Early Childhood Education and Children Development : Evidence from Ghana

Bago, Jean-Louis and Ouédraogo, Moussa and Akakpo, Koffi and Lompo, Miaba Louise and Souratié, Wamadini M. and Ouédraogo, Ernest

Laval University, Anadolu University,, University Ouaga 2

September 2019

Early Childhood Education and Children Development : Evidence from Ghana

Jean-Louis Bago
Laval University, Department of Economics, Canada
Email: jean-louis.bago.1@ulaval.ca

Moussa Ouedraogo
Anadolu University, Department of Economics, Turkey
Email: moussaouedraogo@anadolu.edu.tr

Koffi Akakpo
Laval University, Department of Economics, Canada
Email: koffi.akakpo.2@ulaval.ca

Miaba Louise Lompo
Laval University, Department of Information and Communication, Canada
Email: miaba-louise.lompo.1@ulaval.ca

Wamadini dite Minata Souratié
University Ouaga 2, Department of Economics, Burkina Faso
Email: souratieminata@yahoo.fr

Ernest Ouédraogo
University Ouaga 2, Department of Economics, Burkina Faso
Email: ernestouedra@yahoo.fr

Abstract:

While early childhood education (ECE) has received rising interest from researchers in recent years, its effect on child development is still unclear in Sub-Saharan Africa. This paper investigates the effectiveness of ECE on 3-4 years old children development outcomes in Ghana. We exploit data from the 2011 round of the Ghana Multiple Indicator Cluster Survey (MICS), to build a multidimensional early child development index that accounts for children's ability to read, count, recognize number, interact with peers and other people, follow rules and be independent as well as their health outcomes and physical skills. Then, we estimate the effect of ECE on child development using an endogenous treatment effect model to account for children unequal access to ECE. Results indicate that attending to ECE program increases children early development indicator. This finding is robust to several changes in the specifications.

Keywords: early childhood, education, child development, endogenous treatment, Ghana

---

1. Introduction

Over the last decades, increasing interest has been prompted by a large body of studies focusing on the long-term effects of early childhood education (hereafter ECE) on life outcomes (Barnett, 1995, 1998; Campbell et al., 2002; Belsky et al., 2007; Hurry and Sylva, 2007; Cascio, 2009; Ruhm and Waldfogel, 2012; Cort´azar, 2015; Lehrl et al., 2016; Bakken et al., 2017). This literature promotes the importance of ECE in several domains of development including educational achievement (Reynolds et al., 2004; Pence et al., 2004; Freitas et al., 2008; Corta´zar, 2015), learning skills (Hyde and Kabiru, 2006; Conger et al., 2019), employment performance (Myers, 1992; Schweinhart et al., 1993; Wilson, 1995), physical and mental health outcomes (Fergusson and Horwood, 1998; Waldfogel, 2006; Gibb et al., 2012; Duncan et al., 2013) and drug abuse (Campbell et al., 2002) etc. In addition to these long-term effects, growing empirical studies in high-income and middle-income countries, find evidence that ECE increases children's early development (Haskins, 1989; Currie, 2001; Ramey and Ramey, 2004; Conger et al., 2019). In a recent paper in China, Li et al. (2016) find that ECE quality, teaching and interactions, were positively associated with children language, early mathematics and social development. Using a randomized controlled trial in Switzerland, Schaub et al. (2019) also find that early education, even by parents as teachers, improves children's adaptive behavior, developmental status, and language skills at the age of 3 years. More recently, Rao et al. (2019) find that children's participation in ECE is positively associated with cognitive, language, and socio-emotional development in Mongolia, Cambodia and China. In United States, Conger et al. (2019) find that children who participate in pre-K program have higher rates of promotion to the first grade and the higher rate of school stability between kindergarten and first grade.

Yet, in Sub-Saharan African countries, the extent of this effect of ECE on child development is still unclear. In fact, quantifying the effect of ECE on child development is difficult for two main reasons: First, empirical studies suffer from the fact that child development is a multidimensional concept including cognitive, physical, social and emotional development (Bronfenbrenner and Morris, 1998). Indeed, McCoy et al. (2016) indicate that, even though early childhood development (ECD) is a major target of the global development agenda in developing countries, valid and reliable measures of young children's development are barely available. This scarcity of ECD measures led some researchers to use proxies such as poverty, mortality, stunting, and low birth weight to evaluate children's well-being (Grantham-McGregor et al., 2007; Black et al., 2017). However, although proxies like poverty, mortality and stunting are correlated with child

development, these indicators do not include many developmental outcomes such as children skills, social and cognitive development (Camilli et al., 2010; Black et al., 2017). Other authors rely on children's performance on standardized tests of intelligence and school readiness to measure child development (Zigler and Trickett, 1978; Haskins, 1989; Tomporowski et al., 2008; Russo et al., 2019; Tavassolie and Winsler, 2019). However, these tests are highly subject to criticisms. According to McClelland (1973) and Locurto (1991), using developmental measures from IQ and others standardized test measures may be misleading since a child may perform poorly in mathematical tests for example and would be a genius in a sport or singing competition. McClelland (1973) and Barrett and Depinet (1991) confirmed that social competence, rather than IQ, should be the primary measure of the success of intervention efforts. The second challenge when examining the impact of ECE on child development is that the likelihood of a child to participate in ECE is potentially determined by the family background causing endogeneity issues in the estimation (Lazar and Darlington, 1982; Peisner-Feinberg, 2004; Burchinal and Nelson, 2000). Correcting for this endogeneity bias is necessary to obtain consistent estimates of the effects of attending to ECE on child development outcomes.

To address these issues, we exploit data from the 2011 round of Ghana Multiple Indicator Cluster Surveys (MICS) to build a Multidimensional Early Child Development (MECD) index. Our index of children development focuses on 3-4 years old children's literacy, learning ability, social and physical development. This index captures children ability to read, count, recognize number, interact with peers and other people, his health, his physical skills as well as his ability to follow rules and be independent. Second, in order to account for children unequal likelihood to access in ECE, we use an endogenous treatment effects model (Heckman, 1978, 1979; Terza, 1998; Vella and Verbeek, 1999; Bratti and Miranda, 2011) to estimate the effects of ECE on the MECD index.

Our results suggest that attending to a childhood education program is positively associated with children early development. In order to assess the importance of correcting for ECE endogeneity, we first estimate a baseline model where ECE is consider as exogenous treatment. The estimates from the baseline Poisson model indicates that attending to ECE increases children's score by 0.68 point. After accounting for the endogeneity of the treatment, the effect of attending to childhood education remains positive and statistically significant even though it is slightly reduced (0.62 point) when compared to uncorrected results (0.68 point). This finding is consistent with previous studies in developing countries such as Malmberg et al. (2011) and Mwaura et al.

(2008) in Kenya, Zanzibar and Uganda, Taiwo and Tyolo (2002) in Botswana, Liddell and Rae (2001) in South Africa, and Jaramillo and Tietjen (2001) in Guinea and Cape Verde who find that ECE has a positive effect on early children academic success.

The rest of this paper is structured as follows. Section 2 reviews ECE policy in Ghana. Section 3 presents our data. The identification strategy is presented in Section 4 while Section 5 reports the results. Section 6 reports the results of sensibility analyses. Section 7 concludes the paper.

2. Background: ECE in Ghana

The republic of Ghana is one the first African country to ratify the international convention on children's rights. Following the Millennium Development Goals, Ghana have adopted in 2004 the National Early Childhood Care and Development policy (ECCD) which aims to promote children development and protection through financing kindergarten facilities accessible for vulnerable children as well. This program aims to provide a quality ECE to all children in order to reduce inequalities in development outcomes among children (Wolf et al., 2019). In 2007, Ghana has officially introduced a pre-primary education of two year for children between 3 and 4 years old. Over the last years, main indicators have shown an improvement in children's education in Ghana. Indeed, there has been substantial increase in pre-primary school attendance (UNICEF, Evaluation report 2011). Data from Education Management Information System (2014-2015) indicates an increase by 2,1% in public pre-primary schools while it increased by 8,7% for private pre-primary schools in the same period (Republic of Ghana,2015). Prior to the new Millennium, most of ECE system was run by private sector and the number of schools was few, very expensive and localized in cities and towns (Send Africa,2018). Furthermore, the government has increased the budget allocated to the early education system. According to Ministry of Education report in 2016, the budget allocated to early education system was from 435,502,334 GHS (around 7,6% of education budget) in 2012 to 501,912,110 GHS (7,6% of education budget) in 2014. However, despite the government efforts, a recent study by McCoy et al. (2016) found that around 32.6% of Ghanaian (3- and 4-year-old) still do not meet school readiness indicator threshold.

3. Data

3.1. Data source

We use data from the 2011 round of the Ghana Multiple Indicator Cluster Survey (MICS). The MICS are nationally representative cross-sectional household-based surveys collected by the Ghana Statistical Service (GSS) with the financial and technical support of international institutions such as UNICEF, USAID, UNFPA, the Japanese Government, ICF/MACRO, the Ministry of Health/National Malaria Control Program, and the Navrongo Health Research Centre (Ghana Statistical Service, 2011). The MICS use standardized questionnaires to provide up-to-date information and key indicators on the situation of children and mothers/caretakers. This database contains information about children characteristics such as their age, gender, weight, height, mother's education, father's involvement in the child home education[1], their area and region of residence. The mother/caretakers were also asked if their child is currently attending an ECE program. We create our treatment variable ECE_i as a dummy variable: one if the response is positive and 0 otherwise. Our sample contains 2910 children between 3 and 4 years old.

3.2. Measuring child development

We use the children's questionnaire to construct our main outcome variables which is the Multidimensional Early Child Development (MECD) index. We focus on 10 items/questions contained in children questionnaire of the MICS data to construct the MECD index. This index addresses child development in the domains of literacy, social, physical and learning skills. These items are read as follows: the child's mother/caretaker was first asked: (1) Can your child identify at least ten letters of the alphabet? (2) Can your child read at least four simple popular words? (3) Does child know name and recognizes symbol of all numbers from 1-10? These first three questions are related the child literacy. A positive answer to an item implies that the child is developmentally on track according to this specific ability. Second, the child's mother/caretaker was also asked: (4) Does child get along well with other children? (5) Does child usually kick, bite or hit other children or adults? These questions address the social development of the child. A positive answer to question (4) and a negative answer to question (5) imply that the child is developmentally on track related to each item. Third, the child's mother/caretaker was asked the following question related

[1] Since the MICS focus on children and their mothers/caretakers, it does not include father's education, but it contains some questions about the father's involvement in the child education at home.

to children physical and health development: (7) Is child able to pick up small object with 2 fingers? (8) Is child sometimes too sick to play? A positive answer to question (7) and a negative answer to question (8) imply that the child is developmentally on track related to each item. Finally, the child's mother/caretaker was asked the following question related to children ability to learn easy task and be independent: (9) Does child follow simple directions? (10) Does child able to do something independently? A positive answer to both questions implies that the child is developmentally on track related to each item.

For each item *j*, we create a dummy variable ECD_{ij} equal one if the child *i* is developmentally on track related to this specific item and 0 otherwise. We built the Multidimensional Early Child Development index ($MECD_i$) as the total of items where the child is developmentally on track such as:

$$MECD_i = \sum_{j=1}^{10} ECD_{ij} \tag{1}$$

Note that MECD index is then a count variable taking values between 0 and 10 ($MECD_i \in \{0,1,2,3,4,5,6,7,8,9,10\}$). Figure (1), presents the distribution of children by MECD index.

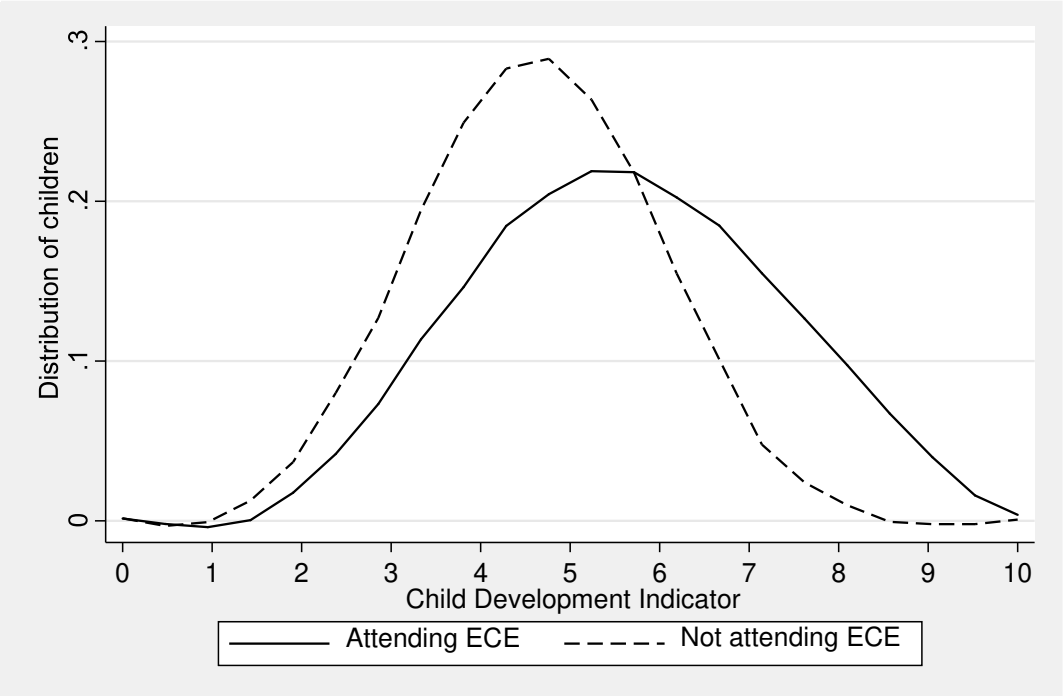

Figure 1: *Distribution of children by child development index and ECE attendance*

and ECE attendance. Observational evidence from figure (1) clearly indicate that children attending ECE are more likely to be in the highest range of child development index ($MECD > 6$) while children who are not attending ECE are more in the lowest range of child development index ($MECD < 6$).

3.2.1. Descriptive statistics

The summary of descriptive statistics on children characteristics are presented in Table 1. We find that 57.2% of children are attending ECE program. This implies that almost half of children in Ghana have not access to an ECE program. The children have on average 3.48 years old and we find that only 28.2% of fathers are involved in their child education at home. A possible reason for this low rate of father's involvement in children's home education is because Ghana is a patriarchal society where women are basically responsible for young children's care and home education. Men act as financial providers of their family. As far as mother's education is concerned, we find that 57.2% of mothers/caretakers have less than a primary education while 36.2 % have a primary education and around 6.4% have a higher education. In addition, 71.7 % of children are living in rural area. A large regional disparity is observed in our data. The highest share (27 %) of children are living in Accra.

Table 1: *Descriptive statistics*

VARIABLES	N	mean	sd	min	max
Attending ECE	2,910	0.571	0.495	0	1
Child Development index	2,910	5.197	1.586	0	10
Child's age	2,910	3.477	0.500	3	4
Child's weight (kilograms)	2,910	14.13	2.051	5.800	30
Child's height (centimeters)	2,903	96.28	6.391	67.50	119.4
Father educate child at home	2,910	0.278	0.448	0	1
1 if female	2,910	0.496	0.500	0	1
Mother's education level					
Less than primary	2,910	0.574	0.495	0	1
Primary	2,910	0.364	0.481	0	1
At least secondary	2,910	0.0622	0.242	0	1
Area of residence					
Rural	2,910	0.716	0.451	0	1
Urban	2,910	0.284	0.451	0	1
Region of residence					
Western	2,910	0.0519	0.222	0	1

Central	2,910	0.132	0.339	0	1
Greater Accra	2,910	0.0529	0.224	0	1
Volta	2,910	0.0588	0.235	0	1
Eastern	2,910	0.0419	0.200	0	1
Asante	2,910	0.0570	0.232	0	1
Brong Ahafo	2,910	0.0522	0.223	0	1
Northern	2,910	0.278	0.448	0	1
Upper-East	2,910	0.146	0.353	0	1
Upper-West	2,910	0.130	0.336	0	1

4. Identification strategy

4.1. ECE as an Exogenous Variable

We first consider a single equation estimation to identify the causal effect of attending ECE (T_i) on a child development index ($MECD_i$). Since $MECD_i$ is a discrete variable,

we use a Poisson regression which is appropriate for count data analysis. The conditional average of the Poisson model denotes λ_i reads as follows:

$$\lambda_i = \beta_0 + \beta_1 T_i + \beta_3 X_i + \epsilon_i \tag{2}$$

where T_i is a dummy variable equals 1 if child i is currently attending ECE and 0 otherwise. X_i is a vector of control covariates including child's age, child's gender, health indicator measured by child's weight (in kilograms) and height (in centimeters), mother's level of education, father participation in child home education and the area of residence (rural or urban). $\in_i$ is a zero-mean error term capturing the unobservable factors affecting child development. The parameter β_1 captures the impact of ECE on child i*'s* MECD index. The likelihood function is:

$$P(MECD = mecd_i | T_i, X_i) = \frac{e^{-\lambda_i} \lambda_i^{mecd_i}}{mecd_i!} \tag{3}$$

For our interpretation, we also estimate the marginal effects in order to evaluate the causal effect of ECE on MECD index. Recall that Eq. (2) is specified under the assumption that the treatment is exogenous. So, the single equation estimates are misleading if the participation in ECE is endogenous and correlated to children characteristics.

4.2. Endogenous treatment effects model

Table (1) analyses the differences in children characteristics between the sub-sample of children attending ECE and the sub-sample of those who are not attending ECE. In addition to ECE, Table (1) indicates that the differences between the two samples in terms of age, gender, weight, height, motherhood education, father involvement in home education, area of residence are all significant suggesting that participation into ECE is not random. To the extent the probability to attend ECE is endogenous, it is necessary to modify the econometric specification accordingly. The equation underlying children endogenous likelihood to attend ECE reads as follows:

$$T_i = I\left[\alpha_0 + \alpha_2 R_i + \eta_i > 0\right] \quad (4)$$

where $I[\cdot]$ is an indicator function equal to 1 if, child i is attending ECE program and zero otherwise; R_i includes all the factors affecting the probability that a child attends ECE. In addition to variables in X_i, we include a dummy variable capturing the household head's religion as exclusion restriction that may affect child probability to be attending early child development but does not directly determine ECD. η_i is a zero-mean error term which captures the effect of unobserved factors that influence participation into ECE. $\in_i$ and η_i are assumed to be jointly normally distributed. The endogeneity bias therefore occurs when there is a statistically significant correlation between unobservable terms of Equations (2) and (4). Correcting for this endogenous treatment effect will produce consistent estimates of the effect of ECE on child development.

Heckman (1976, 1978) developed an endogenous treatment effects model to correct for this endogeneity, adapted by Bratti and Miranda (2011) for count data analysis. The procedure consists in estimating first the probability to attend ECE from Eq. (4) and then introduced the predicted probability, in Eq. (2) to estimate the effect of ECE on MECD using maximum likelihood estimation.

Table 2: *Differences in individual characteristics, between children attending ECE and children who do not attend ECE*

	Attending ECE		Not attending ECE		T-test	
Variable	Mean	SD	Mean	SD	p-value	
MECD index	5.62	1.3	4.63	1.64	0.000	***
Female	0.51	0.5	0.47	0.5	0.013	**
child's weight (kilograms)	14.59	1.94	13.54	2.02	0.000	***

child's height (centimetres)	98.07	6.15	93.91	6	0.000	***
Less than primary	0.45	0.44	0.74	0.5	0.000	***
Primary	0.45	0.43	0.24	0.5	0.000	***
At least Secondary	0.1	0.11	0.01	0.3	0.000	***
Father provide home education	0.31	0.43	0.24	0.46	0.000	***
Rural	0.62	0.36	0.85	0.49	0.000	***
Urban	0.38	0.36	0.15	0.49	0.000	***
Child's age	3.57	0.48	3.36	0.5	0.000	***

Significance threshold: *** p<0.01, ** p<0.05, * p<0.1

5. Results

5.1. Baseline estimates

Table (3) reports the estimates of the one-equation (3) where ECE is treated as exogenous. We present the coefficients and the marginal effects (dy/dx) for each model estimated. The first concern when using MICS data (as in most surveys data), is that participants may be selected and interviewed with unequal probability (Croft et al., 2018). The second concern is the regional heterogeneity that may affect households' characteristics. In order to address these issues, we perform weighted Poisson estimation with stratification over the regions of residence. Table (3) indicates that the P-value for the F-test of overall significance test of all the three specifications are also significant (Prob > F = 0.000) confirming that our regression models fit the data.

In Model (i), we include the attendance to a childhood education program as the only explanatory variable of the child development index. we control for children individual characteristics such as age, gender, weight and height. The results indicate that attending to ECE program increases the child's MECD index by 0.9 point. In addition, one additional year of age increases the child's MECD index by 0.23 while one additional centimeter of height increases the MECD index by 0.04 point. We find that there is no difference in early development related to gender.

In Model (ii), we control for mother's education. We find that the effect of ECE on MECD index is still positive and significant (0.72 point). Results also indicate that mother's education is positively associated with children's MECD index. In fact, children, whose mother has a primary education level, have 0.34 point of MECD more than children whose mother has no education. This effect increases to 1 point when the mother/caretaker has at least a secondary education level.

In Model (iii), we control for father's involvement in the child home education. We find that the effect of ECE on the child MECD index is still positive and significant (0.71 point). Results also indicate that children whose father provides home education (like reading, spelling, playing games etc.) have 0.22 point of MECD more than children whose father does not participate in their home education at all. This result is closed to Schaub et al. (2019) who find that home education by parents as teachers, improves children's adaptive behavior, developmental status, and language skills at the age of 3 years.

Finally, in Model (iv), we control for regional fixed effects. Overall, results indicate that attending to ECE increases the MECD index by 0.68 point. However, these results are only valid if children's assignment into ECE is random. If ECE is endogenous, then the one equation estimates are likely to be biased and inconsistent.

Table 3: *Poisson model: Estimated average partial effects on early child development*

VARIABLES	**Model (i)**		**Model (ii)**		**Model (iii)**		**Model (iv)**	
	coef	dydx	coef	dydx	coef	dydx	coef	dydx
Attending ECE	0.166***	0.896***	0.134***	0.724***	0.131***	0.708***	0.126***	0.682***
	(0.0203)	(0.110)	(0.0192)	(0.103)	(0.0189)	(0.101)	(0.0196)	(0.105)
child's age	0.0418**	0.226**	0.0565***	0.305***	0.0577***	0.311***	0.0622***	0.336***
	(0.0178)	(0.0962)	(0.0173)	(0.0932)	(0.0170)	(0.0915)	(0.0169)	(0.0913)
1 if female	-0.0194	-0.104	-0.0226	-0.122	-0.0225	-0.121	-0.0159	-0.0858
	(0.0179)	(0.0964)	(0.0177)	(0.0952)	(0.0172)	(0.0928)	(0.0167)	(0.0901)
Child's weight	-0.00602	-0.0325	-0.00639	-0.0345	-0.00663	-0.0358	-0.00518	-0.0279
	(0.00584)	(0.0316)	(0.00599)	(0.0324)	(0.00599)	(0.0324)	(0.00579)	(0.0313)
Child's height	0.00783***	0.0423***	0.00659***	0.0356***	0.00634***	0.0342***	0.00583***	0.0315***
	(0.00223)	(0.0122)	(0.00218)	(0.0119)	(0.00219)	(0.0119)	(0.00217)	(0.0118)
Primary			0.0649***	0.342***	0.0643***	0.339***	0.0514***	0.272***
			(0.0171)	(0.0905)	(0.0172)	(0.0913)	(0.0190)	(0.0998)
At least secondary			0.180***	1.008***	0.179***	1.001***	0.158***	0.881***
			(0.0244)	(0.145)	(0.0253)	(0.150)	(0.0245)	(0.139)
Father provide home education					0.0413***	0.223***	0.0380**	0.205**
					(0.0144)	(0.0774)	(0.0149)	(0.0801)
Urban							0.0575***	0.310***
							(0.0172)	(0.0934)
Regional fixed-effects	NO	NO	NO	NO	NO	NO	YES	YES
Constant	0.758***		0.801***		0.815***		0.816***	

	(0.155)		(0.153)		(0.152)		(0.151)	
Observations	2,655	2,578	2,655	2,578	2,655	2,578	2,655	2,578
F-statistic	44.24		50.72		49.72		24.99	
Prob > F	0.0000		0.0000		0.0000		0.0000	

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

5.2. Treatment effect of ECE correcting for endogenous treatment

In this section, we estimate the average treatment effect of ECE using an endogenous treatment effects for count data models developed by Bratti and Miranda, (2011). The results are report in Table (4).

In the first stage, we estimate the partial effects from a probit regression of equation (4) to predict the probability of being enrolled in ECE. As expected, the results indicate that children from educated mothers/caretakers have a higher probability to attend ECE compared to children whose mother/caretaker has no education (p-value <0.001). Moreover, being a female, living in urban area and having a father who participate in the child home education are positively and significantly associated with the child's likelihood to attend ECE.

In the second stage, when we correct for non-random treatment effect of ECE, we find that the effect of ECE on child development remains positive and statistically significant.

In model (i), we control only for child characteristics such as age, gender, weight and height. We find that participating in ECE increases child's MECD index by 0.83 point which is 0.07 less that the uncorrected estimates with the same covariates (see Table 3 Model (1)).

After controlling for mother's education (model(ii), father participation in child home education (Model (iii) the effect of ECE is still positive and significant. The magnitude of these effects remains less than those obtained with the uncorrected model (Table 3: Model (2) and Model (3)).

Finally, when we control for the area of residence (rural or urban) and the regional fixed effects, we find that the average treatment effect of ECE on children MECD index is 0.62 point. This effect is positive and significant as the effect obtained when we do not correct for the endogeneity of attending ECE (Model (4), Table 3). Moreover, we find that there is no difference in early child development which is related to age, gender or weight.

On the other hand, the mother's education and the father involvement in the child education at home have positive effect on child development. Children living in urban area also show higher level of MECD index than those living in rural area.

Table 4: *Heckman endogenous treatment model: Estimated average partial effects on early child development*

VARIABLES	Model (1)		Model (2)		Model (3)		Model (4)	
	coef	dydx	coef	dydx	coef	dydx	coef	dydx
Second Stage Dependent variable: MECD index								
Attending ECE	0.161***	0.827***	0.134***	0.686***	0.132***	0.677***	0.120***	0.618***
	(0.0113)	(0.0578)	(0.0122)	(0.0623)	(0.0122)	(0.0621)	(0.0118)	(0.0602)
Child's age	0.0205*	0.107*	0.0356***	0.185***	0.0373***	0.194***	0.0416***	0.216***
	(0.0122)	(0.0636)	(0.0121)	(0.0631)	(0.0120)	(0.0626)	(0.0120)	(0.0622)
1 if female	-0.00895	-0.0465	-0.0115	-0.0599	-0.0103	-0.0535	-0.00600	-0.0312
	(0.0107)	(0.0557)	(0.0105)	(0.0548)	(0.0105)	(0.0547)	(0.0103)	(0.0538)
child's weight	-0.00382	-0.0199	-0.00354	-0.0184	-0.00360	-0.0187	-0.00323	-0.0168
	(0.00392)	(0.0204)	(0.00387)	(0.0201)	(0.00388)	(0.0202)	(0.00388)	(0.0202)
child's height	0.00765***	0.0398***	0.00614***	0.0319***	0.00596***	0.0310***	0.00587***	0.0305***
	(0.00141)	(0.00732)	(0.00139)	(0.00723)	(0.00139)	(0.00720)	(0.00139)	(0.00721)
Mother's education level								
Primary			0.0840***	0.436***	0.0819***	0.425***	0.0525***	0.272***
			(0.0116)	(0.0607)	(0.0116)	(0.0605)	(0.0131)	(0.0684)
Secondary +			0.173***	0.939***	0.164***	0.890***	0.121***	0.647***
			(0.0210)	(0.122)	(0.0210)	(0.121)	(0.0226)	(0.126)
Father incolves in home education					0.0569***	0.296***	0.0544***	0.283***
					(0.0113)	(0.0587)	(0.0112)	(0.0580)
Urban							0.0676***	0.351***
							(0.0126)	(0.0657)
Religion dummies	YES	YES	YES	YES	YES	YES	YES	YES
Region fixed effects	NO	NO	NO	NO	NO	NO	YES	YES
First Stage Dependent variable:Attending ECE (0/1)								
Child's age	0.224***	0.0773***	0.292***	0.0959***	0.296***	0.0969***	0.338***	0.107***
	(0.0556)	(0.0191)	(0.0568)	(0.0184)	(0.0569)	(0.0184)	(0.0582)	(0.0181)
1 if female	0.179***	0.0619***	0.164***	0.0536***	0.166***	0.0544***	0.168***	0.0534***
	(0.0483)	(0.0166)	(0.0495)	(0.0162)	(0.0495)	(0.0162)	(0.0503)	(0.0159)
Child's weight	0.0164	0.00567	0.0199	0.00653	0.0192	0.00630	0.0238	0.00755
	(0.0186)	(0.00643)	(0.0187)	(0.00612)	(0.0187)	(0.00612)	(0.0192)	(0.00608)
Child's height	0.0544***	0.0188***	0.0473***	0.0155***	0.0471***	0.0154***	0.0443***	0.0140***
	(0.00649)	(0.00217)	(0.00658)	(0.00210)	(0.00658)	(0.00210)	(0.00672)	(0.00209)
Mother's education level								
Primary			0.603***	0.211***	0.600***	0.210***	0.484***	0.162***
			(0.0566)	(0.0194)	(0.0566)	(0.0194)	(0.0623)	(0.0210)
At least secondary			1.359***	0.405***	1.343***	0.401***	1.043***	0.317***
			(0.141)	(0.0284)	(0.141)	(0.0288)	(0.148)	(0.0363)
Father incolves in home education					0.111**	0.0364**	0.110**	0.0349**
					(0.0553)	(0.0181)	(0.0562)	(0.0178)

Urban area							0.454***	0.144***
							(0.0631)	(0.0196)
Constant	-6.196***		-5.940***		-5.953***		-5.909***	
	(0.429)		(0.439)		(0.439)		(0.465)	
Family head's religion	YES	YES	YES	YES	YES	YES	YES	YES
Region fixed effects	NO	NO	NO	NO	NO	NO	YES	YES
Correlation Rho	2.399***		-1.472***		-1.485***		1.265***	
	(0.469)		(0.117)		(0.112)		(0.302)	

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6. Sensibility analysis

Results of our primary estimations are predicted under assumptions of equal distribution of ECE and child development related to household income. We test the robustness of our results to the relaxation of this assumption. A major concern for our identification is the potential heterogeneous impacts of ECE across children from rich and poor households. As household income are not observable in our analysis sample, we use the household wealth index to divide our analysis sample into two sub-samples: the poorer and the richer. We then estimate the effects of our covariates of interest using one sub-sample (poor versus rich) at a time. Test results reported in Table (5) reveal that ECE has a positive effect on children from both poor and rich household. The effect is larger for children from rich household (0.990 point) than children from poor household (0.56 point).

Table 5: *Robustness check: Estimated effect of attending ECE on child development by household's income*

	Baseline Model estimates		**Endogeneous treatment model estimates**	
	Coef	dxdy	coef	dxdy
A- Children from Poor Households	0.116***	0.581***	0.114***	0.561***
	(0.0214)	(0.108)	(0.0137)	(0.0677)
B- Children from Rich Households	0.153***	0.909***	0.174***	0.990***
	(0.0382)	(0.232)	(0.0331)	(0.178)

7. Conclusion

This paper provides new evidence on the positive impact of ECE on children development in sub-Saharan Africa. We take advantage of micro-level data from the 2011 round of the Ghana Multiple index Cluster Survey (MICS). Our strategy consists, first, in building a multidimensional early child development index that accounts for children's ability to read, count, recognize number, interact with peers and other peoples, his health, his physical skills as well as his ability to follow

rules and be independent. Subsequently, we estimate an endogenous treatment effects model to correct for children unequal access to ECE. Results indicate that attending ECE has a positive impact on children early development.

This result is consistent with other studies in developing countries such as Malmberg et al. (2011) and Mwaura et al. (2008) who find that ECE has a positive effect on early children academic success in Kenya, Zanzibar and Uganda. Similar results were found by Taiwo and Tyolo (2002) in Botswana, Liddell and Rae (2001) in South Africa, and Jaramillo and Tietjen (2001) in Guinea and Cape Verde.

In terms of policy implication, this paper tackles the issues of investing in child development through ECE in order to boost human capital and future labor force in Ghana. Our findings imply that policy makers and education program planners in Ghana should promote children access to ECE in order to ensure that children reach a high level of development. Based on our results, increasing ECE program is major key to build human capital in the future generations in Ghana.

8. Limitations

Our study faces some limitations. Using a multidimensional indicator allows us to have a more complete measure of child development. However, while constructing the multidimensional child development indicator, we implicitly assume that all the items (such as reading, counting, recognizing number, being along with others, the physical and health abilities…) have equal weights in child development. In addition, we find that mother's/caretaker's education and fathers' involvement in the child home education have positive effects on children development. Future research may address these issues.

References

Bakken, L., N. Brown, and B. Downing (2017). ECE: The long-term benefits. *Journal of research in Childhood Education 31*(2), 255–269.

Barnett, W. S. (1995). Long-term effects of early childhood programs on cognitive and school outcomes. *The future of children*, 25–50.

Barnett, W. S. (1998). Long-term cognitive and academic effects of ECE on children in poverty. *Preventive Medicine 27*(2), 204–207.

Barrett, G. V. and R. L. Depinet (1991). A reconsideration of testing for competence rather than for intelligence. *American Psychologist 46*(10), 1012.

Belsky, J., D. L. Vandell, M. Burchinal, K. A. Clarke-Stewart, K. McCartney, M. T. Owen, and N. E. C. C. R. Network (2007). Are there long-term effects of early child care? *Child development 78*(2), 681–701.

Black, M. M., S. P. Walker, L. C. Fernald, C. T. Andersen, A. M. DiGirolamo, C. Lu, D. C. McCoy, G. Fink, Y. R. Shawar, J. Shiffman, et al. (2017). Early childhood development coming of age: science through the life course. *The Lancet 389*(10064), 77–90.

Bratti, M. and A. Miranda (2011). Endogenous treatment effects for count data models with endogenous participation or sample selection. *Health Economics 20*(9), 1090–1109.

Bronfenbrenner, U. and P. Morris (1998). The ecology of developmental processes. In *Theorectical models of human development*, pp. 993–1028. Wiley.

Burchinal, M. R. and L. Nelson (2000). Family selection and child care experiences: Implications for studies of child outcomes. *Early Childhood Research Quarterly 15*(3), 385–411.

Camilli, G., S. Vargas, S. Ryan, and W. S. Barnett (2010). Meta-analysis of the effects of early education interventions on cognitive and social development. *Teachers college record 112*(3), 579–620.

Campbell, F. A., C. T. Ramey, E. Pungello, J. Sparling, and S. Miller-Johnson (2002). ECE: Young adult outcomes from the abecedarian project. *Applied developmental science 6*(1), 42–57.

Cascio, E. U. (2009). Do investments in universal early education pay off? long-term effects of introducing kindergartens into public schools. Technical report, National Bureau of Economic Research.

Conger, D., C. R. Gibbs, Y. Uchikoshi, and A. Winsler (2019). New benefits of public school pre-kindergarten programs: Early school stability, grade promotion, and exit from ell services. *Early Childhood Research Quarterly 48*, 26–35.

Corta´zar, A. (2015). Long-term effects of public ECE on academic achievement in chile. *Early Childhood Research Quarterly 32*, 13–22.

Croft, T. N., M. J. M. Aileen, K. A. Courtney, and et al. (2018). Guide to dhs statistics. *Rockville, Maryland, USA: ICF*.

Currie, J. (2001). ECE programs. *Journal of Economic perspectives 15*(2), 213–238.

Duncan, G., A. Kalil, and K. Ziol-Guest (2013). Early childhood poverty and adult achievement, employment and health. *Family Matters: Newsletter of the Australian Institute of Family Studies* (93).

Fergusson, D. M. and L. J. Horwood (1998). Exposure to interparental violence in childhood and psychosocial adjustment in young adulthood. *Child abuse & neglect 22*(5), 339–357.

Freitas, L. B., T. L. Shelton, and J. R. Tudge (2008). Conceptions of us and brazilian early childhood care and education: A historical and comparative analysis. *International Journal of Behavioral Development 32*(2), 161–170.

Ghana Statistical Service, G. (2011). Ghana multiple indicator cluster survey with an enhanced malaria module and biomarker. *Final Report*.

Gibb, S. J., D. M. Fergusson, and L. J. Horwood (2012). Childhood family income and life outcomes in adulthood: findings from a 30-year longitudinal study in new zealand. *Social science & medicine 74*(12), 1979–1986.

Grantham-McGregor, S., Y. B. Cheung, S. Cueto, P. Glewwe, L. Richter, B. Strupp, I. C. D. S. Group, et al. (2007). Developmental potential in the first 5 years for children in developing countries. *The lancet 369*(9555), 60–70.

Haskins, R. (1989). Beyond metaphor: The efficacy of ECE. *American Psychologist 44*(2), 274.

Heckman, J. J. (1976). The common structure of statistical models of truncation, sample selection and limited dependent variables and a simple estimator for such models. In *Annals of Economic and Social Measurement, Volume 5, number 4*, pp. 475–492. NBER.

Heckman, J. J. (1978). Dummy endogenous variables in a simultaneous equation systems. *Econometrica 48*, 931–959.

Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica: Journal of the econometric society*, 153–161.

Hurry, J. and K. Sylva (2007). Long-term outcomes of early reading intervention. *Journal of Research in Reading 30*(3), 227–248.

Hyde, K. A. and M. N. Kabiru (2006). *Early childhood development as an important strategy to improve learning outcomes*. ADEA.

Jaramillo, A. and K. Tietjen (2001). Can we do more for less? a look at the impact and implications of preschools in cape verde and guinea. *World Bank*.

Lazar, I. and R. B. Darlington (1982). Lasting effects of early education: A report from the consortium for longitudinal studies. *Monographs of the society for research in child development*.

Lehrl, S., K. Kluczniok, and H.-G. Rossbach (2016). Longer-term associations of preschool education: The predictive role of preschool quality for the development of mathematical skills through elementary school. *Early Childhood Research Quarterly 36*, 475–488.

Li, K., Y. Pan, B. Hu, M. Burchinal, A. De Marco, X. Fan, and J. Qin (2016). ECE quality and child outcomes in china: Evidence from zhejiang province. *Early Childhood Research Quarterly 36*, 427–438.

Liddell, C. and G. Rae (2001). Predicting early grade retention: A longitudinal investigation of primary school progress in a sample of rural south african children. *British Journal of Educational Psychology 71*(3), 413–428.

Locurto, C. (1991). Beyond iq in preschool programs? *Intelligence 15*(3), 295–312.

Malmberg, L.-E., P. Mwaura, and K. Sylva (2011). Effects of a preschool intervention on cognitive development among east-african preschool children: A flexibly time-coded growth model. *Early Childhood Research Quarterly 26*(1), 124–133.

McClelland, D. C. (1973). Testing for competence rather than for" intelligence.". *American psychologist 28*(1), 1.

McCoy, D. C., M. M. Black, B. Daelmans, and T. Dua (2016). Measuring development in children from birth to age 3 at population level. *The Hague, The Netherlands: Bernard van Leer Foundation*, 34–9.

McCoy, D. C., E. D. Peet, M. Ezzati, G. Danaei, M. M. Black, C. R. Sudfeld, W. Fawzi, and G. Fink (2016). Early childhood developmental status in low-and middle-income countries: national, regional, and global prevalence estimates using predictive modeling. *PLoS Medicine 13*(6), e1002034.

Mwaura, P. A., K. Sylva, and L.-E. Malmberg (2008). Evaluating the madrasa preschool programme in east africa: a quasi-experimental study. *International Journal of Early Years Education 16*(3), 237–255.

Myers, R. (1992). *The twelve who survive: Strengthening programmes of early childhood development in the Third World.* United Nations Educational, Scientific & Cultural Org.

Peisner-Feinberg, E. S. (2004). Child care and its impact on young children's development. *Tremblay RE, Barr RG, Peters RDeV, eds. Encyclopedia on Early Childhood Development*, 1–7.

Pence, A. R., M. Amponsah, F. Chalamanda, A. Habtom, G. Kameka, and H. Nankunda (2004). Ecd policy development and implementation in africa. *International Journal of Educational Policy, Research, and Practice: Reconceptualizing Childhood Studies 5*(3), 13–29.

Ramey, C. T. and S. L. Ramey (2004). Early learning and school readiness: Can early intervention make a difference? *Merrill-Palmer Quarterly 50*(4), 471–491.

Rao, N., B. Richards, J. Sun, A. Weber, and A. Sincovich (2019). ECE and child development in four countries in east asia and the pacific. *Early Childhood Research Quarterly 47*, 169–181.

Reynolds, A. J., S.-R. Ou, and J. W. Topitzes (2004). Paths of effects of early childhood intervention on educational attainment and delinquency: A confirmatory analysis of the chicago child-parent centers. *Child development 75*(5), 1299–1328.

Ruhm, C. and J. Waldfogel (2012). Long-term effects of early childhood care and education. *Nordic Economic Policy Review 1*(1), 23–51.

Russo, J. M., A. P. Williford, A. J. Markowitz, V. E. Vitiello, and D. Bassok (2019). Examining the validity of a widely-used school readiness assessment: Implications for teachers and early childhood programs. *Early Childhood Research Quarterly 48*, 14–25.

Schaub, S., E. Ramseier, A. Neuhauser, S. C. Burkhardt, and A. Lanfranchi (2019). Effects of home-based early intervention on child outcomes: A randomized controlled trial of parents as teachers in switzerland. *Early Childhood Research Quarterly 48*, 173–185.

Schweinhart, L. J. et al. (1993). *Significant Benefits: The High/Scope Perry Preschool Study through Age 27. Monographs of the High/Scope Educational Research Foundation, No. Ten.* ERIC.

Taiwo, A. and J. Tyolo (2002). The effect of pre-school education on academic performance in primary school: a case study of grade one pupils in botswana. *International Journal of Educational Development 22*(2), 169–180.

Tavassolie, T. and A. Winsler (2019). Predictors of mandatory 3rd grade retention from high-stakes test performance for low-income, ethnically diverse children. *Early Childhood Research Quarterly 48*, 62–74.

Terza, J. V. (1998). Estimating count data models with endogenous switching: Sample selection and endogenous treatment effects. *Journal of econometrics 84*(1), 129–154.

Tomporowski, P. D., C. L. Davis, P. H. Miller, and J. A. Naglieri (2008). Exercise and children's intelligence, cognition, and academic achievement. *Educational psychology review 20*(2), 111.

Vella, F. and M. Verbeek (1999). Estimating and interpreting models with endogenous treatment effects. *Journal of Business & Economic Statistics 17*(4), 473–478.

Waldfogel, J. (2006). What do children need? *Public Policy Research 13*(1), 26–34.

Wilson, S. (1995). Ecd programs: Lessons from developing countries. *World Bank, Human Development Department, Washington, DC*.

Wolf, S., J. L. Aber, J. R. Behrman, and E. Tsinigo (2019). Experimental impacts of the "quality preschool for ghana" interventions on teacher professional well-being, classroom quality, and children's school readiness. *Journal of Research on Educational Effectiveness 12*(1), 10–37.

Zigler, E. and P. K. Trickett (1978). Iq, social competence, and evaluation of early childhood intervention programs. *American Psychologist 33*(9), 789.

Zuilkowski, S. S., G. Fink, C. Moucheraud, and B. Matafwali (2012). ECE, child development and school readiness: Evidence from zambia. *South African Journal of Childhood Education 2*(2), 20.