Is Preschool Education Instrumental for the Completion of Secondary Education in Ethiopia? Lessons Drawn from the Longitudinal Data of Young Lives

Tassew Woldehanna (Professor of Economics, Department of Economics at Addis Ababa University, Senior Research Fellow at Ethiopian Development Research Institute, Principal Investigator of Young Lives Ethiopia and RISE Ethiopia Team Leader)

Mesele W. Araya (Assistant Professor, Department of Economics, Addis Ababa University)

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Abstract

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. This study then used longitudinal data from the Young Lives Project in Ethiopia to examine the contribution of preschool participation on successful completion of secondary education and the chance of transitioning to institutions of higher learning at the proper ages. Controlled for relevant covariates, marginal probability from a logit estimate shows that preschoolers are 25.7% 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 3 and 2 years than those who attended only for 1 year. Those who attended for three years are particularly found with higher probability of making transition to higher education at the age of 18. The results are robust to alternative IV methods. The lesson is that a significant part of children's educational inequalities at later ages are explained by the level of early childhood investment as the result of "skill begets skill". In spite of such significance of early childhood investment, public investment being allocated to the preschool subsector is meagre, relative to the other subsectors. Based on the current preschool landscape of the country only one-fourth of the 7.4 million preschool aged children–mainly from the well-to-do families and urban areas–are able to make their way to this vital learning stage while children of the majority simply begin primary school without any early exposure and consequently face considerable difficulties on their later educational pathways such as difficulty of completing secondary education and incapable of transitioning to institutions of higher learning at the proper ages.

JEL Classification
I25; I26; O12

Key words: early childhood education, human capital formation; secondary and post secondary education; Instrumental variable; Ethiopia

1. Introduction

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

As a way of empirical example, Calman & Tarr-Whelan (2005) found that preschool attendance is associated with low dropouts and higher grades. Barnett, Lamy & Jung (2005) also revealed that preschool attendance has positive effect on the children's completion years of primary and secondary education, accompanied by low dropout and repetition rate in each grade for preschoolers compared to non-preschoolers. A positive comtribution on learning dispositions and social-emotional outcomes were also researched by (Fantuzzo, Bulotsky-Shearer, Fusco & McWayne, 2005; Wylie & Thompson, 2003). Goodman and Sianesi (2005) also 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 & Waldfogel (2011) evaluated the long-term effects of early childhood education programs and contended that expansions of early education generally yield benefits at school entry, adolescence, and for adults, with the benefits are largely pronounced for disadvantaged children. In terms of monetarily expected return, the Government of the United States (2014) estimated that *"expanding early learning initiatives would provide benefits to society of roughly $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 the 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 & 2016), Azubuike (2014), Orkin, Yadete & Woodhead (2012) and Hoot, Szente & Mebratu (2004). Except the latter, all those authors made use of Young Lives data in their analyses. For instance, Woldehanna (2011) studied cognitive effects of preschool attendance of urban children aged 5 and 8 years. Recognizing the importance of preschool education on children's cognitive development, he suggested for the expansion of public preschool centers in the country. Azubuike (2014) also investigated factors influencing schooling 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. Much broadly, Orkin, Yadete & Woodhead (2012) looked at the landscape of early childhood development in Ethiopia and indicated that investment in early childhood development is minimal and basic primary school systems are still being consolidated, where children often enrol late and tend to have difficult trajectories through school as the result of dropping out or progressing slowly through different grades.

It is undeniable fact that Ethiopia has lately seen much improvement on the net enrolment rate of primary education, reaching 92% in 2013/14 (MOE, 2013/14). But this stride is said to be without a strong foundation as many of the children simply begin primary school without any exposure of preschool in their early years of life. An annual educational statistical abstract report from the MOE (2013/14) shows that only one-fourth of the 7.4 million preschool-aged children get the opportunity to go to preschool centers in the country. Another sign for the lack of strong base in the education sector is that students are not able to complete secondary education as expected. As of 2013/14, data obtained from the World Bank database shows that gross completion rate for the lower[1] secondary education is as low as 29.4%. Such low completion rate of secondary education may then lead someone to question whether the limited access to preschool centres being experienced in early years of life might be associated with the low completion rate of secondary education. The fact of the matter is that, to the best of our knowledge, using longitudinal data, there is no any study in Ethiopia that has looked at the contribution of preschool education beyond primary school aged children. This study then aimed to fill this research gap by looking at the long-term estimates of early childhood education on

[1] *Gross Enrolment Rate – Secondary (9-10) was 39.3% in 2013/2014, with net enrollment rate of 20.2%.*

successful completion of secondary education and the chance of transitioning to institutions of higher learning by answering the following research questions:

i. Does attending preschool offer an advantage on successful completion of Secondary Education?
ii. Does a two or three years of preschool education have additional benefits on the completion of secondary education?
iii. Do children who attended private preschool programmes show larger gains in term of completing secondary education?
iv. 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 the entrance of 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 anytime between four and six years of old is associated with a significantly increased probability of completing secondary education and transitioning to institutions of higher learning at the proper ages. Empirically, urban preschools are found with 25.7% higher likelihood of completing secondary education than their non-preschool counterparts at proper ages. When disagreed by duration of preschool participation, 1 year of preschool attendance is however found with a smaller magnitude of marginal probability on completing secondary education and becomes statistically insignificant with the probability of entering to institutions of higher learning while those with three years of preschool participation showed 11.2% higher likelihood to join institutions of higher learning at the right ages.The findings are robust for alternative IV estimations.

In what follows, section 2 presents the literature view on preschool investment and its contribution for early skill formation and children's school achievement while section 3 provides the framework and estimation strategy used in the analysis. Section 4 reports the empirical results. Section 5 concludes with some implications.

2. Literature Review

Early childhood is a period of great opportunity for shaping a child's way of interacting with his or her environment, and shaping his or her adulthood, and more generally his or her future (WHO, 2012). Several studies 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 the skills of children. 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. A study from Reynolds, Temple & Barry (2009) also argued that children's preschool participations in the age of 3 to 4 were found to have large and long-term effects on child well-being. Waldfogel (1999) reviewed the potential benefits and the potential ill effects of early childhood interventions focusing on the Rand study of early interventions, the Head Start program, and the NICHD study of early child care. This study showed that early childhood interventions could make a difference in improving outcomes for children. Craig & Sharon (2004) also contended that quality of childhood education and care could bring huge differences in the lives of poor disadvantaged children. Specifically, children who attended in preschool programs were found to have higher scores on reading and mathematics that persisted up to adulthood, stayed more in education, and less likely to became teen parents. Barnett and Lamy (2006) revealed that attending preschool significantly increases the scores on vocabulary and maths skills, while print awareness skills though vocabulary was insignificant for those who attended only 1 year. Wylie & Thompson (2003) investigated the effect of early childhood education at age 14 children and found that children, who attended an early child education service, where most of them were from middle-class families, had higher mathematics and reading scores. Magnuson, Ruhm & Waldfogel (2007b) also revealed that prekindergarten is associated with increases in math and reading skills at kindergarten entry, but also with increases in classroom behaviour problems. However, the gains in math and reading were found to be faded out in grade 1. For the disadvantage children, however, the initial gains were higher and these gains were also more persistent than the full sample. Yao & Cynthia (2003) argued that preschoolers scored higher than the non-preschoolers in both language and maths in the first and third grade standardised tests. In the second grade, though higher for preschoolers, it was insignificant. Early childhood investments has positive externalities in the case that beyond improving cognitive and socio-emotional development of children, it brings

reductions in crime, and lower expenditures on health care and on remedial education which implies that lower correctional and other costs for parents and the society at large. Heckman & Masterov (2007) reviewed the case for investing more on young children from disadvantaged families from the perspective of productivity argument and revealed that early investment is a wise investment as early investments increase school productivities by supplying better quality students which implies that schools would produce quality workforces. They added that early education is a productive and safe investment for the society. Lynch (2005) also examined the likely benefits and characteristics of investing in a high-quality, large-scale, publicly funded early childhood development programs for children living in poverty, and found that early investment in poor young children would have positive economic impacts by raising the GDP, improving the skills of the workforce, reducing poverty, strengthening global competitiveness, and reduce crime rates which helps society produce productive and responsible individuals. Much in the same way, employing the cost-benefit analysis of preschool for disadvantaged children, Barnett (1985) examined the economic perspectives of the critical policy issues of public preschool education and found that preschool education is an economically sound public investment for children from low income families. He argued that it is because low income families invest less in preschool for their children than the investment required by the society as a whole due to lack of resources and hence recommended government needed to provide funding so as to increase quantity and quality of public programs. Reynolds, Temple & Barry (2009) also examined the evidences on cost-effectiveness of early childhood development programs from birth to age 10 using the cost benefit analysis approach which is important for estimating the values or benefits of programs and policies relative to costs. The study revealed that birth to age 3 interventions including nutritional education and home visitation were found to have family, health and social benefits, and children's preschool participations in the age of 3 to 4 were also found to have large and long-term effects on the well-being of children. In addition, Masse and Barnett (2002) analyzed the benefit-cost of the Abecedarian preschool program in the USA, and found that the investment of public resources targeted at a disadvantaged group yields healthy returns but they suggested that the findings may not be replicated perfectly in all settings and for all populations. Lynch (2005) also examined the likely benefits and characteristics of investing in a high-quality, large-scale, publicly funded early childhood development programs for children living in poverty. Other studies have directed towards reviewing previous literatures on the areas of 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 prospective of longitudinal data especially in low income settings .

3. Preschool and Secondary Education in Ethiopia

Though the 1994 Ethiopian Education and Training Policy (ETP) document 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 has until recently any explicit budget been allotted by the Government towards this subsector. Two reasons have commonly been mentioned for de-emphasizing of this subsector until recently (see Hoot, Szente & Mebratu, 2004; Woldehanna, 2011). Firstly, as resources are insufficient for providing even basic primary and secondary education, the government has been trying to maximize its efforts at the other level of the education sector. Secondly, the Government wanted to encourage the involvement of private actors to invest at this level of the education sector (MOE, 2007/08). As result of those two reasons, the subsector has been dominated by Kindergartens owned by private actors, communities and faith-based/NGO preschools.

However, advised by policy makers and international actors that work closely with issues related to early childhood development, the Government of Ethiopia has lately started giving attention to the subsector and incorporated it in the latest two Education Sector Development Plans (ESDP IV and ESDP V). For instance, by the end of 2010 in collaboration with UNICEF and the Child-to-Child initiatives, Early Childhood Care and Education (ECCE) policy framework was introduced at inter-ministerial level. The aim of this ECCE is to provide quality early childhood services under four pillars: Parental education, Health and Early stimulation programme from prenatal up to three years, preschool community-based kindergarten from four to six years, and community based non-formal school readiness programmes (see, Table 1 for preschool type and perceived quality).

Table 1: General type of pre-elementary schools/kindergartens in Ethiopia

Program type	*Funding*	*Children/family served*	*Generally perceived quality*	*Generally perceived limitation*
Private preschools	*Parent fees*	*Upper SES families*	*Very high quality of education*	*Potential conflict between private school curricula & MOE guidelines*
Government preschools (since 2011/12 O' Class', Child to child & an interim accelerated child readiness programme)	Government stipend plus parent 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
Quisi-public School	Government stipend plus parent 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 of education	Limited inputs from parents
Church schools	Church stipends plus parents fees	Middle and upper class families and a few scholarships for lower SES children	Good-quality of education	Limited inputs from parents
Community	Parent fees	Foreign diplomats and upper SES classes	High quality education	Although in Ethiopian community, schools culture and traditions of western culture are emphasized
Nongovernment (NGO) schools	Funded by contact between MOE and NGOs for specific period of time.	Lower SES children/ families	Basic education	Although established local community may still be unable to sustain their share of costs after the contract expires

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

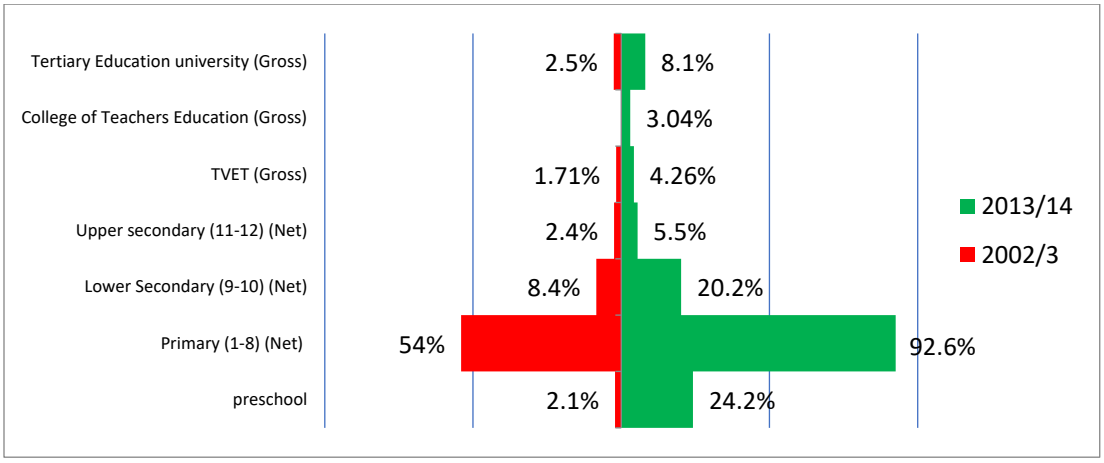
One part of this ECCE framework is the "O" class, which intends to benefit vulnerable and disadvantaged children aged 6, who do not have access to kindergarten by annexing to public primary schools for one year. The attached children are expected to be coached by selected teachers in such a way that they will get ready for their first grade (MoE, 2013/14, p23). 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 neighbour children supervised by qualified teachers and some adult training. Although the quality and sufficiency are still debatable, the playing becomes learning as the younger child gets to know how, say for example, to count, differentiate colours and identify letters before joining primary schools (UNESCO, 2015: 19-26).This implies that since 2011 preschool education in Ethiopia has been provided through three modalities: kindergartens (owned by private providers, community and faith-based organization), "O" Class program and Child-to-child initiative. There is also

a plan for "accelerated school readiness" programme to begin in Benishangul-Gumuz in 2016/17.

As the result of those newly introduced programmes, there has been improvement in access in the subsector. Figure 1 presents data obtained from the Ethiopian Education Statistics Annual Abstract published by the Ministry of Education. It appears that in 2002/03 out of the estimated 6.06 million children of the appropriate age group (ages 4–6), only 2% were reported to have accessed preschool education in 1067 kindergartens. But this figure jumped to more than 24.2% of net enrolment rate in 2013/14. The increase was especially related with the setting up of the "O" class, which has been said to be gotten a widespread response of local authorities, achieving over 1 million enrolments in its first year implementation. The child-to-child strategy also contributed a lot towards this subsector, reaching close to 0.3 million children as of 2013 (MoE, 2013/14). Besides, the Government has outlined a very ambitious plan in its Fifth Education Sector Development Plan (ESDP V) with gross enrolment rate target of 80% by increasing the budget share of the subsector within the general education from 3% in 2015/16 to 11% in 2019/20.

Regarding the other levels, in the last decade Ethiopia has shown notable expansion at primary, secondary and tertiary levels. Particularly, at primary level, the government worked with much emphasis to meet the Millennium Development Goals (MDGs) by abolishing tuition fees and creating a grass-roots access for millions of children. Such improvement can be seen in Figure 1, where the net enrolment for primary level rose from 54% in 2002/03 to 92% 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. For instance, net enrolment at lower secondary education in 2013/14 was about 20% while it was well below 10% for the upper secondary education. The same was true for the enrolment at institutions of higher learning (College of Teachers Education, TVET and University level (see Figure 1).

Figure 1: Enrollment rates in preschool, primary, secondary and higher education in Ethiopia (%)



Source: MoE, 2002/3 & 2013/14

The decline in enrollment rate when one moves up along the educational ladders gives the educational structure of the country the shape of pyramid, 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 that may result in such pyramidal shape of the education sector. But what we focus on this study is whether there is any association between the first stage and the middle and upper levels of the education sector. The need to focus on these levels of the education sector is because the overall development of a given country highly depends on the skill levels of its citizens. Needless to say, Ethiopia has recently witnessed rapid growth, with GDP growth averaging 10.9% between 2004 and 2014 (Word Bank, 2015). If the growth recorded in the last decade continues to sustain, there will be a possibility for the country to become a low middle income nation by 2025 (Growth and Transformation Plan (GTP II), 2015: 16). However, it is our assumption that to realize such development aspiration, at the same there is a need for skilled workforce that is oriented with the ability to learn and use technology. In this regard successful completion of secondary education of citizens could be a necessary condition for such economic take-off and to achieve the intended income status. The argument is that as lack of a properly skilled workforce can hinder the country to be on its development track in the years ahead, there is a need to examine thoroughly the main barriers of secondary education completion and transition to institutions of higher education from the perspective of early childhood investment. In connection to this, Hoot, Szente & Mebratu (2004) contended that without solid foundation in early childhood education, it is

unlikely to prepare children of all families for the 21st century. They added that improving the skill level of citizens that match for the knowledge required in today's dynamic labour market is a long-term phenomenon, which needs adequate investment in the very earliest life time. Based on this conceptual framework, we try to look at the long-term associations of pre-school and secondary/tertiary attendance so that we will be able to create a policy influence for better expansion of public preschool education for those who cannot offer.

4. Methodology

In this section we outline the basic framework that provides a background for early childhood educational investment and the basis for our empirical estimations**.**

4.1. Conceptual framework

As the landscape of preschool education in Ethiopia is dominantly provided by the private sector, where tuition fees and other related costs are paid by parents, we formulate a conceptual framework of preschool investment decision of an altruistic parent. This conceptual framework is basically built up on the work of Raut & 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 some discrete periods during which important life-cycle events relevant to leaning occur.

As the Young Lives data has been collected four times so far, we divide the whole life-cycle of the child into four periods: [0-6], [7-14], [15-16], [17–]. Aggregating the age of the child in this way has important implication as to how parental investment made in the first period [0-6], which comprises preschool age [4-6], 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 help the child develop cognitive skills and non-cognitive skills, which can be denoted as cognitive skill (κ), motivational skill (ω) and social skill ($_{\psi}$). 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. The school performance at this stage depends on the levels of κ, ψ and ω that acquired during the first stage, on the quality of the school that he attends and the intensity of the program 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 & Hagos, 2015).

During the third period [15-16], the child should be enrolled in secondary education (Grade 9-10) and is expected to complete secondary education at the age of 16. What we assume here also is that the cognitive and non-cognitive skills acquired in the first stages will have multiplied effect at this stage and help the child complete secondary education at the proper age (see Cunha, Heckman, Lochner & Masterov, 2005; Cunha, & 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 the costs and benefits of attaining a given level of education, like whether to join TVET institutions; College of Teacher's Education or Preparatory Programme as a way to university. The opportunity costs of schooling at this level mainly include either going for payable 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 new born child (we assume this because about 4% of the Older Cohort children were found to be a teenager parent as of the 4th round of the Young Lives survey).

As mentioned in Heckman & 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 annualized 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-cycle 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 $w(y,\kappa,\omega,\psi,\varepsilon_p)$, the net cost of schooling becomes: $\overline{w}(y,\kappa,\omega,\psi,\varepsilon_p) = w(y,\kappa,\omega,\psi,\varepsilon_p) - C(y,i)$. For simplicity, we write the variables of the vector as $z = (y,\kappa,\omega,\psi,\varepsilon_y,\varepsilon_p)$; so that the optimal educational level of the child will be $y^*(\kappa,\omega,\psi,\overline{ps},\varepsilon_y)$. 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:

$$V(z) = \underset{0\le\overline{PS}\le w(z)}{Max} \bigcup(\bar{w}(z) - \bar{ps}) + \lambda\int V(z')T_{\overline{PS}}(z,dz')$$

Where $V(.)$ be value of the function; $\bigcup(.)$ be the felicity index of parental annual permanent consumption $\bar{w}(\bar{z},\varepsilon_p) - \overline{PS}$; $0 \le \lambda < 1$ is the proportion of parental altruism towards the child, and $T_{\overline{PS}}(z,z')$ 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, socialization and motivational skills that are acquired at early years of life (see Heckman & 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 data of the Older Cohort, we approximate the level of early investment in preschool education ($\overline{PS}$) by whether the child had an opportunity to attend a preschool center anytime between 4 and 6 years of old. This means we simply create a dummy variable as to whether the parent sent the child to preschool centers anytime in 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.

4.2. 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 on the Ethiopian

General secondary education (Grade 10) by the 4th round 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. 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.

$$y^* = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k + u$$

$$= x\beta + u \qquad [1]$$

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:

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

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

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

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

Where Y_i assumes a value of 1 if the adult child i received a certificate for completing the Ethiopian General Secondary Education by the 4th round 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 anytime 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 of time. This duration analysis of preschool education is particularly believed to have a vital policy take up findings for the current one year "O" class programme being expanded in the country. In this regard it is important to remind readers that equating the one year preschool attendance of this study with the recent "O" class of the governmental preschool programme is in its loose sense as the Young Lives children with one year preschool attendance could receive one year of private/NGO/church pre-school. 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 duration of attendance. The need to do this is because private preschool centers are perceived to be with better quality of 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 also extend the Logit Model into Ordered Logit Model. The Ordered Logit Model is developed with a five level Dependent Variables (DV), adopting values of 1 for adult children with "*not educational certificate*" (those who are either with incomplete primary school or never enrolled in school); 2, for those with "*Grade 8 certificate*"; 3, for those with certificate of "*Ethiopian General Secondary Education*"; 4, for those with certificate of TVET or "Preschool Teaching"*; and 5,* for those who received certificate on the "*Ethiopian Higher Education Entrance"* and made their way to institutions of higher learning by the 4th round of the survey. To drive the Order Logit Model, like what did in the Logit Model, we assume there is a continuous, unmeasured latent variable Y* expressed as:

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

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:

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

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

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

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. Recognizing 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.

What is more, though 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 are 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 & 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 fulfill these requirements are identified, IV estimates can address any identified endogeneity problem and provide consistent estimates.

To address any possibility of endogeneity problem 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 instrument 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 pre-school in a site and attendance at pre-school 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 the Young Lives project are located in different part of the country and were with different level of educational service provisions over the years of 1998-2002, in which the sample children were in the range of preschool ages. But when the children reached secondary/tertiary education ages as of the 4th round of the survey in 2013, accesses to secondary/tertiary education were much improved in the country (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 fairly expanded to remote area 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. And this is the main reason that we used three sites form 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 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 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 used the predicated probabilities from this first regression as instrument for preschool in the second stage.

4.3. Data and variables

Early education data on children in Ethiopia are so scant, almost as though they were neither seen nor heard (Hoot, Szente & Mebratu, 2004). The only rich data available to date is the one that comes from the Young Lives Longitudinal Study. We then made use of this data for our analysis. *Young Lives* is an international study of childhood poverty tracking 12,000 children in 4 countries (Ethiopia, Peru, India and Vietnam) over 15 years. In 2002 Young Lives Project in Ethiopia collected data on 1,999 children aged 6 to 18 months and 1,000 children aged 7.5 to 8.5 years as part of the first round of the 15 years of study. While the first sample children are referred as 'Younger Cohort', the second is commonly named as 'Older Cohort". Expecting to carry out the fifth round of the survey in the last quarter of 2016, Young Lives has so far collected a rich dataset of the children four times. However, to take age advantage we used only the 'Older Cohort' in this analysis. The surveys were undertaken in 20 sentinel sites located in Addis Ababa, Oromia, Amhara, SNNP and Tigray regions. The regions were selected because 96% of the population of the country lives in these areas. While selecting the sentinel sites, consultations were made with regional policy makers and other stakeholders and the selection criteria adopted to choose the sites was that the household had to be located in poor areas based on the country's food insecurity designation. For instance, 75% of the sentinel sites in each region were selected from high food deficit *woredas* (districts) while 25% were selected from a lower food deficit *woredas* (districts). Each region comprised 20% of the total sample except Addis Ababa and SNNPR which make up 15% and 25% of the sample, respectively. Also, the children in rural areas comprise 60% of the sample while 40% of them are from urban areas. It is however important to mention that due to the problem of traceability, refusal and death, the sample dropped from 1000 to 908 by the 4th round of the survey. This implies that at the age of 19, only 90.9% (n=908) of the original sample had valid data.

As mentioned above, 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 firth 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 1 hour per day at age 15. We interpreted the results against those who never work. Besides, to account for the variation in households of the children, we included wealth index of households divided into tercile, 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 paramount role on the educational pathways of the children. With the values used in the regressions, the variables used in the analysis 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 received Grade 10 official certificate
Not completed General secondary education	0	If adult child did not receive Grade 10 certificate
Educational Outcomes (Ordered Logit)		
No certificate	1	if adult child has no official certificate
Certificate on grade 8	2	if adult child has official certificate on grade 8
Ethiopian General secondary education	3	if adult child has official certificate on 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 on 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 of old	1	if adult child attended preschool between 3 and 6
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 preschools	1	if adult child attended community preschools
attended private preschool	1	if adult child attended private preschool
Attended public preschool	1	if adult child attended government preschool
Covariates		
height-for-age z-score at 8 (continuous variable)	-	Proxy for nutritional status or health
1st tercile of wealth index (reference)	0	the child is from low-income family
2nd tercile of wealth index	1	the child is from middle-income family
3rd tercile of wealth index	1	the child is from high-income family
Father does not have education (reference)	0	if child's father does not have education at all
Father's education is primary level	1	if child's father education is from 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 education
Mother's education is primary	1	if child's mother education is from 1-8
Mother's education is secondary or above	*1*	If child's mother is grade 9 or above
Household size <5 (reference)	0	If house size is less than five
Household size >4 & < 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 4th or after
Child did not give a birth (reference)	0	Child has not given a birth by the 4th 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/day at age 15
Child worked at least 1 hr / 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

5. 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 center on the successful completion of secondary education and transition to institutions of higher learning at proper ages. We begin our analysis with the descriptive statistics.

5.1. Descriptive Statistics

Table 3 presents the descriptive statistics. The proportion of boys to girls in the sample is somehow equal, with 53.6% for 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 a low height-for-age and malnourished (WHO, 2012). On the basis of this cut off, the sample children had somehow 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. Also, about 9% of the children worked for pay at least 1 hour per day at the age of 15, showing a widespread of child labour. A striking point also is that 4.7% of the children became teenager parent, with at least one birth. Many of the households of the children have large family size, where two-thirds of them are with between 5-9 persons. This large family size can be also demonstrated by the fact that about one-half of the children's birth order was fourth or after. Many of the children also are from less educated families as only one-fourth of the mothers are found to be secondary school achievers.

In terms of preschool participation, of the 908 children about 13.4% (n=122) had the opportunity to attend preschool education. But this rate of preschool participation masks a huge divided between urban and rural areas. The rate of enrollment for urban children was 25.2%, while it was as low as 2.6% for those who grew up in rural areas. With average duration of 1.94 years there is a noticeable difference between urban and rural as well. While about 8%, 10.1% and 7.1% of the urban children were respectively in 1, 2 and 3 years of preschool programmes, these were only 2.1%, 0.4% and 0% for the rural children, respectively. This shows that none of the rural children had the opportunity to attend three years of preschool programme. By preschool ownership, about 7.9%, 1.8% and 3.7% of the sample children were respectively in private, community and governmental centers. However like in the duration of preschool there is a clear distinction on this regards too, with 16.5% of the urban children in private centers and none of the rural ones was in private and community preschool centers. This reveals that all the rural children who attended preschool education were in governmental preschool centers and further signifying that kindergartens are inaccessible to children of rural areas.

Table 3: descriptive Statistics for urban and rural sample

	Urban		Rural		Total	
Variable	Obs	Mean	Obs	Mean	Obs	Mean
Dummy if Completed Secondary Education	436	49.3%	470	18.7%	908	33.4%
Dummy for preschool attendance anytime from4- 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[2]	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 is with primary level(1-8)	436	35.1%	470	29.8%	908	32.3%
Dummy if father is with secondary level or above	436	45.4%	470	37.9%	908	41.6%
Dummy if mother is with primary level(1-8)	436	37.8%	470	19.6%	908	28.3%
Dummy if mother is with 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 after	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: Old Cohort data (Round1, 2, 3 and 4; 2002; 2006; 2009 and 2014)

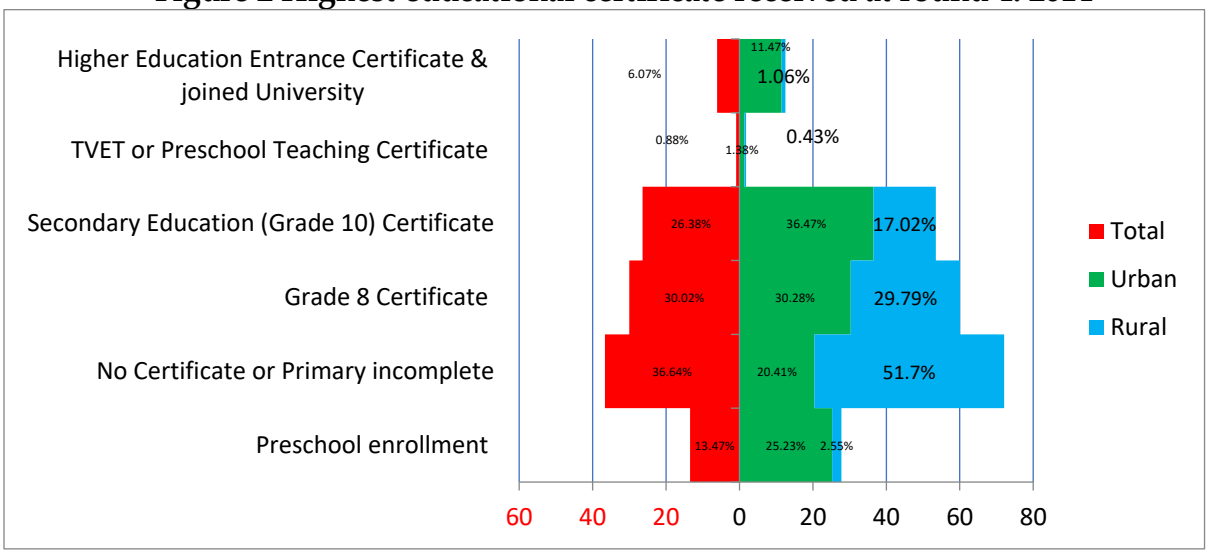
Figure 2 depicts highest certificate received at round 4 of the Young Lives survey for the older cohort. By this round, the overall educational outcomes of the children resemble the pyramidal shape of national educational statistics we reviewed in the literature review section. More specifically, while about 36.67% (n=333) of the children were with no educational certificate, nearly one-third (30.07%) of them received grade 8 certificate. In terms of secondary education, a slightly more than one-third (33.4%) of the children completed general secondary education and already received certificate on the *Ethiopian*

[2] the range for zhfa [-4.93 1.79], for Urban
the range for zhfa [-5.25 2.79], for total sample

general secondary education (Grade 10). But a noticeable gap is still observed between urban and rural areas, in favour of the first (about one-half for urban versus one-fourth for rural). Regarding institutions of higher learning while nearly 1% of them received certificate for completing TVET or Preschool Teaching by the age of 19, about 6% were with Higher Education Entrance certificate and already transitioned to institutions of higher learning (college and university). This implies that by the fourth round survey majority of the children discontinued their education or might still be enrolled somewhere in lower grades with an overage participation.

Generally, the preliminary result indicates that only 13.4% of the children had an opportunity to attend preschool education, with a huge divided between urban (25.2%) and rural (2.6%) areas. Hence, it is important to make clear that given the very small number of preschool enrollment 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 the age of 19 (Table 3).

Figure 2 Highest educational certificate received at round 4: 2014



Source: Own computation based on Young Lives R4 Older Cohort data

5.2. Estimation

As noted earlier, the number of children in rural areas who participated in any kind of preschool programmes early in life and completed secondary education at later ages are inadequate to carry out a robust econometric analysis. The following estimation part of the study hence is for the urban sample children of the Young Lives study.

5.2.1. Does attending preschool offer an advantage on the completion of Secondary Education?

In this subsection we present the regression results and answer that question that deal with 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 enrollment 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 however 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 we 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 are 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 center is found to be statistically significant in contributing for completion of secondary education. Controlled for relevant covariates, urban children who attended preschool education anytime between the age of 4 and 6 are found to be 25.7% more likely to complete general secondary education at the right age. This may reveal how investment in early childhood in the form of sending a child to preschool centers is so curial for the smooth educational progress of children.

Regarding the covariates, child health approximated by the 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 households' wealth index, where children from second tercile and third tercile experienced more than 23% and 36.5% higher probabilities of completing grade 10 than children of the first tercile (the poorest family). 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 with a significant contribution, but mothers' education for all dummies are not statistically significant. The reason why this might be so is that majority of the mothers do not have adequate level of education where it was possible to see that only one-fourth of them were with secondary education. Another variable which has detrimental consequences on children's educational success is child labour experienced at the age of 15. Children who worked for pay at least 1 hour per day at the age of 15 particularly faced 29% lower probability of completing grade 10. What is more, being a teenage parent is associated with 25.4% 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 however found with 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 reason out as to why girls showed better probability of achieving grade 10 than boys. This might however come from the Government's recent affirmative action that has been encouraging girls to stay in school and to be able to continue through their education, where as the result secondary education Gender Parity Index (GPI) has increased to 0.85 as the result (MOE, 2013/14).

5.2.2. Does a 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 explore the contribution of each year's of preschool attendance on successful completion of secondary education. To do this, we create three dummy variables for each year of preschool attendance and examine 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 point of higher probability of completing secondary education than these who attended only for one year. Expectedly, 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 point of higher likelihood of completing grade 10 than those who attended only for a year, representing 40.1% of higher probability from the control groups. This means that level of early childhood investment and the degree of preschool exposure do matter on the educational progress of the children.

4.3.2. Do children who attended private preschool programmes show larger gains in term of completing secondary education?

It also is intuitive to explore the contribution of preschool ownership on the completion of secondary education. Similar to the duration of preschool exposure, we classified the preschool centers 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 centers with high quality of educational provision and usually are a place for the children of the rich. The second is for community preschool, which consists of centers related to quasi-public, missionary, church and nongovernment (NGO) and are named as community centers 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 & Mebratu, 2004).

As expected,

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

Table 4: Estimation of Completion of Secondary Education (Grade 10) on Pre-School Attendance, Length of Preschool Attendance and Preschool Type in urban area

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 anytime between age 3 & 6	0.257***	-	-
	(4.144)	-	-
height-for-age z-score at age 8	0.0953***	0.0935***	0.0967***
	(4.058)	(3.976)	(4.091)
Dummy variable for Household with 2nd tercile wealth index	0.230**	0.219**	0.226**
	(2.186)	(2.072)	(2.134)
Dummy variable for Household with 3rd tercile wealth index	0.365***	0.358***	0.357***
	(3.963)	(3.854)	(3.795)
Dummy variable if father is with primary level(1-8) of education	0.0155	0.0101	0.0170
	(0.184)	(0.119)	(0.202)
Dummy variable if father is with secondary level or above	0.154*	0.153*	0.151*
	(1.897)	(1.875)	(1.854)
Dummy variable if mother is with primary level(1-8)	0.0572	0.0453	0.0641
	(0.819)	(0.645)	(0.913)
Dummy variable if mother is with secondary level or above	0.0323	0.0236	0.0362
	(0.423)	(0.306)	(0.473)
Dummy variable if household members are > 5 and < 9	-0.0642	-0.0692	-0.0640
	(-1.049)	(-1.126)	(-1.046)
Dummy variable if household members are 9 or above	-0.131	-0.131	-0.125
	(-1.581)	(-1.576)	(-1.492)
Dummy variable if the birth order of child is second	0.0721	0.0718	0.0778
	(0.843)	(0.831)	(0.911)
Dummy variable if the birth order of child is third	-0.0200	-0.0195	-0.0264
	(-0.200)	(-0.192)	(-0.262)
Dummy variable if the birth order of child is fourth or after	0.140*	0.148**	0.140*
	(1.904)	(2.010)	(1.900)
Dummy variable if the teenage has become a parent	-0.254**	-0.250**	-0.249**
	(-2.107)	(-2.031)	(-2.016)
Dummy if child worked at least 1 hr/day at age 15	-0.290***	-0.300***	-0.293***
	(-3.769)	(-3.863)	(-3.816)
Dummy variable for male	-0.0702	-0.0733	-0.0747
	(-1.226)	(-1.277)	(-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

Note: z-statistics in parentheses and *** p<0.01, ** p<0.05, * p<0.1

4.3.3. Does the contribution of preschool education go beyond completing secondary education?

To get a full picture of the long-lasting contribution of early childhood investment on the children's educational pathways ranging from primary school to institutions of higher learning, we extend the logit models into Ordered Logistic model, adopting values of 1, for adult children with "*not 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 who got *certificate on the "Ethiopian Higher Education Entrance"* and made their way to institution of higher learning. Instead of looking at the overall estimates, we disaggregated the data of preschool attendance by year so that we will 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. As mentioned in the methodology part, the marginal probabilities of the order 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 are particularly interested in this model in seeing how attending preschool centers in early years of time is associated with the probability of joining institutions of higher learning at the proper age.

Table 5 provides the results for the 5 categories of educational certificates. What is evident from the marginal probabilities of each ordered logit model is that one year preschool attendance is statistically insignificant to have a differential contribution on the educational pathways of the adult children, while two years of preschool participation is associated with 7.5% probability of obtaining certificate on secondary education comparing to non-preschoolers (see Column 3 of Table 5). Attending preschool for three years is howver found to be statistically significant in all the five educational categories. For instance, those with three years of preschool education are 11.2% more likely to receive certificate of higher education entrance and able to join university by the age of 18 than those who did not have preschool exposure. Adult children with three years of participation are also found to be 14% less likely to remain with only grade 8 certificate than their non-preschool counterparts. Here what is important to focus on is that the benefit of one-year preschool attendance does not appear to be significant across the all the five models, while three years of preschool education is associated with statistically significant contribution in all the models. The implication of such result is that one year of preschool investment may not be sufficient enough to be able to bring a long-lasting contribution, while attending a three years of preschool is a significant predictor of

greater academic progression, up to institutions of higher learning. This further imply 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 of ordered logit models): urban sample

VARIABLES	(Ordered Logit 5) mfx	(Ordered Logit 4) mfx	(Ordered Logit 3) mfx	(Ordered Logit 2) mfx	(Ordered Logit 1) 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 is with 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 is with 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 is with 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 is with 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 teenage 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

z-statistics in parentheses and *** p<0.01, ** p<0.05, * p<0.1

4.3. IV Estimator and Robust Check

As explained in the methodology part, the standard estimates from the logit models we discussed earlier might be potentially biased for the fact that preschool attendance is a function of observed and unobserved child and family characteristics. For example, educational progress of a child can be highly associated with innate ability which might result in some endogeneity problem. In our attempt to overcome any problem of this kind, we employed two IV models. While 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 instrument. 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.

Table 6 reports the two IV estimates. The results show that the marginal probabilities from these models are larger in magnitude than the estimates we have 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 center anytime between 4 and 6 years of old increases the probability of completing secondary education to the extent of 32%, in reference to those who never got the chance of going to preschool centers at all. Likewise, as reported in the second column of the table, 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 a little bit downward biased and hence preschool is an endogneious variable.

An interesting part 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 instrument is valid and all the instruments have passed the over-identification test (*Hansen J-statistic=5.339* & *p= 0.2542*). The same are true with the under-identification tests that the 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

	Standard IV[a]	Woodridge IV[b]
Variables	mfx	mfx
Dummy if child attended preschool anytime between age 3 & 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 is with primary level(1-8) of education	0.0173	0.00473
	(0.251)	(0.0686)
Dummy variable if father is with secondary level or above	0.117*	0.112*
	(1.782)	(1.712)
Dummy variable if mother is with primary level(1-8)	0.0491	0.0484
	(0.851)	(0.840)
Dummy variable if mother is with 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 teenage 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
Centered R2	0.215	0.217
Uncentered 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	-

*Note: 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 (Wooldridge (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

Note: *[a] community sites as instrument*

[b] Predicted probabilities from a first logit model as instrument (Wooldridge (2002: 623))

5. Discussion and Conclusions

This study made use of a longitudinal dataset drawn from the Young Lives Project in Ethiopia to look at the long-term contribution of early childhood investment on children's future educational outcomes. As the obtained data showed a huge divided of access to preschool between children of urban (25.2%) and rural (2.6%), we however estimated this long-term estimate only for the urban children. In doing this, we employed several alternative micro-econometric models such as logit and order logit models derived from the concept of dynamic programming problem of Bellman equation. While the Logit model predicts the long-tem contribution of early childhood education on successful completion of secondary education, the ordered logit model summarizes 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 are however carried out to check whether the OLS estimates form the logit models are downward or upward biased as preschool participation might be influenced by unobservable factors that might make it endogenous variable.

Findings show that early childhood investment in the form of giving children an opportunity to attend preschool centre early in life is shown to make significant contribution on the educational pathways of the children, where marginal probability from the logit model indicates that urban children who attended preschool had 25.7% higher likelihood to complete 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 is however found with noticeable difference on completion of secondary education, in which three years of preschool experience is found with much larger marginal effect (40.1%) than two years of preschool attendance (21.3%) and than that of one year (16.8%). The result can better be noticed from the ordered logit model, which tracks the cumulative effect of each year of attendance on the educational progressions of the children: all the way 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 to university at the appropriate age while one year of preschool education is found to be statistically insignificant at all. Those who attended for two academic years are also able to have larger marginal probabilities in getting certificate on secondary education than non-preschoolers, but still 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 grow up, especially when they make a 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 of the country. Firstly, while Ethiopia has obviously seen a stride in the education sector over the last decade and half, many of the achievements were at primary school level, with more than 90% of net enrolment in 2013/14. But the percentages of net enrolment are still as low as 20% for secondary education and well below 10% for institutions of higher learning for both urban and rural areas. One possible contributing factor for declining of enrolment rates over the educational ladder could be the low preschool access being experienced in the early years of the children's life. This study then suggests for more public investment in this vital learning stage as it is found that early investment in preschool education contributes a paramount role and shape the educational pathways of children to a significant level.

Secondly, it is worth noting that Early Child Development (ECD) is now part of the 2030 Global Sustainable Development Goals, where it is explicitly mentioned on 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 now on the move to scale up access to early childhood education up to 80% of gross enrollment 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 of gross enrollemnt in the coming five years. Therefore, it is imperative to point out that as it is the full two or three academic years of the preschool education that is 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 proper ages, it would be more advisable to create an early opportunity for all children of urban and rural areas instead of waiting for the "O" class by the age of 6.

Thirdly, Ethiopia is currently aspiring to be a low middle income nation by 2025, where such economic aspiration seeks abundant skilled workforce that able to meet the 21st labour market demand. However, it is worth noting that such skilled workforce will be available if a significant number of young people are able to complete secondary education and/or join institutions of higher learning at proper ages. So, as human capital formation by its nature is a long-term phenomenon that starts from early years of life, it is indeed 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% out of the 7.4 million preschool-aged children.

All in all, the analysis of this paper implies that if the aim is to reduce educational inequality among the future generation and to be able to conquer poverty in the years ahead, equalizing quality of early education with two to three years of exposure to children aged 4-6 of both urban and rural areas will remain as an essential educational policy for Ethiopia.

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