsequently used to investigate other labour market disparities including racial pay differentials and union pay gaps. In the education literature, (Kingdon, 2002) employed the OB decomposition technique to school attainment gaps between male and female children in India, while (Zhang and Lee, 2011) employed this strategy to decompose student academic performance across OECD countries.

The first decomposition regression is specified to estimate the effect of school type (a treatment) on an outcome (test scores). School type in this case is divided into private and non-private schools.[8] The equations are of the following form;

$$Ap = X_p{}' \beta_p + e_p \quad (3)$$

$$Anp = X_{np}{}' \beta_{np} + e_{np} \quad (4)$$

In this equation the subscripts p and np denote private and non-private school type respectively, β, denotes a vector of unknown parameters for individual, household and school variables and e the error term. We assume that the conditional means of the error terms are equal to zero and an important characteristic of the Ordinary Least Square procedure is that the regression line passes through the means of the data, hence;

$$\overline{Ap} = \overline{X}_p{}' \hat{\beta}_p \quad (5)$$

$$\overline{Anp} = \overline{X}_{np}{}' \hat{\beta}_{np} \quad (6)$$

The average achievement gap by school type can be expressed as:

$$\overline{Anp} - \overline{Ap} = \overline{X}_{np}{}' \hat{\beta}_{np} - \overline{X}_p{}' \hat{\beta}_p = \overline{D_{st}} \quad (7)$$

If we subtract and add $\overline{\boldsymbol{X}}_{\boldsymbol{p}}{}' \widehat{\boldsymbol{\beta}}_{\boldsymbol{np}}$ the average test score predicted for private school pupils if they faced a non-private school score, we have;

$$\overline{D_{st}} = \overline{X}_{np}{}' \hat{\beta}_{np} - \overline{X}_p{}' \hat{\beta}_p + \overline{X}_p{}' \hat{\beta}_{np} \quad (8)$$

And when we arrange we get;

$$\overline{D_{st}} = [\overline{X}_{np} - \overline{X}_p]' \hat{\beta}_{np} + \overline{X}_p{}' [\hat{\beta}_{np} - \hat{\beta}_{np}] \quad (9)$$

The overall average school type differential in achievement of pupils in private and non-private schools $\overline{D_{st}}$ can now be decomposed into a part attributable to differences in measured characteristics (evaluated at the private school estimated score) and another part attributable to differences in the estimated relationship between students who attend private and non-private schools. These two components have been referred to as 'endowment' and 'treatment' effects respectively.

A similar mean decomposition exercise will be carried out for the gender gap in educational achievement, for male and female students in the sample the OB mean decomposition will follow the same form as that of the school type decomposition.

8. NGO, faith-based and private schools are classified under Private schools because these schools are privately owned and managed by individuals or non-governmental organisations while government and community schools are classified under non-private schools because they are publicly funded and managed by the government or local education authority.

4. Descriptive Analysis

4.1 Description of Variables Used in the Educational Achievement Function

There are two dependent variables of interest and they are the final tests conducted at the end of the school year which are mathematics test score and literacy test score, these are written tests, individually administered to each child and consist of twenty-five questions to be answered in both the mathematics and literacy (language).[9] The tests are multiple choice type tests and pupils select the correct answer from a number of options (between 3 and 4). Raw scores of responses for each question were converted to discrete variables 1; correct and 0; for incorrect, the sum of all the responses gives the total score for each test hence in all cases, the scores range from 0 to 25. (0 when a pupil failed to correctly answer any question and 25 when a pupil correctly answered all questions). The dependent variables are hence continuous variables.[10] (Table 1 provides a summary of all the variables)

The first set of tests conducted at the beginning of the school year for mathematics and literacy have been named pre-test scores and are similar to the final test in their administration and calculations. The pre-test scores in mathematics and literacy have been included in the model to capture ability of the child before school inputs but a note of caution about the effectiveness of the pre-test scores as a measure of ability, is that these measures will capture previous school inputs from previous grades before the tests were administered, and may be highly correlated with the final test results because they take place quite close together. The pre-test may in fact contain some measure of the child's ability but is not a perfect proxy for innate ability hence the regression results will report models with and without the pre-test scores.

The independent variables are a mixture of continuous variables (such as age, number of meals, wealth index) and categorical or dummy variables (such as pre-school attendance, gender, etc.) and can be categorized into individual, household and school characteristics. Data was collected to control for a number of individual characteristics of the pupil consistent with the literature reviewed earlier this includes inter alia, health status which is captured by a discrete variable is either 0 if a pupil had no health problems that affected school and 1 if otherwise. Age, child working status, gender, number of meals a day, number of days absent from school are all factors the regression will control for in explaining educational achievement of a pupil.

9. These tests are administered in the language of instruction used in the different schools in different regions.
10. A table of definitions for all the variables is reported in the Appendix (Table A1.1).

Table 1—*Summary statistics of variables*

Variables	N	Mean	Std. Dev.	Min.	Max.
DEPENDENT VARIABLES					
LITERACY_SCORE	10,055	16.36	4.66	0	25
MATHS_SCORE	10,063	14.35	4.44	1	24
INDEPENDENT VARIABLES					
Individual Characteristics					
PRELITERACY SCORE	11,773	18.28	5.12	1	25
PREMATHS SCORE	11,786	13.542	3.98	1	25
HEALTH_PROB	11,977	0.2408	0.43	0	1
CHILD_WORK	11,943	0.54	0.50	0	1
DAYS_ABSENT	11,701	2.03	3.33	0	35
AGE	11,794	11.59	1.83	8	34
GENDER	11,787	0.50	0.50	0	1
MEALS_A_DAY	11,766	2.76	0.52	1	3
ATTEND_PRESCH	11,721	0.51	0.50	0	1
REPEAT_GRADE	11,760	0.24	0.43	0	1
DROP_OUT	11,698	0.18	0.38	0	1
EXTRA_LANG	11,977	0.30	0.46	0	1
EXTRA_MATH	11,977	0.41	0.49	0	1
Household Characteristics					
MOTHER_ALIVE	11,769	0.93	0.25	0	1
FATHER_ALIVE	11,704	0.83	0.38	0	1
MOTHER_READ	11,977	0.47	0.50	0	1
FATHER_READ	11,977	0.58	0.49	0	1
PCA_WEALTHINDEX	11,771	0.00	1.75	-6.90	4.26
School Characteristics					
GOVERNMENT_SCHOOL	11,965	0.86	0.35	0	1
PRIVATE_SCHOOL	11,965	0.08	0.27	0	1
COMMUNITY_SCHOOL	11,965	0.02	0.13	0	1
FAITH_SCHOOL	11,965	0.04	0.20	0	1
NGO_SCHOOL	11,965	0.01	0.07	0	1
SCH_COMPT	11,983	1.28	3.54	0	20
SCH_RADIO	11,983	0.76	0.43	0	1
PIPED_WATER	11,977	0.65	0.48	0	1

Variables	N	Mean	Std. Dev.	Min.	Max.
Teacher Characteristics					
TCH_YEARS	11936	12.32	9.49	1	37
TCH_QUALIFIC	11922	1.86	0.57	0	3
TCH_AGE	11936	33.26	9.45	20	59
SPECIA_MATH	11988	0.34	0.48	0	1
TCH_GENDER	11936	0.49	0.50	0	1
Principal Characteristics					
PRNC_AGE	11965	38.25	8.89	21	65
PRNC_EDU	11579	6.04	1.28	1	7
PRNC_GENDER	11965	0.87	0.34	0	1
Class Characteristics					
log_TOTAL_ENROL	11983	3.98	0.32	1.79	4.98

Household characteristics that are controlled for in the regression include a measure of social economic status (SES) which is the wealth index variable, it is a continuous variable and is derived from assets and consumer durables owned by households and housing services used by households. A principal component analysis (PCA)[11] was used to generate the wealth index and ranges from a negative to a positive number, where higher values indicate wealthier households. Parents' education is another important variable recognized by the research literature, they are discrete variables that captures if a father or mother can read and write.

School characteristics are captured with teacher, principal, class and school level data. At the teacher level, teacher's experience (number of teaching years), qualification (teaching qualifications), gender and age have been included in the regression equation with the aim of examining how much variation in the test scores of the pupil is explained by teacher's characteristics. Principal's age, gender and education have been included in the data to understand the role of the school administrators in students' educational achievement. Variables such as school radio, piped water in the school and school computers are variables that capture school resources and their role in achievement will be equally examined. Lastly, the total number of children enrolled in a class is included in the model to measure class size and its own effect. The log of this variable (total enrol) reduces the wide range of number of pupils enrolled in the different classes to small scopes for a more useful interpretation of the coefficient.

11. Principal component analysis (PCA) is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components.

4.2 Descriptive Statistics

4.2.1 Descriptive Statistics for Educational Achievement by Different Characteristics

Mean maths score by gender reveals that boys have an average maths score of about 14.5 points while the average score for girls is 14.3 points this indicates that boys on average do better than girls in mathematics without controlling for other covariates (see Table A1.5 in the Appendix). Literacy test by gender tells a different story from the maths tests, female pupils outperform boys in literacy with a difference of about 0.5points. Figure 2 and 3 shows a graphical illustration of the gender gap in both tests using kernel density plots.

Figure 2—*Maths test score by gender*

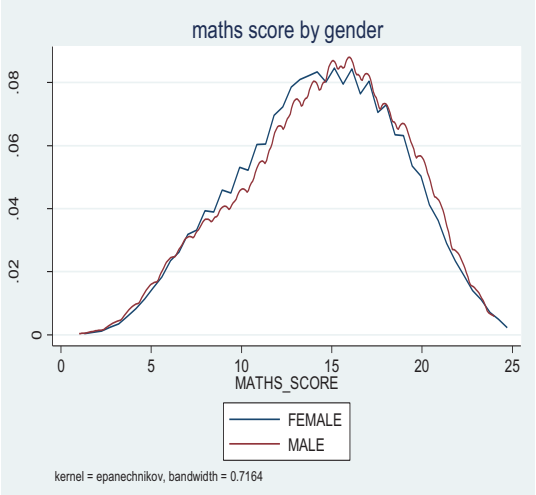
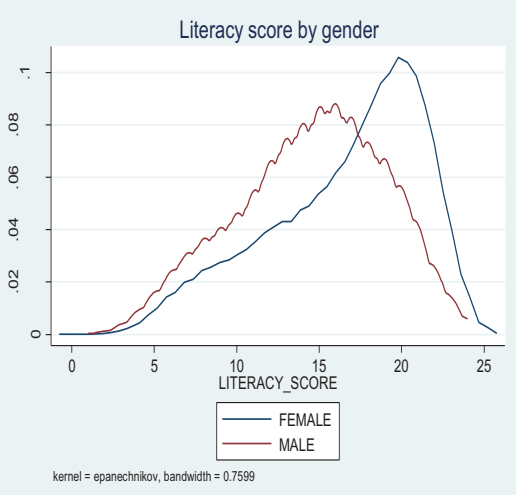


Figure 3—*Literacy test score by gender*



For all categorical variables used in the educational achievement analysis Table A1.5 in the appendix reports mean differences of mathematics and literacy test score for pupils that fall into different individual, household and school categories or not. A pupil that has never repeated a grade scores higher in both literacy and mathematics which is very similar to the scores of pupils who have or have never dropped out of school. Pupils who attend extra classes in both mathematics and languages do worse than those who do not attend and it is surprising because one would expect extra lessons to boost performance but it is possible that pupils who have weaker academic performance in the first instance are more likely to attend extra classes. A pupil that attended pre-school has a higher literacy score than one that didn't attend pre-school, and similar differences exists in the mathematics test, this reveals a case of the importance of early childhood factors on future cognitive outcomes (see Singh, 2014). Child labour and health problems are associated with lower test scores. Pupils whose parents are alive do better in mathematics than orphans and test scores are higher for pupils with literate parents, but there seems to be no significant difference between the literacy scores of pupils whose mothers are alive and ones whose mothers are dead.

Pupils who attend schools with radios and piped borne water have higher test scores in mathematics and literacy than those who do not, Pupils with female teachers and female principal also have higher scores in both tests. A pupil whose teacher specialises in teaching mathematics does better in both maths and literacy.

4.2.2 Descriptive Statistics of Learning Outcomes and Pupils' Characteristics by School Type

Figure 4—*Maths test score by school type*

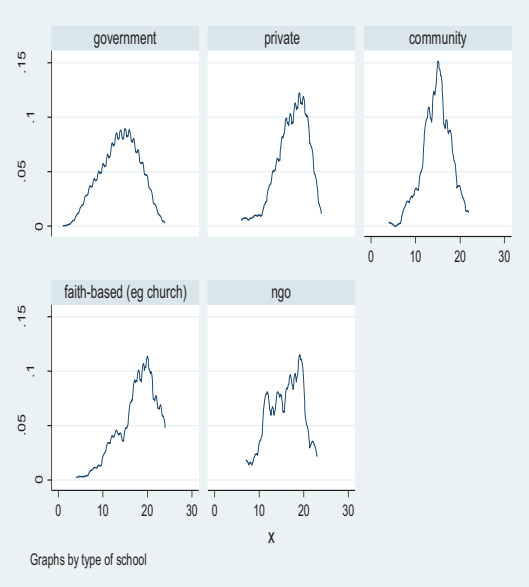
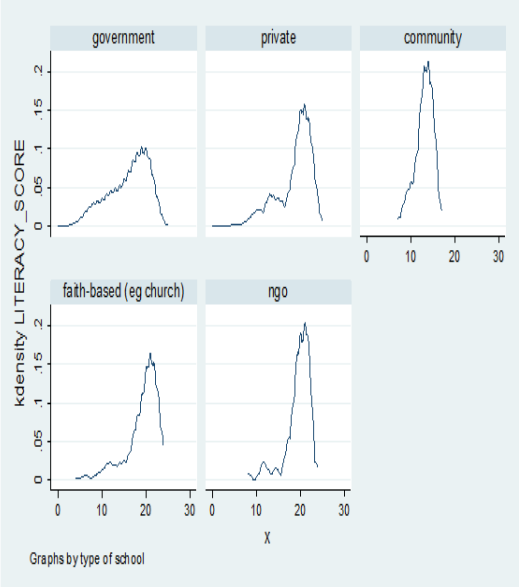


Figure 5—*Literacy test score by school type*



There are two main school types in the current literature; Private and Non-Private Schools. NGO, faith-based and private schools can be classified under Private schools because these schools are privately owned and managed by individuals or non-governmental organisations while government and community schools can be classified under non-private schools because they are publicly funded and managed by the government or local education authority.

Figures 4 and 5 present kernel density plots for school type differences in students' performance in mathematics and literacy and the learning outcomes by school type from Table 2 can be discussed below; pupils that attend privately owned schools perform better in both tests. In literacy, pupils that attend NGO schools scored 19.51points followed closely by pupils in faith-based schools with an average score of 19.14points and next pupils in private schools with a mean score of 18.70points. What is interesting to note here is that the average literacy score of pupils in privately owned schools were much higher than the overall average literacy score of 16.36 (Table 1). A look at the literacy scores for pupils that attend non-private schools shows that pupils that attend government and community schools score much lower in the literacy test than their counterparts in private schools with an average 16.05points and 13.05points respectively which are both below the overall average score in Literacy.

In mathematics, pupils that attend faith-based schools score an average maths score of 17.81points followed closely by those in private schools with an average of 17.45points which are both much higher than the overall average maths score of all the pupils in the sample. NGO school pupils score lower than the other pupils in privately owned schools with an average of 15.82points in mathematics but still score higher than the overall average maths score. For community school pupils, their average maths score is the lowest of all the school types followed by pupils in government schools whose

average scores are lower than the overall average maths score. These comparisons paint a picture of the quality of the school types being discussed here and what is obvious from the descriptive statistics is that without controlling for other characteristics of the pupils, those who attend privately owned schools perform better in both mathematics and literacy tests than their colleagues in non-private schools.

The pre-test scores in Table 2 show significant differences before the school year, indicating that factors that differentiate the type of schools might also influence the pre-test outcomes. The pre-test may also be reflecting the inputs from the previous school year so if we assume that the pupils were in the same types of school in the previous school year then it is unsurprising that they have similar margins between test scores amongst the different school types.

Next a comparison of the pupils characteristics by the type of schools they attend, more pupils in community schools engage in work outside school followed closely by pupils in government schools. There are more pupils in NGO, faith-based schools and private schools who attended pre-school than in the government and community schools. In the previous section we saw that attending preschool is associated with higher scores in maths and literacy hence these descriptive analyses begins to inform our a priori expectations of the factors that influence achievement. We also know from the literature that pre-schools in Ethiopia are privately owned and managed therefore, pupils in the private school types are more likely to have been exposed to private education earlier in life. More students in government schools attend extra classes in mathematics and for literacy community schools.

Table 2—*Mean characteristics of students by school type*

Variables	Government	Private	Community	Faith Based	NGO
DEPENDENT VARIABLES					
LITERACY_SCORE	16.05	18.70	13.05	19.14	19.51
MATHS_SCORE	13.87	17.45	14.81	17.81	15.82
INDEPENDENT VARIABLES					
Individual Characteristics					
PRELITERACY SCORE	17.92	21.04	15.82	21.40	21.55
PREMATHS SCORE	13.10	16.51	14.54	16.66	14.99
HEALTH_PROB	0.24	0.23	0.27	0.31	0.36
CHILD_WORK	0.56	0.36	0.61	0.40	0.39
DAYS_ABSENT	2.10	1.21	1.75	2.41	0.60
AGE	11.64	10.89	12.15	11.68	10.83
GENDER	0.49	0.49	0.61	0.48	0.59
MEALS_A_DAY	2.75	2.91	2.88	2.80	2.80
ATTEND_PRESCH	0.47	0.82	0.37	0.82	0.89
REPEAT_GRADE	0.25	0.22	0.02	0.24	0.12
DROP_OUT	0.19	0.08	0.06	0.13	0.09
EXTRA_LANG	0.30	0.28	0.17	0.33	0.13
EXTRA_MATH	0.43	0.28	0.31	0.25	0.16

Variables	Government	Private	Community	Faith Based	NGO
Household Characteristics					
MOTHER_ALIVE	0.93	0.96	0.97	0.93	0.95
FATHER_ALIVE	0.83	0.93	0.94	0.70	0.70
MOTHER_READ	0.44	0.71	0.43	0.65	0.49
FATHER_READ	0.56	0.73	0.47	0.69	0.43
PCA_WEALTHINDEX	-0.22	1.76	0.18	1.16	0.25
School Characteristics					
SCH_COMPT	1.27	2.02	0.00	1.02	0.00
SCH_RADIO	0.79	0.29	1.00	0.92	1.00
PIPED_WATER	0.68	0.42	1.00	0.31	1.00
Teacher Characteristics					
TCH_YEARS	13.28	5.64	6.99	7.99	3.03
TCH_QUALIFIC	1.87	1.83	1.99	1.80	2.00
TCH_AGE	33.95	28.26	34.89	28.78	23.24
SPECIA_MATH	0.33	0.64	0.01	0.21	0.29
TCH_GENDER	0.43	0.71	1.00	1.00	0.98
Principal Characteristics					
PRNC_AGE	37.86	38.16	35.00	48.21	35.00
PRNC_EDU	6.02	6.40	6.00	5.76	7.00
PRNC_GENDER	0.86	0.89	1.00	0.76	1.00
Class Characteristics					
log_TOTAL_ENROL	4.00	3.68	3.91	4.18	3.53
N	10,289	918	192	499	67

Note: For dummy variables the mean represents the percentage of ones in the sample where yes = 1 and no = 0

Moving to household characteristics, there are more pupils whose parents are literate in private schools than all the other school types and the wealth index is also higher for private school pupils followed closely by those who attend faith based schools. The presence of parents are similar across pupils in the different school types.

The school resources that differentiate the different school type include school computers, school radio and having piped borne water in the school. Community schools and NGO schools did not report having any computers while the average computer for private school was about two and for government school just above one computer per school. All the NGO schools and the community schools in the sample had pipe borne water in the school while faith based and private schools had less schools with piped borne water than government schools. There are more experienced teachers in government schools, more qualified teachers in NGO schools and more specialised mathematics teachers in private schools than in all the other school types. There are also more educated principals in NGO schools than the other school types. Government schools have more pupils enrolled in their classes on average all the other school types.

5. Regression Results

The previous chapter discussed descriptively differences in the educational achievement of pupils in Ethiopia by various characteristics. In this Chapter the regression results will be discussed. The next section will discuss the Ordinary least squares results for the base model and the school inputs model. The final section will discuss the Oaxaca-Blinder decomposition analysis achievement on gender and school type gaps in mathematics and literacy.

5.1 Educational Achievement Results

5.1.1 Achievement in Mathematics

The ordinary least squares achievement (or production) function results for mathematics (Table 3 and 3ii) report two separate results for the base model (column 1 and 2) and the school factors model (column 3 and 4) respectively. The first table excludes the pre-test scores because of the understanding that performance on the test at the beginning of the school year may be influenced by inputs from the previous school years and is highly correlated with the last tests, but it is informative to examine the achievement determinants with and without the pre-test results A quick glance at the regression results shows that including the pre-test score in the models doesn't change the directions (signs) of the estimates but there are changes in the magnitude, and in most cases they become smaller in absolute terms indicating that the pre-test score explains more of the variation in educational achievement. This is also evident in the changes in the R^2 of the two models. The next section discusses each model respectively.

Base model: in the first mathematics base model where the pre-maths test is excluded, the results reveal that having any health problems that potentially affect school attendance reduces a pupil's math score by about 0.2 points which is significant at a conventional level. It becomes a smaller negative effect when the pre-test score is included and is no longer significant. Engagement in child work and number of days absent are detrimental to achievement in mathematics and although including pre-test score reduces the effect it remains significantly negative. Child work may be correlated with the number of days absent if the pupils that work do so during class time and this will increase the number of days absent. In a separate regression (not reported) that excluded the number of days absent, child work results in a bigger negative impact of on mathematics achievement and this is found to be well determined. Pre-school attendance significantly improves test score as well as the number of meals a pupil has a day. Male students do better in maths achievement than their female counterparts. This effect is well determined when the pre-test score is excluded and reduces in magnitude and significance when we include the pre-test scores.

Table 3i—*OLS results for achievement in Mathematics*

Variables	(1)	(2)	(3)	(4)
	Base Model	Base Model (Pre–Test)	School Model	School Model (Pre–Test)
PREMATHS_SCORE		0.669***		0.649***
		(0.00924)		(0.00956)
HEALTH_PROB	−0.265***	−0.0510	−0.287***	−0.0866
	(0.101)	(0.0808)	(0.101)	(0.0825)
CHILD_WORK	−0.278***	−0.115*	−0.116	−0.0310
	(0.0848)	(0.0680)	(0.0855)	(0.0697)
DAYS_ABSENT	−0.174***	−0.0834***	−0.155***	−0.0769***
	(0.0140)	(0.0114)	(0.0145)	(0.0119)
AGE	0.300***	0.0588***	0.288***	0.0497**
	(0.0247)	(0.0202)	(0.0249)	(0.0207)
GENDER	0.241***	0.0797	0.300***	0.112*
	(0.0830)	(0.0666)	(0.0829)	(0.0676)
MEALS_A_DAY	0.788***	0.320***	0.866***	0.368***
	(0.0818)	(0.0659)	(0.0819)	(0.0671)
ATTEND_PRESCH	0.839***	0.397***	0.460***	0.255***
	(0.0907)	(0.0731)	(0.0931)	(0.0760)
REPEAT_GRADE	−1.548***	−0.672***	−1.683***	−0.731***
	(0.0998)	(0.0811)	(0.101)	(0.0835)
DROP_OUT	−0.480***	−0.234**	−0.516***	−0.267***
	(0.116)	(0.0934)	(0.116)	(0.0948)
EXTRA_MATH	−0.535***	−0.274***	−0.428***	−0.214***
	(0.0847)	(0.0680)	(0.0878)	(0.0716)
MOTHER_ALIVE	0.000584	−0.0177	0.201	0.0731
	(0.174)	(0.140)	(0.175)	(0.143)
FATHER_ALIVE	0.140	0.0410	0.290**	0.111
	(0.117)	(0.0943)	(0.120)	(0.0978)
MOTHER_READ	−0.171*	−0.0474	−0.220**	−0.0986
	(0.0916)	(0.0735)	(0.0916)	(0.0747)
FATHER_READ	−0.0881	−0.0383	−0.0359	−0.0219
	(0.0936)	(0.0751)	(0.0940)	(0.0766)
pca_wealthindex	0.371***	0.189***	0.250***	0.143***
	(0.0274)	(0.0221)	(0.0293)	(0.0239)
private_school	2.389***	0.650***	3.395***	1.314***
(omitted: government school)	(0.164)	(0.133)	(0.195)	(0.161)
community_school	0.191	−0.300	0.432	0.0526
	(0.326)	(0.261)	(0.356)	(0.289)

Table 3ii—*Continuation of OLS results for achievement in Mathematics*

Variables	(1)	(2)	(3)	(4)
	Base Model	Base Model (Pre–Test)	School Model	School Model (Pre–Test)
faith_school	3.053***	1.168***	3.402***	1.438***
	(0.201)	(0.162)	(0.227)	(0.187)
ngo_school	1.055**	0.230	0.933*	0.405
	(0.521)	(0.416)	(0.530)	(0.430)
TCH_YEARS			0.0125	0.0172
			(0.0146)	(0.0119)
TCH_QUALIFIC			0.577***	0.170**
			(0.0807)	(0.0659)
SPECIA_MATH			0.328***	0.218**
			(0.115)	(0.0932)
TCH_AGE			−0.0287**	−0.0232**
			(0.0136)	(0.0110)
TCH_GENDER			−0.530***	−0.389***
			(0.106)	(0.0865)
PRNC_AGE			0.0130**	−0.00348
			(0.00569)	(0.00464)
PRNC_EDU			0.148***	0.0441
			(0.0373)	(0.0304)
PRNC_GENDER			−0.934***	−0.423***
			(0.140)	(0.115)
SCH_COMPT			0.0283**	0.0305***
			(0.0140)	(0.0114)
SCH_RADIO			1.705***	1.066***
			(0.133)	(0.109)
PIPED_WATER			−0.107	−0.268***
			(0.120)	(0.0978)
log_TOTAL_ENROL			−0.671***	−0.182
			(0.159)	(0.130)
Constant	9.026***	3.888***	6.314***	2.943***
	(0.427)	(0.350)	(0.913)	(0.744)
Observations[12]	9,414	9,335	9,058	8,987
R–squared	0.190	0.483	0.235	0.496

Notes: Standard errors in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01

12. As discussed in section 4.3, at the item level, missing data at different points is the reason the observation reduces. As more variables with missing data points are added to the regressions more observations are lost. And this is similar for literacy achievement results.

The base model with pre-maths score reports a much higher R^2 than that without the pre-test score. The base model without pre-test explains about 19% of the variation in maths achievement for pupils in Ethiopia. The inclusion of the pre-test score increases the R^2 to 48% reducing the unmeasured component of the model. The pre-test maths score at the beginning of the school year emerges as a strong predictor for achievement in mathematics and the impact is largely positive and significant at the 1% level of significance.

As discussed earlier interpreting this impact as a proxy for ability requires caution but the results reveal that performance on a test at the beginning of the school year is a good predictor for end of the year results and achievement. Pupils whose fathers are alive do better in the maths test but the effect is not well determined while, the variables capturing parental education reveal a negative effect, which is surprising but it loses its significance when the pre-test scores are included. Wealth is also a good predictor for achievement in mathematics and remains a large positive coefficient when the pre-test scores are included. The age of the pupil is positive and significant and may also capture the grade of the student. In separate regression analysis (not reported here), pupils in higher grades performed better in the tests but the age variable becomes insignificant. Thus, older students do better in mathematics, although when school inputs are controlled for the magnitude reduces.

Students who attend private school do better in mathematics and this is the same for pupils in faith schools and NGO schools. The impact for community schools is positive but when the pre-test score is included in the model it becomes negative. It appears that students who attend community schools do not do much better than their colleagues in government schools (which is the base group) but the effect is not statistically significant.

School factors model: this model captures school inputs in addition to the base model comprising individual, household and school type variables. Including the school factors doesn't change the sign of the base model covariate estimates but changes the size of some of the coefficients.

Students in private schools do better in mathematics than students in government schools and the impact is economically significant at a conventional level. The model with the pre-test score indicates that being in a private school increases a pupil's maths score by one point and this impact is very similar for faith school pupils. Community schools and NGO school pupils also do better in mathematics than government school pupils but this impact is neither large nor statistically significant.

School factors that explain variation in mathematical achievement includes teacher's experience, and teacher's qualification. Students with more qualified teachers score 0.5 points higher in mathematics, and if a teacher specialises in mathematics the pupil does better in mathematics. Pupils with female teachers do better in mathematics than pupil with male teachers and in a separate model disaggregated by gender (not reported), the gender story is that if a female student is taught by a female teacher she does better in mathematics and the impact is statistically significant. A male student being taught by a female teacher also does better but the effect is not statistically significant. Having school computers and a school radio positively influences maths test scores. These variables may be proxying for the availability of other resources within the school that improve the quality of the educational environments. Students with female principals also do better in mathematics, though the explanation for this is unclear.

5.1.2 Achievement in Literacy

Base Model: Table 4 and 4ii reports the results for achievement in literacy. Pupils with health problems, those who work and those with more days absent from school perform worse in the literacy test. Older children perform well in literacy in the base model both with and without pre-test included. Unlike mathematics, female students do better in literacy than their male colleagues. A pupil whose father is alive does significantly better than one whose father is dead. The variables capturing parental education are not well determined for literacy, but students from richer households score higher on the literacy test. Pupils in community schools do not perform better than pupils in government schools on the literacy test and attending an NGO school has an advantage in literacy achievement over all the other types of schools in the base model.

School Factor Model: attending a private school increases a student's achievement in literacy. The magnitude of the coefficient increase with the inclusion of other school factors. The variable is well determined and remains significant with the inclusion of pre-test scores in the model. Pupils who attend community schools achieve lower literacy than government school pupils. Moving from the base model to the inclusion of school factors, pupils who attend NGO and Faith-based schools still achieve higher literacy than those who attend government schools.

Table 4i—*OLS results for achievement in Literacy*

Variables	(1)	(2)	(3)	(4)
	Base Model	Base Model (Pre–Test)	School Model	School Model (Pre–Test)
PRELITERACY_SCORE		0.648***		0.614***
		(0.00696)		(0.00735)
HEALTH_PROB	–0.517***	–0.115	–0.483***	–0.127*
	(0.105)	(0.0756)	(0.102)	(0.0768)
CHILD_WORK	–0.695***	–0.200***	–0.477***	–0.134**
	(0.0882)	(0.0639)	(0.0864)	(0.0651)
DAYS_ABSENT	–0.251***	–0.0839***	–0.198***	–0.0740***
	(0.0146)	(0.0108)	(0.0146)	(0.0112)
AGE	0.105***	–0.0230	0.104***	–0.0207
	(0.0256)	(0.0185)	(0.0251)	(0.0189)
GENDER	–0.306***	–0.241***	–0.228***	–0.217***
	(0.0862)	(0.0622)	(0.0837)	(0.0630)
MEALS_A_DAY	0.644***	0.204***	0.743***	0.262***
	(0.0850)	(0.0616)	(0.0827)	(0.0624)
ATTEND_PRESCH	1.342***	0.498***	0.840***	0.352***
	(0.0943)	(0.0687)	(0.0939)	(0.0708)
REPEAT_GRADE	–1.160***	–0.108	–1.355***	–0.231***
	(0.104)	(0.0757)	(0.102)	(0.0777)

Variables	(1)	(2)	(3)	(4)
	Base Model	Base Model (Pre–Test)	School Model	School Model (Pre–Test)
DROP_OUT	−0.648***	−0.187**	−0.649***	−0.221**
	(0.121)	(0.0873)	(0.117)	(0.0883)
EXTRA_LANG	−0.241**	−0.0348	−0.186**	−0.0527
	(0.0935)	(0.0677)	(0.0927)	(0.0698)
MOTHER_ALIVE	−0.322*	−0.196	−0.0350	−0.0673
	(0.180)	(0.130)	(0.176)	(0.132)
FATHER_ALIVE	0.359***	0.291***	0.424***	0.321***
	(0.122)	(0.0879)	(0.121)	(0.0907)
MOTHER_READ	−0.0182	0.0210	−0.0500	0.0190
	(0.0952)	(0.0688)	(0.0925)	(0.0696)
FATHER_READ	−0.127	−0.0417	−0.0455	−0.0270
	(0.0973)	(0.0703)	(0.0948)	(0.0714)
pca_wealthindex	0.456***	0.117***	0.311***	0.0854***
	(0.0284)	(0.0208)	(0.0296)	(0.0224)
private_school	0.982***	0.229*	2.003***	0.638***
(omitted: government school)	(0.169)	(0.122)	(0.193)	(0.146)
community_school	−3.492***	−1.498***	−3.495***	−1.458***
	(0.339)	(0.245)	(0.345)	(0.260)
faith_school	2.045***	0.707***	2.132***	0.639***
	(0.208)	(0.150)	(0.223)	(0.168)
ngo_school	2.241***	0.889**	1.810***	0.786**
	(0.541)	(0.389)	(0.529)	(0.396)
TCH_YEARS			0.000982	0.0137
			(0.0143)	(0.0107)

Table 4ii—*Continuation of OLS results for achievement in Literacy*

Variables	(1)	(2)	(3)	(4)
	Base Model	Base Model (Pre–Test)	School Model	School Model (Pre–Test)
TCH_QUALIFIC			1.289***	0.409***
			(0.0813)	(0.0620)
TCH_AGE			–0.0339**	–0.0318***
			(0.0136)	(0.0102)
TCH_GENDER			–0.656***	–0.223***
			(0.0990)	(0.0746)
PRNC_AGE			0.0692***	0.0311***
			(0.00575)	(0.00435)
PRNC_EDU			0.178***	0.0665**
			(0.0368)	(0.0277)
PRNC_GENDER			–0.728***	–0.404***
			(0.142)	(0.107)
SCH_COMPT			0.00658	0.00105
			(0.0141)	(0.0106)
SCH_RADIO			1.293***	0.558***
			(0.131)	(0.0989)
PIPED_WATER			0.513***	0.0912
			(0.118)	(0.0886)
log_TOTAL_ENROL			–0.812***	–0.261**
			(0.157)	(0.119)
Constant	14.17***	4.199***	8.552***	2.788***
	(0.440)	(0.335)	(0.922)	(0.697)
Observations	9,409	9,329	9,053	8,973
R-squared	0.200	0.584	0.283	0.596

Notes: Standard errors in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01

More qualified teachers produce more literate students and this effect is statistically significant. In particular, for the school model, a qualified teacher can add over one additional point to the literacy score of his/her pupil. Having a younger teacher also improves the literacy level of pupils and having a female teacher increases literacy achievement of pupils as opposed to having a male teacher. Educated principals, female principals, having a school radio and pipe borne water all improve achievement in literacy, while larger classes are detrimental for literacy achievement of pupils. This final result is in contrast to what was detected for maths achievement, where class size was not found to matter.

5.2 Decomposing the Achievement Gaps

The next section discusses the results of the two decomposition techniques carried out using the OLS regression models. The achievement gap is separately investigated in terms of school type and gender.

5.2.1 Decomposing the School Type Gap in Achievement

The school types have been classified into private schools and non-private schools and the decomposition will facilitate an understanding of the treatment and endowment effects of pupils' achievement. Table 5 reports the mean decomposition analysis using the Oaxaca-Blinder framework for achievement in literacy and mathematics. Due to the earlier concerns raised about the inclusion of the pre-test score in the regression, the decomposition discussed here excludes the pre-test score from the model but reports the decomposition results with the pre-tests in Appendix (Table A2.1 and Table A2.2). Including the pre-test in the model reveals that the individual characteristics of the pupil explains most of the variation in achievement having argued that this variable captures previous school inputs excluding it from the model provides a more clear picture of the drivers of pupils achievement. A caveat therefore is that the results may report a large unexplained portion of the gap in achievement which is due to unobserved factors and may include differences in pupil ability.

In Table 5, the variables have been grouped into individual, household, and school factors, while a detailed decomposition that shows the relative contribution of each individual variable to the determination of the overall explained portion of the gap is reported in Table A2.3 in the Appendix. The decomposition is for two groups which are private and non-private schools. The private schools group includes private, NGO and faith-based schools, while non-private schools group include government and community schools.

From Table 5, the achievement gap in mathematics between pupils in private schools and non-private schools is about 3.7 points and of that gap, the differences in endowments explains 54% of the gap, and this estimate is well determined. Thus, holding all the observable characteristics constant, pupils who attend private school types achieve a maths score that is 3.7 points higher than their colleagues in non-private schools. This suggests that the differences in the educational achievement or learning outcomes of pupils that attend private school types and those that attend non-private schools can be largely explained by the differences in their endowments comprising of their individual, household and school characteristics. The remaining gap in mathematics achievement is due to the treatment of pupils in both school types which is known as the unexplained (unobservable) portion of the gap in this application. The unexplained component may capture the influence of unobservable (unmeasured) differences in individual, household and school characteristics between pupils in the two school groups. The individual factors account for 20% of the explained gap, household factors about 14% and school factors account for 65% of the total explained gap and 36% of the total gap in the differences in mathematics test scores of pupils in this application. Hence school characteristics play a large role in explaining the differences in mathematics achievement of Ethiopian primary school children.

Table 5—*Decomposition of school type achievement gaps in Mathematics and Literacy*

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Overall	Explained	Unexplained	Overall	Explained	Unexplained
Private Schools	**17.54*** **			**18.99*** **		
	(0.108)			(0.111)		
Non-Private Schools	**13.83*** **			**15.93*** **		
	(0.0493)			(0.0524)		
Difference	**3.716*** **			**3.056*** **		
	(0.119)			(0.123)		
Explained	**2.033*** **			**1.619*** **		
	(0.285)			(0.252)		
Unexplained	**1.682*** **			**1.437*** **		
	(0.315)			(0.277)		
Individual		0.409***	-1.309		0.651***	-3.144***
		(0.127)	(1.295)		(0.105)	(1.188)
Household		0.286**	0.358		0.136	0.986*
		(0.127)	(0.510)		(0.117)	(0.546)
School		1.338***	-12.44***		0.832***	0.829
		(0.222)	(2.024)		(0.190)	(1.846)
Constant			15.08***			2.766
			(2.523)			(2.358)
Observations	9,058	9,058	9,058	9,053	9,053	9,053

Notes: Robust standard errors in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01

In literacy, the achievement gap between pupils in private and non-private school is about 3.1 points and of that gap, the model explains 1.6points which is about 53% of the literacy achievement gap and this is significant at a conventional level. The other 47% is unexplained (unobserved) and is known as the treatment effect. The pupils' individual characteristics account for 40% of the explained gap in literacy achievement which is also significant at a conventional level. Eight percent of the explained gap in literacy achievement is attributable to the pupils' household characteristics but this effect is not well determined. School characteristics accounts for more than half of the explained gap in literacy achievement (about 52%) and this estimate is well determined. What this suggests is that holding all the observable characteristics constant, private school pupils score about 3.1 points higher in literacy than their colleagues in non-private schools and that the differences in school characteristics is responsible for 0.8 points of that gap.

From the above mean decomposition analysis, we are able to identify drivers of the gaps in educational achievement of primary school pupils in Ethiopia as measured by their performances in mathematics and literacy tests. While individual and household factors of the pupils are very important for their learning outcomes, the results above tells us

that the school characteristics explains a larger portion of the educational achievement gaps for the pupils. Teachers' characteristics, that of the principals, class size and school resources which are all measures of school quality are very important for learning outcomes and gives us a pointer to the advantages the private school pupils have over their colleagues in non-private schools.

5.2.2 Decomposing the Gender Gap in Achievement

Table 6 reports the decomposition of test score gaps by gender in literacy and mathematics. The explanatory variables have been grouped into individual, household and school factors and this model also excludes the pre-test scores. The school variable in this model, is inclusive of the teachers, principals, class size and school type. The school type include the faith schools, private schools, NGO schools and community schools where the omitted category is government school pupils.

Table 6—*Decomposition of achievement gaps by gender in Mathematics and Literacy*

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Overall	Explained	Unexplained	Overall	Explained	Unexplained
Female	**14.24*****			**16.58*****		
	(0.0648)			(0.0684)		
Male	**14.42*****			**16.09*****		
	(0.0681)			(0.0701)		
Difference	**0.188****			**0.483*****		
	(0.0940)			(0.0979)		
Explained	**-0.0998****			**0.292*****		
	(0.0462)			(0.0553)		
Unexplained	**0.288*****			**0.191****		
	(0.0844)			(0.0863)		
Individual		-0.00950	2.617***		0.123***	-2.189***
		(0.0287)	(0.825)		(0.0306)	(0.791)
Household		-0.0195	0.225		0.0244*	0.290
		(0.0123)	(0.370)		(0.0127)	(0.392)
School		-0.0708**	0.0286		0.145***	2.016
		(0.0276)	(1.420)		(0.0339)	(1.425)
Constant			-2.583			0.0736
			(1.721)			(1.714)
Observations	9,064	9,064	9,064	9,059	9,059	9,059

Notes: Robust standard errors in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01

The estimated gap in mathematics achievement for boys and girls is about 0.19 points. Male students score higher in mathematics than their female colleagues and the difference is significant. The difference is largely attributable to unexplained factors, which yield a gap of 0.29 points. In other words, holding all observable characteristics constant, boys achieve a maths score that is 0.29 points higher than girls. This is wider than the raw gap in the maths score. The estimated endowment effect (–0.1) actually suggests that the measured characteristics of the pupils reduces the gender in gap in mathematics. The unexplained component may capture the influence of unobservable differences in individual, household and school characteristics between boys and girls. In literacy, the difference between the two groups is 0.48 suggesting that females score higher than males on average. The unexplained (or treatment) part of the gap accounts for about 60% of the gap in literacy achievement, and the estimated effect is found to be statistically significant. Thus, holding all the observable characteristics constant, girls achieve a literacy score that is about 0.29 points higher than boys. Therefore, Ethiopian boys fare better at maths, but girls do better at literacy.

A note of caution in the gender mean decomposition analysis is that the school variables include school type which omits government school as a base category and when we vary the base group of school type, the results are sensitive and the estimates arbitrarily depend on the choice of the omitted group. This problem is known as the identification problem or the base group problem and according to (Fortin et al., 2011) there is no econometric solution to this problem. Therefore, we must exercise caution when interpreting the estimates for the disaggregated components in this case.

5.3 Addressing Sample Selectivity

In section 3.3 the issue of attrition was discussed and it was recognised that since the regression analysis excluded the sample of pupils who didn't take the final test score there may be issues of selectivity bias. It is possible that some of the pupils who didn't sit for the final test may have dropped out of school, or were absent for one reason or the other, it would be informative to understand the factors that differentiate those who sat for the final test and those who didn't especially in the light of informing government policy. This section provides an insight into factors that might help explain school continuation or school retention which is one of the issues facing the Ethiopian primary education system as highlighted in section 1.4 of this research.

Table A2.4 in the Appendix reports the means and standard deviations of the two sample groups of pupils who sit for the final test and those that don't. There appears to be some differences in the means of the two samples especially the individual characteristics. The first thing to note is that pupils who do not sit for the final test have lower initial test scores,[13] there are more pupils with health problems in the sample that do not sit for the final test, higher proportion are involved in work, they are older and more males than females. Pupils who sit for the final test are less likely to have repeated and more of that sample group attended pre-school. There aren't much differences in the characteristics of the parents, but the mean of wealth index is higher for those who sat for the final exam. The school factors do not portray large distinctions, in case of having

13. The samples addressed here uses pupils who sat for the final maths test and does who didn't , the characteristics are similar in the case of literacy so only the maths test is discussed.

school computers those who sit for the final test even have a lower average number of computers. From the mean comparisons the drivers of the differences between the two groups lie in the individual characteristics.

A probit regression model for those who sit for the final test (Table A2.5 in Appendix) where the dependent variable is a dummy variable, Final Test = 1 if the pupil sat for the final test and 0 = otherwise gives the estimates for the probability of taking the final test. Health, gender, age and performance on the pre-test are significant for individual characteristics and the all have the expected signs. A mother's education increases the probability that a child will take the final test and wealth index is also significant, suggesting that pupils with educated mothers and wealthier households are more likely to remain in school (if we assume that drop-out is the reason they missed the test).

One way to deal with the selection bias in this sample would have been to use the Heckman selection correction procedure (Heckman, 1979). However, this procedure is difficult to implement in the absence of good instruments and is concerned with selection in terms of unobservables. It may be the case that the selection factors influencing whether a pupil sits the exam or not are largely due to observable factors. As these were controlled for in the regression models used, the problem of selection bias may be reduced.

6. Conclusion

6.1 Summary of the Main Findings

The main objective of the research was to examine the impact of school type on educational achievement of pupils in Ethiopia and identify factors that might explain differences in educational achievement. Achievement was measured with test scores in literacy and mathematics for pupils in grade 4 and 5 across five different school types. The research also pried into school attendance determinants as well as school retention. The Summary of the findings are thus;

- Parental/Household wealth is a strong predictor of school attendance, educational achievement and school retention. In the achievement models this variable remained robust even with the inclusion of other variables.
- Attending pre-school improves a student's academic performance in primary school and having more meals a day increases educational achievement of primary school children. Grade repetition is detrimental for academic achievement as well as previously dropping out of school.
- Presence of parents or their level of education have not provided any significant insights on educational achievement, but are predictors for school attendance and school retention. The achievement models capture many other factors that may have likely reduced the impact (explanatory power) of parent's education and their presence.
- Teachers qualification and the same sex gender interaction of teachers and students determines educational achievement (for female students), experience of the teacher doesn't predict achievement in this application. A class teacher who has specialised in a subject will produce better performing pupils in that subject as reflected in test scores in mathematics.
- Principals' education and gender are important factors for school management and pupils achievements. Very large classes negatively impact pupils' performance and school retention.
- The private schools group comprising of private schools, NGO schools and faith-based schools outperform their counter-parts in non-private schools (government and community schools). While the individual and household factors that influence this gap is non-trivial and important, school factors explain a very large share of the gap in the educational achievements of these two groups of students.

6.2 Limitations and Areas for Future Research

Despite identifying in the literature that a measure of ability in the achievement model is important, the data was unable to provide a suitable proxy for this measure, however one can argue that the bias in the result is attenuated in the case when pre-test are excluded because the model captures a wide range of pupils' characteristics that may influence ability. A solution to this issue would have been to use previous test scores of pupils even before entering school, but using cross-sectional data limited this approach. For

a sample of 411 pupils who were surveyed in the third round Young Lives longitudinal survey, PPVT[14] test scores were administered in 2009 three years before the achievement test scores of current interest, the finding is that this score is positively and significantly associated with their mathematics and Literacy achievement of in 2012 (see Appendix A3.1).

The inability to match the longitudinal data with the school survey data was because of the limited sample size of pupils who are sampled in the both surveys in addition to missing data across different variables of interests. A point of departure for future research in education could be to understand the concepts value-added and progression, the current research was unable to investigate this area because of data limitation, despite having access to two periods of study for the pupils in the school survey sample, the comparability of the initial and final test scores were limited. Also having access to longitudinal data but for a relatively small sample size hindered the investigation of factors that influence school progression, however, the results of this research provide insights into the concepts of value added and education progression.

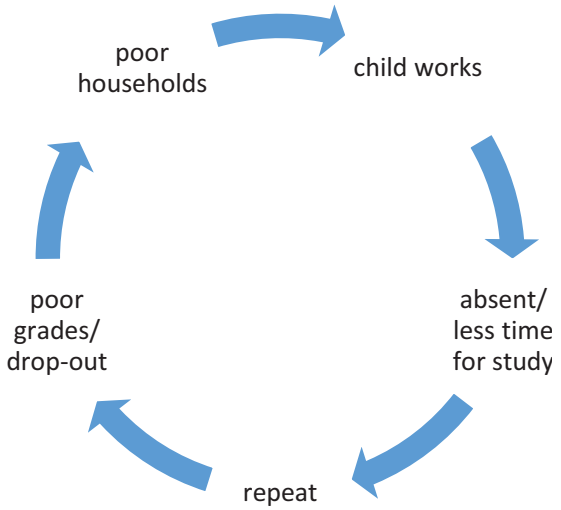
Lastly, the current research did not control for regional differences of the schools attended by the pupils which may be important in explaining differences in learning outcomes. The reason for this is that the data did not provide enough information to distinguish between the different regions where the various schools are located. One way to account for this would have been to include a regional dummy variable in the analysis that controls for the impact that regional differences may have on pupils' achievement. However, the regression analysis controlled for a number of observable school characteristics that may be uniquely different in schools in different regions for example having piped borne water is more likely for schools located in urban areas than for those in rural areas. Controlling for such variables will likely reduce any bias associated with the non-inclusion of a regional dummy variable in the OLS regression analysis.

6.3 Policy Implications and Conclusion

The understanding that household wealth predicts schooling outcomes suggests that government policies that seek to empower households through (for example) employment creation strategies that improve the livelihood options of the poor, as well as targeted conditional cash transfers which enable poor households send their children to school (even access private schooling) and keep them in school may have an impact on the educational achievement of their children. Figure 6 gives a graphical illustration of the disadvantages children from poor households face and which may determine their future outcomes unless they can break away from the cycle.

14. Peabody Picture Vocabulary Test is an untimed test of receptive vocabulary and is intended to provide a quick estimate of verbal ability and scholastic aptitude.

Figure 6—*Cycle of poverty for school children from poor households.*



Source: Own formulation

Early cognitive development is also crucial for a child's achievement in higher levels of education so policies geared towards provision of pre-schools for all children is key to ensuring that education gaps are attenuated. Child labour should be discouraged because it reduces school engagement time and increases the probability that a child will not stay till the end of the school year.

As regards schools, one thing that has been learnt from the private school types is that subject specialisation of teachers should be encouraged, and teachers should teach areas of specialisation as opposed to the "self-contained system" where one class teacher teaches all subjects to a class. The private schools had more specialised maths teachers and this impact is important for achievement. Lower class size policies should also be implemented which was also evident in the differences between the private and non-private school groups in the current research. Although this might conflict with 'increased access to education' policies that the government in Ethiopia is aiming towards, the agreement that increased access doesn't necessarily translate to increase educational achievement should encourage a balance of policy between the two.

In conclusion, school quality is a very important factor in the educational achievement of pupils. School quality is measured with school resources that aid learning, teachers' characteristics, principals' characteristics and the number of students enrolled in a class room. The current literature has deciphered the role of private schools in the process of attaining quality education and it cannot be overemphasized that school types can play a role in reducing inequality in educational achievements. To an extent, if students have enrolled into schools with individual and household characteristics that have set them up for low level educational achievements, access to private school types can help decrease the inequalities they face in terms of learning achievements. This thus has some implications for primary school privatisation and marketization in the Ethiopian context. With the government's realisation that quality learning is key in the educational process, then providing enabling environments where these private school types can thrive as well as improving quality in the non-private school types can go a long way in translating increased access into increased achievements.

Policies that ensure that private schooling is accessible to even the poorest and marginalised groups of children and does not further widen the inequalities that exist in terms of socioeconomic status of Ethiopian children should be pursued. Private schooling increases the choices available to children and provides opportunities for quality learning but government must ensure that such opportunities are also available for the disadvantaged children in their communities.

Appendix

Table A1.1—*Definitions of Variables used in OLS regression*

Variables	Description
HEALTH_PROB	Health problems that affect you in school yes==1 no==0
CHILD_WORK	Work on the farm or family business
DAYS_ABSENT	number of days absent
AGE	what age are you?(write number in box)
GENDER	Are you a boy or a girl?
MEALS_A_DAY	How many meals a day do you normally eat?
ATTEND_PRESCH	Did you attend pre-school?
REPEAT_GRADE	Have you ever repeated a grade?
DROP_OUT	Have you ever dropped out of school?
EXTRA_LANG	Do you attend extra classes in language
EXTRA_MATHS	Do you attend extra classes in language
MOTHER_ALIVE	Is your mother alive?
FATHER_ALIVE	Is your father alive?
MOTHER_READ	Can your mother read and write?
FATHER_READ	Can your father read and write?
Wealth index	PCA of parental wealth based on assets owned and services consumed by household
TCH_YEARS	By the end of the school year how many years have you been a teacher?
TCH_QUALIFIC	What is the highest level of teacher training qualification you have received?
TCH_AGE	Age of teacher
TCH_GENDER	Gender of teacher
SPECIA_MATHS	Teacher specialises in mathematics?
PRNC_AGE	Age of principal
PRNC_EDU	Principal's highest level of general education completed?
PRNC_GENDER	Principal's gender?
SCH_COMPT	How many working computers for students to use?
SCH_RADIO	Does the school have a working radio?
PIPED_WATER	Is piped water the main water source?
TOTAL ENROL	Total enrolled in this class

Table A1.2—*Summary statistics of variables used in probit regression*

Variable	Obs	Mean	Std. Dev.	Min	Max
ENROLLED	1882	0.77	0.42	0	1
HHSIZE	1882	6.20	1.98	2	14
AGE IN YEARS	1885	8.12	0.34	7.2	11.5
GENDER	1881	0.53	0.50	0	1
ORTHODOX	1880	0.71	0.45	0	1
MUSLIM	1880	0.16	0.37	0	1
LEASTPOOR	1881	0.32	0.47	0	1
VERYPOOR	1881	0.42	0.49	0	1
POOREST	1881	0.27	0.44	0	1
URBAN	1882	0.40	0.49	0	1
MOTHER_NOEDU	1880	0.50	0.50	0	1
MOTHER_PRIMARY	1912	0.24	0.43	0	1
MOTHER_SOME_PRIMARY	1912	0.14	0.35	0	1
MOTHER_SECONDARY&HIGHER	1912	0.11	0.31	0	1
FATHER_NOEDU	1880	0.24	0.43	0	1
FATHER_PRIMARY	1912	0.30	0.46	0	1
FATHER_SOME_PRIMARY	1912	0.23	0.42	0	1
FATHER_SECONDARY & HIGHER	1912	0.18	0.39	0	1

Table A1.3—*Probit regression result for enrolment*

Variables	Enrol
Household size	−0.0481***
	(0.0184)
Age	0.303***
	(0.106)
Gender (1= male, 0=female)	−0.174**
	(0.0703)
Orthodox (base group: other religion)	0.894***
	(0.0996)
Muslim (base group: other religion)	0.0148
	(0.117)
Least poor (base group: poorest)	0.434***
	(0.122)
Very poor (base group: poorest)	0.182**
	(0.0835)
Urban (base group : rural)	0.334***
	(0.0956)
Mother Primary (base group: No education)	0.170*
	(0.0969)
Mother Some primary (base group: No education)	0.297***
	(0.112)
Mother Secondary Higher (base group: No education)	0.142
	(0.178)
Father Primary (base group: No education)	−0.00418
	(0.0946)
Father Some primary (base group: No education	0.161*
	(0.0947)
Father Secondary Higher (base group: No education	0.418***
	(0.148)
Constant	−2.385***
	(0.881)
Observations	1,877

Notes: Standard errors in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01

The Determinants of Enrolment

As discussed in chapter three, enrolment is analysed because of selectivity in the sample that doesn't observe children that have not enrolled into school. From the survey data used in the enrolment analysis, only about a quarter of observations are captured in the data used for educational achievement analysis hence the inability to combine the enrolment and achievement models in one analysis but this brief analysis will facilitate an understanding of determinants of school attendance.

Table A1.2 in the Appendix provides summary statistics for the variables used in the probit regression model for school enrolment, where the dependent variable is a dummy variable =1 if currently enrolled and = 0 otherwise. Table A1.3 in the Appendix reports the regression result for a probit model. The probability that a child attends school increases with age with an increase in age by one year raising the probability of attending school by 30 percentage points. This effect is significant at a conventional level. Male children between the ages of 7 and 11.5 years are less likely to be enrolled in school than females in the same age group. Wealth plays a significant role in school attendance. For children in households classified as least poor, they were more likely to be enrolled than children in households that fell within the poorest group in this application (i.e., the base group in the estimation). Hence, ceteris paribus, the wealthier the household, the higher the probability that the child will attend school.

Among other household characteristics, the mother's and father's education influences the probability of attending school differently. For instance, a child whose mother has some primary education is more likely to attend school than one whose mother has no education. But for the father's education, secondary and higher education are positive and very significant determinants for school attendance in Ethiopia. Since the regression model controls for household wealth, parental education impact represents the positive attitude of educated parents to human capital accumulation of their children and not availability of resources. And this is consistent with the enrolment literature (see Al-Samarrai and Reilly, 2000). An additional household member reduces the probability of attending school by about 5 percentage points, which may indicate that less resources will be available for a child's human capital development as the household size grows. Location is captured by a dummy variable named 'urban'. The sign is positive and the significance level indicates that a child who lives in an urban area has a higher probability of attending school compared to than one who lives in a rural area. This may indicate the differences in expected returns to education for those in rural and urban areas. In Ethiopia, the rural areas rely on agricultural production and children are more likely to be on farms than in school, while in the urban areas, white collar jobs requiring educational qualifications are likely to increase the probability of attending school.

Table A1.4—*Descriptive statistics of mean differences in characteristics' of children enrolled or not enrolled*

Variable	Mean	Std. Dev.	Mean	Std. Dev.
	Not enrolled		Enrolled	
HHSIZE	6.66	1.86	6.06	1.99
AGE	8.07	0.33	8.14	0.34
GENDER	0.56	0.50	0.52	0.50
ORTHODOX	0.44	0.50	0.79	0.41
MUSLIM	0.33	0.47	0.11	0.31
LEASTPOOR	0.14	0.35	0.37	0.48
VERYPOOR	0.44	0.50	0.41	0.49
POOREST	0.42	0.49	0.22	0.41
URBAN	0.19	0.39	0.46	0.50
MOTHER_NOEDU	0.67	0.47	0.45	0.50
MOTHER_PRIMARY	0.18	0.39	0.26	0.44
MOTHER_SOME_PRIMARY	0.12	0.32	0.14	0.35
MOTHER_SECONDARY_HIGHER	0.03	0.18	0.13	0.34
FATHER_NOEDU	0.33	0.47	0.22	0.41
FATHER_PRIMARY	0.34	0.48	0.28	0.45
FATHER_SOME_PRIMAY	0.24	0.43	0.23	0.42
FATHER_SECONDARY_HIGHER	0.06	0.24	0.22	0.41
N	436		1,444	

Note: For dummy variables the mean represents the percentage of ones in the sample where yes=1 and no=0

Table A1.5—*Mean test scores in mathematics and literacy test for categorical variables*

	Observations	Maths Test	Literacy test
Overall mean		14.35	16.4
Individual Characteristic			
HEALTH_PROB: no	7717	14.4	16.5
HEALTH_PROB: yes	2341	14	15.8
CHILD_WORK: no	4734	14.8	17.1
CHILD_WORK: yes	5302	13.9	15.7
GENDER: female	5082	14.3	16.6
GENDER: male	4843	14.5	16.1
ATTEND_PRESCH: no	4738	13.4	15.1
ATTEND_PRESCH: yes	5141	15.2	17.5

	Observations	Maths Test	Literacy test
REPEAT_GRADE: no	7578	14.7	16.7
REPEAT_GRADE: yes	2326	13.1	15.4
DROP_OUT: no	8257	14.5	16.6
DROP_OUT: yes	1596	13.5	15.3
EXTRA_LANG: no	7025	14.6	16.4
EXTRA_LANG: yes	3033	13.9	16.2
EXTRA_MATH: no	5879	14.7	16.5
EXTRA_MATH: yes	4179	13.8	16.1
Household Characteristics			
MOTHER_ALIVE: yes	9282	14.4	16.4
MOTHER_ALIVE: no	630	14.3	16.4
FATHER_ALIVE: yes	8191	14.4	16.4
FATHER_ALIVE: no	1666	14.2	16.1
MOTHER_READ: yes	4850	14.7	16.9
MOTHER_READ: no	5208	14	15.9
FATHER_READ: yes	5926	14.5	16.6
FATHER_READ : no	4132	14.1	16
School Characteristics			
SCH_RADIO: yes	7736	14.7	16.8
SCH_RADIO: no	2324	13.0	14.7
PIPED_WATER: yes	6610	14.5	16.7
PIPED_WATER: no	3444	14.0	15.8
Teacher Characteristics			
TCH_GENDER: male	4969	14.3	16
TCH_GENDER: female	5053	14.4	16.7
Special maths: no	6613	14.1	16.3
Special maths: yes	3449	14.8	16.4
Principal Characteristics			
PRNC_GENDER: male	1357	15.3	16.2
PRNC_GENDER: female	8690	14.2	17.2

Table A2.1—*Decomposition of school type achievement gaps in Mathematics and Literacy (including pre-test scores)*

Variables	MATHS			LITERACY		
	(1)	(2)	(3)	(4)	(5)	(6)
	Overall	Explained	Unexplained	Overall	Explained	Unexplained
Private school	17.55***			18.99***		
	(0.108)			(0.111)		
Non-private school	13.85***			15.95***		
	(0.0494)			(0.0525)		
Difference	3.697***			3.040***		
	(0.119)			(0.123)		
Explained	2.981***			2.637***		
	(0.242)			(0.229)		
Unexplained	0.715***			0.403*		
	(0.254)			(0.235)		
Individual		2.375***	-0.755		2.260***	-1.311
		(0.156)	(1.067)		(0.139)	(1.021)
Household		0.117	0.230		-0.0501	0.288
		(0.105)	(0.382)		(0.0851)	(0.416)
School		0.489***	-4.087**		0.428***	0.853
		(0.178)	(1.618)		(0.156)	(1.396)
Constant			5.328***			0.572
			(2.052)			(1.783)
Observations	8,987	8,987	8,987	8,973	8,973	8,973

Notes: Robust standard errors in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01

Table A2.2—*Decomposition of achievement gaps by gender in Mathematics and Literacy (including pre-test scores)*

Variables	MATHEMATICS			LITERACY		
	(1)	(2)	(3)	(4)	(5)	(6)
	Overall	Explained	Unexplained	Overall	Explained	Unexplained
Female	14.24***			16.58***		
	(0.0648)			(0.0684)		
Male	14.42***			16.09***		
	(0.0681)			(0.0701)		
Difference	0.188**			0.483***		
	(0.0940)			(0.0979)		
Explained	−0.0998**			0.292***		
	(0.0462)			(0.0553)		
Unexplained	0.288***			0.191**		
	(0.0844)			(0.0863)		
Individual		−0.00950	2.617***		0.123***	−2.189***
		(0.0287)	(0.825)		(0.0306)	(0.791)
Household		−0.0195	0.225		0.0244*	0.290
		(0.0123)	(0.370)		(0.0127)	(0.392)
School		−0.0708**	0.0286		0.145***	2.016
		(0.0276)	(1.420)		(0.0339)	(1.425)
Constant			−2.583			0.0736
			(1.721)			(1.714)
Observations	9,064	9,064	9,064	9,059	9,059	9,059

Notes: Robust standard errors in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01

Table A2.3—*Detailed decomposition of school type achievement gaps in Mathematics and Literacy*

Variables	MATHEMATICS			LITERACY		
	(1)	(2)	(3)	(4)	(5)	(6)
	Overall	Explained	Unexplained	Overall	Explained	Unexplained
Individual						
GENDER		−0.000215	−0.128		0.000234	0.0628
		(0.00136)	(0.105)		(0.00198)	(0.0985)
ATTEND_PRESCH		0.176*	−0.0264		0.449***	0.177
		(0.105)	(0.147)		(0.0940)	(0.132)
REPEAT_GRADE		0.0215	0.125**		0.0125	0.139**
		(0.0157)	(0.0637)		(0.01000)	(0.0602)
DROP_OUT		0.0560**	−0.0507		0.00794	0.0936
		(0.0273)	(0.0654)		(0.0243)	(0.0614)
EXTRA_CLASSES		0.0977**	−0.0207		−0.00323	0.0961
		(0.0449)	(0.111)		(0.00798)	(0.0741)
CHILD_WORK		0.00975	0.0569		0.0513	0.128
		(0.0349)	(0.124)		(0.0322)	(0.115)
AGE		−0.0755**	−0.781		0.0474*	−2.625***
		(0.0295)	(0.986)		(0.0254)	(0.885)
MEALS_A_DAY		0.0635**	−0.545		0.0247	−1.191*
		(0.0278)	(0.744)		(0.0257)	(0.719)
DAYS_ABSENT		0.0479**	−0.0896		0.0621**	−0.143
		(0.0217)	(0.0989)		(0.0255)	(0.0981)
HEALTH_PROB		0.0122	0.150***		−0.00117	0.119**
		(0.00943)	(0.0571)		(0.00733)	(0.0536)
Household						
MOTHER_ALIVE		−0.00256	−0.373		0.00298	0.227
		(0.00798)	(0.486)		(0.00864)	(0.521)
FATHER_ALIVE		0.00369	0.355		0.00493	0.524*
		(0.00660)	(0.310)		(0.00896)	(0.290)
MOTHER_READ		0.106*	0.365***		0.0107	0.0714
		(0.0560)	(0.132)		(0.0533)	(0.127)
FATHER_READ		−0.0107	−0.0169		0.0258	0.122
		(0.0387)	(0.177)		(0.0373)	(0.172)
pca_wealthindex		0.190	0.0274**		0.0918	0.0432***
		(0.121)	(0.0123)		(0.111)	(0.0124)

Variables	MATHEMATICS			LITERACY		
	(1)	(2)	(3)	(4)	(5)	(6)
	Overall	Explained	Unexplained	Overall	Explained	Unexplained
School						
TCH_GENDER		0.115	0.509***		0.553***	1.170***
		(0.120)	(0.169)		(0.107)	(0.148)
TCH_QUALIFIC		0.0310*	−2.808***		−0.0172*	−1.982***
		(0.0160)	(0.337)		(0.0102)	(0.310)
SPECIA_MATH		0.135***	0.250**			
		(0.0344)	(0.0981)			
PRNC_AGE		0.526***	3.795***		0.662***	2.845***
		(0.0777)	(0.579)		(0.0778)	(0.515)
PRNC_GENDER		−0.0391	−1.844***		0.0228	2.500***
		(0.0345)	(0.467)		(0.0207)	(0.381)
PRNC_EDU		−0.0345**	−2.998***		−0.0239*	−2.804***
		(0.0175)	(0.761)		(0.0131)	(0.611)
SCH_COMPT		−0.00724	−0.0538		0.114***	0.295***
		(0.0268)	(0.0812)		(0.0326)	(0.0768)
PIPED_WATER		0.290***	−1.117***		−0.589***	0.981***
		(0.0905)	(0.236)		(0.0876)	(0.218)
log_TOTAL_ENROL		0.322***	−8.175***		0.111**	−2.178
		(0.0614)	(1.745)		(0.0453)	(1.530)
Private schools	17.54***			18.99***		
	(0.108)			(0.111)		
Non−private schools	13.83***			15.93***		
	(0.0493)			(0.0524)		
difference	3.716***			3.056***		
	(0.119)			(0.123)		
Explained	2.033***			1.619***		
	(0.285)			(0.252)		
unexplained	1.682***			1.437***		
	(0.315)			(0.277)		
Constant			15.08***			2.766
			(2.523)			(2.358)
Observations	9,058	9,058	9,058	9,053	9,053	9,053

Notes: Robust standard errors in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01

Table A2.4—*Mean and standard deviation of characteristics students that take final test or not*

	No Final Test		Final Test	
	Mean	Std. Dev.	Mean	Std. Dev.
PREMATHS_SCORE	12.94	4.03	13.65	3.96
HEALTH_PROB	0.28	0.45	0.23	0.42
CHILD_WORK	0.58	0.49	0.53	0.50
DAYS_ABSENT	3.21	4.42	1.80	3.02
AGE	12.20	2.14	11.48	1.75
GENDER	0.54	0.50	0.49	0.50
MEALS_A_DAY	2.72	0.54	2.77	0.51
ATTEND_PRE~H	0.48	0.50	0.52	0.50
REPEAT_GRADE	0.29	0.45	0.23	0.42
DROP_OUT	0.26	0.44	0.16	0.37
EXTRA_LANG	0.27	0.45	0.30	0.46
EXTRA_MATH	0.37	0.48	0.42	0.49
MOTHER_ALIVE	0.93	0.26	0.94	0.24
FATHER_ALIVE	0.82	0.38	0.83	0.37
MOTHER_READ	0.40	0.49	0.48	0.50
FATHER_READ	0.52	0.50	0.59	0.49
pca_wealthindex	-0.30	1.77	0.06	1.74
TCH_YEARS	12.39	9.03	12.31	9.57
TCH_QUALIFIC	1.86	0.59	1.86	0.57
TCH_AGE	33.27	9.11	33.25	9.51
TCH_GENDER	0.50	0.50	0.50	0.50
PRNC_AGE	37.33	8.96	38.42	8.87
PRNC_EDU	6.01	1.32	6.05	1.27
PRNC_GENDER	0.90	0.30	0.86	0.34
SCH_COMPT	1.46	4.20	1.25	3.40
SCH_RADIO	0.72	0.45	0.77	0.42
PIPED_WATER	0.62	0.49	0.66	0.47
log_TOTAL_ENROL	3.97	0.34	3.98	0.32
private_school	0.07	0.26	0.08	0.27
government school	0.90	0.30	0.85	0.35
community_school	0.01	0.10	0.02	0.13
ngo_school	0.00	0.06	0.01	0.08
faith_school	0.02	0.13	0.05	0.21
N	1927		10,063	

Table A2.5—*Regression result for probability of taking final exam*

Variables	Final test
PREMATHS_SCORE	0.0236***
	(0.00406)
HEALTH_PROB	−0.0776**
	(0.0351)
CHILD_WORK	−0.0459
	(0.0308)
AGE	−0.114***
	(0.00791)
GENDER	−0.0927***
	(0.0298)
MEALS_A_DAY	0.0507*
	(0.0287)
EXTRA_MATH	0.0358
	(0.0317)
MOTHER_ALIVE	0.00254
	(0.0595)
MOTHER_READ	0.0666**
	(0.0315)
pca_wealthindex	0.0388***
	(0.0104)
private_school	−0.253***
	(0.0706)
community_school	0.183
	(0.138)
faith_school	0.277***
	(0.0986)
ngo_school	0.163
	(0.236)
TCH_YEARS	−0.0118**
	(0.00525)
TCH_QUALIFIC	−0.0441
	(0.0295)
SPECIA_MATH	−0.0352
	(0.0397)

Variables	Final test
TCH_AGE	0.00370
	(0.00489)
TCH_GENDER	–0.0581
	(0.0368)
PRNC_AGE	0.00440**
	(0.00207)
PRNC_EDU	0.00780
	(0.0130)
PRNC_GENDER	–0.159***
	(0.0547)
SCH_COMPT	–0.0169***
	(0.00448)
SCH_RADIO	0.0190
	(0.0455)
PIPED_WATER	0.0735*
	(0.0417)
log_TOTAL_ENROL	–0.0880
	(0.0540)
Constant	2.344***
	(0.295)
Observations	11,103

Notes: Standard errors in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01

Table A3.1—*OLS results for Achievement in Mathematics and Literacy including PPVT score*

Variables	(1)	(2)
	LITERACY	MATHS
PPVT	0.0201***	0.0193***
	(0.00528)	(0.00526)
URBAN	0.451	−0.399
	(0.761)	(0.791)
HEALTH_PROB	0.155	−0.400
	(0.469)	(0.465)
CHILD_WORK	−0.0152	−0.220
	(0.421)	(0.420)
AGE	0.240	0.346
	(0.642)	(0.646)
GENDER	−0.423	−0.0596
	(0.390)	(0.389)
MEALS_A_DAY	1.011***	0.820**
	(0.387)	(0.385)
ATTEND_PRESCH	1.529***	0.500
	(0.490)	(0.492)
REPEAT_GRADE	−2.051***	−1.811***
	(0.499)	(0.412)
MOTHER_ALIVE	1.363	3.394***
	(1.008)	(1.011)
FATHER_ALIVE	0.476	0.177
	(0.681)	(0.670)
MOTHER_READ	0.260	−0.720*
	(0.415)	(0.414)
FATHER_READ	−0.262	−0.148
	(0.440)	(0.437)
pca_wealthindex	0.386**	0.421**
	(0.171)	(0.170)
TCH_YEARS	0.00773	−0.000361
	(0.0784)	(0.0773)
TCH_QUALIFIC	1.508***	0.859*
	(0.460)	(0.462)
TCH_AGE	−0.0757	−0.00814

Variables	(1)	(2)
	LITERACY	MATHS
	(0.0755)	(0.0747)
TCH_GENDER	−0.354	0.186
	(0.540)	(0.550)
SPECIA_MATH		1.309**
		(0.637)
PRNC_AGE	0.0613**	0.0549*
	(0.0285)	(0.0284)
PRNC_EDU	0.0479	−0.127
	(0.184)	(0.184)
PRNC_GENDER	0.145	−0.857
	(0.731)	(0.736)
SCH_COMPT	−0.0650	−0.0464
	(0.0729)	(0.0723)
SCH_RADIO	−0.615	0.749
	(0.601)	(0.598)
PIPED_WATER	1.914***	0.785
	(0.689)	(0.691)
log_TOTAL_ENROL	−1.035	−0.209
	(1.080)	(1.081)
school	1.317	−1.238
	(1.283)	(1.293)
Constant	6.969	3.135
	(6.591)	(6.579)
Observations	411	411
R−squared	0.339	0.262

Notes: Standard errors in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01

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Budapest Office
Október 6. u. 12
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London SW1P 4QP, United Kingdom
Tel: +44(0)20 7031 0200

New York Office
224 West 57th Street
New York, New York 10019 USA
Tel: +1 212 548 0600