Working Paper 168

Young Lives

Early Investment in Preschool and Completion of Secondary Education in Ethiopia:

Lessons From Young Lives

Tassew Woldehanna and Mesele W. Araya

www.younglives.org.uk

MARCH 2017

Early Investment in Preschool and Completion of Secondary Education in Ethiopia: Lessons From Young Lives

Tassew Woldehanna and Mesele W. Araya

ISBN 978-1-909403-89-5

A catalogue record for this publication is available from the British Library.

Core funded by

UKaid
from the British people

Young Lives, Oxford Department of International Development (ODID), University of Oxford, Queen Elizabeth House, 3 Mansfield Road, Oxford OX1 3TB, UK

Tel: +44 (0)1865 281751 • Email: younglives@younglives.org.uk

Contents

The authors **4**

Acknowledgements **4**

Summary **5**

1. Introduction **6**

2. Literature review and Ethiopian context **8**

2.1 The economic case for investing in early childhood education 8

2.2 Preschool and secondary education in Ethiopia 10

3. Methodology **13**

3.1 Conceptual framework 13

3.2 Estimation strategy 14

3.3 Data and variables 17

4. Results **19**

4.1 Descriptive statistics 19

4.2 Estimation 21

4.3. IV estimator and robust check 27

5. Discussion and conclusions **29**

References **31**

The authors

Tassew Woldehanna is Professor of Economics, Department of Economics, Addis Ababa University and Principal Investigator of Young Lives, Ethiopia, Ethiopian Development Research Institute (EDRI).

Mesele Araya is a quantitative Research Assistant, Young Lives, Ethiopia, Ethiopian Development Research Institute (EDRI).

Acknowledgements

We wish to thank the external reviewers for their helpful comments and Adam Houlbrook for copyediting the paper. However, the responsibility for any errors is ours.

Summary

Investments in early childhood education are believed to be critical in forming the foundation for life-long learning and providing children with the opportunity to reach their full potential. This is because early childhood is a crucial phase of growth and development, where early circumstances can influence outcomes across the entire course of an individual's life.

Despite the plethora of studies in high-income countries, little is known about the long-term contributions of early childhood investment in low-income countries. To the best of our knowledge, there is no longitudinal study in Ethiopia that has looked at the contribution of preschool education beyond primary school-aged children. The study that this working paper reports on aimed to fill this research gap by using longitudinal data from Young Lives in Ethiopia to look at the long-term estimates of early childhood education on successful completion of secondary education and the chance of transitioning to institutions of higher learning.

As the data showed a huge divide in preschool access between urban and rural children, we used only the urban sample in our logit models. Findings indicate that urban preschool children are 25.7 per cent more likely to complete secondary education than their non-preschool counterparts at the proper age. The marginal returns are higher for those who attended preschool for two and three years than those who only attended for one year. In particular, those who attended for three years have a higher probability of transitioning to higher education at the age of 18.

Overall, the findings suggest that a significant part of children's educational inequalities at later ages are explained by the level of early childhood investment. In spite of such significance, public investment to this subsector of the education system is meagre, relative to the other subsectors. Based on the current preschool landscape of Ethiopia, only a quarter of the 7.4 million preschool-aged children – mainly from better-off families and urban areas – are able to make their way to this vital learning stage. Most children simply begin primary school without any exposure and consequently face considerable difficulties on their educational pathways in completing secondary education and transitioning to institutions of higher learning.

The analysis suggests that if the aim is to reduce educational inequality among future generations and to be able to conquer poverty in the years ahead, equalising the quality of early education, with two to three years of preschool exposure for both urban and rural children aged 4 to 6 years old, will remain an essential educational policy for Ethiopia.

1. Introduction

Investments in early childhood education are believed to be critical in forming the foundation for life-long learning and providing children with the opportunity to reach their full potential. This is because early childhood is a crucial phase of growth and development, where early circumstances can influence outcomes across the entire course of an individual's life (WHO 2012). In many high-income countries, there are a number of studies that support such relationships and strongly suggest that the best hope for changing the educational disparity of children is to invest resources during their earliest years (Cunha, Heckman, Lochner and Masterov 2005; Cunah and Heckman 2006). Others also argue that investing in early childhood development benefits children, individuals and societies by providing the base for healthy development (Berlinski et al. 2006). Authors such as Heckman (2012) and Woodhead et al. (2009) contend that investing in early childhood education might be one of the most effective interventions for helping poor children, families, communities and nations, and may help break the intergenerational cycle of poverty.

In one empirical example, Calman and Tarr-Whelan (2005) found that preschool attendance is associated with lower dropout rates and higher grades. Barnett, Lamy and Jung (2005) also found that preschool attendance has a positive effect on children's completion years of primary and secondary education, accompanied by low dropout and repetition rates in each grade for preschoolers compared to non-preschoolers. Fantuzzo, Bulotsky-Shearer, Fusco and McWayne (2005) and Wylie and Thompson (2003) likewise discovered a positive contribution on learning dispositions and social-emotional outcomes. Goodman and Sianesi (2005) investigated early education and children's outcomes and indicated that investments in human capital before the age of 5 appeared to have long-lasting positive effects on children's educational pathways. Ruhm and Waldfogel (2011) evaluated the long-term effects of early childhood education programmes and contended that expansions of early education generally yield benefits at school entry, adolescence, and for adults, with the benefits largely pronounced for disadvantaged children. In terms of expected economic returns, the Government of the United States (2014) estimated that *'*expanding early learning initiatives would provide benefits to society of roughly [US]$8.60 for every $1 spent, about half of which comes from increased earnings for children when they grow up.*'*

In spite of growing evidence in high-income countries, there is limited empirical evidence on the long-term contributions of preschool education in Africa, particularly in Ethiopia. As far as it is known, there are no studies in Ethiopia on this issue other than the ones by Woldehanna (2011, 2012 and 2016), Azubuike (2014), Orkin, Yadete and Woodhead (2012) and Hoot, Szente and Mebratu (2004). Except the latter, all made use of Young Lives data in their analyses. For instance, Woldehanna (2011) studied the cognitive effects of preschool attendance of urban children aged 5 and 8 years. Recognising the importance of preschool education on children's cognitive development, he recommended the expansion of public preschool centres in the country. Azubuike (2014) also investigated factors influencing school achievements at primary school level and concluded that early investment in the form of preschool education improves the performance and educational achievement of students at primary level. More broadly, Orkin, Yadete and Woodhead (2012) looked at the landscape of early childhood development in Ethiopia, showing that investment in early childhood development is minimal and basic primary school systems are still being consolidated;

children often enrol late and tend to have difficult trajectories through school as a result of dropping out or progressing slowly through grades.

It is undeniable that Ethiopia has recently seen much improvement in the net enrolment rate of primary education, with this reaching 92 per cent in 2013/14 (MoE 2013/14). However, it is argued that this advance is without a strong foundation as many children begin primary school without any exposure to preschool in their early years of life. An annual educational statistical report from the MoE (2013/14) shows that only a quarter of the 7.4 million preschool-aged children in the country get the opportunity to go to preschool centres. Another sign of the uncertain foundation in the education sector is that students are not able to complete secondary education as expected. In 2013/14, World Bank data showed that the gross completion rate for lower secondary education was as low as 29.4 per cent (World Bank 2016).[1] Such a low rate raises the question as to whether the limited access to preschool centres experienced in early years of life might be associated with the low completion rate of secondary education. To the best of our knowledge, using longitudinal data, there is no study in Ethiopia that has looked at the contribution of preschool education beyond primary school-aged children. This study aimed to fill this research gap by looking at the long-term estimates of early childhood education on successful completion of secondary education and the chance of transitioning to institutions of higher learning, by addressing the following research questions:

1. Does attending preschool offer an advantage for the successful completion of secondary education?
2. Do two or three years of preschool education have additional benefits for the completion of secondary education?
3. Do children who attended private preschool programmes show larger gains in terms of completing secondary education?
4. Does the contribution of preschool education go beyond successful completion of secondary education, such as transitioning to institutions of higher learning?

In answering these research questions, we followed the Bellman equation of dynamic programming problem and employed several alternative micro-econometric models: logit, ordered logit and IV estimators. While the logit models are used to estimate the contribution of early childhood investment on successful completion of secondary education, the ordered logit models are useful to look at the cumulative effect of preschool participation on the children's educational pathways, starting from primary school up to entrance into higher education. To check the robustness, we further estimated two IV estimators that used community sites and predicted probability from a first regression of preschool determinants as instruments.

Findings show that preschool participation any time between 4 and 6 years old is associated with a significantly increased probability of completing secondary education and transitioning to institutions of higher learning at the right ages. Empirically, children who attended urban preschools are found to have a 25.7 per cent higher likelihood of completing secondary education than their non-preschool counterparts at the right ages. When disaggregated by duration of preschool participation, one year of preschool attendance is, however, found to

1 The gross enrolment rate for secondary (Grades 9-10) was 39.3 per cent in 2013/14, with net enrolment rate 20.2 per cent.

have a smaller magnitude of marginal probability on completing secondary education and becomes statistically insignificant with the probability of entering into institutions of higher learning. Children with three years of preschool participation showed a 11.2 per cent higher likelihood to join institutions of higher learning at the right ages. The findings are robust for alternative IV estimations.

The rest of this working paper is organised as follows. Section 2 presents the literature review on preschool investment and its contribution for early skill formation and children's school achievement. Section 3 provides the framework and estimation strategy used in the analysis, Section 4 reports the empirical results, and Section 5 concludes.

2. Literature review and Ethiopian context

2.1 The economic case for investing in early childhood education

Early childhood is a period of great opportunity for shaping children's way of interacting with their environment, and shaping their adulthood and more generally their future (WHO 2012). Several studies have investigated the importance of early childhood investment for children's education and their life in general. Cunha and Heckman (2010) studied the life cycle of human skill formation dealing with investments in children's skills. They argued that childhood is a multistage process where early investments feed into later investments as the result of 'skill begets skill' and 'learning begets learning', implying that the economic returns of early investments are higher. Reynolds, Temple and Barry (2009) also found that children's preschool participation at ages 3 to 4 have large and long-term effects on children's well-being. Waldfogel (1999) reviewed the potential benefits and drawbacks of early childhood interventions, focusing on the Rand study[2] of early interventions, the Head Start programme,[3] and the NICHD[4] study of early child care. The review showed that early childhood interventions could make a difference in improving outcomes for children. Craig and Sharon (2004) also contended that quality childhood education and care could bring huge differences in the lives of poor disadvantaged children. Specifically, children who participated in preschool programmes were found to have higher scores on reading and mathematics tests that

2 The Rand study rigorously assessed nine early intervention programmes in the United States (Early Infancy Project (PEIP); Early Training Project (ETP); High/Scope Perry Pre-School; Houston Parent-Child Development Center (PCDC); Syracuse Family Development Research Program (FDRP); Carolina Abecedarian; Project CARE (Carolina Approach to Responsive Education; Infant Health and Development Project (IHDP); Chicago Child-Parent Center (CPC)); and showed that well-designed early intervention programmes can make a positive difference in children's lives. Eight of the nine programmes were found to be cognitively oriented, and all were successful at raising children's cognitive test scores or school achievement as measured by higher IQ scores, higher school achievement test scores, less time in special education, better grades, less grade repetition, or higher rates of graduation from high school (see Waldfogel 1999 for details).

3 The Head Start programme is an intensive preschool programme in the US that operates five days a week for four to eight hours a day over most of the year, targeted for children of low-income families. Studies of this programme indicate that it has significant effects on raising school readiness (cognitive, socio-emotional, and health) of the children.

4 The National Institute of Child Health and Human Development (NICHD) study is part of the National Institutes of Health (NIH) within the US Department of Health and Human Service,s and began in 1991 as a study to collect information about different non-maternal child care arrangements, and about children and families who use child care as well as those who do not, to examine how differences in child care experiences relate to children's social, emotional, intellectual, and language development, and to their physical growth and health.

persisted up to adulthood, stayed longer in education, and were less likely to become teenage parents. Barnett and Lamy (2006) revealed that attending preschool significantly increases scores on vocabulary and maths tests, while print awareness skills though vocabulary were insignificant for those who attended for only one year. Wylie and Thompson (2003) investigated the effect of early childhood education on children at age 14 and found that children who attended an early child education institution, where most were from middle-class families, had higher mathematics and reading scores. Magnuson, Ruhm and Waldfogel (2007) also found that pre-kindergarten is associated with increases in maths and reading skills at kindergarten entry, but that the gains were found to have faded out in Grade 1. For disadvantaged children, however, the initial gains were higher and also more persistent than for the full sample. Yao and Cynthia (2003) argued that preschoolers scored higher than the non-preschoolers in both language and maths in Grades 1 and 3 standardised tests. In Grade 2, though pre-schoolers scored higher, the difference was insignificant.

Early childhood investment has positive externalities beyond improving cognitive and socio-emotional development of children, in that it brings reductions in crime, and lower expenditures on health care and remedial education, which implies lower correctional and other costs for parents and society at large. Heckman and Masterov (2007) looked at investing more on young children from disadvantaged families from the perspective of the productivity argument, and found that early investment is wise, as it increases school productivities by creating better quality students, which in turn should lead to quality workforces. They added that early education is a productive and safe investment for society. Lynch (2005) also examined the likely benefits and characteristics of investing in high-quality, large-scale, publicly funded early childhood development programmes for children living in poverty, and found that early investment in poor young children would have positive economic impacts by raising GDP, improving workforce skills, reducing poverty, strengthening global competitiveness, and reducing crime rates. In much the same way, employing the cost-benefit analysis of preschool for disadvantaged children, Barnett (1985) examined the economic perspectives of critical policy issues around public preschool education and found that preschool education is an economically sound public investment for children from low-income families. Low-income families are unable to invest in preschool for their children due to a lack of resources, and hence government needed to provide funding so as to increase the quantity and quality of public programmes. Reynolds, Temple and Barry (2009) examined the evidence on cost-effectiveness of early childhood development programmes from birth to 10 years old using the cost-benefit analysis approach. The study revealed that interventions between birth and 3 years old, including nutritional education and home visits, were found to have family, health and social benefits, and children's preschool participation at the age of 3 to 4 has large and long-term effects on the well-being of children. In addition, Masse and Barnett (2002) analysed the benefit cost of the Abecedarian preschool programme in the United States, and found that the investment of public resources targeted at a disadvantaged group yields healthy returns; they suggested though that the findings may not be replicated perfectly in all settings and for all populations. Other studies have reviewed previous literature on preschool investment. Barnett and Escobar (1987) critically reviewed the existing literature and tried to assess the strength of the empirical evidence regarding the economics of early intervention. Many of the studies were found to have credible evidence that early intervention for disadvantaged children can be a sound economic investment, but they still suggest that there is a need to look at the significance of early childhood investment empirically by applying a new perspective of longitudinal data, especially in low-income settings.

2.2 Preschool and secondary education in Ethiopia

Although the 1994 Ethiopian Education and Training Policy (ETP) that defines the current education system states 'kindergarten will focus on all round development of the child in preparation for formal schooling', early childhood education in Ethiopia is not compulsory. Neither, until recently, has any explicit budget been allocated by the government towards this subsector. Two reasons have commonly been mentioned for the de-emphasising of this subsector until recently (Hoot, Szente and Mebratu 2004; Woldehanna 2011). First, as resources are insufficient for providing even basic primary and secondary education, the government has been maximising its efforts at these other levels of the education sector. Second, the government wanted to encourage the involvement of private actors to invest in early childhood education (MoE 2007/08). As result, the subsector has been dominated by kindergartens owned by private actors, communities and faith-based/NGO preschools.

However, advised by policymakers and international actors that work closely on issues related to early childhood development, the Government of Ethiopia has lately started paying attention to the subsector and incorporated it in the latest two Education Sector Development Plans (ESDP IV and ESDP V). By the end of 2010, in collaboration with UNICEF and the Child-to-Child initiatives, the Early Childhood Care and Education (ECCE) policy framework was introduced at inter-ministerial level. The ECCE aims to provide quality early childhood services under four pillars: parental education; health and early stimulation programme from prenatal up to 3 years old; preschool community-based kindergarten from 4 to 6 years old; and community based non-formal school readiness programmes (see Table 1 for preschool type and perceived quality).

Table 1. *Types of pre-elementary schools/kindergartens in Ethiopia*

Programme type	Funding	Children/families served	Generally perceived quality	Generally perceived limitations
Private preschools	Parental fees	Upper SES families	Very high-quality education	Potential conflict between private school curricula and MoE guidelines
Government preschools (since 2011/12 O-Class, Child-to-Child and an interim accelerated child readiness programme)	Government stipend plus parental fees	General population/lower SES families	Basic education	Lack of material, large class (50-100+) class size, poor management, little in-service preparation after teachers begin their jobs
Quasi-public school	Government stipend plus parental fees	Middle and upper-class families	High-quality education	Potential conflict between MoE and schools governing boards composed of elected parents
Mission preschools	Religious denomination sponsor	Middle and upper-class families and a few scholarships for lower SES children	Good-quality education	Limited input from parents
Church schools	Church stipends plus parental fees	Middle and upper-class families and a few scholarships for lower SES children	Good-quality education	Limited input from parents
Community schools	Parental fees	Foreign diplomats and upper SES classes	High-quality education	In Ethiopian community schools, culture and traditions of western culture are emphasised
NGO schools	Funded by contact between MoE and NGOs for specific period of time.	Lower SES children/ families	Basic education	Established local community may still be unable to sustain their share of costs after the contract expires

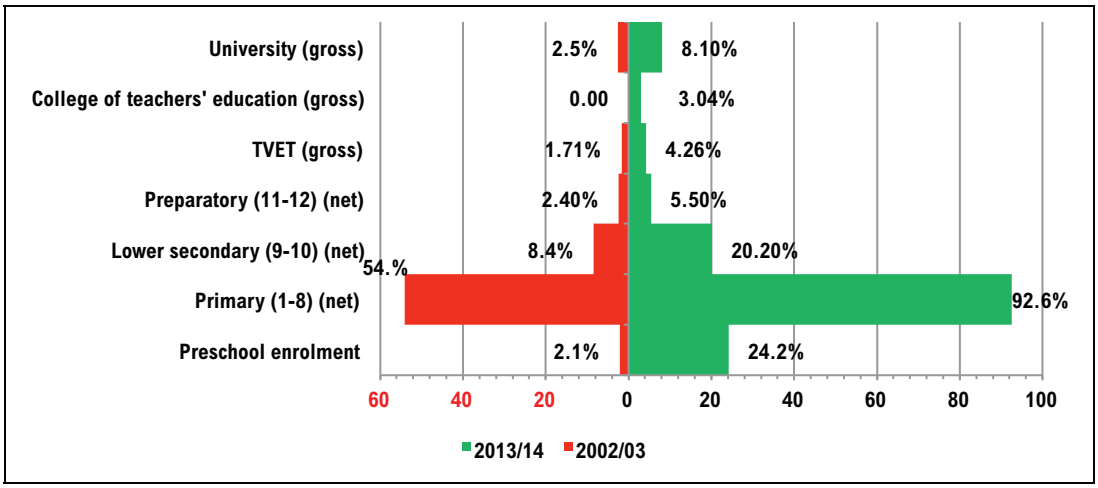
Source: Hoot, Szente and Mebratu 2004; Ethiopian Ministry of Education 2013/2014.

One part of this ECCE framework is the O-Class, which is intended to benefit vulnerable and disadvantaged 6-year-old children who do not have access to kindergarten, by attaching them to public primary schools for one year. The attached children are expected to be taught by selected teachers to prepare them for their first grade (MoE 2013/14: 23). Another type of non-formal preschool service designed as part of the ECCE is the Child-to-Child delivery system, where fifth or sixth graders play with their younger siblings and neighbourhood children, supervised by qualified teachers. Although the quality and adequacy are still debatable, playing becomes learning as the younger child gets to know how, for example, to count, differentiate colours and identify letters, before joining primary school (UNESCO 2015: 19-26). Therefore, since 2011 preschool education in Ethiopia has been provided through three modalities: kindergartens (owned by private providers, community and faith-based organisations), the O-Class programme, and the Child-to-Child initiative. There is also a plan for an "accelerated school readiness" programme to begin in Benishangul-Gumuz in 2016/17.

As the result of these newly introduced programmes, access in the subsector has improved. Figure 1 presents data from the Ethiopian Education Statistics Annual Abstract published by the Ministry of Education. In 2002/03, out of the estimated 6.06 million children of the appropriate age group (ages 4–6), only 2 per cent were reported to have accessed preschool education across 1,067 kindergartens. This figure jumped to more than 24.2 per cent net enrolment rate in 2013/14. The increase was especially related with the setting up of O-Class, which has received a widespread response from local authorities, achieving over 1 million children enrolled in its first year of implementation. Child-to-Child also made a large contribution, reaching close to 0.3 million children as of 2013 (MoE 2013/14). The government has outlined a very ambitious plan in its Fifth Education Sector Development Plan (ESDP V) with a target of 80 per cent gross enrolment rate, through increasing the budget share of the subsector within general education from 3 per cent in 2015/16 to 11 per cent in 2019/20.

In relation to the other levels of education, in the last decade Ethiopia has shown notable expansion at primary, secondary and tertiary levels. At the primary level, in particular, the government worked to meet the Millennium Development Goals (MDGs) by abolishing tuition fees and creating grassroots access for millions of children. Such improvement can be seen in Figure 1, where the net enrolment for the primary level rose from 54 per cent in 2002/03 to 92 per cent in 2013/14. Enrolment in secondary schools and institutions of higher learning has also increased, but not as much as the increase seen at primary level. Net enrolment at lower secondary education in 2013/14 was about 20 per cent, while it was well below 10 per cent for upper secondary education. The same was true for the enrolment at institutions of higher learning (colleges of teachers' education, TVET and university level (see Figure 1).

Figure 1. *Enrolment rates in preschool, primary, secondary and higher education in Ethiopia*



Source: MoE 2002/3 and 2013/14.

The decline in enrolment rate when one moves up the educational ladder gives the educational structure of the country a pyramid shape, where nine out of ten children of appropriate age are enrolled at primary level, two out of ten in secondary education, and only one out of ten at university.

There could be several reasons for the pyramid shape of the education sector. This working paper focuses on whether there is any association between the first stage and the middle and upper levels of education. The need to focus on these levels is because the overall development of a country highly depends on the skill levels of its citizens. Ethiopia has recently witnessed rapid growth, with GDP growth averaging 10.9 per cent between 2004 and 2014 (Word Bank 2015). If the growth recorded in the last decade continues, there is the possibility that the country could become a low-middle income nation by 2025 (Growth and Transformation Plan (GTP II) 2015: 16). However, it is our assumption that to realise such a development aspiration, at the same time there is a need for a skilled workforce that has the ability to learn and use technology. In this regard successful completion of secondary education could be a necessary condition for such economic development and to achieve the intended income status. The argument is that as a lack of a properly skilled workforce could hinder the country on its future development track, there is a need to examine the main barriers of secondary education completion and transition to institutions of higher education from the perspective of early childhood investment. Related to this, Hoot, Szente and Mebratu (2004) contended that lack of solid foundations in early childhood education are likely to leave children of all families unprepared for the twenty-first century. They added that improving the skills of citizens to match the knowledge required in today's dynamic labour market is a long-term phenomenon, which needs adequate investment at the very earliest opportunity. Based on this conceptual framework, we look at the long-term associations of pre-school and secondary/tertiary attendance to be better able to make policy recommendations around the expansion of public preschool education.

3. Methodology

This section outlines the framework that provides a background for early childhood educational investment and the basis for our empirical estimations.

3.1 Conceptual framework

As preschool education in Ethiopia is primarily provided by the private sector, where tuition fees and other related costs are paid by parents, we formulate a conceptual framework of the preschool investment decision of an altruistic parent. This framework builds on the work of Raut and Heckman (2005), where they developed a structural dynamic programming model of preschool investment choices of altruistic parents by applying longitudinal data. Like Heckman and Raut (2013), we presume in the model that there is one child in each family and classify the age of the child into discrete periods during which important life-course events relevant to leaning occur.

As the Young Lives data has been collected four times so far, we divide the whole life course of the child into four periods: [0-6 years old], [7-14], [15-16], and [17–]. Aggregating the age of the child in this way has important implications as to how parental investment made in the first period [0-6], which comprises preschool age [4-6 years old], may contribute to the educational progress of the child over the next age categories: primary school [7-14], lower secondary education [15-16] and institutions of higher learning [17–], including upper secondary [17-18].

Let $\overline{PS}$ be the level of parental preschool investment that helps the child develop cognitive skills and non-cognitive skills, which can be denoted as cognitive skills (κ), motivational skills (ω) and social skills (ψ). The level of each type of skills that the child acquires also depends on other factors like home environment, wealth index of household, level of parental education and related social skills. During the ages of 7-14, the child goes to primary school. School performance at this stage depends on the levels of κ, ψ and ω that are acquired during the first stage, on the quality of the school that she attends and the intensity of the programme during the preschool period. It also depends on parental home inputs such as the level of parental education, nutritional status of the child, birth order and family size, household wealth and how stable and stimulating the relationships among the family members are (Woldehanna and Hagos 2015).

During the third period [15-16], the child should be enrolled in secondary education (Grades 9-10) and is expected to complete secondary education at age 16. We assume here also that the cognitive and non-cognitive skills acquired in the first stages will have a multiplied effect at this stage and help the child complete secondary education at the proper age (see Cunha, Heckman, Lochner and Masterov 2005; Cunha and Heckman 2010). These authors contended that the process of human skill-formation is governed by a multistage technology, where investments at each educational stage produce outputs at the next stage and beyond.

During [17-] the child makes schooling decisions taking into account the costs and benefits of attaining a given level of education, like whether to join TVET institutions, college of teachers' education or a preparatory programme as a way to university. The opportunity costs of schooling at this level mainly include either entering paid work or engaging in other farm duties. Taking the Ethiopian context into account, the child may also form a family with a child and decides how much to invest in preschool, elementary school, and high school of the

newborn child (we assume this because about 4 per cent of the Older Cohort children were a teenage parent by Round 4 of the Young Lives survey).

As mentioned in Heckman and Raut (2013), the structure of educational cost is generally complicated, but we assume that each adult child borrows the whole educational cost from the market. Assume $C(y,i)$ be the cost of y years of education annualised over the working years of the adult child, where i is the interest rate for borrowing the cost of education. Also, the educational choice of the adult child can be influenced by a number of life-course events especially in low-income countries where frequent economic and social shocks are very common. We represent the shocks and all other unobservable factors by an aggregative random variable ε_y. We also assume that the return from education to be permanent income annually and is function of child's number of years of education (y), cognitive skill (κ), motivational skill (ω) and social skill (ψ) and random shock ε_p (see Raut and Hickman 2013). If we assume the annual steady income of the adult child over the working life is given by $\omega\left(\psi,\kappa,\omega,\psi,\varepsilon_p\right)$, the net cost of schooling becomes:

$\omega\left(\psi,\kappa,\omega,\psi,\varepsilon_p\right)=\omega\left(\psi,\kappa,\omega,\psi,\varepsilon_p\right)-C\left(y,i\right)$. For simplicity, we write the variables of the vector as $z=\left(y,\kappa,\omega,\psi,\varepsilon_y,\varepsilon_p\right)$; so that the optimal educational level of the child will be $y^*=\left(\kappa,\omega,\psi,\overline{ps},\varepsilon_y\right)$. Assuming such optimal educational choice of the child, the parent then decides the level of optimal early investment in preschool education by solving the following Bellman equation of dynamic programming problem:

$$V\left(z\right)=\cup\left(\overline{w}\left(z\right)-\overline{ps}\right)+\lambda\int V\left(z'\right)T_{\overline{PS}}\left(z,dz'\right)$$

Where $V(.)$ is value of the function; $\cup(.)$ is the felicity index of parental annual permanent consumption $\overline{w}\left(\overline{z},\varepsilon_p\right)-\overline{PS}$; $0\le\lambda<1$ is the proportion of parental altruism towards the child, and $T\left(z,z'\right)$ the transition probability of the child moving to state z' given the state variable of the parent z, where such probability of transition depends on the level of cognitive, socialisation and motivational skills that are acquired at early years of life (Heckman and Raut 2013; Raut 2003).

Nonetheless, it is worth noting that as there is no information on the amount of money made by parents in preschool investment in the Young Lives Older Cohort data, we approximate the level of early investment in preschool education ($\overline{PS}$) by whether the child had an opportunity to attend a preschool centre any time between 4 and 6 years old. This means we create a dummy variable as to whether the parent sent the child to a preschool centre any time in their early years of life for at least six months. Furthermore, to investigate the duration of early preschool investment as a proxy for quality of preschool investment, we divide the number of preschool academic years attended into three and estimate whether there is any differential effect of each additional year of preschool attendance on the completion of secondary education at the age of 16, and the chance of transition to institutions of higher learning at the age of 18.

3.2 Estimation strategy

The study employed several empirical models. First, to examine to what extent preschool attendance is associated with successful completion of secondary education, we employed logit models being controlled for relevant covariant variables that range from individual child to household characteristics. Successful completion of secondary education is measured by whether an adult child received a certificate for completing Ethiopian general secondary education (Grade 10) by Round 4 of the Young Lives survey. This means we first estimated

logit models (yes=1 or no=0) to examine the contribution of preschool investment on the completion of secondary education. A logit model is traditionally viewed as suitable model for estimating parameters of interest when the dependent variable is not fully observed – a latent variable (Hosmer and Lemeshow 2000). To drive the logit model from a latent variable, let y* be a continuous variable that we do not observe, but can be determined by the model.

$$y^* = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k + u = x\beta + u \quad [1]$$

Where u is a residual, assumed uncorrelated with x; x_k is explanatory variable and β_k denotes parameter of interest. While we do not observe y^*, we do observe the discrete choice made by the individual, according to the following choice rule:

$$y_i = \begin{cases} 1 & if \quad y_i^* > 0 \\ 0 & if \quad y_i^* \le 0 \end{cases} \quad [2]$$

Assuming that the error term follows a logistic distribution, the probability for successful completion of secondary education is given by

$$\Pr(y = 1/x) = \frac{e^{x\beta}}{1 + e^{x\beta}} \quad [3]$$

Where $x\beta = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_{ki}$

Where Y_i assumes a value of 1 if the adult child i received a certificate for completing Ethiopian general secondary education by Round 4, and 0 otherwise; x_i stands for preschool ($\overline{PS}$) and control variables; β_i is the parameter of interest and ε_i is logistically distributed error-term. In a logit model, it is assumed that the explanatory variables affect the outcome through a suitable transformation of the probability of the success that comes from the marginal effect. The marginal effect of x_k is thus given by

$$\frac{\partial \Pr(y = 1/x)}{\partial x_k} = \frac{e^{x\beta}}{(1 + e^{x\beta})^2} \frac{\partial (x\beta)}{\partial (x_k)}$$

$$= \frac{e^{x\beta}}{(1 + e^{x\beta})^2} \beta_k$$

$$= \Pr(y = 1) * \Pr(y = 0) * \beta_k$$

It is also worth noting that $\overline{PS}$ is a dummy variable of preschool attendance any time between the ages of 4 and 6, for at least six months. But in an effort to investigate the impact of preschool duration (a proxy for the level of early investment), we further created three dummy variables. The first dummy is for those who attended only one year of preschool education, while the second and third dummies are for those who stayed for two and three years. This duration analysis of preschool education is particularly believed to have a vital policy element, for findings for the current one-year O-Class programme being expanded in the country. In this regard it is important to note that equating the one year preschool attendance of this study with the recent O-Class governmental preschool programme is done loosely, as the Young Lives children with one year of preschool attendance could receive this at private, NGO, or church preschools. So whenever we relate the one year preschool attendance of this study with the O-Class, it is regardless of the ownership.

Instead of this we estimated the differential effect of preschool ownership by forming three dummy variables: private; community and governmental preschools, regardless of duration of attendance. The need to do this is because private preschool centres are perceived to have better quality facilities and hence we intended to see if the marginal gain from private preschools is actually greater than the other two.

To further substantiate the effect of early preschool investment on the educational progress of the children, we extend the logit model into an ordered logit model. The ordered logit model is developed with five dependent variables (DV), adopting values of 1 for adult children with "*not educational certificate*" (those either with incomplete primary school or never enrolled in school); 2, for those with "*Grade 8 certificate*"; 3, for those with a certificate of "*Ethiopian General Secondary Education*"; 4, for those with certificate of TVET or *"*Preschool Teaching"*;* and 5*,* for those who had received a certificate for the *"Ethiopian Higher Education Entrance"* and entered institutions of higher learning by Round 4. To drive the ordered logit model, as we did in the logit model, we assume there is a continuous, unmeasured latent variable Y* expressed as:

$$Y_i^* = \sum_{k=1}^{k} \beta_k X_{ki} + \varepsilon_i \qquad [6]$$

The continuous latent variable Y* has various threshold points measured by κ . As the number of categories (M) in this study is 5, the value of the observed variable Y depends on whether or not a particular threshold is crossed as shown below:

$$\begin{aligned}
&Y_i = 1 \quad if \quad Y_i^* \quad is \quad \leq \quad \kappa_1 \\
&Y_i = 2 \quad if \quad \kappa_1 \quad < \quad Y_i^* \quad \leq \quad \kappa_2 \\
&Y_i = 3 \quad if \quad \kappa_2 \quad < \quad Y_i^* \quad \leq \quad \kappa_3 \\
&Y_i = 4 \quad if \quad \kappa_3 \quad < \quad Y_i^* \quad \leq \quad \kappa_4 \\
&Y_i = 5 \quad if \quad \kappa_4 \quad < \quad Y_i^* \quad \leq \quad \kappa_5
\end{aligned} \qquad [7]$$

Assuming logistic distribution of the disturbance term, we can generalise the ordered logit model by the following form.

$$\Pr(Y_i > j) = \frac{\exp(X_i\beta - \kappa_j)}{1 + [\exp\left(X_i\beta - \kappa_j\right)} \quad j, \quad 1 \quad 2 \quad ,\ldots, M-1 \qquad [8]$$

Where, Y_i is categorical variable of the educational outcomes of an adult child i; X_i stands for $\overline{PS}$ and covariate variables; β_i is the vector of coefficients to be estimated and ε_i is a logistically distributed error-term. Recognising the fact that marginal effects for categorical independent variables are easy to understand and can be made more intuitively meaningful (Williams 2012), we report only the marginal effects in all the estimated binary models.

Moreover, although our main interest is to estimate the contribution of preschool participation on the probability of completing secondary education and joining institutions of higher learning at proper ages, we must acknowledge the fact that children's educational progress is more likely to be influenced by factors beyond preschool participation and other than the observable control variables. For example, progress can partially be influenced by innate ability, which is very difficult to capture in observational data (Schlotter, Schwerdt and Woessmann 2010). When educational outcomes are connected with such unobservable factors, the dependent variable is correlated to the error-term and may result in inconsistent

estimate of preschool contribution. One way of mitigating this problem is to use instrumental variable (IV). Two conditions should, however, be satisfied for an instrument to be valid and informative.

First, the instrument (Z) should be related with the endogenous variable ($Cov(\overline{PS},Z)\neq 0$). Second, the instrument (Z) should not be correlated with the error-term ($Cov(Z,\varepsilon)=0$). If suitable proxy variables that fulfil these requirements are identified, IV estimates can address any identified endogeneity problem and provide consistent estimates.

To address any possibility of endogeneity problems that may arise from the fact the preschool participation is related to unobserved factors and hence with the error-term, we employed two IV instruments. The first is a standard IV that used community sites from which the sample children were drawn as instrument for preschool participation. We use this because we found a strong correlation between access to preschool in a site and attendance at preschool in that site. That is, a simple test of correlation shows that community site is statistically significant to be correlated with preschool enrolment, but not with completion of secondary education. The reason for this could be because the 20 sentinel sites of Young Lives are located in different part of the country and had different levels of educational service provisions over 1998-2002, when the sample children were in the range of preschool ages. But when the children reached secondary/tertiary education ages as of Round 4 of the survey in 2013, access to secondary/tertiary education was much improved (MoE 2013/14). This implies that community site as the result of distance was highly correlated with preschool access some 20 years ago; but less likely with completing secondary education and with the error process at later ages, given the fact that secondary schools have been expanded into remote areas of the country in recent years.

In addition to the simple test of correlation, we also checked the association of community site with secondary education completion using OLS logit models and found statistically insignificant results. This implies that the urban parts of the community sites are homogeneous in terms of access to secondary/tertiary attendance, but not in terms of preschool service provision. For example, sites from Addis Ababa and Hawassa are shown to have better preschool enrolment than the other urban community sites, but not different in terms of secondary education/tertiary attendance from the other urban community sites. This is the main reason that we used three sites from Addis Ababa and two from Hawassa city as an IV for preschool. Such results are in line with the literature, where many authors use community site as an instrument for school enrolment in early years (see Kane and Rouse 1993; Kling 1999).

The second instrument follows a Woodridge approach (2002: 623) that uses a Two-Stage Least Squares (2SLS) estimator. This 2SLS IV estimator is obtained by regressing all the instruments simultaneously with other determinants of preschool enrolment in a first stage regression and then using the predicated probabilities from this first regression as an instrument for preschool in the second stage.

3.3 Data and variables

Early education data on children in Ethiopia is scarce (Hoot, Szente and Mebratu 2004), and the only rich data available to date is from the Young Lives longitudinal study. We made use of this data for our analysis. Young Lives is an international study of childhood poverty tracking 12,000 children in four countries (Ethiopia, Peru, India and Vietnam) over 15 years. In 2002 Young Lives in Ethiopia collected data on 1,999 children aged 6 to 18 months (the

Younger Cohort) and 1,000 children aged 7.5 to 8.5 years (the Older Cohort) as part of the first round of the study. So far data have been collected four times for both cohorts. However, to take age advantage, we only used the Older Cohort in this analysis. Surveys were undertaken in 20 sentinel sites located in Addis Ababa, Oromia, Amhara, SNNP and Tigray. These regions were selected because more than 90 per cent of the population lives in these areas. While selecting the sentinel sites, regional policymakers and other stakeholders were consulted, and the selection criteria adopted was that the households had to be located in poor areas based on the country's food insecurity designation. For instance, 75 per cent of the sentinel sites in each region were selected from high-food deficit woredas (districts) while 25 per cent were selected from lower food deficit woredas. Each region comprised 20 per cent of the total sample except Addis Ababa and SNNPR, which make up 15 per cent and 25 per cent, respectively. Children in rural areas comprise 60 per cent of the sample, with 40 per cent from urban areas. It is however important to mention that due to the problem of traceability, refusal and death, the Older Cohort sample dropped from 1,000 to 908 by Round 4 of the survey. Therefore, at the age of 19, only 90.8 per cent of the original sample had valid data.

The control variables include child and household characteristics. Important child variables include health status measured by height-for-age-z-score at age 8, gender, birth order and child labour at age 15. In the case of birth order, four dummy variables were created as first born, second, third, and fourth or after; and interpretations are made against the first-born child. Similarly, we created dummies for child labour for those who worked at least one hour per day at age 15. We interpreted the results against those who never work. To account for the variation in households of the children, we included a wealth index of households divided into terciles, where interpretations are made in reference to the first tercile. Parental education and household size are also included in the models, believing that they play a paramount role in children's educational pathways. The variables used in the analysis and values used in the regressions are outlined in Table 2.

Table 2. *Definition of variables used in the analysis*

Dependent variables (DV)	Value	Definition
Educational outcomes (Logit model)		
Completion of general secondary education	1	If adult child had received Grade 10 official certificate
Not completed general secondary education	0	If adult child had not received Grade 10 certificate
Educational outcomes (Ordered Logit)		
No certificate	1	If adult child has no official certificate
Certificate for Grade 8	2	If adult child has official certificate for Grade 8
Ethiopian general secondary education	3	If adult child has official certificate for Grade 10
TVET or preschool teaching certificate	4	If adult child received certificate for TVET
Ethiopian higher education entrance certificate	5	If adult child has official certificate for Grade 12
Preschool variables (variables of interest)		
No preschool education (reference)	0	If adult child did not attend preschool education
Preschool education from 4-6 years old	1	If adult child attended preschool between 4 and 6 years old
1 year of preschool education	1	If adult child attended preschool only for 1 year
2 years of preschool education	1	If adult child attended preschool only for 2 years
3 years of preschool education	1	If adult child attended preschool for 3 years
Attended community preschool	1	If adult child attended community preschool
Attended private preschool	1	If adult child attended private preschool
Attended public preschool	1	If adult child attended government preschool

Dependent variables (DV)	Value	Definition
Covariates		
Height-for-age z-score at age 8 (continuous variable)	-	Proxy for nutritional status or health
1st tercile of wealth index (reference)	0	Child is from low-income family
2nd tercile of wealth index	1	Child is from middle-income family
3rd tercile of wealth index	1	Child is from high-income family
Father does not have education (reference)	0	If child's father does not have an education
Father's education is primary level	1	If child's father education is from Grades 1-8
Father's education is secondary or above	1	If child's father is with Grade 9 or above
Mother does not have education (reference)		If child's mother does not have an education
Mother's education is primary	1	If child's mother education is from Grades 1-8
Mother's education is secondary or above	1	If child's mother education is Grade 9 or above
Household size <5 (reference)	0	If house size is less than 5
Household size >4 and < 9	1	If household size is > 4 and < 9
Household size= >9	1	If household size is equal or above 9
First born (reference)	0	If the birth order of the child is first
Second born	1	If the birth order of the child is second
Third born	1	If the birth order of the child is third
Fourth born or later	1	If the birth order of child is fourth or after
Child did not give birth (reference)	0	Child has not given birth by Round 4 survey
Child became a teenager parent	1	If the adult child has become a parent at age 19
Child did not work at 15 (reference)	0	If adult child did not work at all/worked less than an hour per day at age 15
Child worked at least 1 hour per day at age 15	1	If the child worked 1 hour or more/day at 15
Male child	1	If adult child is a boy

4. Results

The study adopted both descriptive and empirical estimations to explore the contribution of early childhood investment, in the form of sending a child to a preschool centre, on the successful completion of secondary education and transition to institutions of higher learning at proper ages.

4.1 Descriptive statistics

Table 3 presents the descriptive statistics. The proportion of boys to girls in the sample is relatively equal, with 53.6 per cent boys. In terms of health, the height-for-age z-score ranges from -5.25 to 2.79, with average value of -1.51. According to the WHO Global Database on Child Growth and Malnutrition, a Z-score less than -2 signifies low height-for-age and malnourished (WHO 2012). On the basis of this cut off, the children had somewhat standard nutritional status, although additional analysis indicates that about one-third of the children were malnourished, with less than -2 standard deviation of z-score. About 9 per cent of the children worked for pay at least one hour per day at age 15, showing widespread child labour. A striking point is that 4.7 per cent of the children became teenage parents, with at least one birth. Many of the children's households have large families, with two-thirds of households being between 5-9 persons. This large family size can be also demonstrated by the fact that about half of the children's birth order was fourth or after. Many of the children are from less-educated families, as only a quarter of mothers are found to have secondary school education.

In terms of preschool participation, of the 908 children about 13.4 per cent had the opportunity to attend preschool, but this rate of participation masks a huge divide between urban and rural areas. The rate of enrolment for urban children was 25.2 per cent, while it was as low as 2.6 per cent for those in rural areas. With average duration of 1.94 years, there is a noticeable difference between urban and rural as well. While about 8 per cent, 10.1 per cent and 7.1 per cent of the urban children were respectively in one, two and three years of preschool programmes, these figures were only 2.1 per cent, 0.4 per cent and 0 per cent for rural children, respectively. No rural children had the opportunity to attend three years of preschool programmes. About 7.9 per cent, 1.8 per cent and 3.7 per cent of the children were respectively in private, community and governmental centres. However, as with the duration of preschool, there is also a clear distinction here, with 16.5 per cent of urban children in private centres and no rural children in private and community preschool centres. All the rural children who attended preschool education were in governmental preschool centres, further signifying that kindergartens are inaccessible to rural children.

Table 3. *Descriptive statistics for urban and rural sample*

	Urban		Rural		Total (Urban+Rural)	
Variables	**Obs**	**Mean**	**Obs**	**Mean**	**Obs**	**Mean**
Dummy if completed secondary education	436	49.3%	470	18.7%	908	33.4%
Dummy for preschool attendance any time from ages 4-6	436	25.2%	470	2.6%	908	13.4%
Dummy variable for 1 year of preschool attendance	436	8.0%	470	2.1%	908	5.0%
Dummy variable for 2 years of preschool attendance	436	10.1%	470	0.4%	908	5.1%
Dummy variable for 3 years of preschool attendance	436	7.1%	470	0.0%	908	3.4%
Dummy variable for private preschool	436	16.5%	470	0.0%	908	7.9%
Dummy variable for community preschool	436	3.7%	470	0.0%	908	1.8%
Dummy variable for governmental preschool	436	5.0%	470	2.6%	908	3.7%
Height-for-age z-score at 8[5]	426	-1.26	449	-1.74	877	-1.51
Dummy for household with 2nd tercile wealth index	436	29.4%	470	37.7%	908	33.7%
Dummy for household with 3rd tercile wealth index	436	59.4%	470	9.8%	908	33.7%
Dummy if father has primary level (1-8)	436	35.1%	470	29.8%	908	32.3%
Dummy if father has secondary level or above	436	45.4%	470	37.9%	908	41.6%
Dummy if mother has primary level (1-8)	436	37.8%	470	19.6%	908	28.3%
Dummy if mother has secondary level or above	436	27.3%	470	15.3%	908	21.3%
Dummy if household members are > 4 and < 9	436	43.1%	470	52.8%	908	48.0%
Dummy if household members are 8 or above	436	13.8%	470	18.3%	908	16.3%
Dummy if the birth order of child is 2nd	436	19.0%	470	13.2%	908	16.1%
Dummy if the birth order of child is 3rd	436	12.4%	470	15.7%	908	14.1%
Dummy if the birth order of child is 4th or later	436	44.3%	470	57.0%	908	50.8%
Dummy if teenager became a parent	436	3.7%	470	5.7%	908	4.7%
Dummy if child worked at least 1 hr/day at age 15	436	10.1%	470	7.7%	908	9.0%
Dummy variable for male	436	50.9%	470	56.0%	908	53.6%

Source: Young Lives Older Cohort data (Rounds 1, 2, 3 and 4 in 2002, 2006, 2009, and 2014.

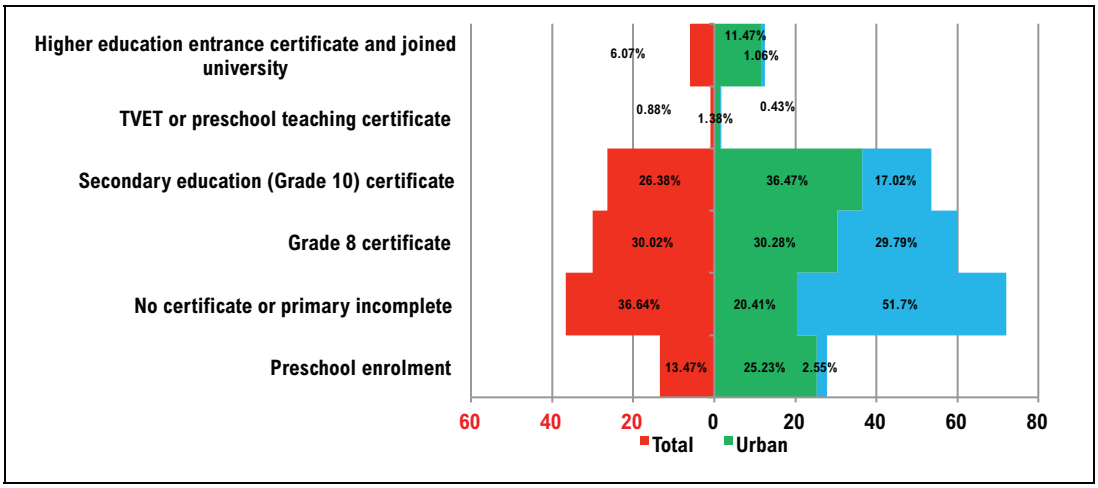
Figure 2 depicts the highest certificate received by the Older Cohort at Round 4 of the Young Lives survey. By this round, the overall educational outcomes of the children resemble the pyramid shape of national educational statistics mentioned in the literature review. More

5 The range for zhfa [-4.93 1.79], for urban. The range for zhfa [-5.25 2.79], for total sample.

specifically, while about 36.67 per cent of the children had no educational certificate, nearly one-third (30.07 per cent) had received the Grade 8 certificate. In terms of secondary education, slightly more than one-third (33.4 per cent) of the children completed general secondary education and had received the Ethiopian general secondary education certificate (Grade 10). But a noticeable gap is still observed between urban and rural areas, in favour of urban (about one-half for urban versus a quarter for rural). Regarding institutions of higher learning, while nearly 1 per cent of children had received the certificate for completing TVET or preschool teaching by age 19, about 6 per cent had a higher education entrance certificate and had already transitioned to institutions of higher learning (college and university). This implies that by the Round 4 survey, the majority of the children had discontinued their education or might still be enrolled overage somewhere in the lower grades.

Generally, the preliminary results indicate that only 13.4 per cent of the children had the opportunity to attend preschool education, with a huge divide between urban (25.2 per cent) and rural (2.6 per cent) areas. Hence, it is important to note that given the very small number of preschool enrolments in rural areas (n=12), the regression part of this study is restricted to urban areas, with a total number of 436 adult children at age 19 (Table 3).

Figure 2. *Highest educational certificate received at Round 4 in 2014*



Source: Based on Young Lives Round 4 Older Cohort data.

4.2 Estimation

As noted earlier, the number of children in rural areas who participated in preschool programmes early in life and completed secondary education at later ages is inadequate to carry out a robust econometric analysis. The following estimation section therefore covers the urban children.

4.2.1 Does attending preschool offer an advantage on the completion of secondary education?

This subsection presents the regression results and answers whether attending preschool offers an advantage on the completion of secondary education. Table 4 reports the marginal probabilities of three logit models. While the first column deals with the overall contribution of preschool enrolment on completion of secondary education, the second column presents the

benefit of each year's preschool attendance. The last column reports the marginal effects of preschool ownership.

Before dealing with the estimates it is important to look at the adequacy of the logit models. After running each logit model we conducted post estimations to see whether the estimated logit models fit well to the data. One of the tests carried out was the Goodness-of-fit (GOF) using Pearson Chi-squared value. For example, for the first logit model the Pearson Chi^2 *(408) is 412.08* with *P= 0.4342*, indicating that there is no evidence of lack of fit of the employed logit model. The same is true for the second and third models as both Pearson Chi^2 *tets* are rejected for lack of evidence of goodness-of-fit.

Coming back to the results, as shown at the first column, early childhood investment in the form of sending children to preschool centre is found to be statistically significant in contributing to completion of secondary education. Controlled for relevant covariates, urban children who attended preschool education any time between ages 4 and 6 are found to be 25.7 per cent more likely to complete general secondary education at the right age. This may reveal how investment in early childhood in the form of sending children to preschool centres is so curial for the smooth educational progress of children.

Regarding the covariates, child health approximated by height-for-age at age 8 also shows a positive and significant marginal effect, implying that health stock is an essential contributing factor for educational progress. Another important control variable that shows a significant differential effect is household wealth index, where children from the second and third terciles experienced more than 23 per cent and 36.5 per cent higher probabilities of completing Grade 10 than children of the first tercile (the poorest families). This suggests that family wealth is an important determinant of children's educational success in Ethiopia. In reference to parental education, only fathers' secondary education or above is found to have a significant contribution, with mothers' education for all dummies not statistically significant. The reason why this might be so is that majority of the mothers do not have an adequate level of education, as only a quarter of them had secondary education. Another variable which has detrimental consequences on children's educational success is child labour experienced at age 15. Children who worked for pay at least one hour per day at age 15 faced a 29 per cent lower probability of completing Grade 10. What is more, being a teenage parent is associated with 25.4 per cent less probability of completing Grade 10.

Some other control variables, however, are not significantly different from zero; especially those related to household size and birth order. Gender is found to be an unexpected sign of marginal probability, where girls experienced better probability of completing secondary education than boys of the same age. It is not easy to suggest why girls showed better probability of achieving Grade 10 than boys. This might be a result of the government's recent affirmative action that has been encouraging girls to stay in school and continue their education, such that the secondary education Gender Parity Index (GPI) has increased to 0.85 as a result (MoE 2013/14).

4.2.2 Do two or three years of preschool education show additional benefits on the completion of secondary education?

In additional to the overall estimates of preschool participation, we also explored the contribution of each year of preschool attendance on successful completion of secondary education. To do this, we created three dummy variables for each year of preschool attendance and examined if one additional year of preschool education has a value-added in terms of completion of secondary education. The marginal estimates for each year of pre-

schooling are reported at the lower part of model 2 in Table 4. It appears that duration of preschool exposure matters, where marginal benefits from two and three years are larger than one year's contribution. More specifically, those who attended two years of preschool education experienced 4.5 percentage points of higher probability of completing secondary education than these who attended only for one year. As expected, the long-term gain from three years of preschool attendance is much larger, where children with three years of preschool exposure are found with 23.3 percentage points of higher likelihood of completing Grade 10 than those who attended only for a year, representing 40.1 per cent of higher probability from the control groups. This means that the level of early childhood investment and the degree of preschool exposure do matter for the educational progress of the children.

4.2.3 Do children who attended private preschool programmes show larger gains in terms of completing secondary education?

It is also instructive to explore the contribution of ownership of preschools on the completion of secondary education. Similar to the duration of preschool exposure, we classified the preschool centres operating in Ethiopia into three broad groups and formed three dummy variables to examine the differential effect of each preschool type. Marginal probabilities of the three types of preschool are reported in the third column of Table 4. The first dummy variable is for private preschools that are perceived as centres with high quality of educational provision and usually are a place for the children of the rich. The second is for community preschools, which consists of centres related to quasi-public, missionary, church and NGOs and are referred to as community centres in this study for simplicity, while the third is for government preschools that are funded by government and usually designed for children of low socio-economic families (Hoot, Szente and Mebratu 2004).

Given the fact that the sample attended predominantly private preschools, the marginal gain from private preschool centres appears to be considerably larger in size than the one from government preschools. The large gains for attending private preschools might arise from the fact that those centres may have better-quality preschool provision that could have a long-lasting effect. While children who attended private preschool are found to have a 29.4 per cent higher likelihood of completing secondary education than those who did not, this is about 20.5 per cent for those who were in government preschool centres. Both marginal probabilities are statistically significant at 1 per cent and 10 per cent levels, respectively. The marginal probability from attending community preschool is, however, statistically insignificant, possibly because only a few (3.7 per cent) of the children were in community preschool centres.

Table 4. *Estimation of completion of secondary education (Grade 10) on preschool attendance, length of preschool attendance, and preschool type in urban areas*

Variables	Logit model 1 Marginal effect (z-statistics)	Logit model 2 Marginal effect (z-statistics)	Logit model 3 Marginal effect (z-statistics)
Dummy if child attended preschool any time between ages 4 and 6	0.257*** (4.144)	- -	- -
Height-for-age z-score at age 8	0.0953*** (4.058)	0.0935*** (3.976)	0.0967*** (4.091)
Dummy variable for household with 2nd tercile wealth index	0.230** (2.186)	0.219** (2.072)	0.226** (2.134)
Dummy variable for household with 3rd tercile wealth index	0.365*** (3.963)	0.358*** (3.854)	0.357*** (3.795)
Dummy variable if father has primary level (1-8) of education	0.0155 (0.184)	0.0101 (0.119)	0.0170 (0.202)
Dummy variable if father has secondary level or above	0.154* (1.897)	0.153* (1.875)	0.151* (1.854)
Dummy variable if mother has primary level (1-8)	0.0572 (0.819)	0.0453 (0.645)	0.0641 (0.913)
Dummy variable if mother has secondary level or above	0.0323 (0.423)	0.0236 (0.306)	0.0362 (0.473)
Dummy variable if household members are > 5 and < 9	-0.0642 (-1.049)	-0.0692 (-1.126)	-0.0640 (-1.046)
Dummy variable if household members are 9 or above	-0.131 (-1.581)	-0.131 (-1.576)	-0.125 (-1.492)
Dummy variable if the birth order of child is second	0.0721 (0.843)	0.0718 (0.831)	0.0778 (0.911)
Dummy variable if the birth order of child is third	-0.0200 (-0.200)	-0.0195 (-0.192)	-0.0264 (-0.262)
Dummy variable if the birth order of child is fourth or after	0.140* (1.904)	0.148** (2.010)	0.140* (1.900)
Dummy variable if the teenager has become a parent	-0.254** (-2.107)	-0.250** (-2.031)	-0.249** (-2.016)
Dummy if child worked at least 1 hr/day at age 15	-0.290*** (-3.769)	-0.300*** (-3.863)	-0.293*** (-3.816)
Dummy variable for male	-0.0702 (-1.226)	-0.0733 (-1.277)	-0.0747 (-1.297)
Dummy variable for 1 year of preschool attendance	-	0.168* (1.741)	-
Dummy variable for 2 years of preschool attendance	-	0.213** (2.486)	-
Dummy variable for 3 years of preschool attendance	-	0.401*** (5.360)	-
Dummy variable for private preschool	-	-	0.294*** (4.161)
Dummy variable for community preschool	-	-	0.161 (1.204)
Dummy variable for governmental preschool	-	-	0.205* (1.796)
Observations	426	426	426
LR chi2(16)	107.09	111.28	108.10
Prob > chi2	0.000	0.000	0.000
Pseudo R2	0.181	0.188	0.183
Pearson chi2(408)	412.08	411.50	414.15
Prob > chi2	0.4342	0.414	0.3793

Notes: z-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

4.2.4 Does the contribution of preschool education go beyond completing secondary education?

To gain a full picture of the long-lasting contribution of early childhood investment on children's educational pathways, ranging from primary school to institutions of higher learning, we extended the logit models into ordered logit models, adopting values of 1, for adult children with "*no educational certificate*"; 2, for those with "*Grade 8 certificate*"; 3, for those with certificate of "*Ethiopian General Secondary Education*"; 4, for those who received a certificate on *TVET* or "*Preschool Teaching*" and 5 for those with a certificate on the *"Ethiopian Higher Education Entrance"* and who entered an institution of higher learning. Instead of looking at the overall estimates, we disaggregated the data of preschool attendance by year to be able to examine the contribution of each year's participation on the educational progress of the children over a long period of time, from primary school to higher education. The marginal probabilities of the ordered logit model are interpreted as the relationship of each predictor, X, to the probability that an adult child will be in each category of educational level or above compared to all lower educational categories. We were particularly interested in this model in seeing how attending preschool centres in early years is associated with the probability of joining institutions of higher learning at the correct age.

Table 5 shows the results for the five categories of educational certificates. What is evident from the marginal probabilities of each ordered logit model is that one year of preschool attendance is statistically insignificant for a differential contribution on the educational pathways of the adult children, while two years of preschool participation is associated with a 7.5 per cent probability of obtaining a certificate on secondary education compared to non-preschoolers (see column 3 of Table 5). Attending preschool for three years is, however, found to be statistically significant in all five educational categories. For instance, those with three years of preschool education are 11.2 per cent more likely to receive a certificate of higher education entrance and be able to join university by age 18 than those who did not have preschool exposure. Adult children with three years of participation are also found to be 14 per cent less likely to finish with only Grade 8 certificate than their non-preschool counterparts. What is important here to focus on is that the benefit of one year of preschool attendance does not appear to be significant across all five models, while three years of preschool education is a statistically significant contribution in all the models. The implication is that one year of preschool investment may not be sufficient to be able to bring a long-lasting contribution, while attending three years of preschool is a significant predictor of greater academic progression, up to institutions of higher learning. This further implies that better exposure to preschool facilities leads to gradually diverging paths in children's school attainment, where the gains increase as the children grow older, as the result of 'skill begets skill' (Heckman 2012).

Table 5. *Estimation of educational pathways on length of pre-school attendance (marginal effects (Mfx) of ordered logit models+): urban sample*

	(Ordered logit 5)	(Ordered logit 4)	(Ordered logit 3)	(Ordered logit 2)	(Ordered logit 1)
Variables	**mfx**	**mfx**	**mfx**	**mfx**	**mfx**
Dummy variable for 1 year of preschool attendance	0.0239	0.00282	0.0458	-0.0360	-0.0365
	(0.802)	(0.787)	(0.945)	(-0.823)	(-0.963)
Dummy variable for 2 years of preschool attendance	0.0441	0.00508	0.0748*	-0.0644	-0.0595*
	(1.372)	(1.266)	(1.843)	(-1.470)	(-1.853)
Dummy variable for 3 years of preschool attendance	0.112**	0.0118*	0.122***	-0.141***	-0.104***
	(2.055)	(1.759)	(4.786)	(-2.664)	(-3.803)
Height-for-age z-score at age 8	0.0275***	0.00333**	0.0615***	-0.0419***	-0.0504***
	(4.351)	(2.221)	(4.468)	(-4.087)	(-4.675)
Dummy variable for household with 2nd tercile wealth index	0.0512	0.00599	0.0955**	-0.0754*	-0.0773**
	(1.607)	(1.411)	(2.000)	(-1.717)	(-1.976)
Dummy variable for household with 3rd tercile wealth index	0.0923***	0.0111**	0.214***	-0.119***	-0.198***
	(3.775)	(2.170)	(4.282)	(-4.446)	(-3.707)
Dummy variable if father has primary level (1-8) of education	-0.00290	-0.000352	-0.00654	0.00443	0.00537
	(-0.143)	(-0.143)	(-0.142)	(0.143)	(0.142)
Dummy variable if father has secondary level or above	0.0196	0.00236	0.0430	-0.0297	-0.0352
	(0.940)	(0.888)	(0.963)	(-0.945)	(-0.963)
Dummy variable if mother has primary level (1-8)	0.0231	0.00277	0.0490	-0.0350	-0.0399
	(1.223)	(1.115)	(1.298)	(-1.232)	(-1.308)
Dummy variable if mother has secondary level or above	0.0223	0.00266	0.0459	-0.0338	-0.0371
	(1.048)	(0.985)	(1.144)	(-1.061)	(-1.157)
Dummy variable if household members are > 5 and < 9	-0.0124	-0.00151	-0.0281	0.0189	0.0232
	(-0.829)	(-0.787)	(-0.821)	(0.829)	(0.818)
Dummy variable if household members are 9 or above	-0.0261	-0.00324	-0.0679	0.0382	0.0589
	(-1.490)	(-1.272)	(-1.306)	(1.594)	(1.227)
Dummy variable if the birth order of child is second	0.0178	0.00212	0.0364	-0.0270	-0.0293
	(0.763)	(0.743)	(0.838)	(-0.771)	(-0.849)
Dummy variable if the birth order of child is third	-0.0132	-0.00162	-0.0319	0.0199	0.0268
	(-0.624)	(-0.600)	(-0.579)	(0.636)	(0.563)
Dummy variable if the birth order of child is fourth or after	0.0297	0.00358	0.0642	-0.0449	-0.0526
	(1.549)	(1.339)	(1.627)	(-1.567)	(-1.627)
Dummy variable if the teenager has become a parent	-0.0442**	-0.00565	-0.140	0.0519***	0.138
	(-2.115)	(-1.599)	(-1.591)	(4.032)	(1.289)
Dummy if child worked at least 1 hr/day at age 15	-0.0662***	-0.00851**	-0.225***	0.0506**	0.249***
	(-5.030)	(-2.310)	(-4.653)	(2.085)	(3.439)
Dummy variable for male	-0.0120	-0.00145	-0.0267	0.0182	0.0219
	(-0.847)	(-0.808)	(-0.850)	(0.847)	(0.850)
Observations	426	426	426	426	426

Notes: z-statistics in parentheses and *** p<0.01, ** p<0.05, * p<0.1. +Order ligit values are assigned as follows: 1 for adult children with no educational certificate; 2 for those with Grade 8 certificate; 3 for those with certificate of Ethiopian General Secondary Education; 4 for those who received a certificate on TVET or preschool teaching, and 5 for those with certificate of the Ethiopian Higher Education Entrance and who entered an institution of higher learning.

4.3. IV estimator and robust check

As explained earlier, the standard estimates from the logit models might be potentially biased as preschool attendance is a function of observed and unobserved child and family characteristics. For example, the educational progress of a child can be highly associated with innate ability, which might result in some endogeneity problem. To attempt to overcome these problems, we employed two IV models. The first is a standard model that used five dummies of community sites as instrumental variables; the second is a Woodridge IV that makes use of predicted probabilities from a first logit model of preschool determinants as instrumentz. Identifying these instrumental variables, Two Stage Least Square (2SLS) estimates were carried out by applying a robust generalised method of moments (GMM) estimation technique that gives robust standard errors in both IV estimations.

The results in Table 6 show that the marginal probabilities from these models are larger in magnitude than the estimates seen in the logit models. The standard IV estimator specifically shows that early investment in the form of giving a child an opportunity to attend preschool centre any time between 4 and 6 years old increases the probability of completing secondary education by 32 per cent, in relation to those who never had the chance to go to preschool centres at all. Likewise, as reported in the second column of Table 6, the marginal probability from the Woodridge IV is larger in magnitude than the standard logit estimate. Such IV results show that estimates from the logit models are slightly downward biased and hence preschool is an endogneious variable.

An interesting aspect of the IV estimators is that they are subjected to a number of robust tests such as under-identification, weak identification and over-identification tests. Robustness tests generated from STATA using ‘ivreg2’ are reported in Table 7. As seen at the bottom of the table, the standard IV estimate that used community site as an instrument is valid and all the instruments have passed the over-identification test (Hansen J-statistic= 5.339 and p= 0.2542). The same is true with the under-identification tests that both IV models are identified and the excluded instruments are relevant and have correlation with children’s preschool participation. Also, the Kleibergen-Paap statistics for both IV models are much greater than 10, implying that the estimations are not weakly identified.

Table 6. *IV estimation of completion of secondary education on preschool in urban areas*

Variables	Standard IV[a] Marginal effect	Woodridge IV[b] Marginal effect
Dummy if child attended preschool any time between age 4 and 6	0.320***	0.304***
	(3.477)	(3.467)
Height-for-age z-score at age 8	0.0670***	0.0677***
	(3.843)	(3.886)
Dummy variable for household with 2nd tercile wealth index	0.148**	0.154**
	(2.132)	(2.230)
Dummy variable for household with 3rd tercile wealth index	0.268***	0.269***
	(3.949)	(3.982)
Dummy if father has primary level (1-8) of education	0.0173	0.00473
	(0.251)	(0.0686)
Dummy variable if father has secondary level or above	0.117*	0.112*
	(1.782)	(1.712)
Dummy variable if mother has primary level (1-8) of education	0.0491	0.0484
	(0.851)	(0.840)
Dummy variable if mother has secondary level or above	0.0217	0.0223
	(0.347)	(0.356)
Dummy variable if household members are > 5 and < 9	-0.0400	-0.0459
	(-0.820)	(-0.938)
Dummy variable if household members are 9 or above	-0.0919	-0.103
	(-1.271)	(-1.425)
Dummy variable if the birth order of child is second	0.0477	0.0507
	(0.737)	(0.774)
Dummy variable if the birth order of child is third	-0.0251	-0.0245
	(-0.341)	(-0.326)
Dummy variable if the birth order of child is fourth or after	0.126**	0.120**
	(2.125)	(2.014)
Dummy variable if the teenager has become a parent	-0.207*	-0.202*
	(-1.933)	(-1.863)
Dummy if child worked at least 1 hr/day at age 15	-0.233***	-0.237***
	(-3.539)	(-3.572)
Dummy variable for male	-0.0566	-0.0573
	(-1.260)	(-1.276)
Observations	426	426
Centred R2	0.215	0.217
Uncentred R2	0.6055	0.6067
Under identification test (Kleibergen-Paap rk LM statistic) (idstat)	84.736	87.880
Chi-sq(5) P-val	0.0000	0.0000
Hansen J statistic (over identification test of all instruments):	5.339	-
Chi-sq(1) P-val	0.2542	-

Notes: Robust z-statistics in parentheses and *** p<0.01, ** p<0.05, * p<0.1. [a] community sites as instrument. [b] predicted probabilities as instrument (Woodridge (2002: 623)).

Table 7. *Robustness tests*

Completion of secondary education	Standard-IV[a	Woodridge-IV[b
Underidentification test (Kleibergen-Paap rk LM statistic)	84.736	87.880
P-value	0.0000	0.0000
Weak identification test (Kleibergen-Paap rk Wald F statistic)	28.069	149.530
Stock-Yogo weak ID test critical values: 5% maximal IV relative bias	18.37	-
10% maximal IV relative bias	10.83	-
20% maximal IV relative bias	6.77	-
30% maximal IV relative bias	5.25	-
10% maximal IV size	26.87	16.38
15% maximal IV size	15.09	8.96
20% maximal IV size	10.98	6.66
25% maximal IV size	8.84	5.53
Hansen J statistic (overidentification test of all instruments)	5.339	0.000
P-value	0.2542	na

Notes: [a] community sites as instrument. [b] predicted probabilities from a first logit model as instrument (Woodridge (2002: 623)).

5. Discussion and conclusions

This study made use of a longitudinal dataset from Young Lives in Ethiopia to look at the long-term contribution of early childhood investment on children's future educational outcomes. As the data showed a huge difference of access to preschool between children of urban (25.2 per cent) and rural (2.6 per cent) areas, we addressed this long-term estimate only for the urban children. In doing so, we employed several alternative micro-econometric models such as logit and ordered logit models. While the logit model predicts the long-term contribution of early childhood education on successful completion of secondary education, the ordered logit model summarises the cumulative estimate of preschool attendance on children's educational pathways, including the probability of obtaining a certificate for higher education entrance and making a timely transition to university or college. The IV models check whether the OLS estimates from the logit models are downward or upward biased, as preschool participation might be influenced by unobservable factors that might make it an endogenous variable.

Findings show that early childhood investment in the form of giving children an opportunity to attend a preschool centre early in life makes a significant contribution to the educational pathways of the children, where marginal probability from the logit model indicates that urban children who attended preschool had a 25.7 per cent higher likelihood of completing secondary education at the appropriate age than their non-preschool counterparts. The long-lasting gains are robust to alternative methods, where all IV estimates are slightly larger than the OLS estimates.

When disaggregated by duration, preschool participation has noticeable differences on the completion of secondary education, where three years of preschool experience is found with much larger marginal effect (40.1 per cent) than two years of preschool attendance (21.3 per cent) or one year (16.8 per cent). The result can better be seen in the ordered logit model, which tracks the cumulative effect of each year of attendance on the educational progressions of the children, from primary school to institutions of higher learning. Children

who attended three years of preschool education made their way to institutions of higher learning, mainly university, at the appropriate age, while attending one year of preschool education is found to be statistically insignificant. Those who attended for two years also have larger marginal probabilities in achieving a certificate of secondary education than non-preschoolers, but with little progress to institutions of higher learning at the appropriate age. The long-term estimates generally show that the benefits of preschool participation magnify as the children get older, especially when they transition to institutions of higher learning.

Although the estimation part of this study is a representative of urban areas, the findings are important in a number of ways for both urban and rural children in Ethiopia. First, while Ethiopia has seen obvious strides in the education sector over the last decade and half, many of the achievements have been at primary school level, with more than 90 per cent net enrolment in 2013/14. But net enrolment is still as low as 20 per cent for secondary education and well below 10 per cent for institutions of higher learning for both urban and rural areas. One possible contributing factor for declining enrolment rates over the educational ladder could be the low preschool access in the early years of children's lives. This study suggests that more public investment is needed in this vital learning stage, as it is found that early investment in preschool education makes a key contribution to the role and shape of children's educational pathways.

Second, it is worth noting that early child development (ECD) is now part of the 2030 Global Sustainable Development Goals, where it is explicitly mentioned in Target 4.2 that countries need to 'ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education'. Taking this into account, the Government of Ethiopia is moving to increase access to early childhood education to 80 per cent gross enrolment over the next five years. Although the Fifth Education Sector Development Plan (ESDP V) does not mention explicitly the modality to be used in scaling up this preschool access, we believe that the newly introduced O-Class will be one of the instruments for this ambitious target in the coming five years. Therefore, it is imperative to point out that as a full two or three academic years of preschool education have been found to have a long-lasting contribution on the educational pathways of the Young Lives children and lead them to institutions of higher learning at the proper ages, it would be more advisable to create an earlier opportunity for all urban and rural children instead of waiting for the O-Class at age 6.

Third, Ethiopia is currently aspiring to be a low-middle income nation by 2025, where such economic aspirations needs an abundant skilled workforce able to meet the twenty-first century labour market demand. It is worth noting that such a skilled workforce would be available if a significant number of young people are able to complete secondary education and/or join institutions of higher learning at the proper ages. As human capital formation by its nature is a long-term phenomenon that starts from the early years of life, it is a wise investment to spend scarce public resources in quality early childhood education, as the current access to this fundamental stage of education is as low as 25 per cent of the 7.4 million preschool-aged children.

Overall, the analysis suggests that if the aim is to reduce educational inequality among future generations and to be able to conquer poverty in the years ahead, equalising the quality of early education, with two to three years of preschool exposure for both urban and rural children aged 4 to 6 years old, will remain an essential educational policy for Ethiopia.

References

Abadie, A and G.W. Imbens (2012) 'Matching on the estimated propensity score', Harvard University and National Bureau of Economic Research, www.hks.harvard.edu/fs/aabadie/pscore.pdf (accessed 17 October 2016).

Azubuike, B. (2015) *Impact of Different Types of Schooling on Achievement in the School System: Evidence from Ethiopia*, ESP Working Paper Series No. 67. Privatisation in Education Research Initiative (PERI).

Berlinski, S., S. Galiani, and M. Manacorda (2007) *Giving Children a Better Start: Preschool Attendance and School-Age Profiles*, Institute for Fiscal Studies Working Paper 06/18, London: Institute for Fiscal Studies..

Barnett, W.S., and C.E. Lamy (2006) 'Estimated Impacts of Number of Years of Preschool Attendance on Vocabulary, Literacy and Math Skills at Kindergarten Entry', http://nieer.org/resources/research/EstimatedImpacts.pdf (accessed 28 May 2016).

Barnett, W.S., C. Lamy, and K. Jung (2005) 'The effects of state prekindergarten programs on young children's school readiness in five states', New Brunswick: National Institute for Early Education Research, Rutgers University.

Barnett, W.S. (1995). 'Long-Term Effects of Early Childhood Programs on Cognitive and School Outcomes', *The Future of Children Long-Term Outcomes of Early Childhood Programs* 5.3: 25-50.

Barnett, W.S and C.M. Escobar (1987) 'The economics of early educational intervention: A Review', *Review of Educational Research* 57.4: 387–414.

Barnett, W.S. (1985) *The Perry Preschool Program and Its Long-Term Effects: A Benefit Cost Analysis*, High/Scope Early Childhood Policy Papers No. 2. Ypsilanti: ERIC.

Calman, L. and L. Tarr-Whelan (2005) *Early Childhood Education for All: A Wise Investment*, New York: Lega Momentum.

Craig, T.R, and L.R. Sharon (2004) 'Early Learning and School Readiness: Can Early Intervention Make a Difference?, *Merrill-Palmer Quarterly* 50.4: 471-491.

Cunha, F. and Heckman, J. (2010) *Investing in our young people*, NBER Working Paper 16201, Cambridge, MA: National Bureau of Economic Research.

Cunha, F., J. Heckman, L. Lochner, and D. Masterov (2005) *Interpreting the Evidence on Life Cycle Skill Formation,* NBER Working Paper 11331, Cambridge, MA: National Bureau of Economic Research.

Cunha, F., and J. Heckman (2007) 'The Technology of Skill Formation', *American Economic Review* 97.2: 31–47.

Currie, J. (2001) 'Early Childhood Education Programs', *Journal of Economic Perspectives* 15.2: 213–38.

Currie, J. and D. Thomas (2000) 'School Quality and the Longer-term Effects of Head Start', *Journal of Human Resources* 35: 755–74.

Federal Democratic Republic of Ethiopia (2015) 'The Second Growth and Transformation Plan (GTP II) (2015/16-2019/20), September 2015', Addis Ababa: National Planning Commission .

Federal Democratic Republic of Ethiopia (1994) 'Education and Training Policy E.E.P-86', Addis Ababa: Federal Democratic Republic Government of Ethiopia.

Fantuzzo, J.W., R. Bulotsky-Shearer, R. Fusco, and G. McWayne (2005) 'An investigation of preschool classroom behavioral adjustment problems and social emotional school readiness competencies', *Early Childhood Research Quarterly* 20: 259–275.

Goodman, A., and B. Sianesi (2005) 'Early education and children's outcomes: How long do the impacts last?' Institute for Fiscal Studies, July 2005, www.ifs.org.uk/docs/ee_impact.pdf (accessed 19 January 2006).

Government of the United States (2014) 'The Economics of Early Childhood Investments', www.whitehouse.gov/sites/default/files/docs/early_childhood_report1.pdf (accessed 12 April 12 2016).

Hoot, J., J. Szente, and B. Mebratu (2004) 'Early Education in Ethiopia: Progress and Prospects', *Early Childhood Education Journal* 32.I: 3-8.

Heckman, J.J., and D.V. Masterov (2007) 'The productivity argument for investing in young children, *Review of Agricultural Economics* 29.3: 446–493.

Heckman, J.J. (2012) *The case for investing in disadvantaged young children*, EENEE Policy Brief 1/2012, Munich: European Expert Network on Economics of Education.

Heckman, J.J., and L. Raut, L. 2013 *Intergenerational Long Term Effects of Preschool – Structural Estimates from a Discrete Dynamic Programming Model*, NBER Working Paper 19077, Cambridge, MA: National Bureau of Economic Research.

Heckman, J. J., and D.V. Masterov (2007) 'The Productivity Argument for Investing in Young Children', paper presented at the Allied Social Sciences Association Annual Meeting, Chicago, USA, 5–7 January.

Hosmer, D.W., Jr., and S. Lemeshow (2000) *Applied Logistic Regression*, New York: Wiley.

Kane, T.J., and C. Rouse (1993) *Labor Market Returns to Two- and Four-Year Colleges: Is a Credit a Credit and Do Degrees Matter?* NBER Working Paper 4268, Cambridge, MA: National Bureau of Economic Research.

Kling, J. (1999) *Interpreting Instrumental Variables Estimates of the Returns to Schooling*, Princeton University Industrial Relations Section Working Paper No. 415, Princeton: Princeton University.

Lynch, R.G. (2005) *Early Childhood Investment Yields Big Payoff*, Policy Perspectives, San Francisco: WestEd..

Martinez, S., S. Naudeau, and V. Pereira (2012) 'The Promise of Preschool in Africa: A Randomized Impact Evaluation of Early Childhood Development in Rural Mozambique', London: Save the Children.

Masse, L., and W.S. Barnett (2002) 'A Benefit Cost Analysis of the Abecedarian Early Childhood Intervention', New Brunswick: National Institute for Early Education Research.

Ministry of Education (MoE) (2015) 'Education Sector Development Programme V (ESDP V) 2015/16 - 2019/20', Addis Ababa: Federal Democratic Republic of Ethiopia.

Ministry of Education (MoE) (2016) 'Education Statistics Annual Abstract (2013/14)' www.moe.gov.et/English/Information/Documents/Education%20Statistics%20Annual%20Abstract%202006E.C%20(2013-2014%20G.C).pdf (accessed 15 March 2016).

Magnuson, K., C. Ruhm, and J. Waldfogel (2007) 'The persistence of preschool effects: Do subsequent classroom experiences matter?' *Early Childhood Research Quarterly* 22.1: 18–38.

Moller, C. (2015) *Ethiopia's great run: the growth acceleration and how to pace it,* Washington, DC: World Bank.

Orkin, K., W. Abebe, W. Yadete, and M. Woodhead (2012) *Delivering quality early learning in low-resource settings: Progress and challenges in Ethiopia*, Working Paper No. 59, Studies in Early Childhood Transitions. The Hague: Bernard van Leer Foundation.

Schlotter, M., G. Schwerdt, and L. Woessmann (2010) *Econometric Methods for Causal Evaluation of Education Policies and Practices: A Non-Technical Guide*, IZA Discussion Paper No. 4725, Bonn: IZA.

Sylva, K., and J. Wiltshire (1993) 'The impact of early learning on children's later development: a review prepared for the RSA inquiry 'start right'', *European Early Childhood Education Research Journal* 1.1: 17-40.

Raut, L., and J.J. Heckman (2005) 'Long Term Effects of Preschool: Evidence from NLSY', Fullerton: California State University at Fullerton.

Raut, L.K. (2003) *Long term effects of preschool investment on school performance and labor market outcome,* Labor and Demography Technical Report 0307002, Econ WPA.

Rossiter, J. (2016) *Scaling Up Access to Quality Early Education in Ethiopia: Guidance from International Experience*, Policy Paper 8, Oxford: Young Lives.

Ruhm, C., and J. Waldfoge (2011) *Long-Term Effects of Early Childhood Care and Education*, IZA Discussion Paper No. 6149, Bonn: IZA.

Reynolds, A.J., J.A. Temple, and A. Barry (2009) 'Cost-Effective Early Childhood Development Programs: A Synthesis of Evidence in the First Decade of Life', Minneapolis: University of Minnesota.

UNESCO (2015) 'Education for All 2015 National Review Report: Ethiopia', http://unesdoc.unesco.org/images/0023/002317/231724e.pdf (accessed 28 May 2016).

Waldfogel, J. (1999) *Early childhood interventions and outcomes*, Centre for Analysis of Social Exclusion (CASE), London: London School of Economics.

WHO (2012) *Early childhood development and disability*, Discussion paper WS368, Geneva: World Health Organization.

Williams, R. (2012) 'Using the margins command to estimate and interpret adjusted predictions and marginal effects' *The Stata Journal* 12.2: 308–331.

Woldehanna, T and Hagos, A. (2015). Economic Shocks and Children's Dropout from Primary School: Implications for Education Policy in Ethiopia, *Africa Education Review*, 12:1, 28-47.

Woldehanna, T. (2016). Inequality, Pre-primary education and cognitive Development in Ethiopia: Implication for public investment in pre-school education**,** *International Journal of Behavioral Development* 1-8.

Woldehanna, T., and A. Gebremedhin (2015) *Is Child Work Detrimental to the Educational Achievement of Children? Results from Young Lives in Ethiopia*, Working Paper 140, Oxford: Young Lives.

Woldehanna, T., A. Mekonnen, and T. Alemu (2008) *Young Lives: Ethiopia Round 2 Survey Report*, Oxford: Young Lives.

Woldehanna, T. (2011) 'The Effects of Early Childhood Education Attendance on Cognitive Development: Evidence from Urban Ethiopia', *Ethiopian Journal of Economics* 20.1: 113–64.

Woodhead, M. (2009) *Pathways through Early Childhood Education in Ethiopia, India and Peru: Rights, Diversity and Equity*, Working Paper 54, Oxford: Young Lives.

Wooldridge. J.M. (2002) *Econometric Analysis of Cross Section and Panel Data*, Cambridge, MA: MIT Press.

World Bank (2016) 'Lower secondary completion rate, total (% of relevant age group)', http://data.worldbank.org/indicator/SE.SEC.CMPT.LO.ZS/countries?display=default (accessed 17 October 2016)

Wylie, C., and J. Thompson (2003) 'The long-term contribution of early childhood education to children's performance - evidence from New Zealand', *International Journal of Early Years Education* 11.1: 69-78.

Yao, W. and H. Cynthia (2003) 'Later Academic Achievements of Child Development Program Participants: A Longitudinal Study of the South Carolina Early Childhood Development Program for Four -Year-Olds'. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, April 21-25.

Yoshikawa, H. et al. (2013) *Investing in Our Future: The Evidence Base on Preschool Education*, New York: Foundation for Child Development.

Early Investment in Preschool and Completion of Secondary Education in Ethiopia: Lessons From Young Lives

Investments in early childhood education are believed to be critical in forming the foundation for life-long learning and providing children with the opportunity to reach their full potential. This is because early childhood is a crucial phase of growth and development, where early circumstances can influence outcomes across the entire course of an individual's life.

Despite the plethora of studies in high-income countries, little is known about the long-term contributions of early childhood investment in low-income countries. To the best of our knowledge, there is no longitudinal study in Ethiopia that has looked at the contribution of preschool education beyond primary school-aged children. The study that this working paper reports on aimed to fill this research gap by using longitudinal data from Young Lives in Ethiopia to look at the long-term estimates of early childhood education on successful completion of secondary education and the chance of transitioning to institutions of higher learning.

As the data showed a huge divide in preschool access between urban and rural children, we used only the urban sample in our logit models. Findings indicate that urban preschool children are 25.7 per cent more likely to complete secondary education than their non-preschool counterparts at the proper age. The marginal returns are higher for those who attended preschool for two and three years than those who only attended for one year. In particular, those who attended for three years have a higher probability of transitioning to higher education at the age of 18.

Overall, the findings suggest that a significant part of children's educational inequalities at later ages are explained by the level of early childhood investment. In spite of such significance, public investment to this subsector of the education system is meagre, relative to the other subsectors. Based on the current preschool landscape of Ethiopia, only a quarter of the 7.4 million preschool-aged children – mainly from better-off families and urban areas – are able to make their way to this vital learning stage. Most children simply begin primary school without any exposure and consequently face considerable difficulties on their educational pathways in completing secondary education and transitioning to institutions of higher learning.

The analysis suggests that if the aim is to reduce educational inequality among future generations and to be able to conquer poverty in the years ahead, equalising the quality of early education, with two to three years of preschool exposure for both urban and rural children aged 4 to 6 years old, will remain an essential educational policy for Ethiopia.

Young Lives

Young Lives
An International Study of Childhood Poverty

About Young Lives

Young Lives is an international study of childhood poverty, involving 12,000 children in 4 countries over 15 years. It is led by a team in the Department of International Development at the University of Oxford in association with research and policy partners in the 4 study countries: Ethiopia, India, Peru and Vietnam.

Through researching different aspects of children's lives, we seek to improve policies and programmes for children.

Young Lives Partners

Young Lives is coordinated by a small team based at the University of Oxford, led by Professor Jo Boyden.

- *Ethiopian Development Research Institute, Ethiopia*
- *Pankhurst Development Research and Consulting plc, Ethiopia*
- *Centre for Economic and Social Studies, Hyderabad, India*
- *Save the Children India*
- *Sri Padmavathi Mahila Visvavidyalayam (Women's University), Andhra Pradesh, India*
- *Grupo de Análisis para el Desarollo (GRADE), Peru*
- *Instituto de Investigación Nutricional, Peru*
- *Centre for Analysis and Forecasting, Vietnamese Academy of Social Sciences, Vietnam*
- *General Statistics Office, Vietnam*
- *Oxford Department of International Development, University of Oxford, UK*

Contact:
Young Lives
Oxford Department of International Development,
University of Oxford,
3 Mansfield Road,
Oxford OX1 3TB, UK
Tel: +44 (0)1865 281751
Email: younglives@younglives.org.uk
Website: www.younglives.org.uk